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**AN ORAL ACCOUNT OF OVERFISHING AND HABITAT DESTRUCTION  
AT PORORAN ISLAND, PAPUA NEW GUINEA**

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# AN ORAL ACCOUNT OF OVERFISHING AND HABITAT DESTRUCTION AT PORORAN ISLAND, PAPUA NEW GUINEA

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## Abstract

Changes in fishing gear, increased populations, intensive fishing and habitat destruction have contributed to overfishing at Pororan island. From traditional communal fishing using traditional nets, pole and line for tuna and other conservative traditional fishing gear in the 1960's, recent introduction of modern gears in the 1970's and 80's of nylon nets, hook & line, pressure lamp, under water touches, and others have contributed directly to overfishing. Habitat destruction by removal of dead and live corals for the construction of jetties and fencing around the villages and recent destruction of live corals and sea grass habitats due to a combination of natural and man induced factors has contributed to depleted stocks. Reduced catch rates, changes in the catch composition and reduced yields are evidence of overfishing. Recent introductions of some management measures by village elders failed. A management approach based on traditional conservation is discussed.

## Introduction

Like the rest of Papua New Guinea, Development at Pororan island has been slow or absent before PNG became independent in 1975. After this period the need for cash rapidly replaced the subsistence economy, although not completely. With a limitation on the availability of land, the main source of cash is from the sea. The last 30 years has seen a dramatic increase in population at Pororan island and the need for cash which have lead directly to changes in fishing techniques from traditional to modern fishing gears and therefore increased fishing effort. High population density and agriculture poor island was responsible for high finfish yields in the Port Moresby area (Lock, 1986). Pernetta and Hill (1981) highlighted the effect of monetisation of subsistence resources would strain resources to levels of over-exploitation.

The concept of overfishing is associated with the economy of the fishery in the West and is related to generating profit. The

fishery would collapse if the fishery became unprofitable. In subsistence economies in the South Pacific profit does not motivate (Johannes, 19..?) and therefore the use of catch per unit of effort may be illusive when used to monitor abundance. It is difficult therefore to use the same analogy in a subsistence economy where the cost structure is absent, or if it is present it is not important to the fishermen. Effort and yield may continue to rise despite biological overfishing of some form. Biological overfishing may reach critical levels without the fishermen being conscious of it.

In this paper changes that have occurred in terms of fishing gear and fishing techniques and the destruction of habitats in an island village, that have led to overfishing are presented. This is based entirely on a personal account from observations and oral discussions with fishermen on the island. It is difficult for a biologist to suddenly resort to what appears to be anecdotal information of overfishing after having relied on hard data to detect overfishing. I feel justified that this is a situation where oral account from the island fishermen who know more about the resource which they have used over the years, for whom I have been a participant know more about it than any professional biologist. Johannes (19...) collected verifiable valid biological information from the fishermen in Palau which could not have been studied by a biologist in his lifetime.

### Overfishing

There are no hard historical data to substantiate cases of overfishing at Pororan island, but there are obvious evidence. Overfishing that has occurred are biological in nature and not economical. This is because of the absence of costs structure. Evidence of overfishing has been directly observed by myself and fishermen at Pororan (pers. obs.) in the form of changes in the size structure of catches, changes in catch composition, low catch rates, low yields compared to the 1960's, spatial shift in effort to more distant grounds and fishing in secret places. The once abundant sea bird life on the island completely disappeared by the mid eighties.

The level of overfishing that has occurred does not need a biologist to verify, as that would be purely academic. In a society that never acknowledged the possibility of overfishing, it was very hard to convince fishermen in the 1970's and early 80's that overfishing could occur (pers. obs.). This was justified to the fishermen and elders since there was never any case of overfishing experienced on the island. How then did the fishermen change their opinion in the 1990's that there was a case of overfishing, with village elders introducing remedial management measures. Despite lacking hard data, fishermen possess a huge amount of knowledge. Johannes (1981) highlighted the underutilised knowledge of fishermen on local marine resources which are verifiable by professional biologists and the good sources of information on aspects of their fisheries (Johannes, ...).

Visible cases of overfishing occurred initially in trochus and green snail, followed by finfish and most recently, beche-de-mer. Trochus yields in 19... was estimated to be .. (Lokani, undated). No recent harvesting of green snail has been observed on the island, and there is a strong possibility that it may have been fished to extinction in the immediate vicinity of the island. In the early 1970's it was very common for fishermen to have at least some green snail in their catch of trochus.

There is a unique counting system for fish in units (pilits) and baskets (kohel) that is used on the island to quantify the catch and also used in the barter system which trade fish for garden produce with mainland Buka islanders. With the counting system fishermen are able to quantify catches in the 1960's and 1970's quite accurately and compare it with the present catches.

Several important factors that have contributed to overfishing are discussed below. Which factors are more important is not known. To put the overfishing argument in perspective traditional fishing methods are discussed first to provide a baseline scenario as a comparison to the present. It is thought that improved fishing gear and absence of conservation was one of the most important human induced factors that contributed to overfishing.

#### **TRADITIONAL FISHING METHODS**

Traditional fishing methods are briefly discussed below. The methods described here only cover some of the more common methods.

##### **Nets**

Two types of nets were constructed, for catching dugong and fish. Netting for dugong is similar to modern nets, which was a rectangular meshed nets with sinkers and floaters. The net was set in the daily feeding migration path of the dugong. This was normally between the shallows and deeper waters. Dugong fishing was carried occasionally, mainly for ceremonial feasting.

Nets for fish were constructed in a cone shape and hung from specially constructed frame to maintain the shape. Each fishermen had two nets. Fisherman stood on the reef forming a line of nets by stretching their two nets outward with both hands in opposite directions of the hands. This effectively formed a series of nets. Assisting fishermen polled canoes and drove fish by splashing the surface in an organised manner towards the nets. Fish were caught tangled or gilled in the nets.

This was the most common fishing method on the island. Fishing using this method was subjected to open and closed season as determined by kieching (see below). As kieching was mainly performed for specific fish species net fishing was used to catch other fish on a more regular basis.

Net fishing was the principle method used in the 1960's. With the

introduction of nylon nets in the 1970's traditional nets phased itself out. It is no longer used today.

### **Bow and Arrow**

Bows and Arrows were used to spear various reef fish that sheltered on crevices, rocks and corals on the reef flats during low tide. The tip of the arrow was made from sharpened palms. This method was rarely used in the 1960's and is no longer used today.

Because this method of fishing was used in relatively clear shallow waters, its use was common at a time when fish is said to have been more abundant on the reef flats.

### **Tuna**

Fishing for skipjack tuna was the most important fishing activities. The catch was smoked or cooked in earth ovens. Smoke preserved tuna could be preserved for months or years. Skipjack tuna was one of the principle food used in traditional and ceremonial feasting.

Skipjack tuna was the last to have been 'Kieched'. This meant that skipjack tuna was not fished until it was kieched by the 'Kiechman' ('Tson Kiech'). Although kieching was associated with so called magic powers, the kiechman opened fishing after performing 'Kiech' at a time when fishing was best. Elders today still talk about fish not being as abundant because they are not 'Kieched'. It was apparent from my observations when the last few of kieching was performed in the 1970's that the Kiechman was knowledgeable in predicting the best fishing season. Interviews with elders today indicate that the Kiechman used sprouting leaves from special trees (currently not known because Kiechman kept these secrets) as indicators of the best fishing season.

Trail fishing commenced, traditionally known as 'hakot' (almost equivalent to try nets in prawning) to gauge a feel of the coming catch except only one fish had to be caught. This was ceremoniously eaten by all the elders. After this the fishing season officially commenced. The Kiechman never actually participated in fishing. He sat at the kiech place (special place) maintaining his power to keep the catches high. He was rewarded with fish by every fishermen that caught skipjack tuna. The fishing season closed immediately as soon as the Kiechman declared it closed.

Fishing was carried out from outrigger canoes taking at least two people or from single hulled boats, known as 'mun'. Mun carried more fishermen as peddlers with two pole fishermen. Actual fishing was by a single barbless lure constructed from hawkbill turtle shell and cone shells. The lure was attached to a bamboo pole by a traditionally woven string.

## Fish Poisoning

Traditionally derris roots were used at Pororan but were rarely used in the 1960's and 1980's. Today it is unheard of to use derris roots. The more common method is to use what is locally known as luts, derived from a special tree plant.

Branches and leaves from the tree is broken into little pieces to extract the sap in sea water. The sap from the tree mixes with seawater to form a lethal solution, which kills all fish when the solution is in high concentration. Luts is used at low tide in pools to maximise its concentration and therefore its effect. Luts is relatively commonly used today.

The sap from the seed of the beach barrington (Barringtonia asiatica) is also used in poisoning fish. The sap is extracted by pounding the seed with a stone or wood. Because it is quite labour intensive, it is not common in poisoning fish.

## INTRODUCED FISHING GEAR

The first multifilament nets were introduced in the early 1970's by a villager trainee from a vocational center. The nets were large meshed (3 to 6 inches) multi filament nylon nets. These were set nets and caught mainly large fish. These nets were set at the edge of the reefs on the lagoon side of the reef. By the late 80's nylon mono filament nets were used. Communal fishing using modern multifilament and nylon nets were a modification of traditional fishing using traditional nets (see above). As soon as communal fishing nets using multifilament and monofilament nylon nets commenced traditional communal net fishing ceased.

The use of nylon nets in communal fishing is said to have had the biggest impact on overfishing. The nature of this fishing method meant that the reef was systematically intensively fished 4 days a week (figure 1). The three villages on the 2 islands of Pororan all fished at the same time thus the whole reef was fished intensively simultaneously.

Although goggles were introduced earlier, these are now commonly used to dive for trochus, green snail and fish. The recent past has seen the popular use of mask and snorkel in dive fishing.

Dive fishing in the night was introduced in the late 1970's using underwater torches. Fish are most vulnerable in the night leading to exceptionally high catches. Fish that were difficult to catch at day time using other methods were most vulnerable to night time underwater spear fishing. Clearly understood knowledge on habitats and behavior made high catches guaranteed.

The combined use of both traditional and introduced fishing methods ensured that the whole spectrum of species on the reef were fished. Some species although caught, were not taken as they were considered inferior. Among these were Therapon jabua, Kamuo and malat. These fish were considered a non fishermens (Gugun) catch, caught when the urchin to eat fish was irresistible (huot).

Interestingly these species started to appear in the catch sold at the local markets in the late 1980's. Fishermens pride was no longer important out of neccesasity. This was a direct result of decreased catches of the other species.

### Frequency of Fishing

Fishing on the island is an everyday activity for subsistence use, as food commodity for barter and as a cash commodity for sale at the local markets. All the fish destined for barter or sale are smoked or sold fresh at Kessa, Karoola and Buka Town market (Figure 1). Buka Town market operates Monday to Friday Saturday. Karoola and Kessa Market operate on Wednesday and Saturday only of every week. Intense fishing destined for these markets are mainly carried out on Monday, Tuesday, Thursday and Friday. Fishing is scaled down on market days and Sunday.

### Habitat Destruction

Man induced habitate destruction are related directly to fishing methods and indirectly to construction. Habitate destruction related to fishing were/are;

- Dynamiting
- Lime processing
- Pole (Tun - various)
- Reef Walking

Habitate destruction due to construction were for the contruction of jetties, permanent fencing to keep animals especially pigs outside the village perimeter and recently, construction of seawalls to stop and minimise erosion of the shoreline.

Although destructive, dynamiting was mainly targeted for schooling fish such as mullets, Rabbitfish (Siganus lineatus), blackspot snapper, Rastrelliger kanagurta and yellowtail scad (Atule mate). Most of the dynamiting occurred outside of established reefs or near the perimeter of reefs. Direct damage to coral reefs has therefore been minimal. The most destructive damage caused by dynamiting to coral reefs is estimated to cover a diameter of about 2 meters. The use of dynamiting was used more commonly in the 1970's when the weather was bad preventing effective fishing and when large schools were spotted (see figure 1). Dynamiting in the 1990's was very rare or not practised.

Just about everybody in the village chews betelnut thus the demand for lime is always high. Island women process lime from live staghorn corals. A typical batch of lime to be processed required approximately colonies of live staghorn corals collected from the reef measuring a diameter of 4 square meters and approximately 40 cm in hieght. The frequency of processing lime and the biomass removed from the reef is unknown. The amount of corals collected for lime processing per year is estimated to be much larger than those destroyed by dynamiting. Fish mortality associated with removably of corals is not known.

Poling is what is known to the islanders as tun, constructed from mangrove 6 to 10 meters long. Poling is used in outrigger canoes to push the canoe forward. This is done by pushing the pole directly below the canoe and pushing it backward. By doing so the canoe is pushed forward. This is use primarily in shallow waters.

In communal fishing using traditional and also modern nylon nets the pole is used to scare fish towards the net by splashing on the surface of the water and pushing the pole under the water towards rocks, corals and crevices to scare fish. Because poles have to be pushed from the bottom of the substrate, travelling over coral colonies always mean that corals are broken when the poles are pushed to the bottom. Branching corals of the genus *Acropora*, *Porites*, and soft corals are the most vulnerable to destruction from poles.

Most of the traditional fishing and recent communal fishing using nylon nets require some level of walking, especially during low tide. Most of the walking is undertaken when spear fishing, gleaning for various gastropods, bivalves, other sedentary organisms and fish. Spear fishing is a common communal fishing method for boys and young men. This involves chasing fish on the reef flat barefooted or with water sandals. Boys would chase fish at top speed, stepping on everything on their path. As the eyes were on the fleeing fish there was no time to avoid corals and other live forms. It was not uncommon to step on sea urchins and getting coral cuts.

In the early 19th century construction of jetties and village wall (figure 2) saw the necessity to collect rocks and corals from the sea as there were no other sources on the island. The construction of village walls was to keep mainly pigs outside of the village. Collection of corals for the village wall continued in the 1960's and 1980's as the village expanded. The total length of the village walls in the 3 villages at Pororan and Hitau (figure 1) is estimated at ..... (1.5 meters high and 1 meters wide). The collection of rocks and corals which were communal activities literally left reef flats bare of rocks and live corals. Coral collection continues today at a much lower scale for the construction of sea wall to stop or minimise erosion of the shoreline.

In 1991 the health division of Bougainville took the initiative to remove the pigs from the island to an adjacent island. This was agreed to by the community which now required to increase its subsistence planting of food on the island. It was a choice of fencing the gardens and maintaining the village wall or doing without these by removing the pigs from the island. It now seems ethically wrong that corals should have been removed from the reef for the construction of jetties and village walls which are no longer needed today.

## MANAGEMENT

## Traditional Management

### Kiech - Closed Season

No strict traditional management regimes is known from Pororan. However, the concept of 'Kiech' was a form of management analogues to conventional closed seasons. Kiech was a form of open and closed season which was controlled by various individuals. All forms of fish was fished only after it was Kieched. Kieching was performed only by certain individuals in a clan who passed their skills only to chosen ones within their clan. It was a mixture of magical powers and knowledge of the behavior of fishes.

Kieching was achieved by magic powers to make fish plentiful. It was performed only occasionally at the discretion of the wise ones who were responsible for each types of fish. This knowledge has unfortunately been lost. There appears to be biological significance in Kieching, in that those who were responsible for Kieching had knowledge on the behavior of the fishes associated with their biology. In Kieching skipjack tuna which was practised as late as the late 1970's, a special plant sprouting signalled the good time for Kieching which must have been associated with the skipjack tuna coming closer to the shores to feed.

The concept of kieching is identical to Western conventional management. The authority responsible for determining the closed and open season was a single individual. It is evident that the objective of this form of management was to maximise yield, and probably fishing was even carried at MSY levels. The Kiechman knew a lot about the population and obviously his status and pride in the community was maintained by his success in maintaining high yields. A form of tax to the authority was even enforced in the form of part of the catch being given to the Kiechman.

Kieching is no longer practised and the knowledge for its basis has been lost. Its revival is impossible. The elderly population alive today understand its concept which could be positively exploited by re-introducing closed areas and closed seasons, but with the assistance of more conventional modes of obtaining Maximum Sustainable Yields.

The Pororan community has already taken management initiatives. Restrictions on the type of net used, closed area and closed season have all been applied with limited success. These measures relied on the obedience of the community which worked for a while. There was no legal mechanism to uphold enforcement and prosecution. The results however were encouraging to the villagers. A ban on gill nets saw a visual increase of fish on the reef flats closer to the villages. This encouraged certain individuals to start using the nets again due to what is known by the islanders as 'riri'. This means that the visually appealing presence of fish is so tempting that it is impossible to resist catching them.

Failure in management and particularly enforcement is always most likely to collapse when the point of 'Riri' is reached. Any future management has to have a legal framework within the legal system of the community. Under the current adhoc management measures, defaulting fishermen only receive a public scolding from the chief. Unfortunately once the public learns of it, they all start fishing.

There is a very strong will in the community to apply management measures with an alternative to fish a new fish resource. The greatest potential is the deep bottom snappers and pelagics to be fished from FADS.

It is proposed that properly established closed areas will be established at adjacent and on the main reef at Pororan. This is open for discussion with the fishermen and elders on the island but has to be introduced with the introduction of some new methods of fishing for some other stocks (e.g. deep bottom fish) to divert effort and maintain the food and artisinal requirements of the village. Russ .... presented some evidence suggesting adjacent closed areas can be a source of recruitment into the fishery...

### Goagon - Closed Areas

Certain parts of the reefs surrounding Pororan island (figure 1) were effectively closed to fishing because they were secret places inhabited by monstrous creatures and ancestral spirits. Some were burial places and others for rituals. There are no clear reasons as to how these evolved, but they served a purpose in restricting or closing certain areas from fishing. In a society where the super natural was real, respected and feared, what better enforcement then to have these mytes.

Known areas closed to fishing or restricted were Maliliu, Hanou, Keketin and Tutula (figure 1). There are other less known areas.

It is said that a giant octopus capable of swallowing and sinking ships inhabited the reefs around Maliliu sand cay (figure 1). Ancestral spirits also resided on the island. New comers to the island never went there by themselves. They always had to accompany persons that have been on the island on previous occasions. Visits to the islands were rare.

A group of anenome fish resided at Hanou point? It was here that hair cut off from death persons were thrown to the anenome (Matats). The anenome were never touched. If touched there would be big waves and wind. No shouting and playing ever occurred there. This area stretched from Keketin to Hanou. At Hitau the area close to Tutula (figure 1) and was rarely fished because ancestral spirits resided in those areas.

By the early 1970's people were beginning to fish in the vicinity of Maliliu and by the late eighties all the secret areas were fished. The last secret place to have been fished was at the ocean end of Maliliu said to be where the giant octopus had its

home.

### Development of New Fisheries

Development of new fisheries can be used to divert fishing effort from overfished stocks. This has occurred for beche-de-mer which has been severely overfished. Beche-de-mer however, is destined exclusively for export, and meets only the cash requirement. Effort has to be diverted to new fisheries which meet both cash and food requirements. The greatest potential lies in deep bottom fishing. Some level of fishing has already occurred. Development of this fisheries lacks proper development and fishing strategy.

Deploying FADS in the offshore reef areas but relatively close to the island has a big potential to target pelagic fishes. It is though that pelagics are relatively underfished. It is currently being fished by handline using lights at night.

### GENERAL DISCUSSION

Trampling or reef walking has been demonstrated to destroy 3/4 of living corals after only 18 tranverses (Woodland and Hooper, 1976). Algal populations have also been demonstrated to be reduced by trampling (Ghazanshashi et al., 1982). The amount of walking and poling at Pororan island reefs per year are very high and therefore damage caused to live coral would certainly be high. This would certainly have contributed to the total destruction of live coral cover from the reef flat. By 1994 all live corals on the reef flat have totally been destroyed (figure 1). What is left is a barren stretch of sand with scattered rocks.

The combined effects of habitate destruction, due to dynamiting, rocks and coral collection for lime and jetties and village walls, poling and reef walking has the potential of having contributed significantly to the destruction of reef flats. The level of destruction due to human and environmental factors is unknown. Blasting of reef channels has the potential of devastating destruction of 100's of meters (Kaly and Jones, 1994).

The physical complexity of substrate can influence coral-reef fish communities (Risk, 1972, Luckhurst and Luckhurst, 1978, Gladfelter, et al. 1980, Bell and Galzin, 1984, Spotte, et al. 1992) by providing increased surface area which are used for shelter and feeding sites. Live corals are structurally complex while dead corals lose their complexity rapidly through erosion (Bell and Galzin, 1984) and this will affect the diversity of fish communities (Risk, 1972, Luckhurst and Luckhurst, 1978, Gladfelter, et al. 1980, Bell and Galzin, 1984). Some fish feed directly on live coral (Hiatt and Strasburg, 1960, Randall, 1967) and its destruction would therefore affect fish directly or indirectly through the food chain and community interactions. Bell and Galzia (1984) presented evidence of fish avoiding sites

without live coral cover, while some fish may be associated with sites due to behavior (Spotte, 1992).

The absence or poor correlation between substratum and species diversity or abundance (Moles, 1978), species diversity and biological nature of substratum (Risk, 1972), species diversity and substratum covered by corals in contrast to the presence of correlations between gross surface area and fish density (Sale and Douglass, 1984), substratum complexity and species diversity (Luckhurst and Luckhurst, 1978a) suggest that there is still a lot more to be studied on the role of reef systems and the role they play in the ecology of reef fishes.

The period in which the rocks and corals were collected from the reef may have been correct as far as the village communities were concerned, but the current situation of overfishing and erosion of live cover from the reef flat and shoreline should now make this activity ethically wrong. The fact that corals are destroyed and habitats destroyed without raising any concern from other members of the community and the responsible authorities in the Government sector poses a very big threat to the shallow coral reef systems in PNG. Reef tenure is common in PNG and the South Pacific (...) and the possibility of destruction of reefs without the so called reef owners knowledge is huge. Customary fishing rights is legislated in Fiji (Munro and Fakahau, 1988), and recognised in Solomon islands, Papua New Guinea (.....). If this case is taken as indicative of habitat destruction and overfishing, then there is a real threat of overfishing and environmental destruction which are easily overlooked, because the resource they support are not economically important to the country or because habitat destruction and overfishing occurs at a smaller scale.

The building of jetties and village wall from corals was not worth the destruction of habitats and mortality it caused, given these are no longer required and used today. The maintenance of the habitat which would surely have resulted in maintaining fish yields were/are more useful than the jetties and village walls. Fishing from the reef flats has been an important area of fishing for food for past generations. Today it continues to support fishing for food and cash. Maintaining fish resources means maintaining the reef system by minimising man induced destruction.

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