Torba Province

Vanuatu

Stock assessment survey.

Beche de mer, Giant Clam, Rock Lobster & Coconut crab.

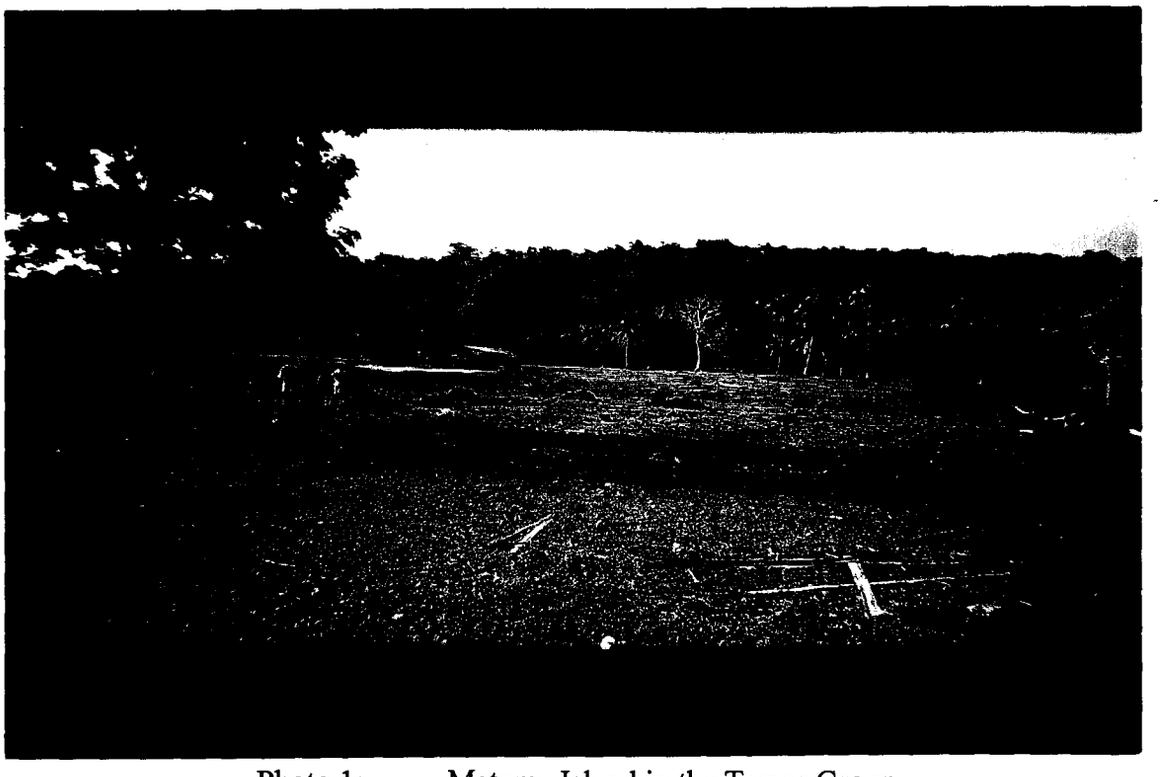


Photo 1: Metoma Island in the Torres Group

Report compiled by
Rob Lamont, Tony Boyle &
Carly Templeton.

September-October 1999

Diploma in Marine Studies
Windermere Campus
Bay of Plenty Polytechnic
Private bag TG12001
Tauranga
Telephone (07) 5440920
Fax 07 5442386

Preface.

As part of the Marine Reporting 2 module in the Diploma in Marine Studies Course 1999, every student is required to complete a written report that is based on surveys done within the marine environment.

This report is based on a trip three student Rob Lamont, Tony Boyle, and Carly Templeton went on to Vanuatu.

The reason for this trip was to help the Vanuatu Fisheries Department survey the islands of the Banks and Torres groups (Torba Province) to asses the stock numbers of various species. These species included coconut crabs, lobsters, giant clams and beche de mer.

Many skills learnt from past experiences would be called upon from each of the students as they under take the journey ahead. At times character, stamina, and knowledge will be stretched to its limits.

Photo 2 Traditional dwelling of Gaua Island.

Acknowledgements

First and foremost many thanks must go to Dean Tully for his innovation and creativity in securing access for the Polytech students into the Vanuatu Fisheries Departments stock assessment program. His dogged determination and persistence in communicating with the Vanuatu fisheries constantly, paid dividends and presented the students with a once in a life time opportunity to travel and work in an exotic island location.

Many thanks to Air Vanuatu for their huge support to the students in the way of discount airfare, which without would have made it very difficult for us to be able to afford the trip to your great land. The fantastic in flight service must be commended, which set the scene for an awesome experience.

Thanks to Moses Amos, Director of the Vanuatu Fisheries Department for allowing us to participate in the program and for his fantastic hospitality and patience. The tours of the Kava bars were very educational and socially a pleasant way to end the day. Although two members of the group will probably remember the reaction from overindulgence for a long time to come. Thank you also for your quiet caring attitude and for ensuring our safety and comfort was well taken care of.

To Karlo Pakoa for his great leadership and guidance throughout the trip. Even though it was necessary for you to return to Port Vila half way through the project your guidance and presence was always felt. Your knowledge of Vanuatu history and willingness to share it with us has proved to be invaluable in helping to understand the plight of your countries fishing industry.

Thank you, Bill Willie for guiding the vessel to a safe passage around the Torres and Banks Islands. Without your previous knowledge of the Torba province the safety of the vessel and crew may have been compromised at times. Your coolness and quiet determination had a calming affect on many and was a great contributor toward making the trip a pleasurable one.

To Jean Baptiste a big thank you for the personal attention and care you bestowed on us and for your willingness to pass on much information about local customs, beliefs, and legends. Many of the tales you told will remain with us for a long time and some probably forever. Your colourful stories and unique way of telling them was very entertaining and helped to break the monotony during many a long day and night.
Thank you, so much for your engineering skills and knowledge of the boat, it was without doubt the single biggest contributor to maintaining the safety and comfort of every one on board.

This acknowledgment would not be complete if the terrible trio of Emae were not included. Firstly to Seule Samuel, thanks for you're great assistance and tenacity with the survey dives and daily duties around the boat. Next to Donald Samuel, (slave) thanks for your entertaining and jocular personality. We all agree that your youthful enthusiasm and lighthearted approach to life was a daily inspiration to everyone. Last but by no means least a huge thanks to Mark Sandy,(Old fella) for your dogged determination and willingness to take on any task that was asked without question or hesitation. Your fishing knowledge and skills are to be envied and worthy of mention. Thanks for sharing a part of this with us as it was quite likely the reason for a lot of our fishing success.

The purpose of this survey is to assist the Fisheries Department in gathering data for the stock assessment program so management strategies can be formulated for the long term.
This stock assessment survey was year two of a three-year program. The survey encompassed the Torba Province, which is the northern most province of the Vanuatu group and is made up of the Banks and Torres group of islands. The species surveyed were beche-de-mer, rock lobsters, giant clams, and coconut crabs. This area has not been surveyed before so this will provide a base line for future surveys and play an integral part in formulating management plans for the fishery.

In order to gain some insight and understanding of the state of the Vanuatu fishery a brief history has been documented in the report. This illustrates how and why the fishery is seemingly undeveloped and under utilised. Many schemes have been started and failed leading up to Vanuatu's independence and Republic formation. Every aspect of the growth and development of the fishing industry in Vanuatu is dictated by the financial position of the country, therefore any progress will be slow and calculated.

Giant clam and beche-de-mer made up the bulk of the first part of the surveys using transect and timed drift methods. The most prolific species of beche-de-mer found was the lolly fish although a scattering of other species were recorded. Although the lolly fish are of low commercial value their ability to reproduce in large numbers and several times per year shows them as having great potential as a commercially cultured species.
There are eighteen species of beche-de-mer known to be present in the Vanuatu waters.

The giant clam *Tridacna maxima* was the most abundant clam of all found with encouraging numbers recorded throughout the islands. Hiu Island had the highest density of clams.
The two larger species, *Tridacna squamosa* and *Hippopus hippopus*, which are commonly harvested, are very limited and the numbers found were not adequate to sustain harvesting.

The lobster surveys differed slightly in as much as they were carried out during the hours of darkness for the simple reason that they are nocturnal and come out to feed at night. Of the three species, the double spine is by far the most prolific lobster (58%) on all the islands except Reef Island. On this island the painted lobster recorded slightly more than the double spine, which simply may be because the latter is the most preferred species for consumption. The slipper lobster accounted for a small proportion of the total lobster count (11%) except for the site on Pakea Island. As is with the painted lobster the slipper is not popular for consumption and is generally left alone. Because the slipper lobster is much smaller than the other two, competing for habitat and food would be difficult, which could also explain the low overall numbers found, which tends to suggest that sustainable harvesting would be marginal.

Coconut crabs are probably the biggest revenue earner of the Torba province and the least known about, especially when it comes to the state of the population.
It is widely known that the majority of coconut crabs in Vanuatu come from the Torres group especially the island of Hiu. The pressure on the stocks is ultimately controlled by the demand for the product. More often than not the demand for crabs is higher than the supply. The effects of over harvesting was present at several sites and the increasing exploitation is of growing concern to some of the locals.

Table of contents

Section 1

Introduction

1.1 Introduction
1.2 About Vanuatu
1.3 Fishing history

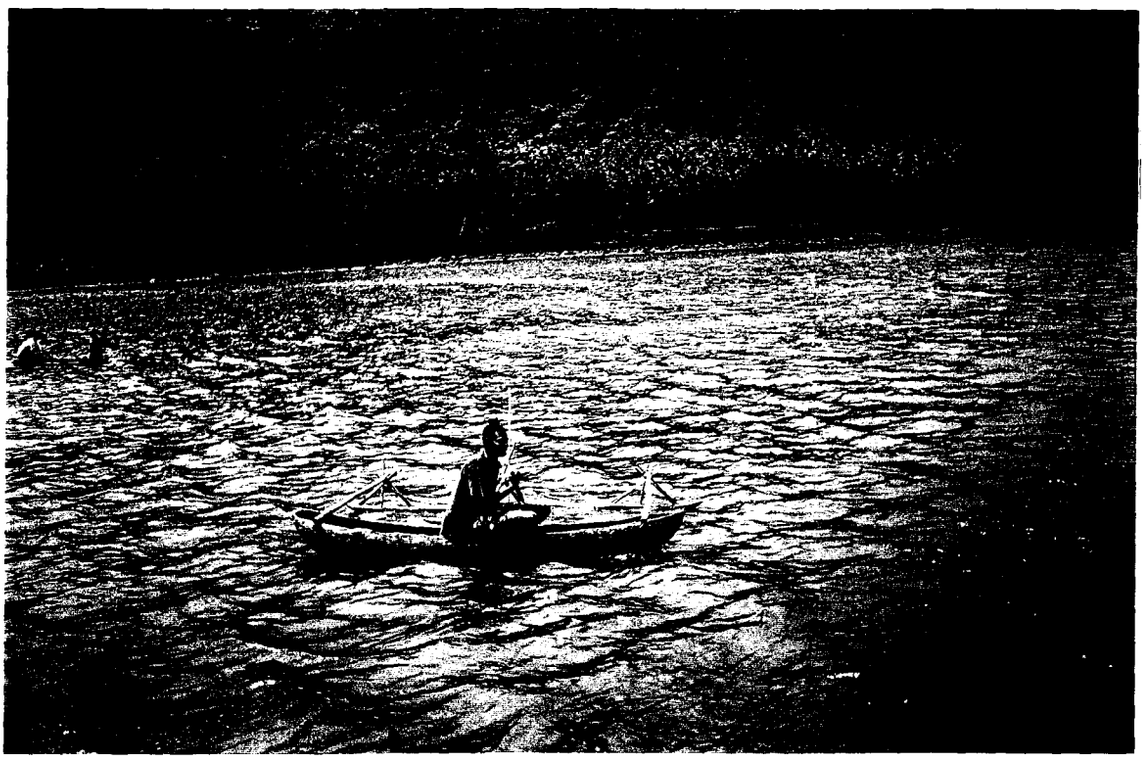


Photo 4 Traditional dugout canoe of the Vanuatu people.

The Stock Assessment Project was set up by Vanuatu Fisheries Department in order to gain knowledge on the condition and distribution of the country's marine resources.

The assessment was carried out by a series of marine and land-based surveys for giant clams, beche-de-mer, rock lobsters and coconut crabs. These species were chosen due to their high economic value and widespread harvesting as a food source.

The results from the project will be compiled after the third year of study to find the abundance of each species. This knowledge will be used by the Fisheries Department to facilitate management strategies and awareness programs. The new strategies and programs will focus on sustainable development and harvesting of the relatively undeveloped fisheries of Vanuatu.

The South Pacific Forum Fisheries Agency, Solomon Islands, provided funding assistance for the project. The assessments are to be under taken as a three-year project with ongoing assessments to be carried out every 5 to 6 years.

To date the stock assessments have been undertaken in the Tafea and Shefa provinces. This report covers the second year of a three year project and is centred on the island groups of the Banks and Torres in the Torba province (*see map 1*). Future assessments are planned for the Malampa, Sanma and Penama provinces.

During this years assessments the survey team consisted of three students from the Diploma in Marine Studies in New Zealand and six members from the Fisheries Department staff. Mr Kalo Pakoa, co-ordinated the operation as the Head Biologist and Acting Principal Research Officer. Mr Soule, Donald Samuel,& Mr Mark Sandy provided research assistance and Mr Bill Willie captained the survey vessel MV Lewia along with Mr Jean Baptiste the Head Engineer and Technician. Casual assistance was also enlisted from some of the islands where locals were employed by the team to act as guides.

The objectives of this report were:

- To gather data to assist the Fisheries Department of Vanuatu in their Stock Assessment Program
- To demonstrate the abundance of species through site comparisons
- To investigate and document the types of habitats each species of beche-de-mer and giant clams inhabits
- To discuss variations in lobster numbers through site comparisons
- To define the condition of coconut crab population in the Torres group.

1.2 General information about Vanuatu

Vanuatu.

Vanuatu is a 'Y' shaped chain of over 80 islands, which stretch approximately 850km in length, 12 of the islands are considered major (Bell & Amos 1993). These islands are located 2000km north of Auckland and are located between latitude 13° South and longitude 166° East
The capital of Vanuatu is Port Vila that is located on the island of Efate.
The total landmass is around 13,000 sq. km.
Vanuatu's location is on the margin of the Indian and the Pacific plate's therefore volcanic activity is common with some of the islands being live volcanoes e.g. Ambrym.
The islands are composed of volcanic rock and marine limestone.
They have an Exclusive Economic Zone that covers an estimated 680,000 km^2 (Bell & Amos 1993).
Vanuatu is close to the Solomon Islands and the northern islands in Vanuatu (Torres Group) are largely influenced by the Solomon islanders costumes and beliefs.

Climate.

The climate in Vanuatu varies from tropical in the northern islands to sub-tropical in the southern islands.
The dry season is from April to October with southeasterly winds being the predominant winds at this time.
Summer is from November to March, during this season cyclones are common with an average of two cyclones occurring every year.
The temperature during the year ranges from 17° to over 30° Celsius.

Government.

Prior to independence in 1980 Vanuatu was known as The New Hebrides and was jointly administered by France and Great Britain as a 'condominium' for 74 years.
After the independence of Vanuatu on the 30th July 1980 Vanuatu became a self-governing republic and a member of the commonwealth.
The members of parliament are elected every 4 years. Besides the government there is also the National Council of Chiefs, which is mainly an advisory body to the government. This group is made up of custom chiefs who are elected by their peers sitting in the District Council of Chiefs.
The government's income comes from grant aid and government collections such as import duties, export duties, and taxes.

Flora & Fauna

Vanuatu is a safe island being free from dangerous land animals. There are two crocodiles and the occasional snake that can be seen in the Torba province. Mosquito's that can carry malaria, are present throughout the islands and a common native Flying Fox can be seen at nights heading off to feed.
There are several species of Turtles that live and breed around the island, that are occasionally consumed by the local island people.
Pigs, cattle, chickens and goats have been introduced to provide food for many islanders.
Dogs and cats have also been introduced as pets.

Within Vanuatu there are islands and villages still run as they were in the 1800's with chiefs still commonly seen in most villages. This position is normally handed down to the eldest son of the family.
The role of each chief is to conserve and manage the land of the villagers so that there is always a supply of food and to ensure the people of the village are safe.
Everyone respects the chief.

The main source of income for the villagers on the outer islands is the export of copra.
The Ni Vanuatu people are well supplied with fruit and vegetables as most families have a garden in which they grow vegetables like taro, yam, manioc, bananas, pawpaws, coconuts and other tropical fruits and vegetables.
Approximately 70% of the population live within 2km of the ocean, this gives them the opportunity to use the resources offered. Traditional methods of collecting fish included fish poisoning. This is done by making up a mixture of leaves and seeds and then sticking it all in a hole in the reef, the poison will kill everything making it easy to collect the fish.
The chiefs often put a Tabu on a certain area around their island or village to allow it to re-establish.

Fisheries Department.

The Department of Fisheries is responsible for the control, development and management of the fisheries resources under the Fisheries Act 1983.
The emphasis is on the development of activities which have the greatest potential to generate, or sustain, income earning opportunities and employment,and to stabilise or reduce imports and increase government revenue.(Bell & Amos 1993)
The main goal of the Fisheries Department is the development and the management of the fishing industry.
The development strategies were listed under six sectors.

- 1.Subsistance Fisheries
  Conserve inshore fishing to ensure the resources last and remain at reasonable levels to enable continued use.

- 2.Small scale Commercial Fisheries.
  Continue to assist with the formation of small coastal fishing operations and ensure the long-term viability of such operations.
  Provide sufficient fresh fish to satisfy local demand, and to improve local distribution and storage.
  Develop export markets and develop local canned fish operations.

- 3.Oceanic Fisheries.
  Develop small locally based Tuna fishery and consider and encourage requests for fishing rights within Vanuatu's EEZ from foreign nations.

- 4.Aquaculture.
  To conduct pilot trials to test the feasibility of the artificial culture of aquatic organisms and the reseeding of over-exploited areas of reef.

1.3 FISHING HISTORY OF VANUATU IN BRIEF

Fishing as a commercial industry prior to 1980 in Vanuatu was virtually non existent as fishing was always considered secondary to agriculture and was generally on a subsistence level. Several different methods of catching and gathering fish were employed by the Ni – Vanuatu depending on reef topography, size, and accessibility. A few examples are still being practised today on some of the 80 islands of the Vanuatu group. Three of these being spear fishing, fish trapping, and less common fish poisoning.

Fish poisoning is now prohibited under the Fisheries Act of 1983 but because of the remoteness of many of the islands, policing and enforcement is difficult. The poison used for this type of fishing originates from the toxic fruit of a native plant. After grinding the fruit into a paste it is then mixed with some other (secret)ingredients, the finished product is then wrapped in leaves for easy handling. One of the small parcels is then submerged into a hole on the reef and left for a short time. The result is total destruction of all life within a 1-2 meter radius. This method is however the least used out of any other method and thanks to the fishery departments education and awareness efforts most people realise how destructive poisoning can be to the reef system in general. One villager from the island of Ureparapara was reported as saying that even though they did use poisons it was very rare and only for a special occasion such as for a customary feast.

The fisheries department actively discourages fish trapping although it is not prohibited.

In this method two fences are constructed parallel to each other in a perpendicular direction from the shore out into the reef fringe far enough to ensure that the majority of the area will remain in the tide. A special entry point is then constructed between the two fences, which will allow entry for schools of migrating fish but prevent exit. At low tide the fishermen would then be able to wade out into the enclosure and gather the trapped fish. Unfortunately because there is no way of opening up the trap to release any excess fish this method tends to work on the all or nothing system. Fortunately due to the fisheries departments education and awareness program this method also is not used very often.

Spear fishing is to date probably the most widely used method for catching fish. To own a spear gun is every boy's dream but because they are so expensive in Vanuatu it is usually not an option. A common substitute is a sling spear, which is relatively inexpensive and easy to make. Most of the villagers from the islands are limited however to daytime spear fishing as dive torches and even batteries were a very rare and expensive commodity.

A bow with a three pronged arrow is also a very effective apparatus and can be used either wading the reef or from a dugout canoe.

A more modern style of fishing had been seen being used on several of the islands and that is shore based rod fishing. With the rod made from a long piece of bamboo and nylon line attached to the tip the fisherman could stand at the water edge and cast their lines very effectively out into the reef. Unfortunately cost and distance often prohibited villagers from being able to replenish their fishing line or hooks very often.

A privately owned company called the South Pacific Fishing Company (SPFC) established the first commercial fishing venture in Vanuatu in the late 1950's. This was set up essentially as a processing and shipping base for the Japanese and Taiwanese fleets that were operating in the local waters at the time. This venture lasted until 1987 at which time the operation was forced to close down. Many reasons were sited for the closure but one of the main ones was depleted fish stocks. The government then took over the administration side of SPFC essentially as a vehicle for controlling and regulating access of foreign vessels. One of the conditions of consent was that the vessel to which access was granted must employ a set

uncontrollable factors such as bad weather and cyclones. Businesses were starting to fail so a third type of vessel was tried. This was a design taken from the Kiribati Islands and was hoped to be the saviour for the remaining fishermen. The boat was a large outrigger design, which had the capability to operate under either sail or motor. This was the area of main gain, as fuel consumption should theoretically be halved. Unfortunately the Ni-Vanuatu were not skilled enough to master this type of boat because sail was never part of their traditional methods. Popularity was short lived and these vessels were pushed to one side. In a last ditch effort to save the project the more familiar Vanuatu outrigger was adapted for a motor and tried but unfortunately this was a total failure.

Photo 6, Vanuatu Fisheries Department survey vessel M.V Lewia.

In 1995 a local boat building firm was established to manufacture a new fibre glass boat. This proved to be the most successful and can still be found in use today not only as a fishing boat but also several are in use as water taxis. Unfortunately by this time the project was already in serious threat of collapse. Foreign funding had ceased, many of the ice machines were in need of repair, fishermen where losing interest in fishing, and the fish markets were financially struggling. The ice machines were the biggest headache because the fishermen could not keep their catch fresh. The problem was that the machines were of the type that produced CFC and because of environmentalist pressures parts were no longer available. This meant that slowly one by one the ice machines could no longer operate.

In 1996 the fisheries department investigated the possibility of privatising the fishing industry so employed a consultant for advice. His advice was to write off all of the equipment, which in the fisheries departments eyes was counter productive. As part of the restructuring the last two fish markets remaining (Port Vila & Espiritu Santo) were leased to private business men with a view to Ni-Vanuatu taking over the management role at the appropriate time. Due to many factors ie, political pressures, corruption, and poor management skills the markets were soon in financial trouble and had to be sold off.

Section 2

Methods

2.1.1 General introduction
2.1.2 Zonation of survey sites
2.1.3 Giant clams and beche de mer survey methods
2.1.4 Rock lobster survey methods
2.1.5 Coconut crab survey methods

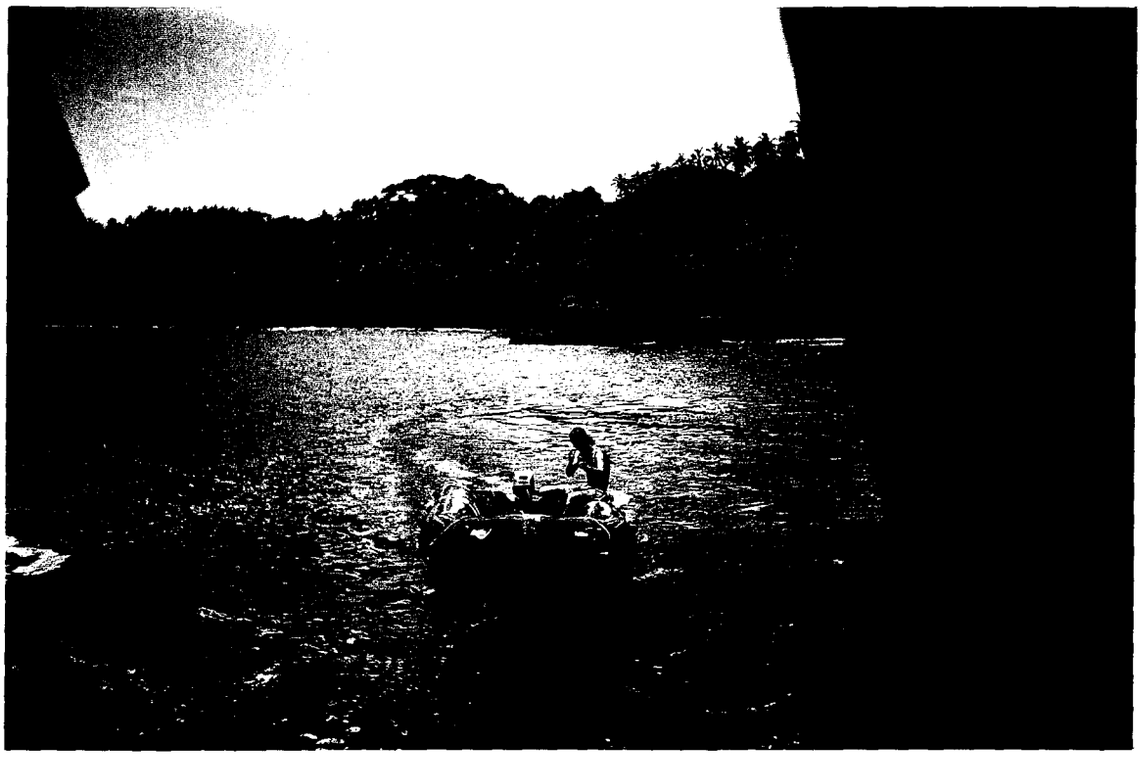


Photo 7 Rubber dinghy used for survey support.

2.1 Methods

2.1.1 General Introduction

The protocol of the Stock Assessment Project required consultation with the Chiefs of each island before any of the sites were surveyed. This gave the survey team important knowledge about the local environment, location of survey species, Tabu areas, access to sites and other information that was relevant to the project like the past and present harvesting activity in survey areas. Local guides were also enlisted to help orientate the survey team when conducting land based surveys

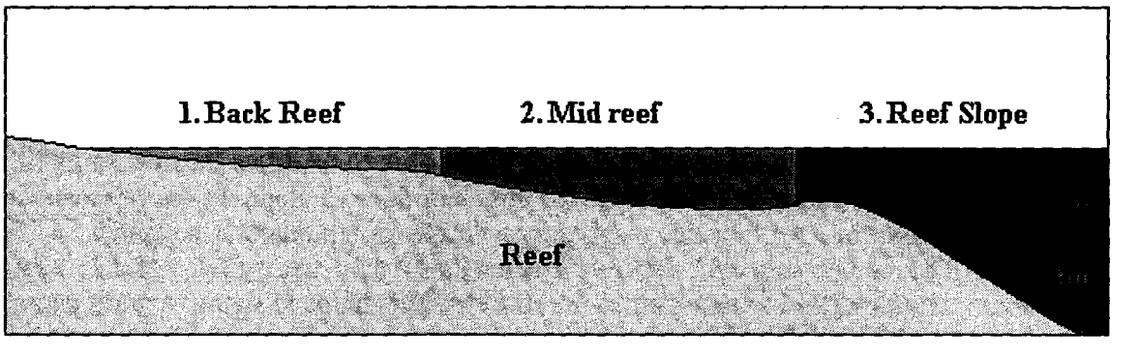
Following consultation with the presiding chief and the enlisting of local guides, the survey leader should conduct a briefing. This briefing should include:-

- expected tidal and current conditions,
- description of survey area
- start times and length of survey,
- delegation of duties such as timekeeper and recorders,
- general description of the method to be practiced,
- emergency procedures such as equipment failure or team separation.

2.1.2 Zonation of Survey Sites

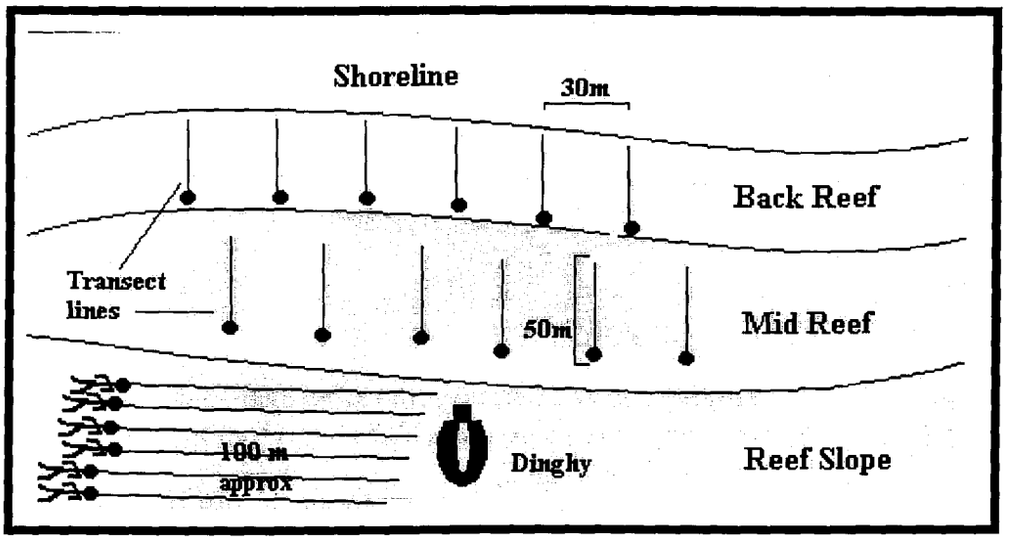
Ideally the survey sites on the reefs around the islands should consist of 3 zones.(see fig 1) The zones are distinguished by the general characteristics typically found in a reef system.

Figure 1. General Zonation of a Reef System.

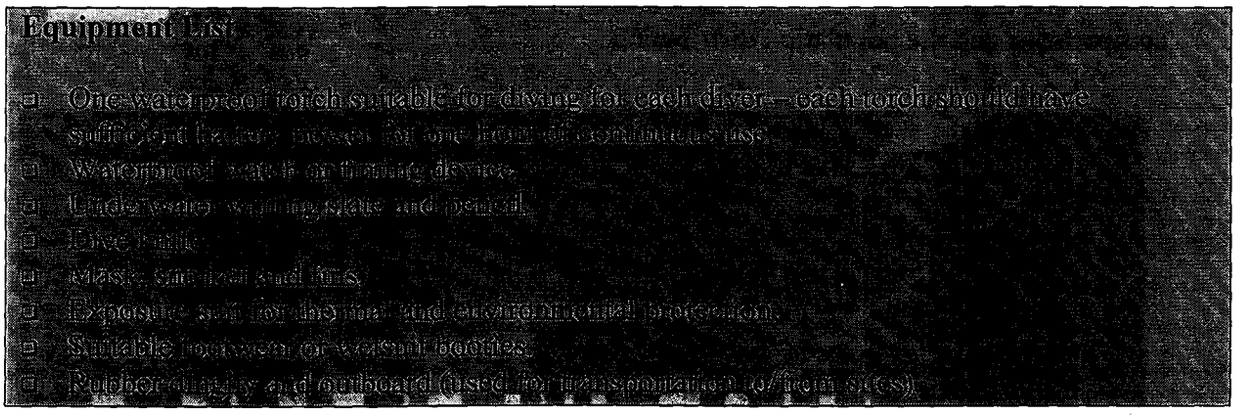


Zone 1- Back Reef; Consist of the area from the shore of the island extending seaward to depths of about 1m. The back reef is usually sand or weathered rock with sparse crops of coral. It contains a habitat dominated by beche de mer, small reef fishes and night feeding lobsters.

Figure 2. Transect Survey Methods



2.1.4 Rock Lobster Survey Methods



The lobster surveys were conducted at night by free diving with torches and recording the numbers observed for each species. The survey was timed for an hour and began most nights at 6.30pm, however delaying the start time longer allowed more lobsters to leave their daytime cover.

Members of the team were grouped into buddy pairs with one buddy selected to record data onto the dive slate. The pairs were lined up perpendicular to the shoreline and swam parallel to the shore where possible, much like the method used for surveying the reef slope during the day dives (*see fig 2.*).

Each buddy pair were instructed to stay together at all times, and all members of the team travelled as one big group. When the timekeeper signalled the end the survey was completed. The numbers taken from the survey were then be collated into graphs showing the site comparisons for each island.

Photo 9 Coconut crab traps once set.

Photo 10 Coconut crab on the trap.

Section 3

Island Descriptions

3.1.1 Banks Islands
3.1.2 Torres Islands

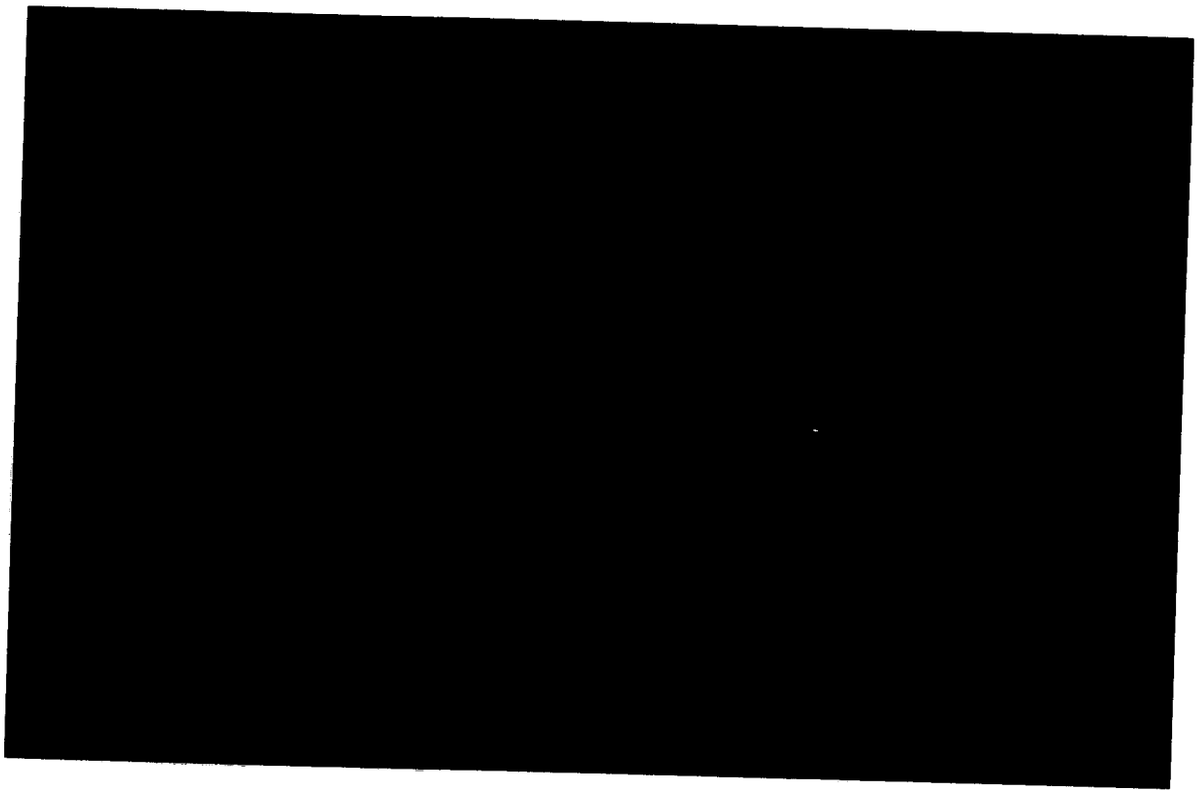
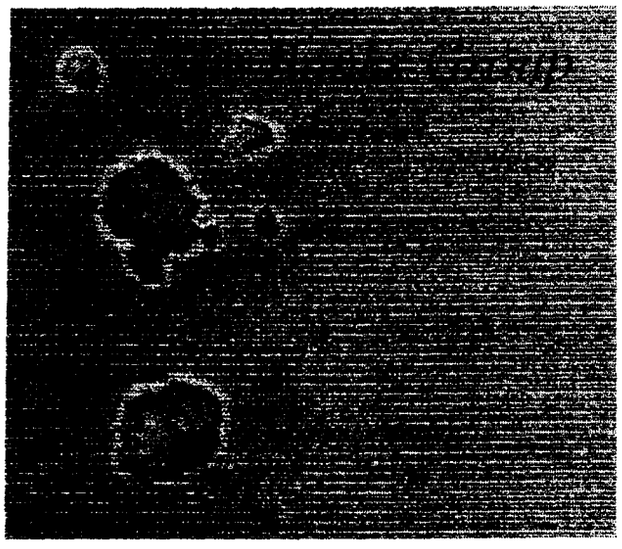


Photo 11 Sunset over the Torba Province

3.1.2 The Banks Group.



The Banks is a scattered group of islands that lies 350km North of Efate.(see map 2) The group is made up of 13 islands; 12 of which formed part of the survey and are described below. All except Reef Island are inhabited. The Ni Vanuatu people of the Banks Group are well known for their colourful dance costumes worn during traditional ceremonies. Most of the Banks group are Anglican and very committed to their religious beliefs.

The islands are of volcanic origin with volcanic activity still present on the largest islands of the group, Gaua and Vanua Lava. This report studies 12 islands from the group, where 23 sites were surveyed.

Map 2, The Banks group of islands.

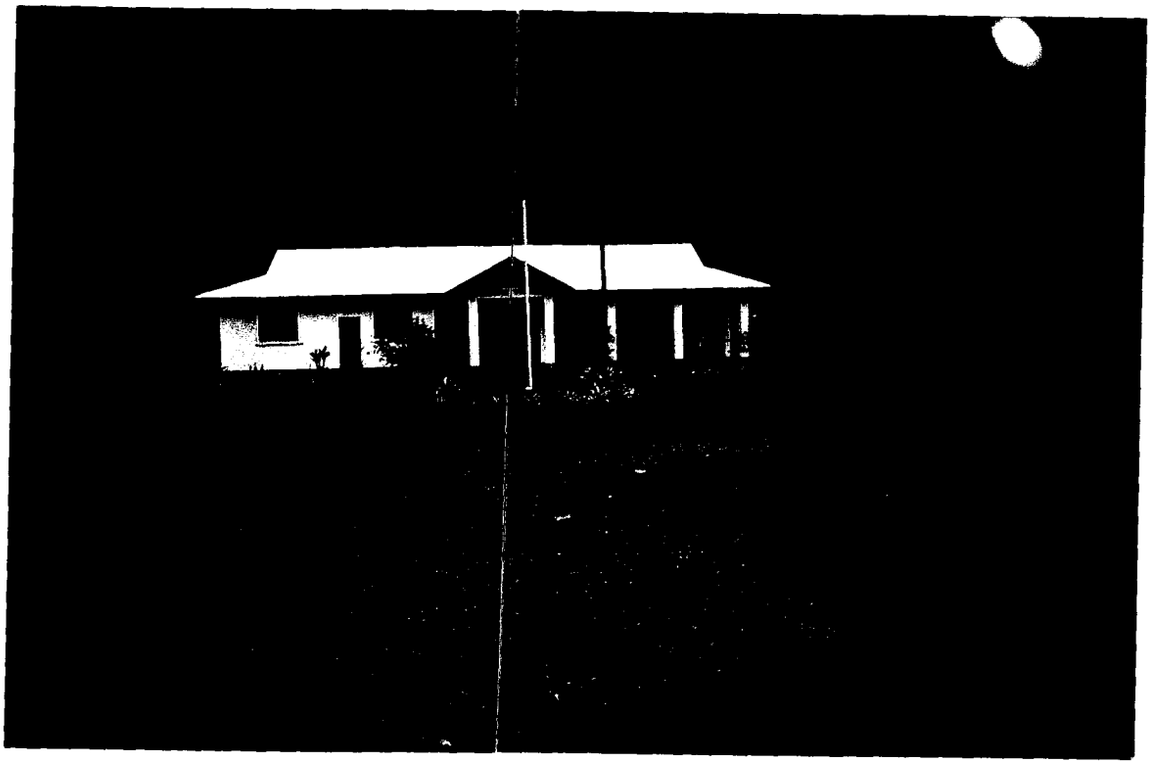
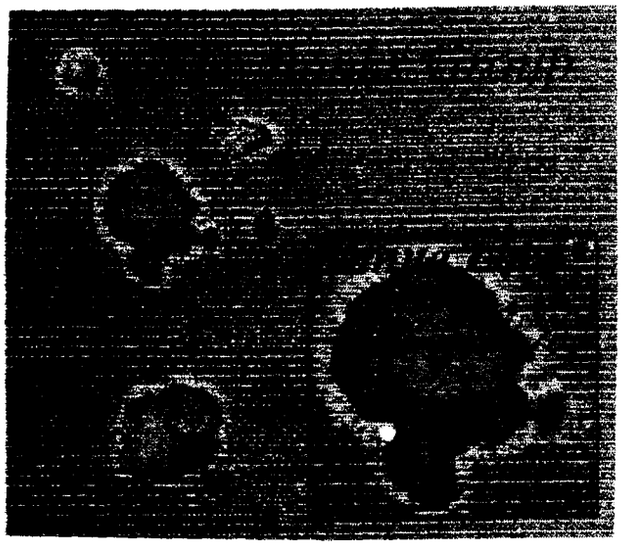


Photo 12 Courthouse at Sola on the island of Vanua Lava where the Torba Province is administered.

Vanua Lava

Vanua Lava is in the middle of the Banks group and is about the same size as Gaua. The highest point on the island is an active volcano called Mt Suretimeat (950m) which was once mined by the French for its rich sulphur deposits and last erupted in August 1965 coinciding with the eruption of Mt Garet on Gaua (Douglas et al). There are 3 main villages on the island, the largest being Sola.



Map 4, Vanua Lava Island

Sola is the administrative centre of the Torba Province and contains the Provincial Head Quarters, Courthouse, and the primary and secondary schools. It is also the most developed village on the island with an airstrip that receives regular flights and roads to accommodate the few vehicles. Building materials and bulky supplies that can't be flown in by small plane are transported by trading ships from Port Vila (Efate).

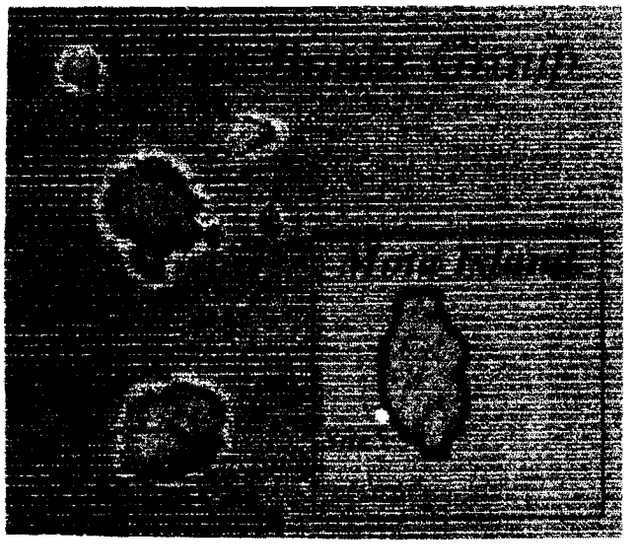
Tourism is not big on the island as only two small operations had bungalows to accommodate tourist. Chief Godfrey who lived at Vuras Bay, on the western side of the island, made comment on how hard it is for tourist to get to Vanua Lava due to its remote location.

North of Sola is Port Patterson, an excellent anchorage that was first discovered by Bishop Selwyn. The Bishop named the port after the first Bishop of Melanesia, and is now the site of a small Melanesian Mission School (Douglas et al). Port Patterson is also the site of Vanuatu's only resident Salt water Crocodiles. The locals were more than happy to talk about the crocodiles but conflicting stories made it hard to distinguish where they were from, how long they had been there, or even how many were still around. Nonetheless a place of great interest to the survey team as one of the survey sites was apparently close to the territory of one particular crocodile that had already attacked people.

There were two sites planned for Vanua Lava but in the interest of team safety only Site 2,(see map 4) at Vuras Bay was surveyed. Vuras Bay offered good anchorage and a reef that contained all three zones needed for the survey. It was found that the islanders harvested lobsters and some giant clams but it was unclear how much, if any, commercial harvesting of the survey species was taking place.

Mota Island

Mota is about 15Kms east of Vanua Lava. It has a narrow reef with a deep drop off around the entire island. There are 5 villages on the island with a couple of shops between them and the staple food on the island is Taro and Manioc.



Map 6, Mota Island

High populations of Flying Fox and birds have caused a lot of damage to fruit and vegetable crops in the past. There are no guns on the island to help control the problem, so the Flying Fox and birds have basically been left to flourish. The size of the reef and lack of beaches makes the island very inaccessible so supplies to the island can only be transported by small boat. The main source of income was from selling Copra until the market collapsed.

The reef slope was the only zone that could be surveyed as the mid reef and back reef zones were absent from the site. Site 5,(see map 6) on the western side of the island was the only site scheduled for Mota and was only surveyed at night for Lobsters. This site was in a Tabu area and had been under protection for the last year and a half, discussion with chiefs on the eastern side of the island expressed concern about the lack of respect some people have had for the Tabu areas.

Mota Lava

Mota Lava is actually made up of two islands (these are Ra and Mota Lava Islands). A shallow lagoon separates these two islands approximately 100 metres wide. This island is distinct for having the largest populated island within the entire Banks group. Different locals could not accurately ascertain the exact number of inhabitants but it seems the population would be between 200 and 600. There are seven villages in total on the islands, five are within very close proximity of each other and the other two are on Ra.

Map 8, Mota Lava Island

The island has a well known reputation for traditional fish poisoning which was widely practised up to three years ago when a ban was placed on its use. The Vanuatu Fisheries Department employed the chiefs of each village to implement the ban and also educate the people about the destructive nature that poisoning has on the reef. Unfortunately due to the remoteness of the banks group from Vanuatu monitoring and policing of the ban is virtually impossible and it is feared that as the fish reinhabit the reef the ban will be flaunted.

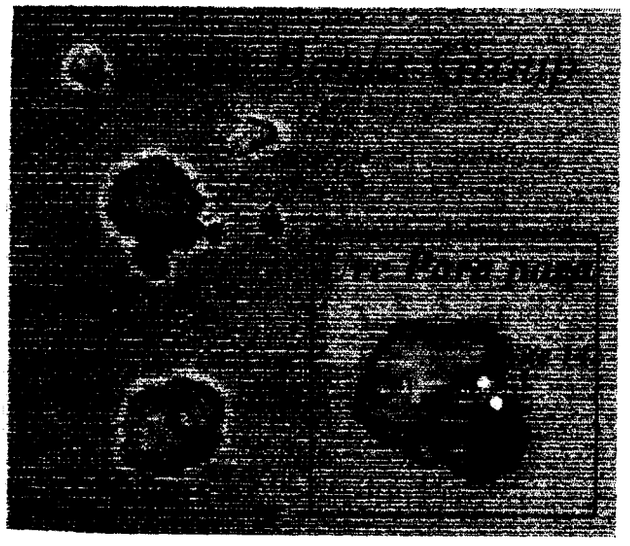
Beche De Mer are harvested only from the lagoon as reef harvesting is into the second year of a five-year ban, which the chiefs imposed as a measure to rejuvenate the depleted stocks. At the time of this survey part of the reef was also under a four-month tapu, which prevented the collection of all seafood as a measure to increase the stocks for an up coming religious feast. After the feast the tapu would be lifted.

Copra is the main source of income for the islanders and beche de mer is the secondary earner. Because there is only the one site for beche de mer harvesting this income is very sporadic. The main subsistence crop grown is Manioc (Tapioca) but the other usual fruits and vegetables are also grown to supplement this. Because all the villages are situated on sand flats the people must walk for some time to reach higher ground before they are able to cultivate their gardens.

The main island of Mota Lava is a dormant volcano, which has three peaks remaining of the original crater edge at its centre. There is evidence of volcanic action on parts of the island in the way of silica deposits in the lagoon and what appeared to be small steam vents on the side of one of the peaks.

Para para Island (Ure Para para)

Para para Island, commonly known as Uraparapara is the top of an old volcano, one side of which collapsed and disappeared (see map 10) This has left an excellent harbour with great shelter and anchorage. The first impressions as you enter the harbour are its similarity to the Marlborough Sounds with its deep blue waters and bush clad sides steeply rising up from the water to 742 metres. There is no commercial harvesting done at all within the harbour and very little subsistence fishing.



Map 10, Para para Island

The island lies about 20km north west of Vanua Lava and about 80km south east of the Torres group so it is probably the most isolated island of the whole Torba province. There is one telephone and one radiotelephone on the island but because of high operating costs use of these is reserved for emergencies. The telephone link is by way of a solar powered satellite dish directed to relay from Solar.

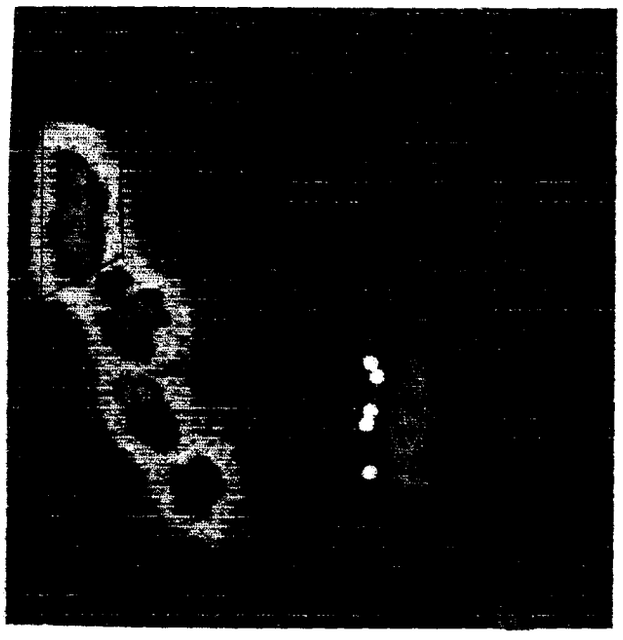
Because of the isolation simple commodities become hard to obtain and expensive when they are available. Fishing line and hooks are just one example. Because of this the locals don't appear to do much fishing of any sort except for the rare occasion (cultural event) when the traditional method of fish poisoning will be used.

The island is also unique in the respect of how a chief is selected. The traditional way throughout Vanuatu is for the chieftainship to pass down from father to son but in Uraparapara the method is completely different. About nine years ago the people of both the villages of the island decided to adopt the western method of holding elections. Within each village community there is the clan style structure or family groups. Each clan has a head and that person is put forward as a candidate for the chiefly elections. Elections are held approximately every 5 years but so far the chieftainship has not left the original family.

Along with this break in tradition it seems that many other traditional practises have been lost through the years. A big influence on this may be that there appears to be a lot of immigration into the island from other islands, some as far away as the Solomon Islands. On arrival into the harbour the survey party was greeted by a flotilla of canoes and amongst these there was one canoe that looked totally different to the others. This canoe did not have an outrigger and had a slightly different hull design to the rest. One of the crew questioned the young man who was in it as to the origan of the canoe. To our surprise he told us that the canoe was from the Solomon Islands and that he had paddled to Ureparapara in it twelve months ago. As the nearest of the Solomon Islands is about 175km away this demonstrates not only the sea worthiness of the canoes but also the tenacity of the people of the South Pacific.

Hiu Island

Hiu Island is the northern-most island of the Torres and the Vanuatu groups (see map 12). There are three villages on the island (1 large and 2 smaller ones) all on the southern side, which is also the most sheltered side. The main village is situated at the waters edge and from the sea looks like something you would see in a postcard with its white sand beach and coconut palms lined up along the edge of the beach with the crisp clear tropical waters gently lapping the glistening sand.



Map 12, Hiu Island

Once the population was considerable but since has dwindled to little more than 200. The structure of the village and construction of the dwellings appears to be slightly different to those of other parts of Vanuatu (materials used, and in size and shape). Even their use of the national language Bislama (Pidgin English) seemed to differ. This variation has apparently come about because of the close links that the people of Hiu have with the Solomon Islands. The people spoke of travels to and from the Solomon's quite regularly, both by canoe and motor boat.

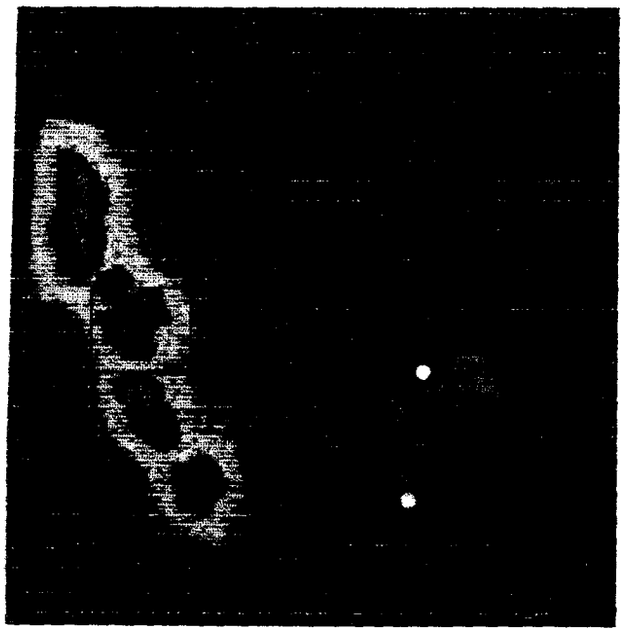
The main village has a primary school, small shop, a telephone, and a radiotelephone but apparently the telephone can only be used for incoming calls. For the children who wish to carry onto secondary school they need to board on Loh Island and attend the school there. The people of Hiu need to be mainly self sufficient as the trading boat visits the island once every six months or so. If any supplies are required urgently then they can have them sent to Loh on one of the weekly flights that service the island.

The main source of income is from the harvested coconut crabs, which are sent by air once every four weeks and sold in Port Vila to an agent. Most of the coconut crab harvesting areas are controlled by alternating open and closed seasons, these seasons are set by the chief. On average an area may be closed for 3 to 4 years at a time under a total catch ban (Tabu). As well as the local control there is also a regulatory ban every year for 2 months during the breeding season from September to November. During this survey there were two areas which were affected by the local ban system so it would be necessary to conduct a survey in both the closed areas as well the neighbouring open ones so as to get a clear comparison.

Because Hiu Island is the northern most island it is the first to be hit by tropical cyclones and tidal waves. Over the last couple of years tidal waves have caused some devastating destruction. Two years ago in late 1997 a large tidal wave completely flattened the villages on Hiu and caused a lot of reef damage to the northern and northeastern sides. Many habitats for species such as lobster, beche de mer, and coconut crab were destroyed or seriously affected. The main affect of this was to force many of the surviving coconut crabs further inland. Most of the affected areas are still recovering and probably will be for a few more years, assuming no more tidal waves hit the island.

Tegua.

Tegua Island is a steep island with a narrow reef, with sharp volcanic rock scattered around the waters edge.



Map 14, Tegua Island

Two sites were surveyed on Tegua Island these were located on the West at Metabe Bay and South west at Hayter Bay where the main village is located (see map 14).

Due to the narrow reefs present around this island only one zone could be surveyed.

At site two, which was Hayter Bay, the reef had some terrigenous influences, which may explain the dead and damaged coral.

There was also a lot of damage noticed that was caused by the heavy wave action.

The local villagers warned the group not to eat any of the fish in the bay, as they were poisonous.

Cooks Reef.

Cooks Reef is located South-west of Emae Island(see Map 1). No people live on the reef and due to its location the reef provides easy access from a number of the larger islands around Vanuatu to gather food.

The reef is owned by the Chiefs of the three islands that surround it, these islands include Emae, Mataso and Makira Islands.

Cooks Reef can be very dangerous and is believed that permission must be asked from the gods and gifts must be given to ensure a safe time while on the reef. Permission must also be gained from all three chiefs who own the reef. During World War II Vanuatu, then known as the New Hebrides was heavily occupied by the U.S. military. One evening after a successful day's targets practise a navy vessel (name unknown) inadvertently crashed into the reef and sunk. Coral has claimed most of the remains of the ship but some pieces are still evident today. (see photo 14)

Commercial harvesting of beche de mer, giant clams and lobsters occur frequently, where accessible, as the reef is known for its high population of these species. These stocks have been decimated due to the exploitation of the reef.

Photo 14 Remains of the U.S. navy vessel, which was wrecked after manoeuvres during World War II.

Section 4

Biology

4.1 Biology
4.1.1 Clams
4.1.2 Beche de mer
4.1.3 Lobsters
4.1.4 Coconut crabs.

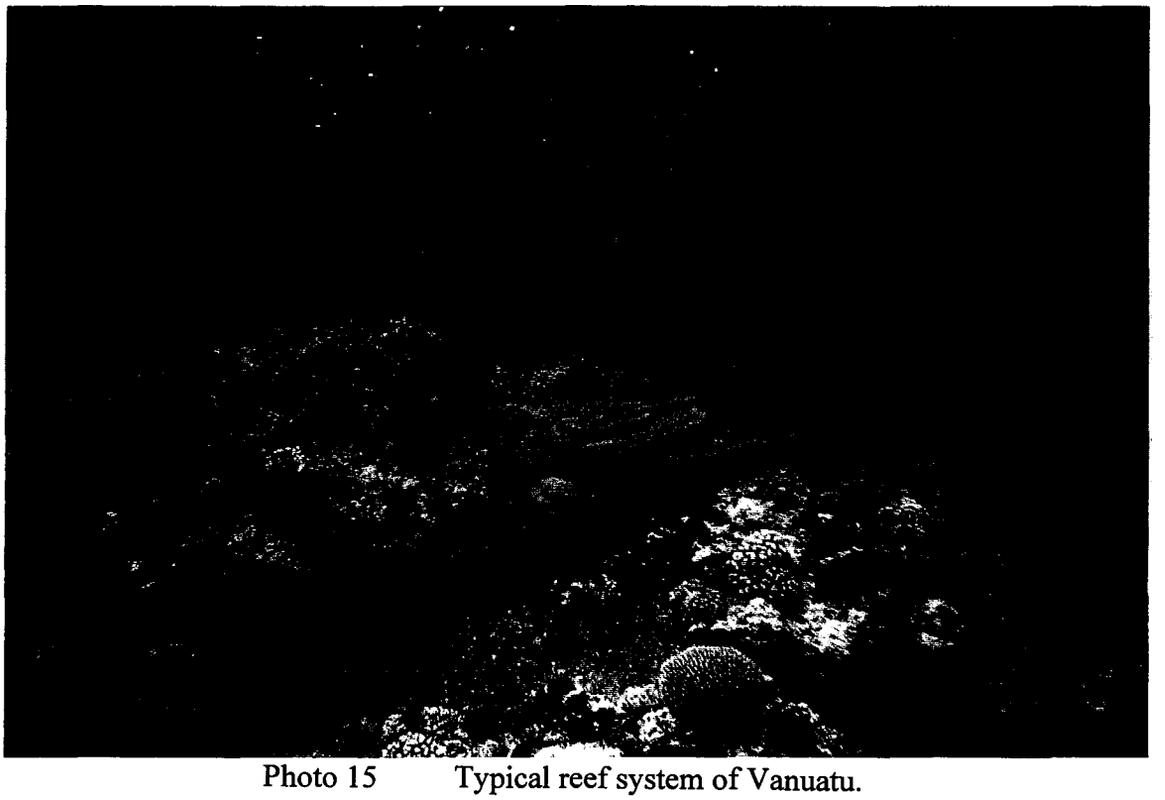


Photo 15 Typical reef system of Vanuatu.

4.1.1 The Giant Clam

Giant clams are the largest bivalves found in the world. They are generally found in the shallow clear water of coral reefs between Mean Low Water and approximately 10 metres, although some species are found up to 20 metres deep.

Species Present

Four species of giant clams have been recorded in Vanuatu waters. These include *Tridacna maxima*,(see photo 16) *T. crosia, T. squamosa, and Hippopus hippopus.* Two other species *T. gigas* and *T. derasa* were recorded by Rosewater in 1965 as being present in Vanuatu but in this survey, as in recent past surveys neither of these had been seen indicating that they possibly may be extinct in Vanuatu waters.

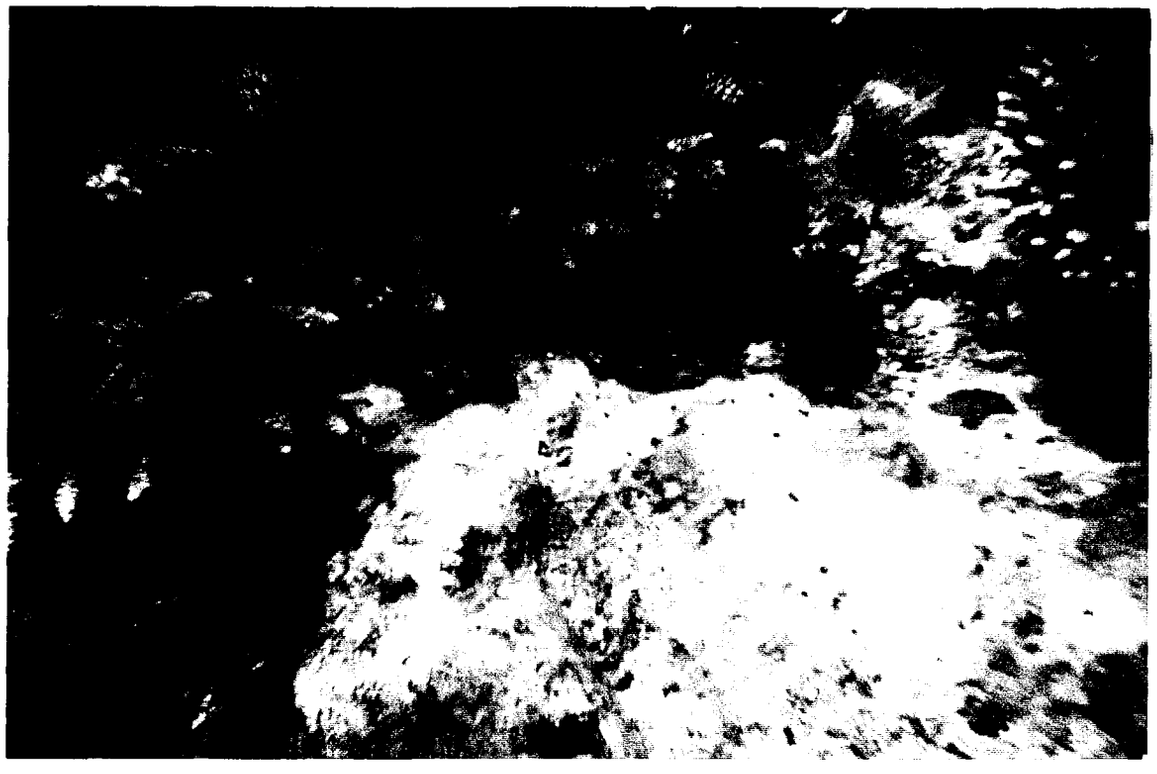


Photo 16 the giant Clam *Tridacna maxima*, which is the most common.

Biology

Giant clams have two main parts, the shell (which can be used for identification of the different species) and the soft flesh which is covered by a mantle (the coloured flesh of the clam). The mantle has an elongated incurrent aperture and a round excurrent aperture for seawater to pass over the clam's gills. Beneath the mantle are the different organs, including

T. maxima is the most predominant of the 4 giant clams present in Vanuatu waters where specimens can found in the reef systems of the majority of the islands within the group. Some islands have suffered from over exploitation mainly for the local market and personal consumption. Because of the geographical nearness of some islands (especially in the Torba Province), harvesting of one reef could be done by people from many different villages, which tends to place the stocks under too much pressure to be sustainable.

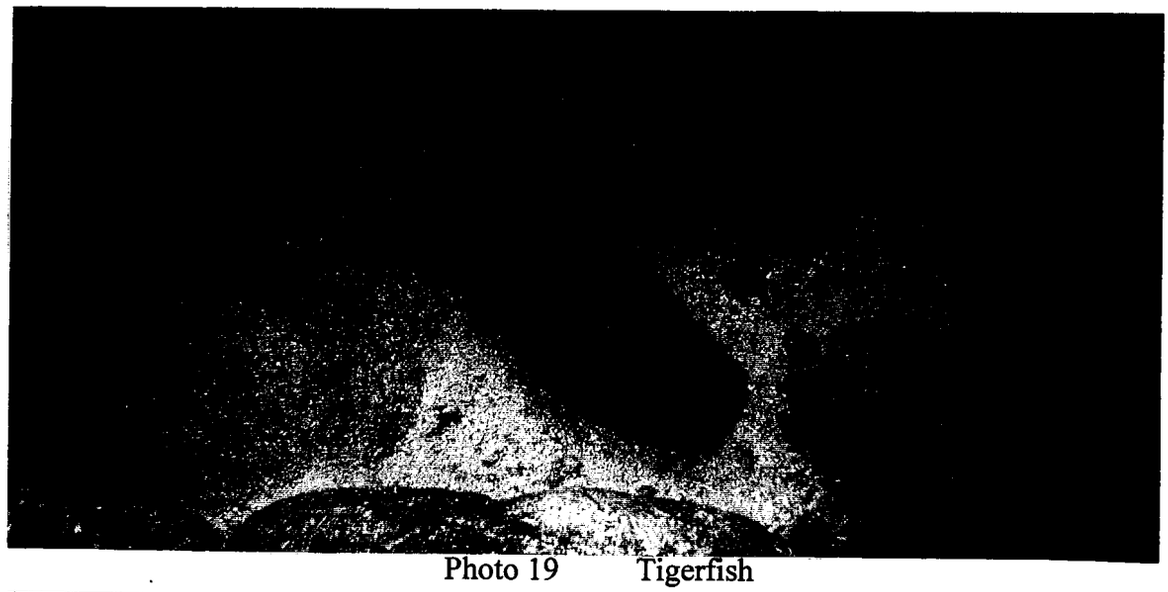


Photo 19 Tigerfish

Photo 20 Elephant's trunk fish.

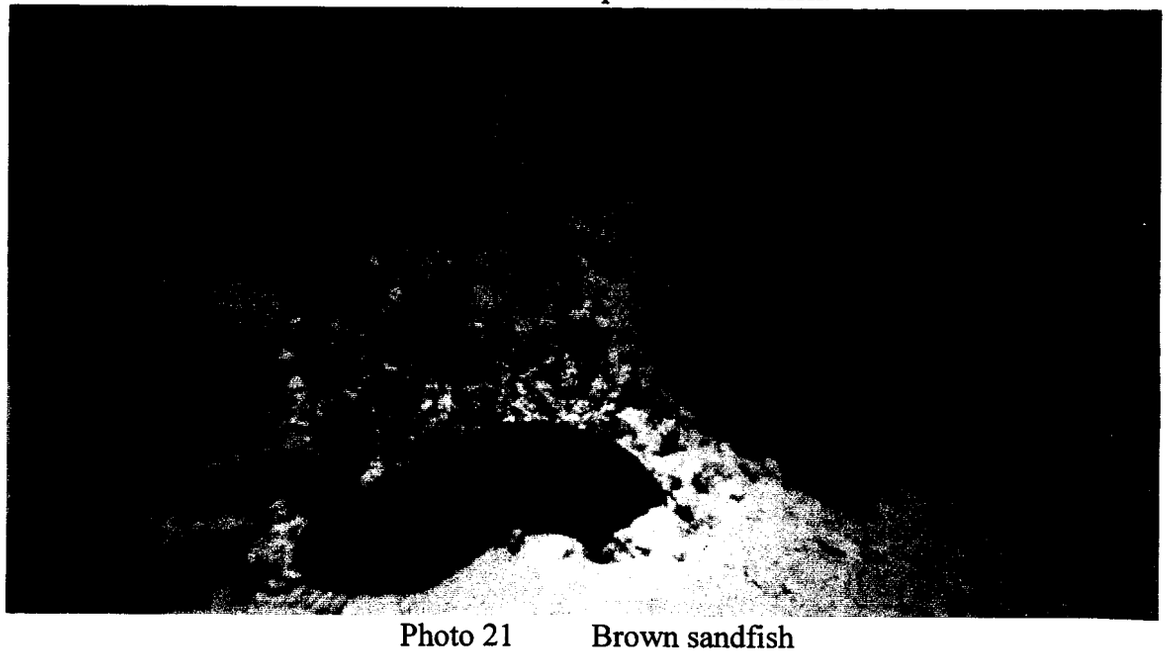


Photo 21 Brown sandfish

Fig 4: Common beche de mer species in Vanuatu.(Gibbs et al 1998)

COMMON NAME	SCIENTIFIC NAME	LENGTH (cm)	WIDTH (cm)	HABITAT	VALUE
Amberfish	*Thelenota anax*	80	15	Coral sand, shell rubble, 15-30m depth	Low
Black teatfish	*Holothuria (Microthele) nobbilis*	30-40	10-15	Shallow reef bottoms	High
Brown sandfish	*Bohadischia marmorata/vitiensis*	15-35	8-10	Shallow protected silty areas	Low
Curryfish	*Stichopus variegatus*	20-25	6-12	Turtle grass beds, silty sand bottom. Up to 30m	Medium
Deepwater redfish	*Actinopyga echinites*	15-30	8-10	Reef flats, sand bottom, 0-5m depth	Low
Greenfish	*Stichopus chloronotus*	10-30	3-6	Reef flats. 0-5m	Low
Lollyfish	*Holothuria (Halodeima) atra*	10-50	3-8	All habitats	Low
Pinkfish	*Holothuria (Halodeima) edulis*	20-30	3-6	Most lagoon bottom habitats	Low
Prickly redfish	*Thelenota ananas*	40-70	10-15	Clean sand bottoms, 2-30m	High
Sandfish	*Holothuria (Metriatyla) scabra*	25-45	-	Inner reefs and estuaries	High
Stonefish	*Actinopyga lecanora*	40	9	Hard reef substrates. 0-20m	Low
Surf redfish	*Actinopyga mauritiana*	20-30	8-10	Outer reefs with wave action. 0-5m	Medium

Feeding & Nutrition.

Beche de mer are deposit feeders. When feeding they swallow the upper layer of sediment, which they are living on, this sediment is swallowed by the use of modified tube feet formed into a fine network of mouth tentacles to catch plankton. Sticky pads are used to pick up detritus (Coleman 1991). The bottom sediment is then passed through into their intestines where the detritus is sorted from the sediment. The sediment is then passed out through the anus.

Beche de mer eat inorganic matter, organic matter, micro-organisms and their own faecal matter (South Pacific Commission, 1994) however the major nutritional component is bacteria.

The species, which live in the reef flats act as a vacuum, cleaning off the film of sediment that settles.

Beche de mer generally feed continuously or have a daily rhythm in their feeding frequencies; this is often related to light levels (Bell & Amos, 1993).

Habitat.

Beche de mer live in a wide range of reef habitats. They are able to inhabitant sand, rubble, mud, and sponges and also beneath rocks.

They can live at a range of depths from 0-30 metres.

Reproduction.

Beche de mer can be hermaphrodites or separate sexes; they release sperm and eggs on the rising tide at dusk (Coleman 1991). Millions of eggs are released from one female at one time, this number varies according to the species. Spawning occurs during spring, and, or summer, the eggs are caught by the tentacles and transferred to the dorsal side of the animal for incubation.

Development takes place externally in seawater.

Gradual metamorphosis during the later part of the planktonic existence results in a juvenile animals (refer fig 6).

Growth rates of beche de mer vary from.5mm-1cm per month and they generally mature at the age of three years.

The life span of most beche de mer is generally between 5-10 years.

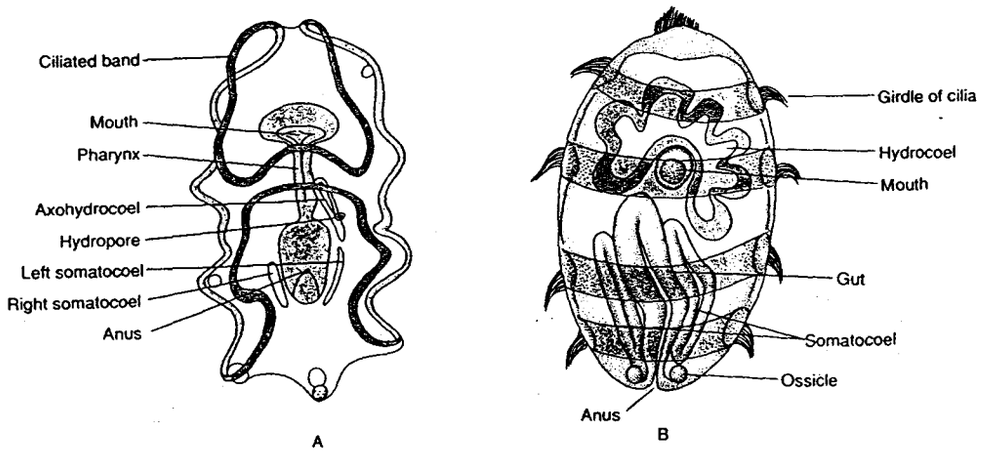


Fig 6: Larval stages of the beche de mer.(South Pacific commission, 1994)

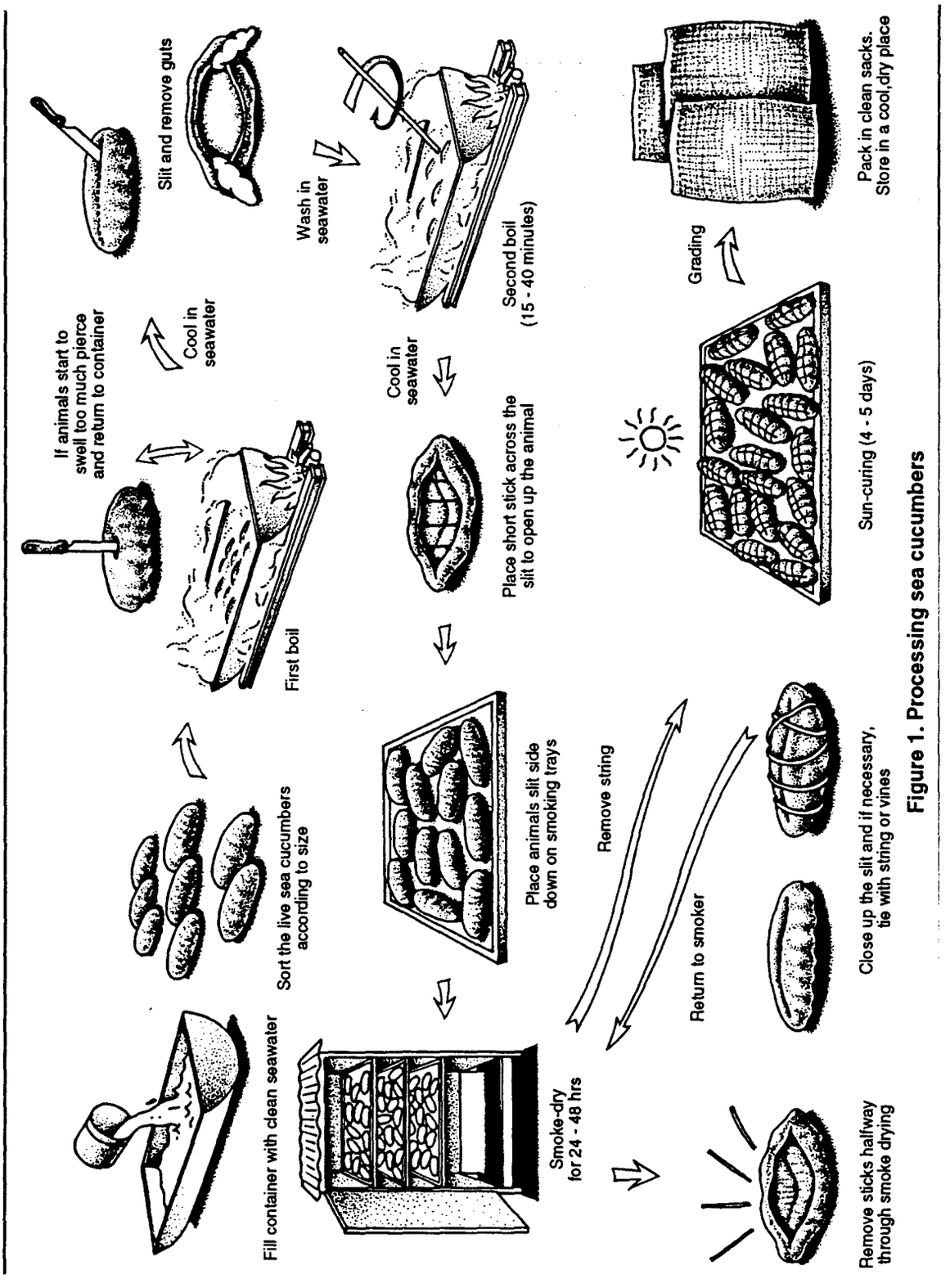


Fig 7: Flow chart of beche de mer processing.(South Pacific commission 1994)

4.1.3 Lobster.

Species present.

Lobsters are from the phylum Crustacea and the class Malacostraca.
There are four species of lobster known throughout Vanuatu; the pronghorn spiny lobster,(or double spined lobster) *Panulirus penicillatus*, painted spiny lobster, *P. versicolor*,(refer photo 25) longlegged spiny lobster, *P.longipes femoristriga* and the slipper lobster *Parribacus caledonicus.* The main species of commercial value is the double spine lobster (pronghorn spiny)(see photo 25).

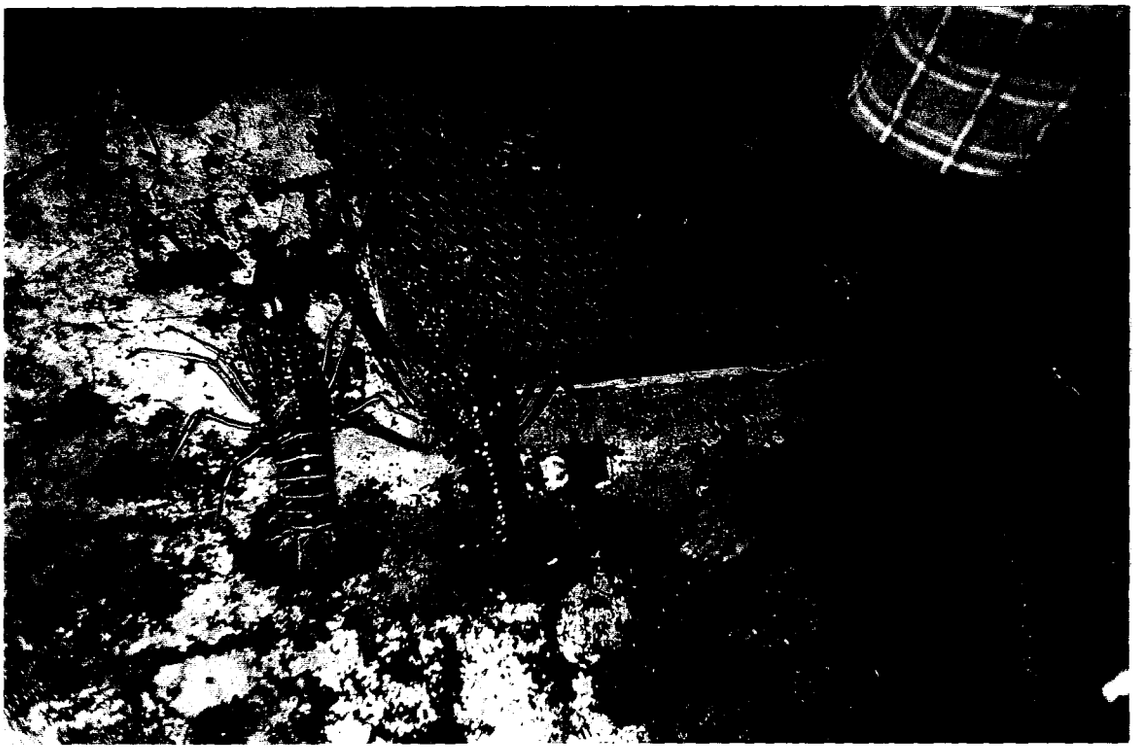


Photo 25 Two of the lobster species surveyed. The double spine lobster is on the right and the painted on the left.

External & internal features.

Lobsters are in the crustacean phylum, therefore they have a hard exoskeleton.
Their head bears five pairs of appendages with the presence of two pairs of antennae being a distinguishing feature of crustaceans. They also have a pair of mandibles that are usually short and heavy and are used for grinding and biting surfaces. Behind the mandibles there are two pairs of maxillae which assist with feeding. The body is compressed and has distinctive segments.Gills are found on appendages and hidden under the carapace. Waste products such as ammonia are excreted via glands on the animals' head while the solid waste exits the body via the anus after passing through the gut (Ruppert & Barnes, 1994). Lobsters have compound eyes which are usually found at the end of stalks.

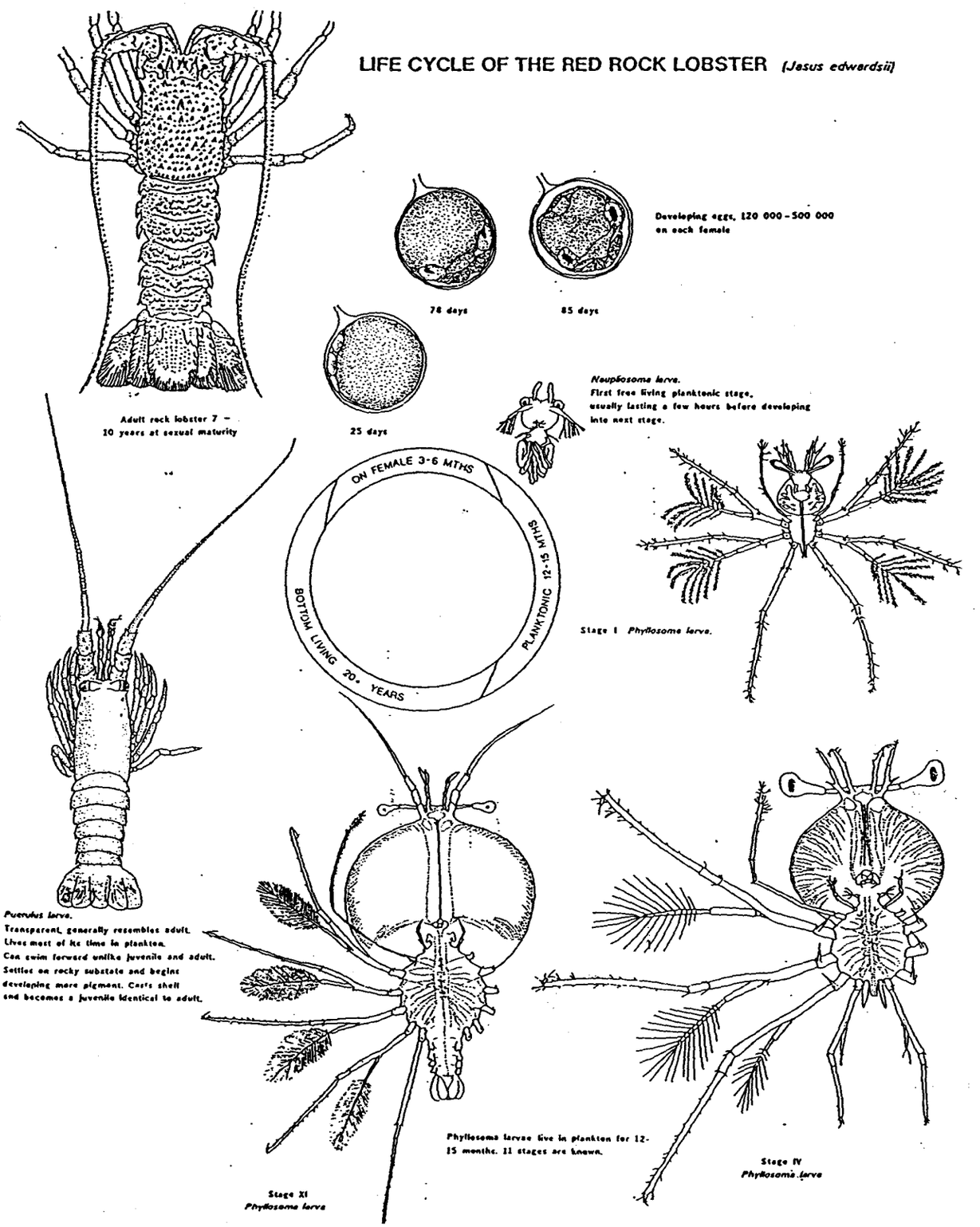


Fig 8: Stages in the life cycle of rock lobsters.(Gibbs et al 1998)

4.1.4 Coconut Crabs

One of the most interesting species of the stock assessment project was the Coconut Crab (*Birgus latro*) (see photo 26). Coconut Crabs are distributed throughout the Indo- Pacific, but overexploitation has caused a dramatic decline in their populations. Which in some areas has almost pushed the crabs to the point of extinction. Vanuatu is one of the few regions known to still have substantial stocks despite being harvested for many years.
Coconut Crabs are a vital resource for many communities in Vanuatu. Sometimes the crabs are the only form of cash crop available in some regions making the conservation of this resource of paramount importance (Amos, 97).

Photo 26 Coconut crab.

Biology.

The crab is related to other species of Hermit Crab and is the largest of all land dwelling Crustaceans, reaching weights in excess of 5 kg. Adult crabs tend to live in solitude with established territories, they can be found in hollow tree stumps or burrows under fallen trees. Younger crabs may live in closer proximity to each other and some are found in small groups living in caves.
Like any Crustacean, the crabs need to moult in order to grow.
Approximately once a year during the winter months the crabs go into hibernation to moult. They bury themselves in a burrow for about a month, they shed their moult and then eat it as a means of recycling the important minerals and nutrient needed for the manufacture a new shell.

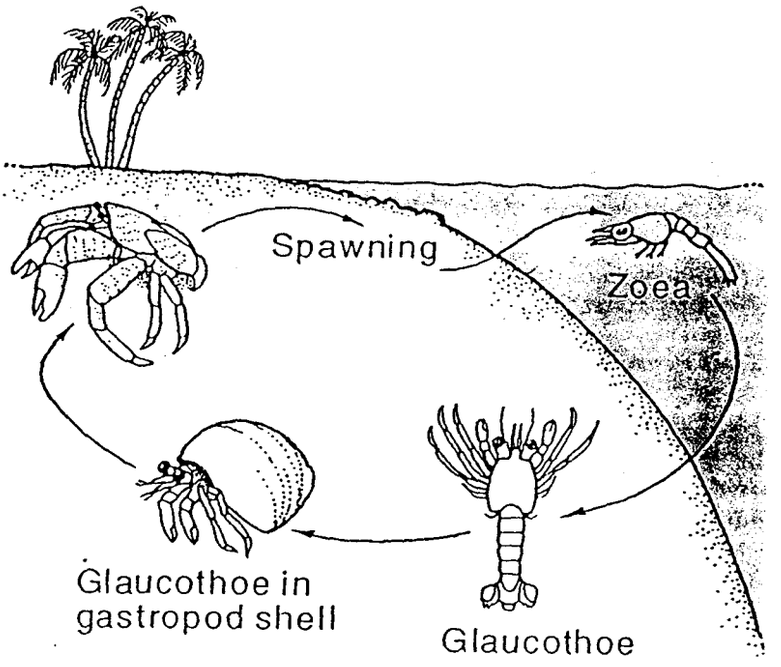


Fig 9: Life cycle stages of the coconut crab. (Fletcher W J. 1992)

Harvesting.

The Torres Group is the main supplier of Coconut Crabs to whole of Vanuatu. The crabs can only be distributed to the markets via small plane, which in turn limits the amount of crabs that can be sent to the markets.

Recently the number of dealing licenses has doubled to 4 and new airlines flying to the Torres have increased the numbers of crabs leaving the islands. In the short term the extra money made from the increased sales is beneficial to the individuals harvesting the crabs, but in the long term locals fear that the extra harvesting could lead to over exploitation and the demise of the Torres main source of income.

Section 5
Results, Discussion, Conclusion & Recommendations.

5.1 Beche de mer & Giant clams
5.2 Rock lobster
5.3 Coconut crab.

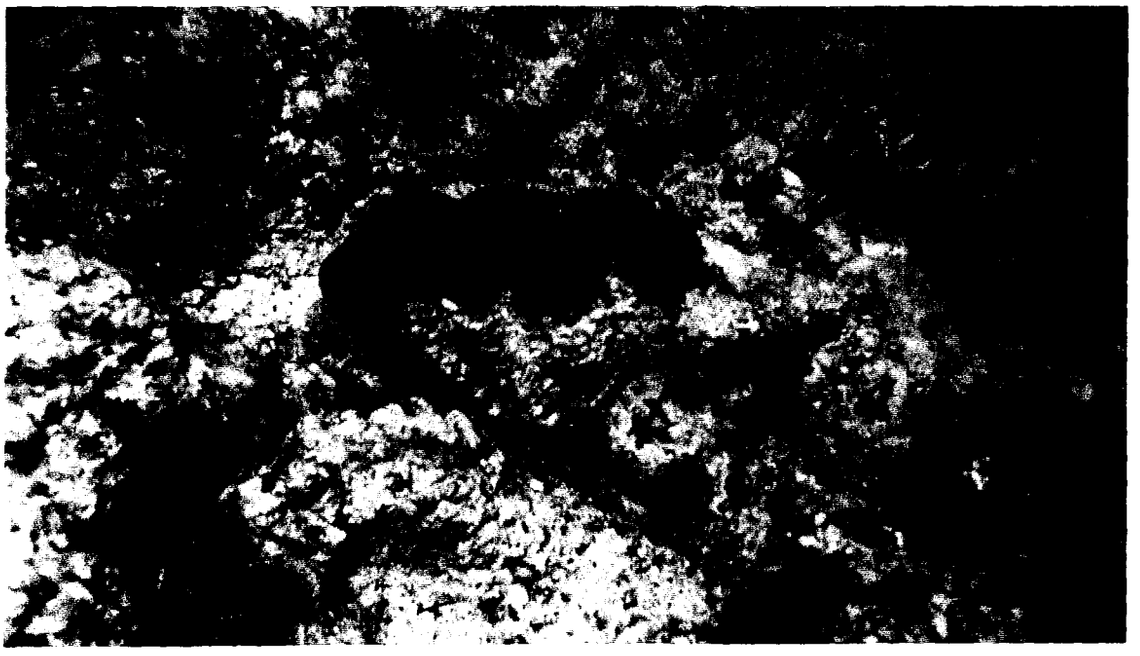


Photo 27 *Tridacna maxima* one of the giant clams seen during a survey.

Results

Fig 10:**Key of name abbreviations as seen in tables 1 & 2.**

COMMON NAME	ABBREVIATION
Beche de mer	
Black teatfish	BTF
White teatfish	WTF
Prickly redfish	PRF
Deepwater redfish	DWR
Stonefish	STF
Surf redfish	SRF
Blackfish	BF
Brown sandfish	BSF
Lollyfish	LF
Pinkfish	PF
Elephant trunk fish	ETF
Greenfish	GF
Curryfish	CF
Amberfish	AF
Tigerfish	TGF
Giant Clams	
Tridacna maxima	TM
Tridacna crosia	TC
Tridacna squamosa	TSQ
Hippopus hippopus	HH

Table 2. Results for Beche-De-Mer & Giant Clams in the Torres Group.

Island:	Hiu					Metoma	Pegua	&	Loh	Cooks Reef
Site:	15	16	17	18	19	20	21	22	23	24
Beche-De-Mer				Total number of species found						
BTF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	3
WTF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
PRF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
DWR	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
STF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
SRF	ND&CC	CC	3	CC	ND&CC	ND&CC	ND&CC	36	ND&CC	5
BF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
BSF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	8
LF	ND&CC	CC	27	CC	ND&CC	ND&CC	ND&CC	17	ND&CC	10
PF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	1
ETF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
GF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	22
CF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
AF	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	0
TGF	ND&CC	CC	3	CC	ND&CC	ND&CC	ND&CC	0	ND&CC	16
Giant Clams										
TM	ND&CC	CC	148	CC	ND&CC	ND&CC	ND&CC	9	ND&CC	7
TC	ND&CC	CC	5	CC	ND&CC	ND&CC	ND&CC	4	ND&CC	0
TSQ	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	1	ND&CC	0
HH	ND&CC	CC	0	CC	ND&CC	ND&CC	ND&CC	2	ND&CC	6
	N D = Night Dive Site			C C = Coconut Crab Site						

This table shows the total numbers of species found for each site during the day time surveys in the Torres Group and also includes the Cooks Reef results.

Pakea Site 3&4

There were two sites surveyed on this island. Site 3 was on the Southwest side and site 4 on the Northwest side.
At Site 3, zone three was not completed due to the heavy wave action. The substrate at this site consisted mainly of sand with a few corals.
Only one clam was counted during this survey and this was *T.maxima*.
Site 4 zone two was not completed due to the low tide exposing the reef. This side was sheltered from the swells, and its substrate was rock, rubbles and sand.
27 *T.maxima* and 12 *T.crossia* were recorded during this survey.
The higher numbers of clams at site 4 may be due to the sheltered conditions and the substrate as the clams recorded live on rocks and corals.
Clams on this island are harvested by the outer islanders and the frequency of this harvesting is not known. This may explain the low numbers.
Four species of beche de mer were present at this location, these species being the stonefish, lollyfish, greenfish and the blackteet fish. Site 4 showed disappointing numbers with only 25 lollyfish and 1 blackteet recorded.
Reasonable numbers of lollyfish were recorded at site 3 with a total of 744 being counted.
Other species were not as common with only 8 greenfish and 1 Stonefish being recorded.
The lack of diversity around this site may be because of beche de mer harvesting that occurs throughout the lagoon, there is also a beche de mer drying factory on this island.
The abundance of lollyfish in site 3 may be due to the sandy substrate on which the lollyfish prefer to live.

Ravenga Site 7&8

Two sites were surveyed for giant clams on this island.
At both of these sites only zone three was surveyed this was due to the lack of reef and the reef being exposed at low tide.
Site 7 was located on the Southwest side with site 8 on the Northwest.
The substrate at site 7 consisted of rock, coral rubble and sand, the depth range was from 0.3-15m.
There were three species recorded at site 7. With *T.maxima* being the most abundant with 25, 6 *T.crossia* were counted and 2 *H.hippopus* recorded.
The substrate at site 8 was similar to that at site 7, with more sandy patches and a depth range being from 0.2-14m.
Four species were at this site. 43 *T.maxima* and 23 *T.crossia* were recorded as the most abundant of the four species. 1 *T.squamosa* and 2 *H.hippopus* were counted as well.

Nine species of beche de mer were found to be inhabiting the reefs of this island. Site 7 had all 9 species present while Site 8 only had 3 of the 9 species found. In site 7 a total of 197 beche de mer were counted. Out of these the green fish had by far the largest proportion with 169 counted in total. This may be attributed to the fact that they rate low in value on the export market, but when compared to the considerably lower numbers found at all the other sites in the Torres group there must be other reasons as to why there are so many on this particular reef. Further study would need to be carried out in order to answer this question.
Site 8 showed elephant trunk were the most abundant at 12.

Two species of clams were found with the most abundant being *T.maxima* with a total of 148 individual animals being counted and only 5 *T.crossia* seen.
Four species of beche de mer were recorded with 27 lollyfish being the most abundant. Surf redfish were supposed to be abundant but are commonly seen at night.
No commercial harvesting occurs around these sites even though the numbers are very low.

Tegua Site 22

Site 22 consisted of surveying zones 1 and 3. The substrate consisted of rock, sand, corals and rocks, with the depth ranging from 0.2-10 m.
All four species of clams were recorded with the most abundant being *T.maxima* and the least abundant *T.squamosa.*
There was a lot of dead and dying coral in the water and the water had some terrigenous influences which may explain why there were quite low numbers, it was also understood that all the fish in this particular bay were poisonous.
Two species of beche de mer were present both found in low numbers with 36 Surf red fish and 17 lollyfish recorded.
There are commonly tidal waves, which hit the island and destroy the reef, this may explain the low numbers.

Cooks Reef. Site 24

Site 24 was completed with all three zones being surveyed.
The substrate at this site consisted of rock, sand and corals.
T.maxima and *H.hippopus* were the only two species seen and these were both uncommon.
The low numbers of clams on Reef Island may be due to the commercial harvesting that occurs from the local fisheries
Seven species of beche de mer were present with low numbers of each species recorded.
This area is commonly harvested due to its accessibility to the main island.

may be following *T. gigas* and *T. derasa* into extinction. Unless some sort of restrictions are placed on their harvest and/or a reseeding program is instigated this may become a reality
Due to the location of the Torres Island group being further north and more remote then the Banks Island group, it was noticed that the average number of clams found within the Torres group was higher then that of the Banks group. The average number of clams within the Torres group was 84.65 compared to 55.25 in the Banks group. These figures take into account the difference in transect length from island to island as due to some unforseen circumstances not all transects where the same .

T.maxima was the most abundant clam with good numbers recorded throughout the islands, the island with the most clams recorded was Hiu.
The two larger species, which are commonly harvested, however are very limited and these numbers are not adequate for sustaining harvesting.

The preferred habitats for Clams were on rocky, coral reefs that were sheltered from heavy winds and wave action.

The sites that we were surveying were not always suitable for the clams as we were surveying the clams and the beche de mer at the same time. The sites were sometimes more appropriate for one species then the other.

Ten different species of beche de mer were recorded throughout the surveys with lollyfish being the most abundant, and pinkfish being the least with a total of two recorded, while the highest number of lollyfish recorded at one site was 744.
Most beche de mer were recorded throughout the Banks groups with the highest populated island being Pakea Island, with a total of 779, out of which 744 were lollyfish.

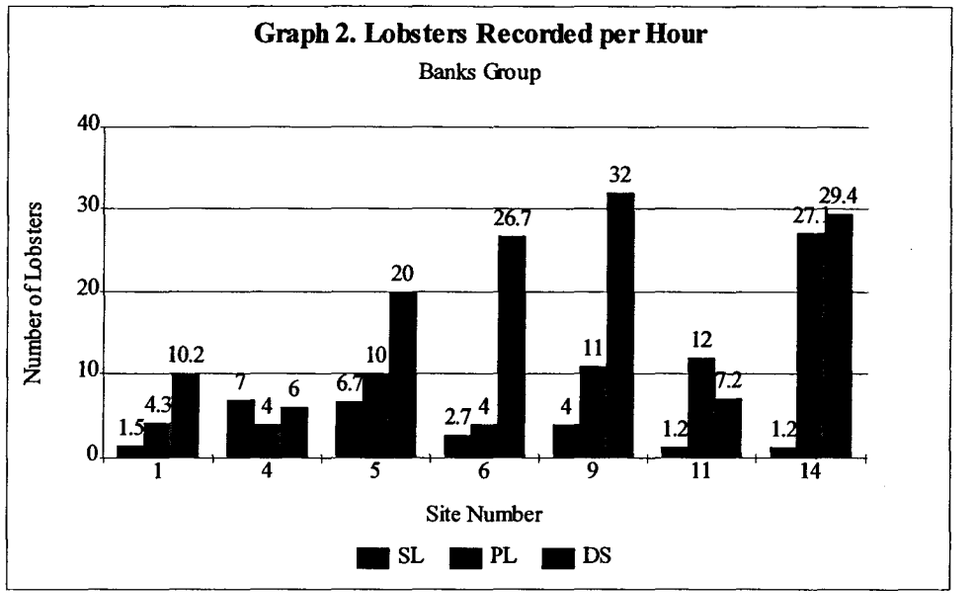
Beche de mer showed higher densities throughout all sites in the Torres and Banks Islands, which were shallow, sheltered and contained large sand flats. This could possibly be due to the amount of detritus (on which the beche de mer feed) being higher at these sites.
The surveys showed low densities of high value species such as the surf red fish at all survey sites. This could be an indicator that these species have been over exploited and now the stock numbers are suffering.

Beche de mer is not present in large enough numbers to withstand commercial harvesting. The only island that may handle harvesting is Pakea, the only species there in numbers sustainable for harvesting is the lollyfish.

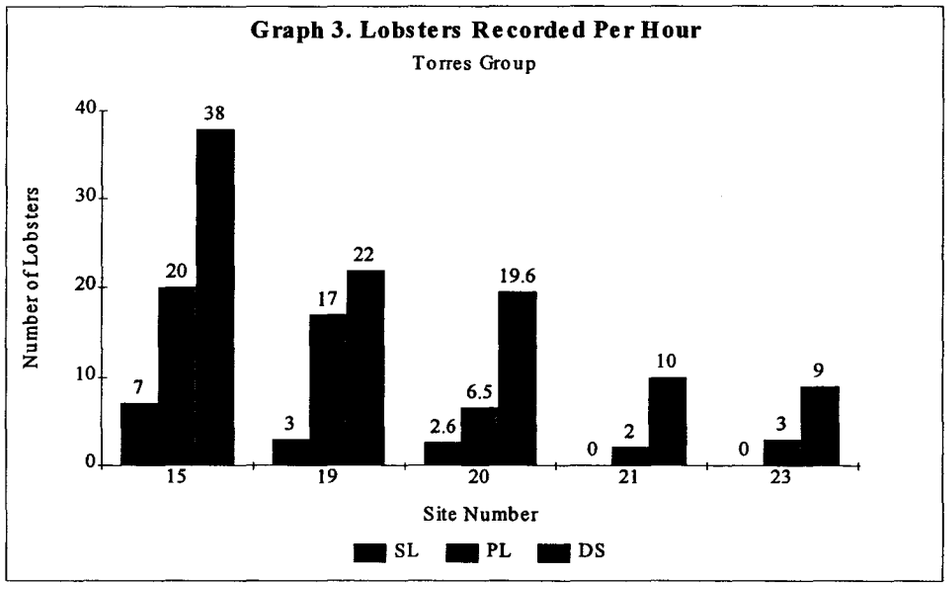
The habitat in which most beche de mer were found was on sandy, silty substrates.

5.2 Rock Lobster

Results



Graph 2. Shows the total number of lobsters found, per hour, during the night surveys of the Banks Group.
The site within the Banks group that had the highest population of lobsters present was site 14, which contained reasonably high numbers of double spines and painted lobsters.



Graph 3. Shows the total number of lobsters found, per hour, during the night surveys of the Torres Group.
Site 15 was the highest populated site surveyed within the Torres group with the highest totals of each species being recorded.

Good numbers of lobster were recorded even though the dive was limited to 45 minutes because of the shortness of the reef. The actual numbers recorded were, double spine 20, painted 3, and slipper 2. As graph 1 shows the number of each species seen per hour is calculated at double spine 26.7, painted 4, and slipper lobster 2.7. Although not many painted lobsters were seen during this dive, a total of 11 animals had been recorded on the daytime surveys. This may suggest that they prefer to come out to feed either early or later than the double spine lobster, perhaps because the double spine lobsters are generally larger and more competitive. Further study could possibly be done on this in the future.
A great positive for the future of the island is that the chief is planning to place a permanent total fishing ban, which would leave Ravenga as an excellent source of stock recruitment for other reefs in the vicinity.

Mota Lava Island (site 9)

The site chosen for this survey is located on a relatively narrow reef, which tends to drop off reasonably steeply to 20 metres plus. The local inhabitants reported that they do not participate in lobster fishing very often and as outsiders seldom visit the reef the lobster stocks should be reasonably abundant.
The 1-hour survey produced some promising result with 11 painted lobster, 32 double spine, and 4 slipper lobster being recorded. Although not documented a promising number of juveniles are included in this result. With some further education on reef protection and fish stock conservation the future possibility of commercially harvesting lobster from Mota Lava is very probable.

Reef Island (site 11)

This island is reported as being fished by people from several of the islands in the surrounding territory so expectations of recording high numbers of lobster were not great. These fears were confirmed unfortunately. Only 6 double spine, 10 painted and 1 slipper lobster were recorded during the 50-minute survey. As shown in graph 2. These numbers have been calculated to animals seen per hour, double spine 7.2, painted 12, and slipper lobster 1.2. Surprisingly there were more painted lobster seen than double spine, which differs from all other surveys. One possibility for this may be because the painted lobsters is generally smaller than the double spine so they are not the preferred species of most of the fishermen.
As mentioned in the island description earlier Reef Island has many ownership claims and until these can be settled there is not much hope of the pressure of over fishing being relieved. Until this happens the best option for the fishery is for the fisheries department to continue with their education program in the hope that the users of the island instigate a joint control system.

Parapara Island (Ureparapara) (site 13)

This site, which is called Lorup Bay is situated opposite the main village on the island and for this reason was thought to be an ideal place to be surveyed.
Because one of the members of the survey team was suffering with ear problems only 5 divers were used for the survey. Also due to some confusion by the timekeeper the dive time was only 51 minutes instead of the 1-hour. Graph 2 shows the recalculated data based on animals seen per hour, and averaged over six divers.. The results calculated are double spine 29.4, painted 27.1, and slipper lobster 1.2. The actual number of animals counted was considered by the biologist to be very encouraging with a total of 25 double spine, 23 painted, and 1 slipper lobster were recorded. This reef is not too dissimilar to many of the reefs found

Tegua Island (site 21)

Parts of reef in this site were quite hostile because of the volcanic rock, which at times was very jagged and not easy to swim over. Generally it did not show many good characteristics for lobster habitat. Only 5 double spine, 1 painted, and 0 slipper lobster were recorded in the first 1/2 hour of the survey and as the condition of the reef was not improving it was decided to end the dive there. Animals seen per hour equated to double spine 10, painted 2, and slipper lobster 0 (see graph 3).Some harvesting has been reported as being carried out in this area but generally for personal consumption. Weather and time constraints meant that no further lobster surveys would be done on Tegua.

Loh Island (site 23)

There were 2 sites planned for survey on the reefs of Loh but because of strong north-easterly winds and worsening weather we were restricted to the second site at Natgavinga Bay on the western side of the island. This site was in close proximity to a reasonably large village (approx. 190 people) and could be easily accessed by the villagers. The reef itself was narrow and dropped off to 20 metres in a very short distance. By this stage in the survey physical stress was starting to take its toll and because of injuries the team was down to only four fit divers. Because of this it was decided to shorten the dive time to 40 minutes and not to dive too far away from the safety of the ship.
The actual number of lobster recorded during the survey were, 6 double spine, 2 painted, and 0 slipper lobster, which is shown in graph 3 calculated to the animals seen per hour and recalculated as if there were six divers by multiplying the number of divers present. The results calculated are double spine 9, painted 3, and slipper lobster 0.
The chief of the village claimed that there was much larger numbers to be found about 1 km further south of where we surveyed but for the reasons mentioned earlier we were unable to follow this up.

Conclusion

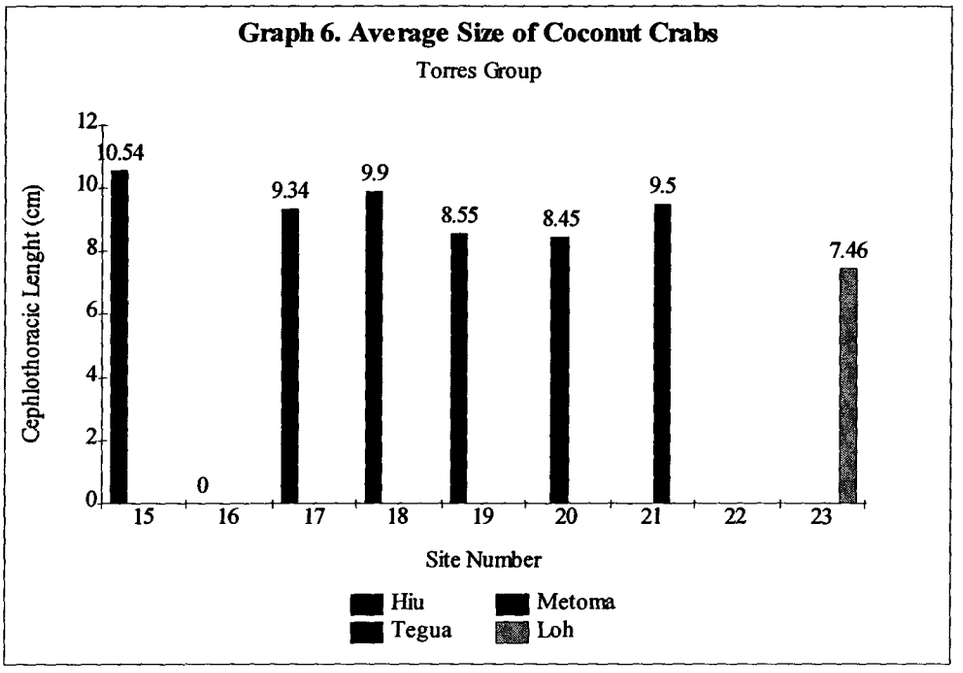
The population of the rock lobster throughout the Torba province does not appear to be evenly distributed or follow any significant pattern. In some of the more highly populated islands such as Mota Lava or in other areas where lobsters are known to be commercially fished i.e. Hiu, the numbers of lobster seen are reasonably high. Whereas in other more remote islands such as Ureparapara, Reef Island and Tegua greater densities would be expected but in fact numbers were quite mediocre to low. On the other hand the islands of Gaua and Pakea both appeared to carry low numbers of all three species. This is probably attributed to the fact that both islands are within easy access of several highly populated islands.

Of the three species, the double spine is by far the most prolific lobster (58%) on all the islands except Reef Island. On this island the painted lobster recorded slightly more than the double spine, which simply may be because the latter is the most preferred species for consumption. The slipper lobster accounted for a small proportion of the total lobster count (11%) except for the site on Pakea Island. As is with the painted lobster the slipper is not popular for consumption and is generally left alone. Because the slipper lobster is much smaller than the other two, competing for habitat and food would be difficult, which could also explain the low overall numbers. The painted lobsters average size falls between the

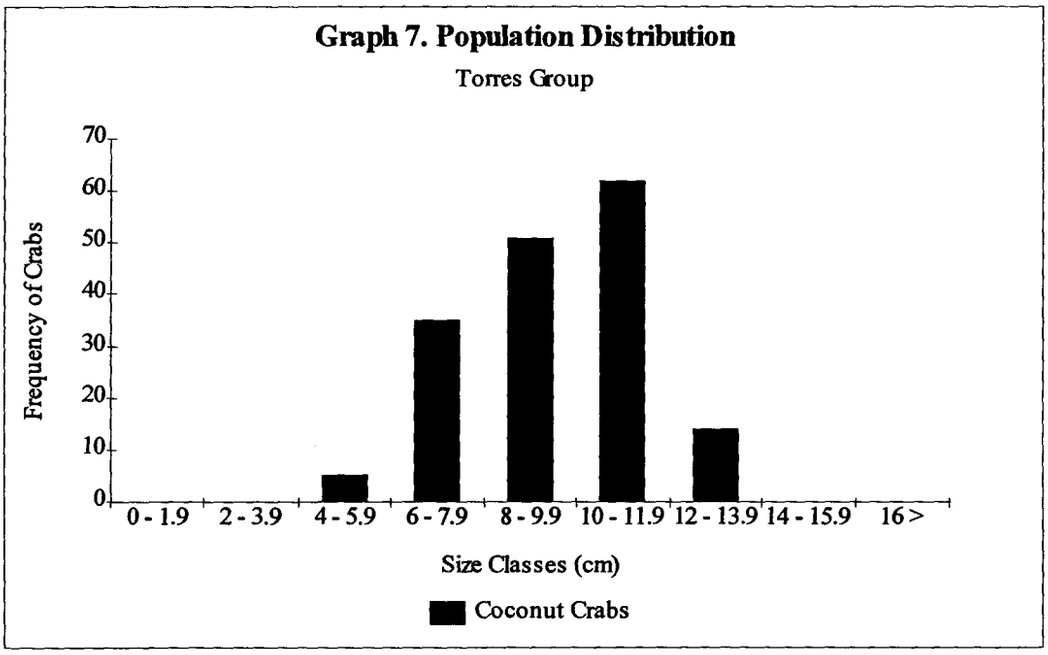
Recommendations

- For greater accuracy it is recommended that each island be surveyed at multiple sites, as this will enable more detailed comparisons to be made.
- Size as well as species could be recorded in order to graph maturity of the population and recruitment of juveniles.
- Experiments could be carried out using lobster pots as a possible alternative survey method in areas less conducive to diving.

Photo 29 Karlo Pakoa measuring lobsters collected during the trip.



Graph 6. Shows the average size in cephlathoracic length of crabs measured at each site. This graphs shows that the size of coconut crabs range from 10.54-7.46.



Graph 7. Shows the distribution of the coconut crabs population in the Torres group. Most of the crabs recorded within the Torres group was between the size of 6-13.9cm.

possibility is that harvesting of this area may have occurred closer to the groups arrival time than first thought.

Metoma

Site 20 was situated on Metoma, the only non-official reserve for Coconut Crabs in Vanuatu. The site was on private land where heavy traffic from livestock had opened the cover of the bush quite substantially

The crab population was healthy with 44 being recorded with an average size of 8.45 cm. During the survey 4 baits were found eaten but empty and one crab ran away into the bush and could not be measured. There was definitely no commercial harvesting of crabs on the island so as expected a lot more crabs were found.

There were also many smaller crabs than expected, this may have been because the location of the site was only a few hundred metres inland from the shore. The survey team was told after the survey that many larger crabs could be found in the hills in the middle of the island but time restrictions did not allow further investigation.

Tegua

Site 21 was located on the northwest side of the island, situated at the bottom of a group of cliffs. The terrain was very rocky and steep with thick bush cover that offered an ideal habitat for the crabs. The closed season was the only restrictions on the area but the surrounding cliffs would've made access a problem. A good number of 33 crabs with an average size of 9.5 cm were found which was the highest number of crabs recorded in a unrestricted area. It was thought that the pressure on stocks was not great in this area due to the its inaccessibility, which would suggest that harvesting was not an easy task and would require a lot of travelling from closest village.

Loh

Site 23 was fairly close to one of the villages on the western side of Loh and had a moderate cover of bush, once again the baits were set on an old bait line.

This site had the most disappointing results with only 3 coconut crabs averaging 7.46 cm and seven hermit crabs recorded. Six of the baits had also been left untouched.

Loh was the only place where crabs could be flown out from in the Torres and the harvesting of crabs was greater due to this access to the markets. It was thought that over-exploitation in past years may have caused a large decline in adult crabs, hence the low average, which has lowered the level of juvenile recruitment and therefore inhibited stocks from replenishing themselves.

Conclusion

It is widely known that the majority of coconut crabs in Vanuatu come from the Torres group especially the island of Hiu. Therefore it would be fair to expect that the crab population of Hiu would be under the most pressure from commercial harvesting. The pressure on the stocks is ultimately controlled by the demand for the product. More often than not the demand for crabs is higher than the supply. Greater demand has led to the increase of flights to Loh, which allows a greater number of crabs to be sent to the market, therefore increasing the pressure on stocks.

The surveys in the unrestricted areas suggest that some areas have been over exploited, like sites 16 at Hiu & 23 at Loh, while other areas still have reasonable stocks, like sites 19 & 21 on Tegua. The difference may be because sites like 16 were very accessible and reasonably close to a village allowing the collection of crabs to take place quite frequently. The open sites 19 and 21 may have recorded greater numbers because they were less accessible and/or at greater distances from the villages, meaning the crabs are not harvested as much and would have lower pressure on stocks.

The comparisons of the Tabu and open areas show that the Tabu at site 15 was well established and good numbers of crabs were recorded which meant that the villages of Hiu respected the Tabu. The Tabu at site 17 was still getting established, as it was only 3 months old at the time of survey. The survey showed little difference between it and a nearby open site and suggest that the Tabu has not been in place long enough for any substantial change in stock numbers.

Metoma Island had the most crabs found in all of the surveys. The reserve type status of this island makes it the perfect place to continue further study on the crabs. The island can be used as a tool for gauging and comparing with other islands to estimate harvesting rates and pressures as well as set the example to the rest of Vanuatu on the value of reserves.

In conclusion the well-established Tabu's showed good numbers and are a good way to preserve present stocks. They could also prove to be a valuable source of spawning stock to reinhabit the areas where coconut crabs numbers were low.

The lifecycle and habits of the coconut crabs is an area of debate requiring further research as information gathered from local inhabitants tends to suggest that the published lifecycle of the coconut crab may not be entirely correct. Metoma would be the most logical place to conduct further study on the crabs as this is the only island where the crabs live with minimal impact from harvesting or mankind in general. The lack of these external influences allows the crabs to live an almost completely normal life and their habits and lifecycles would evolve naturally. The value of this is that the whole island could be an ideal research model, which would allow accurate information to be gathered from a population of crabs in their natural state.

The effects of over harvesting was present at several sites and the increasing exploitation is of growing concern to some of the locals. The relatively new development in the frequency of crabs leaving the islands is due to the increase of flights delivering crabs to the markets from Loh.

This could cause increasing pressure on stocks, especially large crabs and could reduce the already low recruitment rate of the juveniles which in turn, could lead to a rapid decline in the populations of some islands. Furthermore the potential for this to happened is increased due to the lack of accurate monitoring and regulating that would usually account for every crab leaving the islands.

6 Final summary

The results of this survey will provide the Fisheries Department with valuable data on the stock numbers of beche de mer, rock lobsters, giant clams, and coconut crabs. As this is part two of a three year survey to assess the stock numbers of these species throughout Vanuatu the final outcome won't be seen for another 18 months or so. For the immediate future though the data from this survey will be very useful in formulating interim educational and protection policies for the fishery of the Torba Province.

Many of the people of Vanuatu appeared to be uncertain as to the state of their reefs and what condition the fish stocks were in. In a few areas such as Vanua Lava, Gaua, Mota Lava, Metoma, and Loh the inhabitants made claims to having large numbers of clams and lobsters on the reefs but the surveys did not reflect this.

Because this is a base line survey it would be counter productive to state whether or not the results from each survey were good or bad. Only once the data from all three years surveys has been collected, correlated, and analysed can any conclusions be drawn.

Overall however the survey project must be considered a great success both from the point of view of the Fisheries Department and of the students who participated in it. Most of the proposed sites were covered and only a few extra sites were missed out because of bad weather or sea conditions.

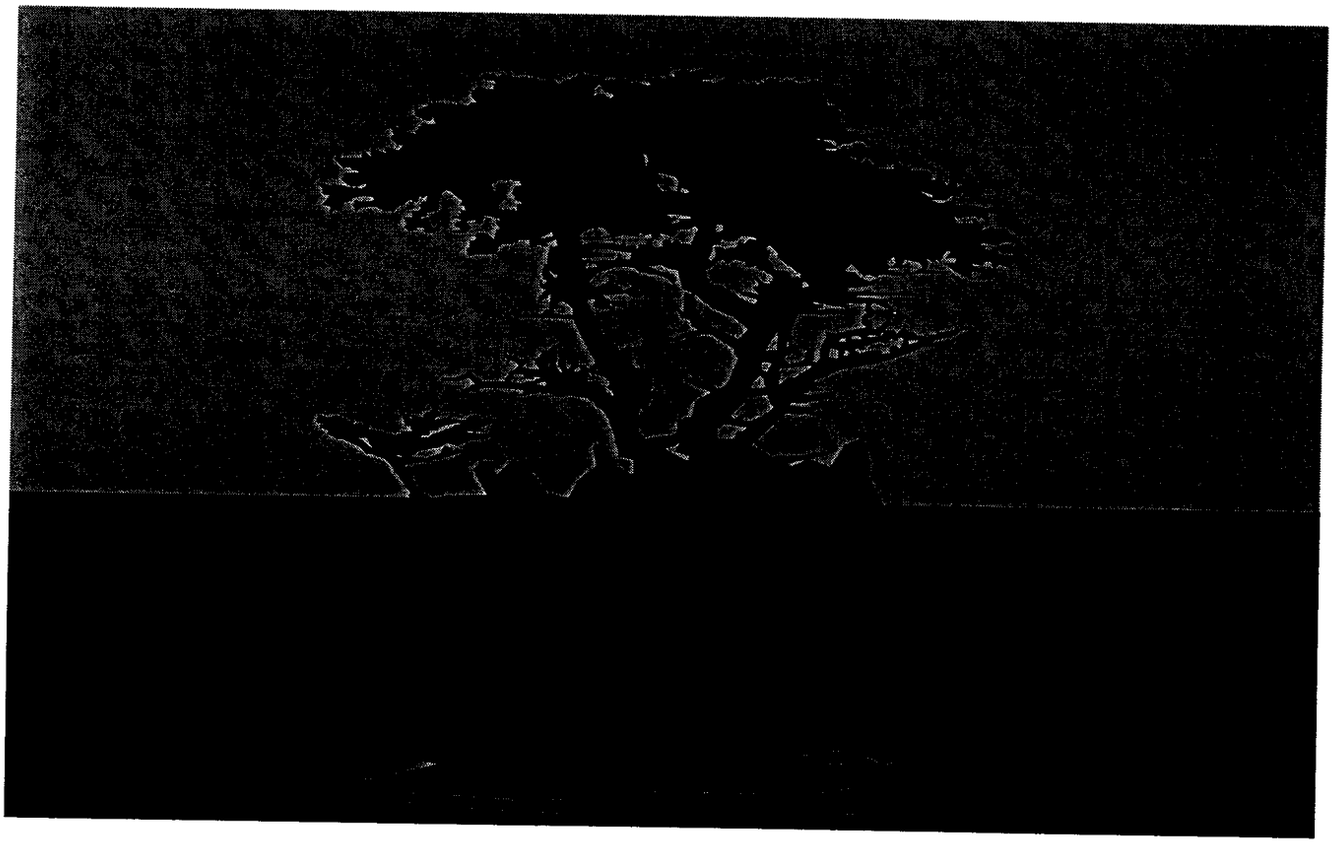
The Fisheries Department should be commended for their resourcefulness and determination as there were times when the completion of the surveys seemed uncertain due to failing equipment, financial limits and logistical dilemmas. Full credit must also be given to all of the members in the survey team as it was their hard work and sheer determination and stamina to get the job done that made the project so successful.

7 Bibliography

- ACIAR, May 1994, Coconut Crabs, Giants Under Threat, Australian Centre for International Agricultural Research.
- Amos, Moses J. 1997, Beche de mer/ Coconut Crab/ Rock Lobster and Giant Clam Stock Assessment Project.
- Amos, Moses J. & Bell, Lui A.J., 1993, Republic of Vanuatu Fisheries Resource Profiles, FFA Report 93/49, South Pacific Forum Fisheries Agency, Honiara, Solomon Islands and Fisheries Department, Government of Vanuatu, Port Vila, Republic of Vanuatu.
- Bay of Plenty Polytechnic, 1997, Certificate in Marine Studies, Marine Invertebrates Workbook, Tauranga.
- Coleman, N., 1991, Encyclopaedia of Marine Animals. Angus & Robertson Publishers, Australia.
- Fletcher W.J, 1992, Stock Assessment & Management of Coconut Crabs in Vanuatu, AIDAB funded project for Fisheries Department, Republic of Vanuatu.
- Gibbs, D., Hannam, N., Houghton, K., Rapson, A., & Reid, C., 1998, Vanuatu Stock Assessment Surveys, Shepard Islands Group Report, Diploma in Marine Studies, Bay of Plenty Polytechnic, Tauranga, New Zealand.
- Douglas, Norman & Ngaire, Pacific Islands Yearbook, 16 th Edition, Angus & Robertson Publishers, Australia.
- Ruppert, E.E & Barnes, R.D., 1994, Invertebrate Zoology, sixth edition, Saunders Collage Publishing, USA.
- South Pacific Commission, 1994, Handbook No.18, Sea Cucumbers & Beche De Mer of the Tropic Pacific, a hand book for fishers, South Pacific Commission, Noumea, New Caledonia.
- Vanuatu Fisheries Department, Stock Assessment Project 1998-2000, Survey of Invertebrate Resources.

Section 8

Appendices.



Eggs, which are carried under the female crab's tail (abdomen) for about 3 weeks, are initially bright orange but darken in colour during the gestation period. The eggs are released into the ocean at dusk, generally coinciding with a high tide and the dark phase of the moon. The eggs hatch immediately upon release from the female and progress through several larval stages which drift in the sea for 2 to 3 weeks. The final (glaucothoe) larval stage must find and enter a suitable sea-shell in which it emerges from the ocean to live amongst the coral rubble of the intertidal zone.

Once the glaucothoe reaches approximately 5 mm in length a further metamorphosis to a juvenile coconut crab occurs when it dispenses with using a snail shell for protection. The juvenile lives in burrows to avoid potential predators including other larger coconut crabs. As it grows, the juvenile adopts a more terrestrial habit, and moves further inland.

The usual method for capturing coconut crabs is by placing opened coconuts during the day along a previously used trail. These trails are re-visited after dark, and the coconut crabs, attracted by the prospect of an easy meal, are captured. Local stock sizes can be determined using the catch rate as an index of abundance.

Coconut crabs have now disappeared over much of their previous range. Their ease of capture, and the destruction of their habitats, are now threatening their survival. An intensive research programme, sponsored by the Australian Centre for International Agricultural Research, is aimed at the conservation, management and potential for farming of the species.

WHAT THE VANUATU FISHERIES DEPARTMENT IS DOING TO HELP THE CRAB'S SURVIVAL

Current Management Rules:

* A 9cm cephalothoracic length minimum size limit.
* A ban on the collection of berried (egg bearing) females.
* Closed seasons (Santo - Oct to April and Torres/Banks - Aug to Nov).
* Quotas (Santo - 2000 crabs per year and Torres/Banks - 5000 crabs per year).
* A public awareness campaign.

Based on research by Dr. Rick Fletcher, Mr M. Amos and Dr C. Schiller.
Designed by Jeremy King, BAppSc. Grad.Dip.(Fisheries)

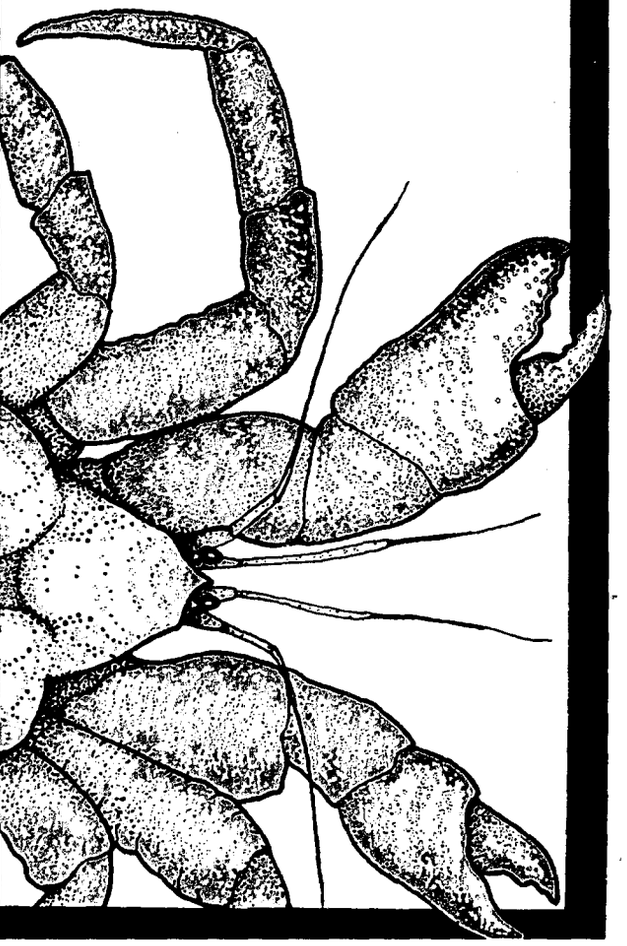
ACIAR
The Australian Centre for International Agricultural Research

Produced by **ACIAR**
Australian Centre for International Agricultural Research
in collaboration with the
Vanuatu Fisheries Department
Port Vila.

May 1994

COCONUT CRABS

GIANTS UNDER THREAT

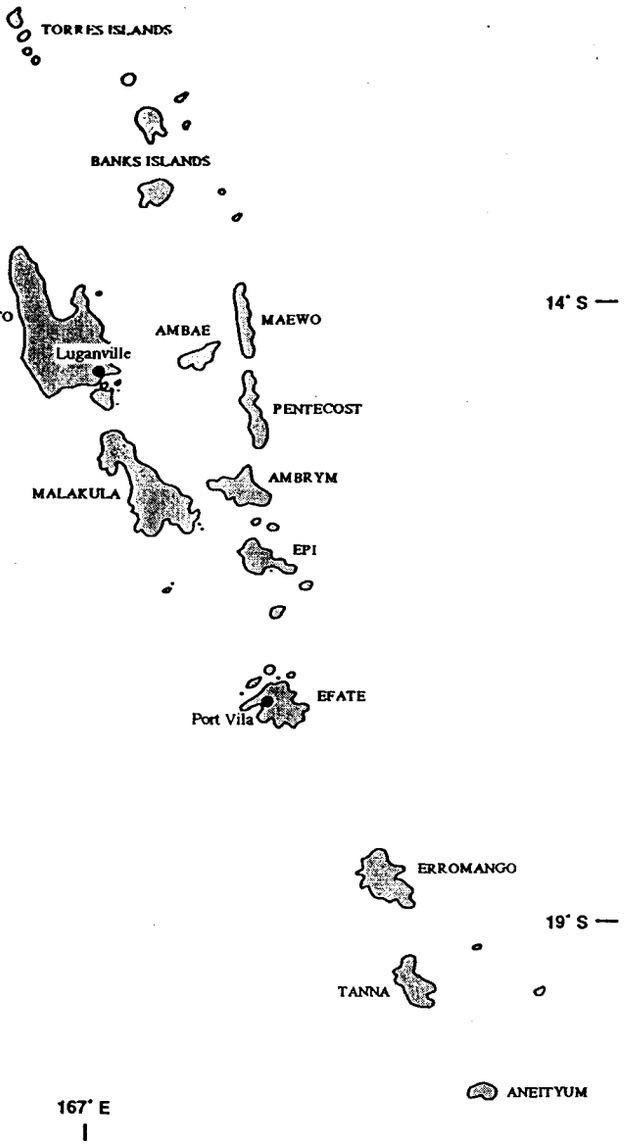


VANUATU

OL LOA BLONG FISERI

WE I LUKAOTEM OL SAMTING BLONG SOLWOTA

I N S A E D



Vanuatu
(map ia i soem ol bigfala aelem nomo)

OL SAMTING WE I STAP AFEKTEM OL TROKA

1. Wom blong solwota oli kaikai ol eks taem oli stap flot.
2. Hariken i kilim olgeta.
3. Fis i kaikai ol eks mo ol smol troka.
4. Yumi ol man yumi stap ova havestem, mo karem ol smol smol sais troka.
5. Strong tait i karem olgeta igo long dip solwota, mo afta oli ded.

LOA BLONG OL TROKA

Subsidiary Act Cap. 158 Part 4 Section 17

17.2 Ino kat eni man i save spolem, pikimap, kipim, salem mo pem eni troka we i smol long 9 sentimita.

17.3 Ino kat eni man i save expotem troka shell ovasi anles yu kat rait long Minista consen we hemi mas stap long wan pepa.

PENELTI — Subsidiary Act Cap. 158 Part 4 Section 24

24. Eni man we i brekem ol loa ia isave pas long kot mo pem wan faen we ino bitim VT 100,000.

11. FAD

FAD (Fish Aggregating Device)

Fish Aggregating Device hemi eni samting we man i mekem, we i save flot mo igat anka blong holem tait blong solwota ino save karem aot. I mas gat flaek mo laet istap long hem, blong ol sip oli no save bangem taem oli stap ron long nait.

Wok blong wan FAD i blong pulum ol smol smol fis ikam stap haed mo kaikai oltaem long hem, mekem se ol narafala big fis tu oli atraktet mo oli kam stap kaikai raon long hem. Ol fis ia oli kam stap kaikai mo haed long FAD, mekem se oli nomo wandem swim iko olbaot. So i minim se long FAD oltaem i stap kat fulap fis raon long hem. Ol fis we man i save kasem raon long wan FAD hemi ol Tuna, Marlin, Mahimahi, Rainbow Runner mo samfala mo.

Eni man ino save setemap o sakem o flotem wan FAD long solwota blong Vanuatu. Blong yu putum wan FAD, yu mas askem olgeta long Fiseri Dipatmen fastaem. Sapos Direkta blong Fiseri i givim raet long yu we imas stap long pepa, then yu save gohed blong setemap wan FAD mo sakem o flotem long solwota blong yu. Raet ia we direkta blong Fiseri i givim long yu, hemi talem tu se FAD we yu sakem long solwota blong yu, eni man nomo i save kam fising kolosap long hem.

Yu mas talem aot long Ports & Marine mo Fiseri Dipatmen stret ples we yu bin flotem or sakem FAD ia long hem. Yu mas givim stret latitude mo longitude long ples blong FAD ia.

Eni man we i brekem olgeta loa ia antap, i save pas long kot mo pem wan faen long 100.000 VT.

OL SAMTING WE I STAP AFEKTEM OL EKS MO YANG GRIN SNEL

1. Hariken i distroem ol eks mo ol yang wan taem oli stap flot long solwota.
2. Wom blong solwota oli kaikai ol yang grin snel long ol rif.
3. Ol strong skin fis, ol krab, nawita, puffer fis, mo ol spaeni lobsta oli kaikai ol yang grin snel, espeseli taem oli stat blong setel daon long rif.
4 Strong tait i karem olgeta i go long dip solwota we oli nomo save swim i kam bak long sho, mo oli ded.

KAIKAI BLONG OL GRIN SNEL

Ol grin snel oli stap kaikai ol nalumlum long ol ston mo rif, espeseli olgeta we kala blong olgeta i luk grin mo red (*Gracilaria, Hypnes, Eucheuma*). Yu save faenem grin snel long ol rif we i dip kasem 1 mita go kasem 20 mitas dip.

LOA BLONG OL GRIN SNEL

Subsidiary Act Cap. 158 Part 4 Section 16

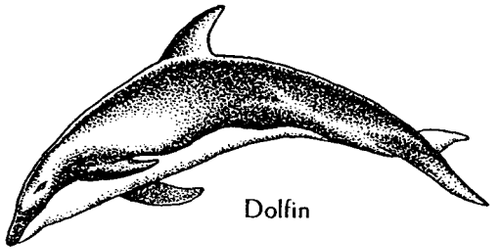
16.2 Ino gat eni man i save spolem, pikimap, kipim, salem o pem eni grin snel we i smol long 15 sentimita olsem pija i soem

16.3 Ino gat eni man i save expotem anles ikat wan rait long Minista consen long wan pepa wetem ol condisen we Minista i givim.

PENELTI — Subsidiary Act Cap. 158 Part 4 Section 24

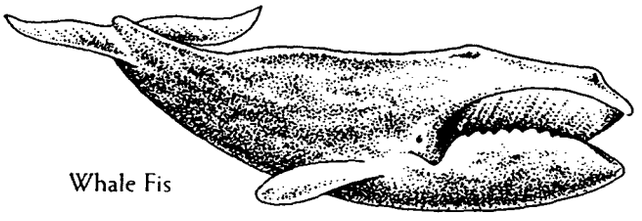
24 Eni man we i brekem ol loa ia isave pas long kot mo pem wan faen we ino bitim VT 100.000.

10. Marin mamol



Dolfin

Kao Fis (*Dugong dugon*)



Whale Fis

EK BLONG WAN BIGFALA NAURA

Wan naura we sais blong hem i bigfala emi save putum abaot 300,000 eks. Samfala naura we sais blong olgeta i smol oli save putum abaot 1,000 eks.

Ol smol smol animol blong solwota oli stap kakai ol eks blong naura.

Naura emi mekem pikinini truaut long yia. Long wom sisen (manis Octoba kasem Februari) oli save mekem plenti long wan manis.

Wan woman naura i stat putum ek taem sel blong hem long baksait i kasem 5 sentimita.

Folem ol wei ia, ikat Loa we i protektem ol naura.

LOA BLONG OL NAURA

Subsidiary Act Cap.158 Part 4 Section 13

13.2 a) Ino kat eni man o woman i save spolem, pikimap, kipim, salem o pem eni naura we i kat eks, o
b) Eni naura we ino kasem 22 sentimita yet olsem i stap long pija.

13.3 No kat eni man o woman i save usum eni spia o traem samfala diferen weis blong spiarem naura.

13.4 Ino kat eni man o woman i save karemaut ol eks we i stap fas long beli blong wan naura, mo kipim, salem o pem naura we oli karemaut eks finis.

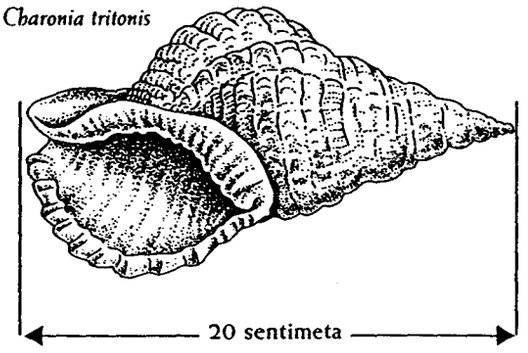
PENELTI — Subsidiary Act Cap. 158 Part 4 Section 24

24. Eni man we i brekem ol loa ia isave pas long kot mo pem wan faen we ino bitim VT 100.000.

8. Pupu Sel

PUPU SEL

Charonia tritonis



Lukautem gud mo protektem gud ol pupu sel long rif blong yu. Taem yu ko long rif blong karem ol pupu sel, karem nomo olgeta we oli big big wan or saes blong olgeta ikasem 20 sentimeta olsem hemia long pija antap. Fasin olsem i save mekem se bae ikat oltaem long rif blong yu ol pupu sel we yu save karem bakeken next taem mo long fiuja.

LOA BLONG OL PUPU SEL

Subsidiary Act Cap 158 Part 4 Section 18

18.2 Ino kat eni man i save spolem, pikimap, salem o pem eni Pupu Sel we sais blong hem ino kasem 20 sentimita yet olsem we istap long pija ia

PENELTI — Subsidiary Act Cap. 158 Part 4 Section 24

24. Eni man we i brekem ol loa ia isave pas long kot mo pem wan faen we ino bitim VT 100.000.

OL SAMTING WE ISTAP AFEKTEM OL KRAB KOKONAS

1. Strong taid ikarem olgeta igo long dip saltwota, afta oli ded.
2. Fis i kaikai ol smol krab.
3. Hariken i kilim olgeta taem oli stap flot long solwota.
4. Taem oli kam soa, samtaem sandbij i hot mo oli save det from.
5. Yumi ol man i karem ol yang krab kokonas blong kaikai o salem.

LOA BLONG OL KRAB KOKONAS

Subsidiary Act Cap.158 Part 4.Section 15

15.2 Yu no save spolem, kasem, kipim, salem o pem
(a) eni krab kokonas we ikarem eks,
(b) eni krab kokonas we sais blong hem ino kasem 9 sentimeta yet.

15.3 Yu no save karemaut ol eks blong eni krab kokonas mo salem o pem taem oli karemaut eks finis.

PENELTI — Subsidiary Act Cap. 158 Part 4 Section 24

24. Eni man we i brekem ol loa ia isave pas long kot mo pem wan faen we ino bitim VT 100.000.