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

* 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.

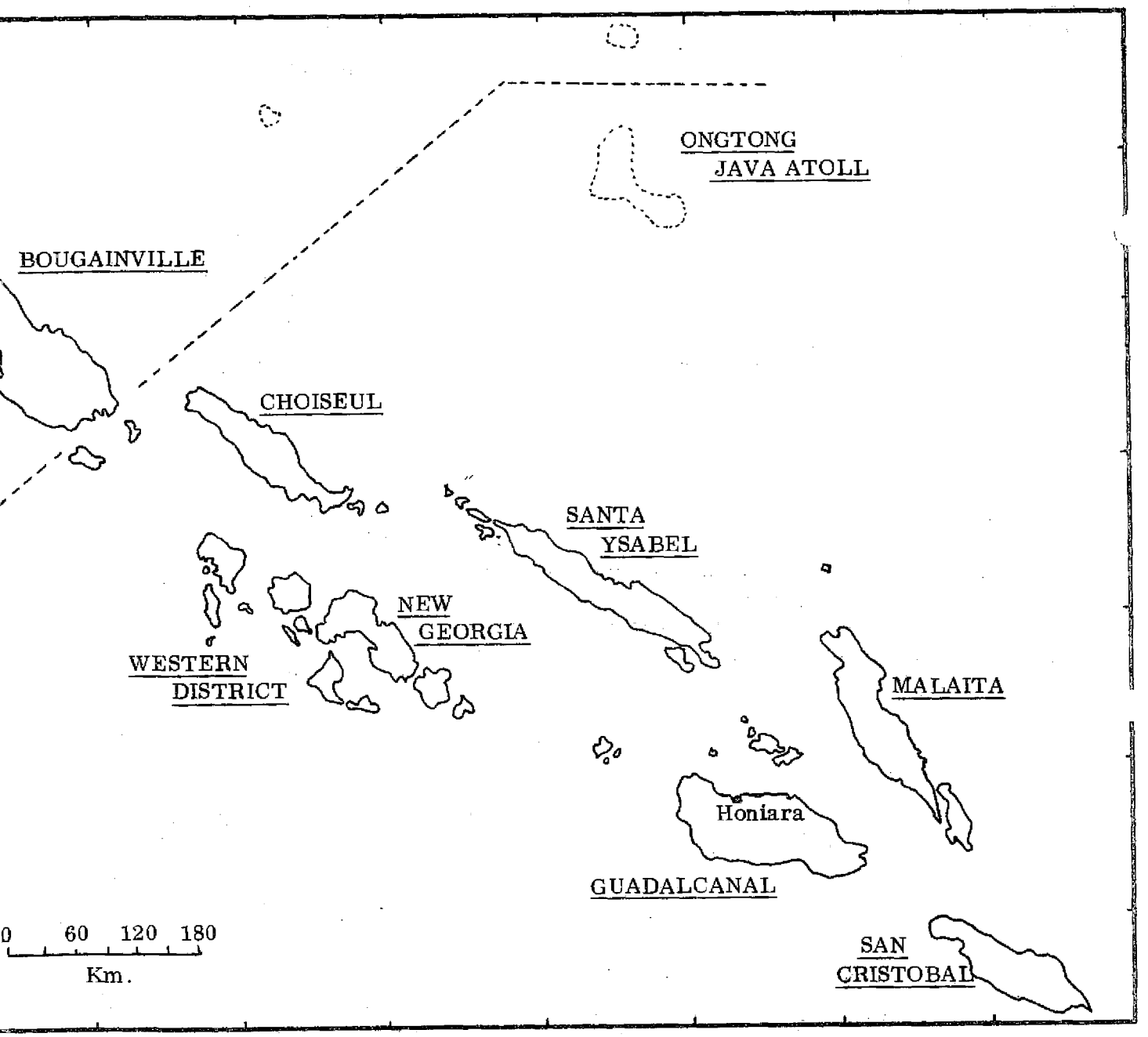

Fig. 1: THE SOLOMON ISLANDS, SHOWING POSITION OF ONGTONG JAVA ATOLL

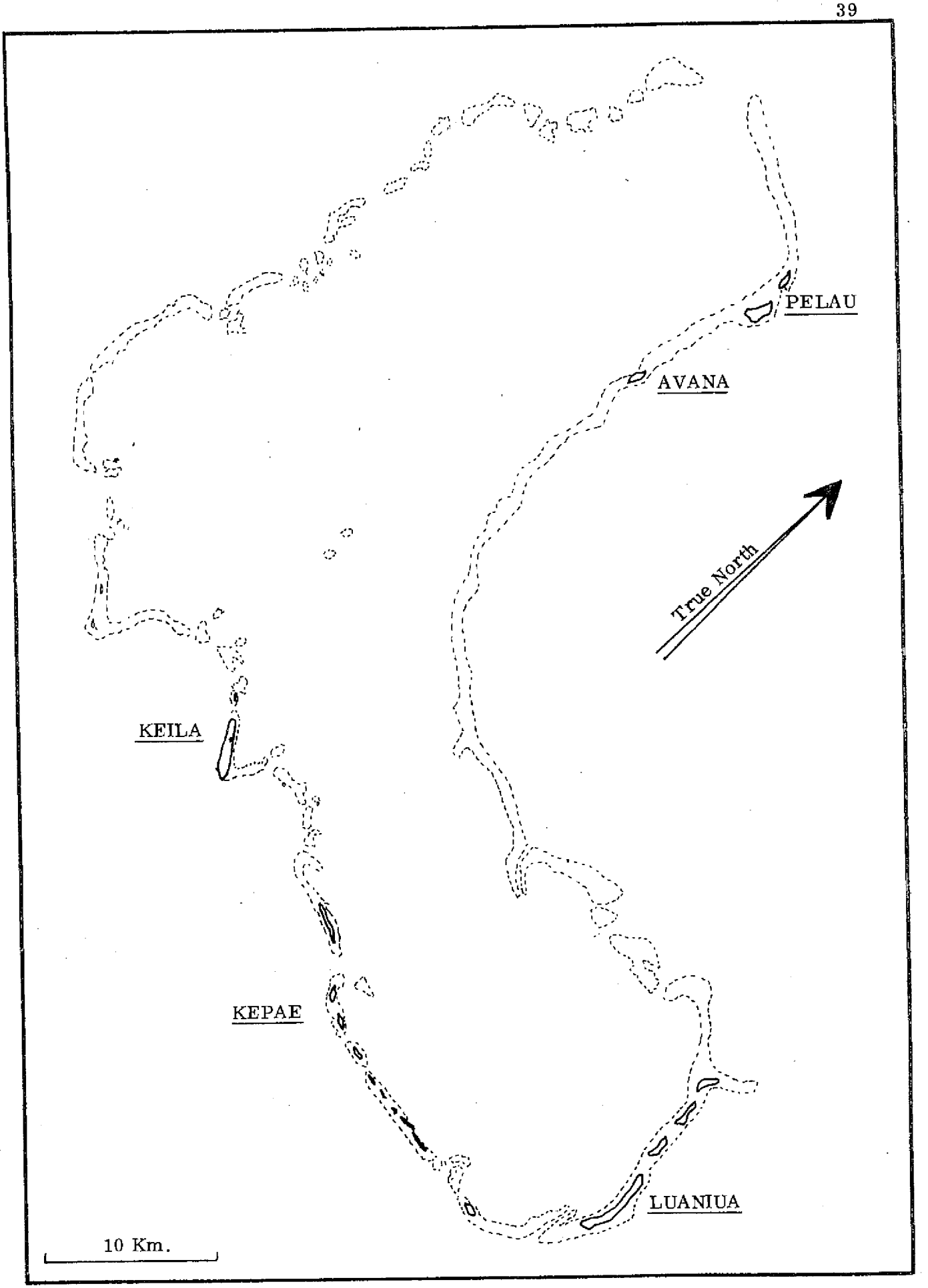

Fig. 2: ONGTONG JAVA ATOLL

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.

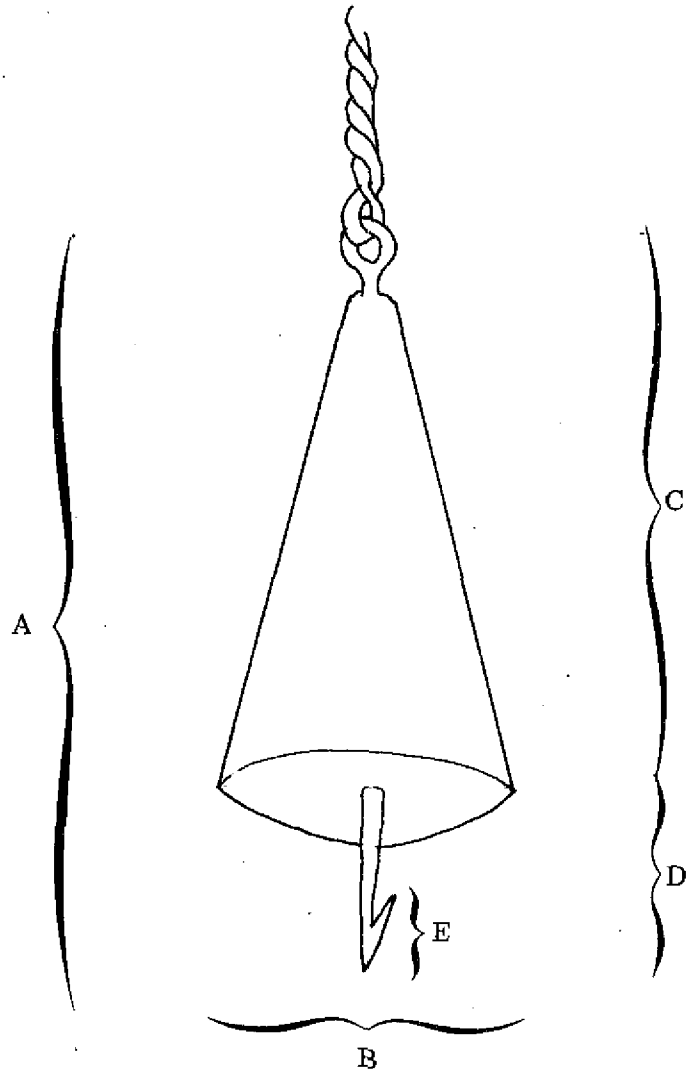

Fig. 3: WEIGHTED SPEARING POINT USED TO COLLECT BECHE-DE-MER.
(2/3 actual size)

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 (°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	20.5	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.

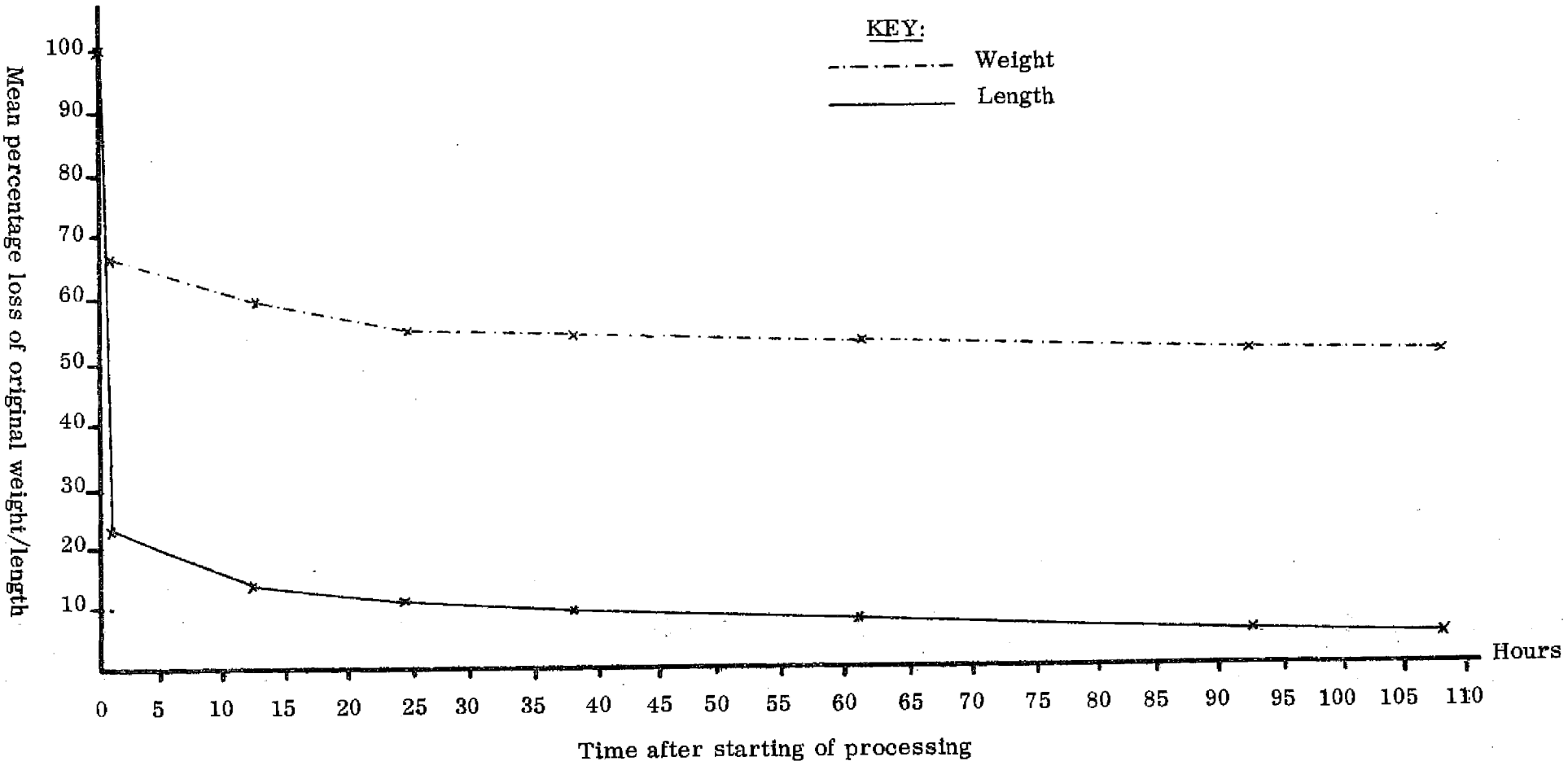

Table 6 contains length and weight data for 100 specimens of bêche-de-mer. The average weight of individual specimens was 116.7 g with an average length of 213 mm. The relationship linking weight and length calculated for this sample of 100 is described by the equation $W = 0.0064\ L\ 1.82$.

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

Mean weight value = 116.7 g

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 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

REFERENCES

Barnes, R. (1974) Invertebrate zoology (3rd edition). London, W. S. Saunders.

Bayliss-Smith, T.P. (1973) Ecosystem and economic system of Ontong Java atoll. Cambridge University, Department of Geography. Ph D. Thesis.

McElroy, S. (1973) The bêche-de-mer industry: its exploitation and conservation. Findings of an exploratory bêche-de-mer resource survey at Ontong Java atoll. Honiara, British Solomon Islands. Department of Agriculture, Fisheries Division (Internal report).

Sachithananthan, K. (1973) South Pacific Islands bêche-de-mer industry. Rome, Food and Agriculture Organisation of the United Nations (FI:DP/RAS/69/102/11).

South Pacific Commission (1974) Bêche-de-mer of the South Pacific Islands: a handbook for fishermen [based on work by K. Sachithananthan]. Noumea, South Pacific Commission.

ooo000ooo