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Note from the coordinator

The literature on traditional marine resource management and the local knowledge systems underpinning it is growing rapidly for Solomon Islands. We are happy to add to that with a lead article by Simon Foale on West Nggela fish taxonomy. Shankar Aswani, who recently completed his doctorate, is becoming a regular contributor. In this issue we include his methodological contribution on the use of optimal foraging theory. We hope that this might prove of value for fishery managers in the region. The third article is Julie Lahn's update on the issues of indigenous rights and management strategies facing the Great Barrier Reef Marine Park Authority. Allison Perry briefly describes the 'Global survey of marine and estuarine species used for traditional medicines and/or tonic foods'. We would be grateful if you would assist her by providing the information requested in the short questionnaire. Please also copy and circulate it among other knowledgeable persons.

We draw you attention to the newly available software ICONS (International Conservation Networking System). ICONS for Windows software is produced by a team of conservation and information professionals supported by the Information Management Group of IUCN – The World Conservation Union, the International Development Research Center (IDRC) and the Norwegian Agency for Development Cooperation (NORAD).

Finally, we have just received information on a World Bank call for case studies for an international workshop on community-based natural resource management (see p. 34). The call is for practical papers based on actual projects, rather than for academic studies.

Please note my new e-mail address (above). It would be appreciated if contributions and information could be received by e-mail.

Kenneth Ruddle

Inside this issue

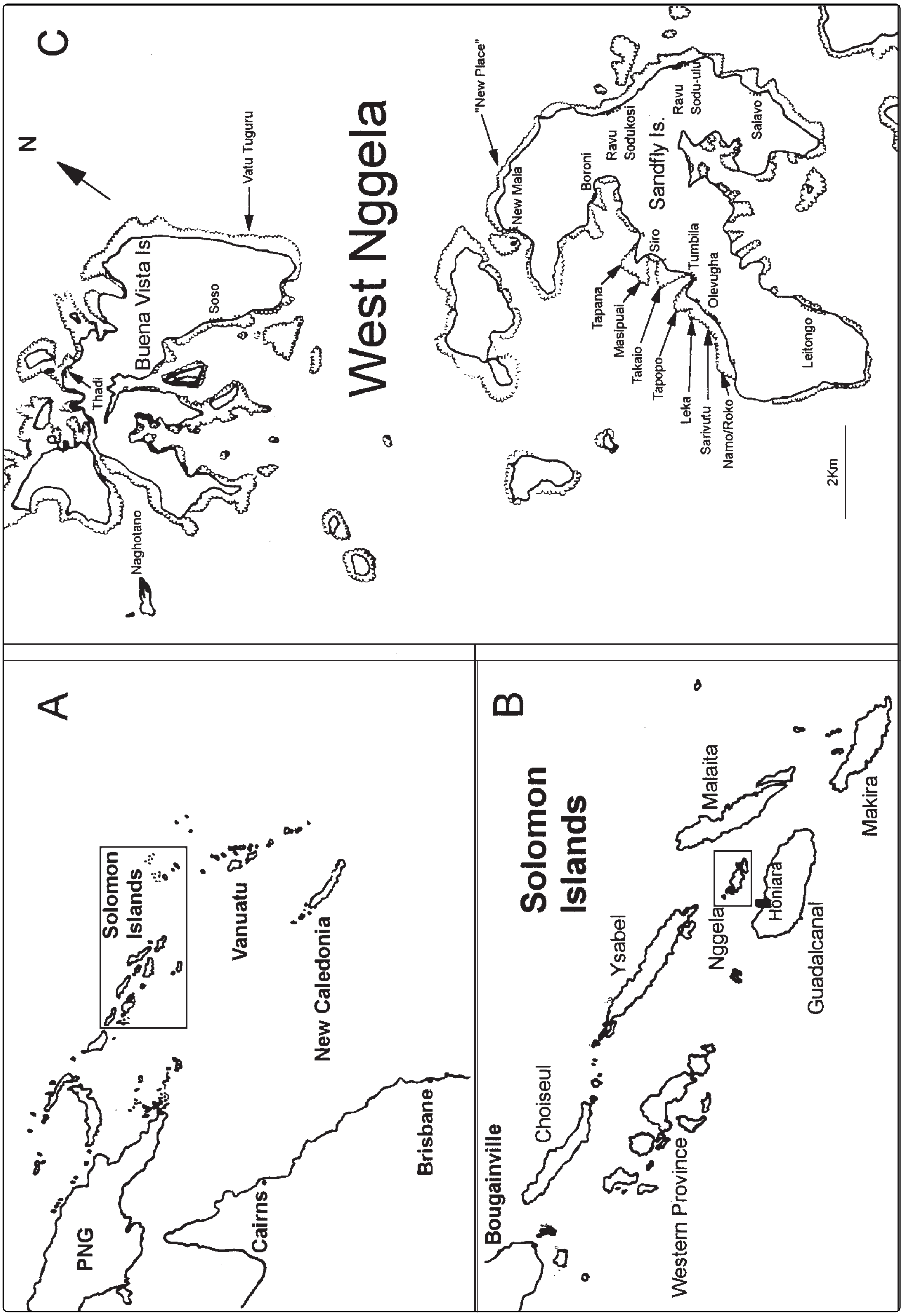

Figure 1: Map of the Solomon Islands showing the West Nggela region

What's in a name? An analysis of the West Nggela (Solomon Islands) fish taxonomy.

by Simon Foale [1]

Introduction

Accurate knowledge about the behaviour, biology and ecology of organisms comprising marine fisheries is a vital prerequisite for their management. Before beginning any study on local knowledge of marine fauna, a working knowledge of their local names must be obtained. Moreover, a great deal of local knowledge can often emerge in the very process of obtaining names (Ruddle, 1994). A detailed treatment of the local naming system of West Nggela marine fauna is given in this paper.

Methods

Local names of fish were collected by asking people to provide the Nggela names for fishes from photographs in books featuring most of the common Indo-Pacific species (Randall *et al.*, 1990 and Myers, 1991). Most identifications were cross-checked with at least five people before being included in the list. This could still, however, sometimes be an unreliable way of obtaining the correct name (Bulmer, 1969; Diamond, 1989, 1991).

Occasionally the photograph might have been of an individual whose colour variation did not quite match that of the population that occurs at Nggela (even though it was still the same species), or the colour balance of the photograph might have been a bit unnatural, or the fish was not easy to recognise for some other reason. Occasionally, people would create names for fishes, based on their appearance in photographs, even if the fish did not occur in the Nggela region. With this in mind, I tried to obtain names of living, or freshly-caught specimens whenever possible.

For some groups of fish this was difficult, or impossible. I depended heavily or entirely on photographs for Nggela identifications of species in 22 of the 86 scientific families of cartilaginous and bony fishes listed in Appendix 1. They were: Pseudochromidae, Kuhlidae, Priacanthidae, Lobotidae, Gerreidae, Sparidae, Ephippidae, Chaetodontidae, Pomacentridae, Cirhitidae, Polynemidae, Labridae, Opistognathidae, Trichonotidae, Pinguipedidae, Blenniidae, Gobiidae, Microdesmidae, Zanclidae, Bothidae, Pleuronectidae, and Soleidae.

The English names of many species of fish vary quite a bit, even within one country such as Australia. For most of the species listed in Appendix 1, I have used the English names given by Randall *et al.* (1990). For species not included in Randall *et al.* (1990), names from Kailola (1987a, b, 1991) were used.

Results

Appendix 1 contains 350 unique Nggela folk taxa for cartilaginous and bony fishes, together with the scientific (Linnean) taxa they correspond to and, where available, a brief note describing an aspect of local knowledge about the taxon. Wherever possible, an etymology was provided for the Nggela taxon (in many cases, the Nggela dictionary compiled by Fox, 1955 was used). Similar data are also presented for marine mammals, reptiles, commonly-used invertebrates, and some important plants. The list includes a small number of Nggela taxa that I was unable to identify.

Some scientific species correspond to more than one folk taxon. In some cases these folk taxa could be regarded as sub-taxa, since they were usually acknowledged to simply be different growth stages of the same Nggela 'species'. The most notable example of this is for the small carangid, *Selaroides leptolepis* (Smooth-tailed trevally), which is most usually referred to as **Malaboro**, but which can also be referred to by four other names, depending on its size (see Appendix 1). In other cases, however, usually where species (such as many scarids) show strong sexual dimorphism, the Nggela taxa are not necessarily regarded as being related. In general, splitting of taxa was more common for species that were commonly

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used, whereas fish that were of relatively little economic importance tended to be 'lumped' together.

Semantically speaking, the Nggela taxa can be divided into primary and secondary lexemes (Berlin *et al.*, 1973; Hooper, 1991). The former usually comprise one word, such as **Kara** ('trevally'), while the latter are typically binomials, such as **Kara mera** (Blue-spot trevally, *Caranx melampygus*), comprising a primary, 'generic' term and a descriptive qualifier (**mera** = blue). In a few cases this descriptive qualifier comprises two words, which in most cases can be treated as one lexeme (e.g. **Bagea papala vohe** {Scalloped hammerhead shark}: **Bagea** = shark generic; **papala** = handle; **vohe** = paddle; thus: 'paddle-handle shark'). However, several names do not fit well with this model (e.g. **Kuli tuguru ni tahi, Tauna na sori, Malole ngongora rurugu**—see etymologies in Appendix 1). While Nggela primary lexemes sometimes roughly correspond to scientific genera, and secondary lexemes to scientific species, this is certainly not the rule. Many primary lexemes correspond directly to scientific species (e.g. **Kepo** = *Herklotsichthys quadrimaculatus*). However, a larger number of West Nggela fish taxa correspond to more than one scientific species. Mostly these multiple correspondences are limited to similar looking fish within one scientific family, but ten West Nggela taxa correspond to two or more species which belong to different scientific families.

Etymologies of Nggela folk taxa are categorised in Table 1 according to the type of information they reveal about the animal. Many primary lexemes have no translation (e.g. **Kavala, Ango**) and are classified as such. The largest category of taxa comprises names that simply describe the external appearance of the fish. Some of these include a generic referent (e.g. **Atu livoga** {Dogtooth tuna}: **Atu** = tuna generic; **livo** = tooth), and some don't (e.g. **Igu koni** {Yellow-tailed emperor}: **Igu** = tail; **koni** = yellow). Other names refer to the fish's habitat (e.g. **Kukupi horara** {Spotted oceanic triggerfish}: **Kukupi** = large triggerfish generic; **horara** = open sea) or some aspect of its behaviour (e.g. **Vulovatu** {White damsel, or Farmerfish}: **Vulo** = to clean or brush; **vatu** = stone, or dead coral—this refers to the grazing behaviour of pomacentrid 'farmer fishes' which appear to clean the seabed within their small territories). These dominant categories suggest that the Nggela fish-naming system is predominantly constructed around the linguistic representation of fish and their environment as they are observed visually. Hence there must inevitably be some correspondence between the Nggela and Linnean systems, since the latter is usually based on morphological criteria, which are often (though not always) betrayed by the animal's external appearance.

Some taxa combine a term connoting behaviour or appearance or habitat with another term (e.g. **Hangguvia ni horara** {Rockmover wrasse and various Razorfishes}: **Hangguvia** = to blow off, as a strong wind blows off a roof—refers to the mode of feeding of these fishes {behaviour}; **ni horara** = of the open sea {habitat}). A small number of taxa describe the smell or taste of the fish (e.g. **Vurusinge** {Black-banded seaperch}: **Vuru** = smells {like}; **singe** = *Convolvulus* {a plant}). The second-last category in Table 1 includes names which describe something about the ecology of the fish (e.g. **Puhuduki** {Archerfish}: **puhu** = to spout, gush; **duki** = a species of ant which the Archerfish preys on by knocking it off mangrove roots with jets of water), or its interaction with certain types of fishing gear. The etymologies of 13 taxa did not appear to fit into any of these categories. Overall, most of the etymological categories listed in Table 1 portray fishes as they are experienced by fishers, so that local knowledge about them, as reflected in their names, is constructed principally in terms of human interaction with the marine environment.

Table 1: **Categories of etymological information in West Nggela fish names**

Etymological category	No. of taxa
Untranslatable primary lexeme	110
Descriptive only	136
Habitat only	30
Behaviour only	10
Descriptive + other	15
Habitat + other	15
Behaviour + other	15
Taste or smell	4
Ecology/fishing	18
Other	13

Note that owing to the overlapping nature of some categories the total does not equal 350.

Taxonomic structure

The West Nggela fish taxonomy appears to be relatively shallow, unlike the scientific system, which employs seven basic levels of classification from species through to kingdom. The next level of Nggela classification above 'generic' (e.g. **Kara**) is **Iga**, which equates roughly to 'fish', including bony and cartilaginous fishes. **Iga** fits the criteria for the category of 'Life-form' used by Berlin *et al.* (1973) and Clark (1981).

Answers to some survey questions indicated that whales, dolphins, dugongs, turtles and crocodiles may also be classified, at least occasionally, under **Iga** (see also Clark, 1991). However, **Iga** is also used as a generic for many taxa, including one species of shark (**Iga tao**, the Tassled wobbegong). In addition to its status as a generic, **Bagea** is almost certainly used as an 'intermediate' (Berlin *et al.*, 1973), between generic and life form, since most sharks are referred to as **Bagea** prior to being properly identified.

The specific Nggela name for *Trochus niloticus* is **Lala**. Its next level of classification, probably equating to 'life-form' (Clark, 1981), is **Vanguda**, which most commonly means 'shelled mollusc' and includes bivalves, but may also include other groups of (usually edible) invertebrates, such as echinoderms and crustaceans (see also Clark, 1991).

Discussion

There are many aspects of the West Nggela marine fauna taxonomy that warrant discussion, particularly in a comparative context, but which are beyond the scope of this paper. Some local knowledge is immediately available from etymologies (Appendix 1), and this was often supplemented with more detailed information which emerged in the course of my discussions and fishing activities with West Nggela fishers. Some of this information became the subject of more thorough investigations which have been published or submitted for publication elsewhere (Foale, 1997, in review a, b; Foale & Day, in press).

The lack of Nggela names for most of the deep-sea snappers (the Solomon pidgin term, **Siliva pis** (= 'Silver fish'), is used for most species of *Etelis*, *Pristipomoides* and *Aphareus*) indicates that these species have not been an important feature of the Nggela subsistence economy in the past. This is not the case for many Polynesian societies, where a tradition of deep-sea fishing clearly existed prior to colonisation (Nordhoff, 1930; Hooper, 1990, 1991). However, recent surveys by the Solomon Islands Fisheries Division indicated that sizeable stocks of several species of deep-sea snappers exist in the Sandfly area (Michael Batty, pers. comm.). During the last 3 months of 1995, the infrastructure for a deep-sea snapper fishery was in fact installed at Semege Sub-station on Sandfly Island, and fishing had commenced by March 1996.

On the other hand, the complexity of the naming system for more commonly exploited fishes, such as *Selaroides leptolepis* (Smooth-tailed trevally) and *Selar crumenophtalmus* (Purse-eyed scad), belies a much greater depth of experience with such species. Concerted questioning about these fishes (and observations of fishing practices) would very likely reveal detailed local knowledge of their biology and behaviour.

It is important to note that while relatively little of the information gleaned from the etymologies and folklore presented here could be considered as being directly applicable to contemporary stock management issues (i.e. maximising and sustaining yields), the information nevertheless has considerable worth in its own right.

Moreover, given the linguistic and cultural handicaps faced by the cross-cultural worker in an investigation of such limited duration, the data should be regarded as far from comprehensive; a great deal more information would surely come to light if more time were available for fieldwork. The data presented here are clearly also a necessary starting point for any concerted investigations into indigenous knowledge about more fisheries-relevant aspects of natural history such as growth, natural mortality, and recruitment.

Acknowledgements

Paramount Chief Christian Sale and his contemporaries from Tumbila and Olevuga villages provided many of the names in Appendix 1. Frank Tura and Paul Pule and their senior relatives also contributed significantly to the identification of many species of fish and other marine animals, and also provided much interesting folklore about many species.

There are many other West Nggela people who contributed material in Appendix 1 and to these I am also most grateful. Many thanks to Rob Day, Peter Dwyer, Martha Macintyre and Catherine Black for reading drafts of the thesis chapter from which the text of this paper was extracted.

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WWF has published a version of Appendix 1 intended for distribution in West Nggela schools. Rob Day also contributed an outboard motor (from consulting fees) and an airfare to the Solomons.

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Appendix 1

Nggela marine fauna taxonomy

Notes on pronunciation

Vowels: *a* as in far, *e* as in end, *i* as in tin, *o* as in or, *u* as in put. *G* is the Melanesian *g*, a velar fricative, sounded as the old English *gh*, with the back of the tongue articulating with but not touching the back of the palate. *Ng* as in singer, *ngg* as in finger. *D* is always pronounced *nd* (daro = ndaro) and *b* always *mb* (bosa = mbosa). The accent is always on the penultimate syllable.

Iga: Cartilaginous and bony fishes

Sharks

Stegostomidae – Leopard sharks
Bagea oneone: *Stegostoma fasciatum* (Leopard shark). Etymology: **oneone** = black sand. Name probably refers to the black spotted pattern of this shark.

Ginglymostomatidae – Nurse sharks
Bagea (ro)rodo: *Nebrius ferrugineus* (Tawny nurse shark). Etymology: **(ro)rodo** = blind. Name may connote the small eye of this species or it's sedentary habit. In pijin it is called 'sleeping shark'.

Carcharhinidae – Whaler sharks or Requiem sharks
Bagea mara: *Carcharhinus albimarginatus* (Silvertip shark). Etymology: **Mara** = bright, colourful. May refer to the silver markings on the fins.
Bagea totoho: *Carcharhinus amblyrhynchos* (Grey reef shark).
Bakebake: *Carcharhinus melanopterus* (Blacktip reef shark).

Hemigaleidae – Weasel sharks
Eno-eno: *Triaenodon obesus* (White-tip reef shark).

Sphyrnidae – Hammerhead sharks
Bagea papala vohe: *Sphyrna lewini* (Scalloped hammerhead). Etymology: **papala** = handle. **vohe** = paddle. The name describes the paddle-handle shape of the lateral extensions on the head of this species.

Rhyncodontidae – Whale sharks
Bagea ni oka: *Rhincodon typus* (Whale shark). Etymology: **Oka** = open, broad, far reaching (a synonym of **horara** = open ocean).

Orectolobidae – Wobbegongs
Iga tao: *Eucrossorhinus dasypogon* (Tassled wobbegong). Etymology: **tao** = lying flat, flat on face. Connotes the sedentary habit of this species.

Rays

Dasyatidae – Stingrays
Vali: *Dasyatis kuhlii* (Kuhl's stingray), *Taeniura lymna* (Blue-spotted stingray) and *T. melanospila* (Black-blotched stingray).
Vali sagalea: *Urogymnus africanus* (Thorny ray). Etymology: **sagalea** = sand, beach.

Myliobatididae – Eagle rays
Vali lovo: *Aetobatus narinari* (Spotted eagle ray). Etymology: **lovo** = to fly.

Mobulidae – Devil or Manta rays
Vali lovo: *Manta birostris* (Manta ray) and *Mobula tarapacana* (Devil ray). Etymology: **lovo** = to fly.

Fishes

Albulidae – Bonefishes
Oaa: *Albula neoguinaica* (Pacific bonefish). Note: the milkfish, *Chanos chanos*, is also called Oaa.

Muraenidae – Moray eels
Daununu: *Gymnothorax javanicus* (Giant moray) and other large *Gymnothorax* spp.
Poli ni tahi: *Gymnothorax* spp. (smaller) + remaining Muraenid genera. Etymology: **Poli** = snake; **tahi** = sea.
Posau: *Gymnothorax nudivomer* (Yellowmouth moray), *G. meleagris* (Whitemouth moray) and *Echidna nebulosa* (Starry moray)

Eels from various other families
Poli ni tahi: *Moringua ferruginea* (Slender worm eel) (Moringuidae – Worm eels),
Kaupichthys hyoproroides (Grey reef eel) (Chlopsidae – False morays),
Leiuranus semicinctus (Culverin) (Ophichthidae – Snake eels).
Etymology: **Poli** = snake; **tahi** = sea.
Posali:*Conger cinerius* (Black-edged conger) (Congridae – Conger eels).

Sia kale: *Myrichthys maculosis* (Spotted snake eel) (Ophichthidae). Etymology: **Sia** = flower of sugar cane, reed or bamboo; **kale** = to strike, hit. May connote the fine spotted pattern of this species.
Toitokiri: *Myrichthys colubrinus* (Harlequin snake eel) (Ophichthidae).

Clupeidae – Herrings and sardines

Kepo: *Herklotsichthys quadrimaculatus* (Four spot herring). Note: This species usually mills around in large schools under wharves or along sandy beaches in protected bays. It usually goes into deep water at night. **Kepo** is an important food species to the Nggela people and is usually parcelled in leaves and baked in a motu oven if large numbers are netted. According to some fishers, **Kepo** populations do not recover quite as quickly as other species of baitfish after heavy fishing.

Chanidae – Milkfishes

Oaa: *Chanos chanos* (Milkfish).

Plotosidae and Ophidiidae – Catfishes

Iga bola: *Plotosus lineatus* (Striped catfish) (Plotosidae – Eeltail catfishes) and *Brotula multibarbata* (Bearded brotula) (Ophidiidae – Brotulas). Etymology: **bola** = 1. a pigeon; 2. a constellation, Southern Cross.

Carapidae – Pearlfishes

Iga ni opaopa: *Onuxodon margaritifer* (Bivalve pearlfish). Etymology: This species is commonly found in a species of bivalve called **opaopa**.

Synodontidae – Lizardfishes

Koisogavu: *Saurida gracilis* (Slender lizardfish), *Synodus* spp. (various lizardfishes) and *Trachinocephalus myops* (Snakefish).

Stonefishes, scorpionfishes, toadfishes, frogfishes and gurnards

Novu: 1. All species of the family Scorpaenidae (Scorpionfishes) except for *Dendrochirus* spp. and *Pterois* spp. This includes: *Ablabys taenianotus* (Cockatoo waspfish), *Inimicus caledonicus* (Caledonian stinger), *Scorpaenoides* spp., *Scorpaenopsis* spp., *Sebastapistes* spp. (Scorpionfishes), *Synanceia* spp. (Stonefishes), and *Taenianotus triacanthus* (Leaf scorpionfish).
Novu: 2. *Antennarius* spp. (Antennariidae – Frogfishes or anglerfishes) .
Novu lovo: *Dendrochirus* spp. and *Pterois* spp. (Lionfishes, firefishes), *Histrio histrio* (Sargassumfish) (Antennariidae – Frogfishes or anglerfishes), *Dactyloptena orientalis* (Flying gurnard) (Dactylopteridae: Flying gurnards). Etymology: **lovo** = to fly. So named because the fishes appear to have wings.
Novu tonikama: *Halophryne diamensis* (Banded frogfish) (Batrachoididae – Toadfishes). Etymology: **tonikama** = old woman, or old man. Local knowledge: Stings from the spines of fishes in the **Novu** group can be treated with the leaves of the **Dirigi** tree (no identification).

Exocetidae – Flyingfishes

Kidu: *Cypselurus* spp. (and other common genera of flyingfishes).

Hemiramphidae – Halfbeaks

Kelo: *Hemiramphus* spp. and *Hyporamphus* spp.
Totoro: *Zenarchopterus dispar* (Estuarine halfbeak). Note: **Totoro** occurs mainly in shallow water around mangroves in sheltered bays.

Belonidae – Longtoms and needlefishes

Malole: (Belonidae {generic}) and possibly also the larger individuals of *Tylosurus crocodilus crocodilus* (Crocodile longtom) which are found some distance seaward of the edge of reefs.
Malole golpoto (No identification).
Malole legolego (No identification—this may be the pelagic belonid, *Ablennes hians*, which is a highly laterally-compressed species). Etymology: **Legolego** = flat, laterally compressed, as in some species of trevallies.
Malole ngongora: either smaller *Strongylura incisa* (Reef needlefish) or *S. leiura* (Slender longtom) or *Platybelone platyura* (Keeled needlefish). Etymology: **Ngora** = a young girl. The name refers to the relatively small size of this variety of **Malole**.
Malole ngongora rurugu (no identification) Etymology: **Ngora** = a young girl; **Rurugu** = under, below, a space under a tree.
Malole poli (No identification). Etymology: **Poli** = snake.
Malole sobolonga: *Tylosurus crocodilus crocodilus* (Crocodile longtom). Etymology: **Sobo** = to float; **Longa** = shorewards. Medium-sized and small individuals of this species are supposed to occur close to the shore, generally around fringing reefs. This is either the largest or second largest (after **Malole**) type of **Malole**.
Malole vaivaripapa: *Strongylura incisa* (Reef needlefish). Etymology: **Vaivari** = a reciprocal prefix with some verbs. **Papa** = to carry on one's back, piggyback. The name probably refers to this species' habit of going in pairs or small groups.
Malole valala: *Tylosurus acus melanotus* (Keel-jawed or Black-finned longtom).
Note: Has a compressed horny appendage under chin and occurs in open sea or around deep reefs. Is often preyed up on by dolphins. Etymology: **Valala** = right angle, right angled, possessing a cross-handle, as a small adze. This name obviously refers to the horny appendage under the chin of this species. It should be noted that juveniles of several species of belonids may have a barbel or bony tab on the tip of the bottom jaw. Consequently this taxon may also correspond to the juvenile form of some of the other taxa listed here.
Local knowledge:

1. Some types of **Malole** are reproductive when the **Habaga** tree (*Alstonia scholaris* or 'Milky pine') flowers and fruits. This is usually in June/July.
2. Larger Malole are caught traditionally with sago palm leaf kites and spiderweb lures (**Dala** on Nggela). They can also be caught by trolling (**Ariari**), or with a technique called

Koikoito, which comprises a baited hook on a short line (1–2 fathoms) which is tied to the dried fruit of the Barringtonia tree and left to float off the edge of the reef for a while, before being picked up by the fisherman in his canoe.

3. A very commonly told story in the Sandfly region describes a bizarre interaction (which many people profess to have witnessed) between any of the above types of **Malole** and a land snake called **Torokoe** (*Denrelaphus caligastra*). The snake usually jumps into the sea from a mangrove, **koilo** (*Calophyllum inophyllum*) or coconut tree and swims to a waiting **Malole**. The snake then coils its body around the fish, which makes no attempt to escape, and appears to mate with it. The snake then uncoils from the fish and swims back to the shore.

Atherinidae – Hardyheads or silversides

Sipu: *Hypoatherina* sp. (Hardyhead). Note: As **Sipu** gets bigger, it becomes **Gohi**, then **Kodove**. These names may equate to other species, which may be in other families. **Sipu** is a preferred bait for some types of trolling.

Holocentridae – Soldierfishes and squirrelfishes

Sori beta: *Plectropops lima* (Cardinal soldierfish). Etymology: **beta** = breadfruit tree, or its fruit.

Sori gau: *Neoniphon* spp. and some *Sargocentron* spp. Etymology: **gau** = knife.

Sori tubu mata: *Myripristes adusta* (Shadowfin soldierfish) and *M. berndti* (Bigscale soldierfish). Etymology: **Tubu** = to swell, expand. **Mata** = eye.

Sori: *Myripristes* spp. (Soldierfishes {generic}). Note: **Sori** are commonly fished using a small hook baited with cotton wool (or any small bright piece of cloth or feather), which is tied to a short line on a bamboo pole and dragged across the surface on moonlit nights.

Talaa: *Sargocentron spiniferum* (Spinecheek squirrelfish). Local knowledge: The red flowers of the **Rara** tree (*Erythrina indica* – the Coral or Flame tree), usually around August, mark the time when the flesh of **Talaa** is greasiest.

Fistulariidae – Flutemouths

Konga: *Fistularia commersoni* (Smooth flutemouth). Local knowledge: **Ulu ni Konga** (**Ulu** = head) is a metaphor for stupidity and refers to the thick bony structure of the head region of this species.

Aulostomidae – Trumpetfishes

Iga veoveo: *Aulostomus chinensis* (Trumpetfish). Etymology: **Veoveo** = hole in net or fence. Refers to the long thin shape of the fish.

Aeoliscidae – Razorfishes

Iga tuguru: *Aeoliscus strigatus* (Razorfish). Etymology: **Tuguru** = stand up, standing.

Syngnathidae – Pipefishes

Hinapi ni vua: *Corythoichthys* spp. and *Doryrhamphus* spp. (Pipefishes). Etymology: **Hinapi** = lime-stick (used to transfer powdered lime, for chewing with betelnut, from its container to the mouth). **Vua** = crocodile

Iga ni kuli: *Halicampus nitidus* (Glittering pipefish). Etymology: **Kuli** = seagrass

Kuli tuguru ni tahi: *Hippocampus kuda* (Spotted seahorse). Etymology: **Kuli** = seagrass; **Tuguru** = standing (Standing seagrass (fish) of the sea).

Platycephalidae – Flatheads

Usa vero: *Thysanophrys otaitensis* and *T. chiltonae* (Flatheads). Etymology: **Vero** = erect penis. Maybe that's what it looks like!

Vugovugo sadana: *Thysanophrys arenicola* (Sand flathead). Etymology: **Vugo** = net; **Sada** = 1. woman's skirt of banana leaves, 2. to tie the thatch in beginning a roof.

Serranidae – Rockcods or groupers

Subfamily Anthiinae:

Vare: *Pseudanthias* spp. and related genera.

Subfamily Epinephelinae:

Angora gere: *Cephalopholis sexmaculata* (Six-spotted rockcod). Etymology: **gere** = writing.

Iga koleo: *Aethaloperca rogaa* (Redmouth rockcod). Etymology: **Koleo** = Megapode bird.

Karamalabo: *Plectropomus* spp. (Coral trouts). Includes *P. areolatus*, *P. laevis*, *P. leopardus*, *P. maculatus*, and *P. oligacanthus* (the latter is also sometimes called **Taburara, Sili taburara** and **Gaumare**).

Kobili: *Epinephelus* sp. (unidentified rockcod).

Kohoa: *Epinephelus lanceolatus* (Queensland grouper). Also called **Bangabanga**. Etymology: **Kohoa** = carried, using stick shouldered by two people (Verb, transitive: **Kali koho**). Bangabanga is a slang term connoting extreme gluttony. This is the largest Indo-Pacific reef fish, and can attain weights of over 400 kg.

Kuli patu: *Epinephelus polyphekadion* (Camouflage rockcod). Etymology: **Kuli** = seagrass; **Patu** = joint in bamboo, knot.

Kusele: *Epinephelus corallicula* (Coral rockcod), *E. hexagonatus* (Hexagon rockcod), *E. howlandii* (Blacksaddle rockcod), *E. macrospilos* (Snubnose rockcod), *E. merra* (Dwarf-spotted rockcod).

Kusele geregerea: *Epinephelus quoyanus* (Longfin rockcod). Etymology: **Geregere** = to write.

Kuva: *Cephalopholis argus* (Peacock rockcod).

Mankovava: *E. fuscoguttatus* (Flowery cod).

Polo: *Cephalopholis cyanostigmata* (Blue-spotted rockcod), C. *miniata* (Coral cod) (sometimes also called **Sivari baba**), *Epinephelus malabaricus* (Malabar grouper). Etymology: **Polo** = hide; **Baba** = hole/cave.

Sivari: *Variola albimarginata* (Lyre-tail trout), *V. louti* (Coronation trout) (latter sometimes also called **Sivari baba**). Etymology: **Baba** = hole/cave.

Sogilo ni kolo: *Cromileptes altivelis* (Baramundi cod) (Sometimes called **Demara** and **Iga Piu**). Etymology: **Kolo** = strait; **Piu** = a species of bird.

Tagulu pohaha: *Epinephelus areolatus* (Areolate rockcod). Etymology: **Pohaha** = mottled grey and white smudges as a banana leaf.

Vualia: *Epinephelus tukula* (Potato cod).

Subfamily Grammistinae:

Tubuna vua: *Liiproma susumi* (Meteor perch),

Rainfordia opercularis (Flathead perch). Etymology: **Tubu** = Sister's child or mother's brother; **Vua** = crocodile.
Iga poipoi: *Diploprion bifasciatum* (Barred soapfish), *Gramistops ocellata* (Ocellated podge).

Pseudochromidae – Dottybacks and eel blennies
Iga lade: *Congorogadus subducens* (Carpet eel blenny), Dottybacks (generic). Etymology: **Lade** = coral.

Terapotidae – Grunters
Kaboa: *Terapon jarbua* (Cresent grunter). Note: This species is commonly referred to as 'Harbour master' in pijin, due to its scavenging habit, and common occurrence near toilet beaches.

Kuhlidae – Flagtails
Valuado: *Kuhlia mugil* (Fiveband flagtail). Etymology: **Valu** = a species of tree; **Ado** = to think, understand.

Priacanthidae – Bigeyes
Kaulau ni horara: *Heteropriacanthus* spp. and *Priacanthus* spp. (Glasseyes {generic}). Etymology: **Kaulau** = Archerfish (*Toxotes* sp.); **Horara** = Open sea.

Apogonidae – Cardinalfishes
Vivihi: Apogonidae (generic).

Malacanthidae – Sandtile fishes
Iga kuikui: *Malacanthus latovittatus* (Blue blanquillo). Etymology: **Kuikui** = lizard.

Echeneididae – Remoras:
Raorago bagea: *Echeneis naucrates* (Slender suckerfish). Etymology: **Rago** = to join two ends together; **Bagea** = shark. Connotes the common association this fish has with sharks.

Carangidae – Trevallies
Andiandi: *Megalaspis cordyla* (Finny scad). Note: Also called **Kai iguga** (**iguga** = possessing a tail) and **Panggapanggati** (**Pangga** = ten pigs, birds, or fish).
Babalatu: *Trachinotus bailloni* (Black-spotted dart) and *Trachinotus blochii* (Snub-nosed dart). Etymology: **Baba** = hole or cave. **Latu** = going on forever, unending.
Buma: *Selar crumenopthalmus* (Purse-eyed scad). Note: Juveniles are called **Papa**. **Buma** are an important subsistence species at Nggela (along with **Malaboro**—and they often school together) and are caught with a variety of techniques, including **Soga**, **Unggalu** and **Ariari**.
Doa: *Atule mate* (Fringe-finned trevally) and *Caranx bucculentis* (Blue-spotted trevally).
Ili koni: *Coryphaena hippurus* (Common dolphinfish). Etymology: **Koni** = yellow.
Kai daro: *Decapterus russelli* (Russell's mackerel scad). Etymology: **Daro** = long.
Kai vala daro: *Scomberoides commersonianus* (Talang queenfish). Etymology: **Vala** = shoulder, collarbone. **Daro** = long.
Kara: (Trevallies {generic}), *Carangoides fulvoguttatus* (Gold-spotted trevally) and *Caranx papuensis* (Brassy trevally).
Kara gabutogo: *Caranx melampygus* (Blue-fin trevally). Etymology: **Gabu** = blood. **Togo** = to spear. Note: also called **Kara mera** (**mera** = blue). Feeding schools of this and other types of Kara are called **Vangavanga**.
Kara iguga: *Carangoides gymnostethus* (Bludger trevally). Etymology: **Iguga** = possessing a tail.
Kara kara: *Carangoides uii* (Japanese trevally).
Kara koni: *Gnathanodon speciosus* (Golden trevally). Etymology: **koni** = yellow.
Kara legolego: *Carangoides caeruleopinnatus* (Onion trevally). Etymology: **legolego** = flat.
Kara nadi: *Caranx para* (Banded scad). Etymology: **nadi** = hard.
Kara pura: *Carangoides chrysophrys* (Club-nosed trevally). Etymology: **pura** = white.
Kara uluga: *Caranx tille* (Tille trevally). Etymology: **uluga** = possessing a head—refers to the steep forehead of this species.
Kara vali: *Parastromateus niger* (Black pomfret). Etymology: **vali** = stingray.
Kara voramua: *Caranx sexfasciatus* (Bigeye trevally). Etymology: **vora** = to open eyes wide. **mua** = yet, still. Refers to the very large staring eye of this species.
Kavala: *Scomberoides tala* (Barred queenfish).
Lailahi: *Scomberoides lysan* (Double-spotted queenfish). Note: this name is also commonly used as a generic term for *Scomberoides* spp.
Lailahi kaekalea: *Scomberoides tol* (Needleskin queenfish). Etymology: **kaekale** = needle, spine.
Malaboro: *Selaroides leptolepis* (Smooth-tailed trevally). Note: **Maloboro** sub-taxa as follows, in order of increasing size: **Tata poipoi** (smallest), **Malaboro**, **Malaboro tutura**, **Puri**, **Pailori** (biggest). Malaboro are a very important subsistence species at Nggela and are caught with a variety of techniques, including **Soga**, **Unggalu** and **Ariari**. Etymology: **Mala** = 1. occupation, rank; 2. as, like; **boro** = bottom, inside, keel of a canoe (so the name **Malaboro** may refer to the fact that the species, because it is small, usually gravitates to the bottom of the canoe, i.e. under all the other fish); **Tata** = to shiver, tremble; **poi** = foam, spray; **tutura** = a string with anything strung on it.
Malaboro mala: *Decapterus macrosoma* (Long-bodied scad). Etymology: **Mala** = 1. occupation, rank; 2. as, like.
Malahau koni igu: *Seriola lalandi* (Yellowtail kingfish). Etymology: **Mala** = 1. occupation, rank; 2. as, like; **hau** = 1. far, old; 2. to stretch, raise up; **Koni** = yellow; **Igu** = tail.
Malahau ni horara: *Seriola rivoliana* (Almaco jack). Etymology: **Mala** = 1. occupation, rank; 2. as, like; **hau** = 1. far, old; 2. to stretch, raise up; **Horara** = open sea.
Malahau tunutunua: *Seriolina nigrofasciata* (Black-banded kingfish). Etymology: **Mala** = 1. occupation, rank; 2. as, like; **hau** = 1. far, old; 2. to stretch, raise up; **tunutunua** = spotted.
Maroho: *Elagatis bipinnulata* (Rainbow runner). Note: This name appeared to be falling into disuse at the time of fieldwork. The species is more commonly referred to by its market (Solomon Pidgin) name of 'Rainbow' by most people these days.

Oaa vaivine: *Trachinotus botla* (Common dart). Etymology: **vaivine** = girl, female.
Raerave: *Naucrates ductor* (Pilot fish) and *Carangoides ferdau* (Barred trevally).
Rora: *Alectes ciliaris* (Pennantfish).
Taligu mane: *Caranx ignobilis* (Giant trevally). Note: also sometimes called **Kara uluga** (**uluga** = possessing a head).
Teutevu niu: *Seriola dumerili* (Amberjack). Etymology: **Niu** = coconut (tree or mature fruit).
Tutupa: *Caranx lugubris* (Black trevally).
Vaivalihiga: *Absalom radiosus* (Fringe-finned trevally) and *Carangoides hedlandensis* (Bump-nosed trevally).

Lutjanidae – Snappers

Ango: *Lutjanus rivulatus* (Maori seaperch) and *Symphorus nematophorus* (Chinaman fish).
Ango gautago: *Symphorichthys spilurus* (Sailfin snapper). Etymology: **gau** = knife; **tago** = to fish, go fishing.
Ango ni bongi: *Macolor macularis* (Midnight seaperch). Etymology: **bongi** = night.
Ango ni horara: *Macolor niger* (Black and white seaperch). Etymology: **horara** = open sea. Note: Juveniles of both *Macolor* species are called **Iga kuikui** ('Lizard fish').
Bulobulo geregerea: *Lutjanus decussatus* (Checkered seaperch). Etymology: **geregere** = write.
Bulobulo horara: *Lutjanus kasmira* (Bluestripe seaperch). Etymology: **horara** = open sea.
Bulobulo koni: *Lutjanus fulviflamma* (Blackspot snapper). Etymology: **koni** = yellow.
Bulobulo ni kolo: *Lutjanus quinquelineatus* (Five-lined seaperch). Etymology: **kolo** = strait.
Bulobulo ni toke: *Lutjanus monostigma* (Onespot perch). Etymology: **toke** = point of a reef.
Bulobulo pura: *Lutjanus lemniscatus* (Dark-tailed seaperch) and *Lutjanus russelli* (Moses perch). Etymology: **pura** = white.
Bulobulo tubumata: *Lutjanus lutjanus* (Bigeye seaperch). Etymology: **tubu** = to swell, expand; **mata** = eye.
Gaumare: *Lutjanus biguttatus* (Two-spot snapper). Etymology: **gau** = knife; **mare** = shape, image, appearance.
Iga mona or 'Curry Fish': *Lutjanus boutton*. Note: commonly caught using strikeline and **kura**, in sheltered areas over sandy or rubble bottoms deeper than 20 m.
Koukoru: *Lutjanus bohar* (Red bass). Etymology: **koru** = fat. This is a highly prized table fish.
Labiango: *Aphareus furca* (Small-toothed jobfish).
Livo gau: *Lutjanus carponatus* (Spanish flag) and *Lutjanus vitta* (Brownstripe seaperch). Etymology: **Livo** = tooth; **gau** = knife.
Mahi: *Lutjanus argentimaculatus* (Mangrove jack).
Sagasaga: *Lutjanus fulvus* (Yellow-margined seaperch).
Siliva pis: *Etelis* spp. *(coruscans, carbunculus and others)* (Deepwater snappers / jobfish). Note: There is no Nggela name for these species, as it would appear they were not commonly fished until recent times.
Susi, or Susi ni horara: *Aprion virescens* (Green jobfish). Etymology: **horara** = open sea.
Uvoro: *Lutjanus gibbus* (Paddletail).
Uvoro horara: *Lutjanus adetti* (Hussar) and *Lutjanus sebae* (Red emperor). Etymology: **horara** = open sea.
Vurusinge: *Lutjanus semicinctus* (Black-banded seaperch). Etymology: **Vuru** = smell; **singe** = a plant (*Convolvulus* spp., known in Nggela as **Mandala** and **Momona**).

Caesionidae – Fusiliers

Toatoa pote: *Caesio caerulaurea* (Gold-banded fusilier). Etymology: **pote** = to fill, bulge, swollen, expanded.
Igu saga: *Caesio cuning* (Red-bellied fusilier). Etymology: **Igu** = tail; **saga** = to wither.
Igu saga mane: *Caesio lunaris* (Lunar fusilier). Etymology: **Igu** = tail; **saga** = to wither; **mane** = man, male.
Igu saga ni horara: *Caesio teres* (Blue and gold fusilier). Etymology: **Igu** = tail; **Saga** = to wither, **horara** = open sea.
Toatoa: *Pteracaesio marri* (Marr's fusilier)
Toatoa ni lade: *Pteracaesio tile* (Neon fusilier). Etymology: **lade** = coral.
Toatoa ni tuvi: *Pteracaesio trilineata* (Three-lined fusilier). Etymology: **tuvi** = the flat, shallow part of a reef near the edge.

Lobotidae – Tripletails

Kohoa dale: *Lobotes surinamensis* (Tripletail). Etymology: **Kohoa** = *Epinephelus lanceolatus* (Queensland grouper); **dale** = child, offspring.

Gerreidae – Siver biddies

Pabeta: *Gerres oyena* (Oceanic silver biddy).

Haemulidae – Sweetlips

Gaumare: *Plectorhinchus chaetodontoides* (Many-spotted sweetlips) and *P. flavomaculatus* (Netted sweetlips). Etymology: **Gau** = knife; **mare** = shape, image, appearance.
Kaboa mane: *Plectorhinchus celebicus* (Celebes sweetlips). Etymology: **mane** = male, man.
Kaboa ni bongi: *Plectorhinchus diagrammus* (Striped sweetlips) and *P. goldmani* (Diagonal-banded sweetlips). Etymology: **bongi** = night.
Kometulu: *Plectorhinchus gibbosus* (Brown sweet-lips), *P. obscurus* (Giant sweetlips) and *P. schotaf* (Somber sweetlips). Etymology: **Kome** = a gastropod (*Strombus canarium*); **tulu** = to wade, or float.
Tauna na kometulu: *Plectorhinchus picus* (Dotted sweetlips). Etymology: **Tauna** = wife/husband of.
Tiakoko: *Diagramma pictum* (Painted sweetlips).

Sparidae – Sea breams

Daivula ni horara: *Chrysophrys auratus* (Snapper). Etymology: **horara** = open sea.

Lethrinidae – Emperors

Asu: *Gnathodentex aurolineatus* (Gold-lined sea bream).
Daivula: *Monotaxis grandoculis* (Big-eye bream). Note: juveniles are called: **Mata buru** (**Mata** = eye; **buru** = to throng).

Dami popolo: *Lethrinus erythropterus* (Masked emperor). Etymology: **Dami** = to chew betelnut; **polo** = to hide. The name refers to the red colour inside this fish's mouth, implying that it chews betelnut covertly.
Esa-esa: *Lethrinus miniatus* (Sweetlip emperor), *L. rubrioperculatus* (Red-eared emperor), and *L. xanthochilus* (Yellow-lip emperor).
Goluhihi: *Lethrinus erythracanthus* (Yellow-spotted emperor). Etymology: **Goli** = to scrape out flesh of a coconut with a bivalve (**Tue**) shell; **hihi** = to scoop out the flesh of a coconut.
Huru: *Lethrinus harak* (Thumbprint emperor) and *L. obsoletus* (Orange-striped emperor). Note: *L. harak* is also known as **Mangatata**—both names appear to be accepted by most people as valid for this species.
Iga meresin: *Gymnocranius grandoculis* (Robinson's sea bream). Etymology: **Meresin** is the pijin pronunciation of medicine; the name refers to the strange taste and smell of this species.
Igu koni: *Lethrinus atkinsoni* (Yellow-tailed emperor). Etymology: **Igu** = tail; **koni** = yellow.
Labiango: *Lethrinus variegatus* (Variegated emperor).
Mangatata *Gymnocranius euanus* (Japanese sea bream) and *L. harak* (Thumbprint emperor). Note: *L. harak* is also called **Huru**. Etymology: **Manga** = mouth; **tata** = to shiver, tremble.
Paere (or **Papaere**): *Lethrinus genivittatus* (Lancer), *L. laticaudis* (Grass emperor), *L. lentjan* (Pink-eared emperor) and *L. ornatus* (Yellow-striped emperor).
Piho: *Lethrinus olivaceus* (Long-nosed emperor) and *L. nebulosus* (Spangled emperor).

Nemipteridae – Coral breams

Asu ni horara: *Pentapodus* spp. (Butterfishes). Etymology: **Asu** = *Gnathodentex aurolineatus* (Gold-lined seabream); **horara** = open sea.
Bubukele: *Scolopsis affinis* (Pale monocle bream). Etymology: **Bubu** = to stare at; **kele** = a woman's private parts.
Susi pile: *Scolopsis* spp. (Monocle breams). Etymology: **Susi** = *Aprion virescens* (Green jobfish); **pile** = small.

Mullidae – Goatfishes

Mahavi: *Parupeneus cyclostomus* (Goldsaddle goatfish).
Mala bulua: *Parupeneus bifasciatus* (Doublebar goatfish). Etymology: **Mala** = 1. position, rank; 2. like, as. **bulu** = to light with a lamp or torch. This species is commonly taken by gleaning over the top of the reef at low tide at night (usually around new moon in the wet season) using a lamp or torch. The name connotes either this fishing technique or the reddish colour that the animal assumes at night, which might be likened to a lamp or torch.
Ngingi: *Parupeneus flavolineatus* (Yellowstripe goatfish), *P. heptacanthus* (Cinnabar goatfish), *P. indicus* (Indian goatfish), *P. multifasciatus* (Manybar goatfish) and *P. pleurostigma* (Sidespot goatfish).
Ngingi bagea: *Upeneus tragula* (Freckled goatfish). Etymology: **Bagea** = shark.
Ngingi horara: *Parupeneus ciliatus* (Cardinal goatfish). Etymology: **horara** = open sea.
Ngingi sisi: *Parupeneus spilurus* (Blackspot goatfish). Etymology: **sisi** = red.
Noma: *Mulloides vanicolensis* (Yellowfin goatfish).
Tio: *Parupeneus barberinoides* (Bicolour goatfish) and *P. barberinus* (Dash-dot goatfish).

Pempheridae – Sweepers

Tauna na sori: *Pempheris* spp. (Sweepers). Etymology: **Tauna** = wife/husband of; **sori** = soldierfishes (generic).

Kyphosidae – Drummers

Langui: *Kyphosus cinerascens* (Topsail drummer) and *K. vaigiensis* (Long-finned drummer). Note: Both species are called **Simasima** as juveniles and **Leoleko** when they reach very large size.

Ephippidae – Batfishes

Koitovao: *Platax pinnatus* (Pinnate batfish) *P. orbicularis* (Circular batfish) *P. teira* (Longfin batfish, adult). Etymology: **Koito** = a style of fishing; **vaovao** = 1. a shrub with very large leaves, 2. a very big ear.
Iga raurau: *Platax teira* (Longfin batfish, juvenile). Etymology: **Rau** = leaf.

Chaetodontidae – Butterflyfishes

Arulole: *Chaetodon ulietensis* (Pacific double-saddled butterflyfish). Etymology: **Aru** = a species of tree (*Casuarina*); **lole** = to scrape clean a yam, a stick.
Gautago: *Heniochus* spp. (Bannerfishes). Etymology: **Gau** = knife; **tago** = to fish, fishing (= **taotago**).
Iga vila: *Hemituarichthys polylepis* (Pyramid butterflyfish) and *Heniochus varius* (Humphead bannerfish). Etymology: **vila** = to flash, flashing. Name refers to the striking colours and patterns of these fishes.
Sigo vugo: *Chaetodon spp.* (Butterflyfishes {generic}). Etymology: **Sigo** = to move silently, stealthily; **vugo** = net. **Sigo vugo** refers to the habit of these fishes of 'checking' the net, or following the net, but never getting caught.

Pomacanthidae – Angelfishes

Belava: *Genicanthus* spp. (Angelfishes gen., except for those listed below).
Iga vila: *Pomacanthus* and *Centropyge* spp. (Angelfishes {generic}). Etymology: **Vila** = to flash, flashing. Name refers to the striking colours and patterns of these fishes (NB: this name is also used for some butterflyfishes, above).
Sigo vugo: *Pygoplites diacanthus* (Regal angelfish). Etymology: **Sigo** = to move silently, stealthily; **vugo** = net. **Sigo vugo** refers to the habit of these fishes of 'checking' the net, or following the net, but never getting caught (NB: this name is also used for some butterflyfishes, above).

Pomacentridae – Damselfishes

Gegela: *Abudefduf vaigiensis* and *A. sexfasciatus* (Sergeants).
Guali: *Chrysiptera unimaculata, Chromis agilis, Stegastes* spp.
Iga ni bubula: *Premnas biaculeatus* (Spine-cheek

anemonefish) and *Amphiprion melanopus* (Red and black anemonefish). Etymology: **bubula** is the name of the anemone (*Entacmaea quadricolor*) with which these species are associated.
Iga ni gavoro *Amphiprion perideraion* (Pink anemonefish). Etymology: **gavoro** is the name of the anemone (*Heteractis magnifica*) with which this fish is often associated.
Iga ni lade *Chromis* spp. (small damselfishes closely associated with corals). Etymology: **lade** = coral.
Iga ni raerade: *Amphiprion chrysopterus* (Orange-fin anemonefish) and *A. clarkii* (Clark's anemonefish). Etymology: **Raerade** is the name of the anemone (*Stichodactyla mertensii*) to which these fishes are commonly but not exclusively associated.
Maumanu ni masao: *Amphiprion percula* (Clown anemonefish). Etymology: **Maumanu** = 1. flying insect; 2. spark; 3. animal; **masao** = the anemone, *Stichodactyla gigantae*, with which this fish is sometimes associated (it is also associated with other anemones, including *Heteractis magnifica*).
Poto: Several species, in several genera, including *Amblyglyphidodon, Acanthochromis, Chromis, Chrysiptera, Hemiglyphidodon, Neopomacentrus, Neoglyphidodon, Plectroglyphidodon* and *Pomacentrus* spp.
Poto koni: *Pomacentrus moluccensis* (Lemon damsel). Etymology: **koni** = yellow.
Poto sagalea *Pomacentrus lepidogenys* (Scaly damsel), *P. nagasakiensis* (Sandy damsel). Etymology: **sagalea** = sand, beach, sandy place. The name refers to the typically shallow, sandy habitat of these species.
Sao: *Abudefduf bengalensis*, *A. septemfasciatus* and *A. sordidus* (Sergeants).
Vulovatu: *Distichodus perspicillatus* (White damsel, or farmerfish) and *D. melanotus* (Black-vent damsel). Etymology: **Vulo** = to clean, brush away; **vatu** = stone. The name referes to the habit of these 'Farmer fishes' of grazing the algae on a small territory which they defend from other herbivores.

Cirrhitidae – Hawkfishes

Tavilade: (Hawkfishes, gen.). Etymology: **Tavi** = to slip, stumble, turn suddenly. **lade** = coral.
Koni mata: *Paracirrhites arcatus* (Arc-eye hawkfish). Etymology: **Koni** = yellow. **mata** = eye.
Iga totoho: *Oxycirrhites typus* (Longnose hawkfish). Etymology: **Totogo** = to put one thing on another, strata, series one on another. May refer to the cross-hatched pattern of the fish.

Mugilidae – Mullets

Galua: *Crenimugil crenilabis* (Warty-lipped mullet).
Geru, Kuli binu: *Liza vaigiensis* (Diamond-scaled mullet). Etymology: **Kuli** = ear; **binumbinu** = to line an oven with leaves. The name may connote the black colour of the pectoral fin ('ear') in smaller individuals of this species, which might be likened to the blackened leaves lining an oven.

Sphyraenidae – Barracudas

Alu: *Sphyraena putnamiae* (Chevron barracuda). Note: This species usually occurs in groups, and sometimes in large stationary schools during the day.
Gavi koburu (no identification made). Etymology: **koburu** = the westerly monsoonal trade wind.
Gori: *Sphyraena helleri* (Heller's barracuda) and/or *Sphyraena forsteri*
Ngganggasu: *Sphyraena flavicauda* (Yellowtail barracuda) and/or *S. novaehollandiae* (Arrow barracuda).
Ono: *Sphyraena barracuda* (Great barracuda). Local knowledge: This species is usually solitary but is reported by some Nggela fishermen to occur in groups around new and full moons at certain places around Sandfly Island.

Polynemidae – Threadfins

Bou na pana: *Polydactylus sexfilis* (Six-fingered threadfin). Etymology: **Bou** = hard, seasoned; **pana** = the common tuber crop eaten as a starch staple at Nggela.

Labridae – Wrasses

Gatuvi: *Choerodon anchorago* (Anchor tuskfish), *C. cephalotes* (Grass tuskfish).
Hangguvia: *Novaculichthys taeniourus* (Rockmover wrasse). Etymology: **Hanggu** = to blow off, as a strong wind blows off a roof. Via is a transitive marker. The name probably refers to the ability of this species to overturn large rocks in search of food.
Hangguvia ni horara: *Xyrichthys pavo* (Pavo razorfish), *X. aneitensis* (Whitepatch razorfish), *X. pentadactylus* (Fivefinger razorfish). Etymology: **Hangguvia** (see above); **horara** = open sea. These fish may have been likened to the Rockmover wrasse through similarity of appearance.
Iga piu: *Gomphosus varius* (Bird wrasse), *Bodianus diana* (Diana's hogfish). Etymology: **piu** = a species of small bird.
Iga raorago: *Labroides dimidiatus* and *Labroides* spp. (Cleaner wrasses). Etymology: **rago** = to join two ends together. Probably connotes the association of these cleaners with larger (host) fishes.
Kama kaluha: *Halichoeres chloropterus* (Pastel-green wrasse) *H. hortulanus* (Checkerboard wrasse). Etymology: **Kama** = great big, very, a king; **kaluha** = a species of bivalve mollusc. Note: these fishes both inhabit shallow, sandy/rubble areas.
Kaumavi: *Thalassoma amblycephalum* (Bluntheaded wrasse), *T. lunare* (Moon wrasse). Etymology: **Kau** = to stick fast; **mavi** (abbreviated from mavitu) = all together, in a body. The name connotes its densely aggregating behaviour.
Koilauko: *Anampses* spp., *Coris aygula* (Clown coris), *C. dorsomacula* (Pale-barred coris), *C. gaimard* (Yellowtail coris), *C. schroederi* (Schroeder's coris), *Halichoeres melanurus* (Tailspot wrasse), *H. melasmapomus* (Ocellated wrasse), *Thalassoma quinquevittatum.*
Koleo: *Epibulus insidiator* (Slingjaw wrasse).
Kolodau: *Thalassoma hardwicke* (Sixbar wrasse). Etymology: **Kolo** = strait, **dau** = to seize, swoop on, snatch.
Malaraurabu: *Halichoeres miniatus* (Circle-cheek wrasse). Etymology: **Mala** = 1. position, rank; 2. as, like; **rau** = leaf; **rabu** = a species of tree.

Nggalanggari: *Choerodon jordani, C. schoeleinii, Cirrhilabrus* spp. and *Thalassoma janseni.* Etymology: **Nggala** = a hand net; **ganggari** = a traditional method of catching fish with a hand net. It is likely that these species are no doubt traditionally caught with this method.
Peopeo talia: *Cheilinus diagrammus* (Cheeklined maori wrasse), *C. unifasciatus* (Ringtail maori wrasse). Etymology: **Peopeo** = a species of gastropod mollusc, *Cypraecassis rufa* (helmet shell), the shell of which is used as a trumpet; **talia** = *C. fasciatus* (see below).
Pulupulu sui: *Chelinus fasciatus* (Redbreasted maori wrasse). Etymology: **Pulupulu** = 1. to wrap up; 2. to put on clothes; **sui** = a species of red parakeet.
Roso taranggau / Iga taranggau: *Bodianus perditio, Cheilinus chlorourus, C. oxycephalus, C. trilobatus.* Etymology: **Roso** = young fruit of coconut, with soft meat, commonly used for drinking; **taranggau** is the Nggela name for a fish-eating bird of prey (probably the Osprey, *Pandion haliaetus*). The name may refer to the soft flesh of these fishes, which may also be a favourite prey item for the **taranggau**.
Talia: *Cheilinus undulatus* (Humphead Maori wrasse).
Veoveo koni: *Chelio inermis* (Cigar wrasse). Etymology: **Veoveo** = a hole in a net or fence; **koni** = yellow.

Scaridae – Parrotfishes

Note: TP = Terminal Phase; IP = Initial Phase.
Boila: *Bolbometopon muricatum* (Humphead parrotfish).
Mala boila: *Scarus microrhinos* (Steephead parrotfish). Etymology: **Mala** = like, as; **boila** = *B. muricatum*. Name connotes the similarities in appearance of the two species.
Mara: *Scarus* spp. (Parrotfish TP gen.). Etymology: **Maramara** = bright, colourful. Refers to the bright colours of many Terminal Phase scarids.
Mara kirita: *Scarus frenatus* (Bridled parrotfish) and *S. psittacus* (Palenose parrotfish, TP).
Mara papauga: *Scarus niger* (Swarthy parrotfish). Etymology: **papauga** = a variety of **Ngali** nut (*Canarium indicum*) with very black skin.
Mui: *Cetoscarus bicolor* (Bicolour parrotfish, IP).
Sapa viviha: *Scarus altipinnis* (Minifin parrotfish). Etymology: **Sapa** = to go out, seawards, away from the shore; **viviha** = thunder. May connote the noise made by these fish as they feed in very large aggregations over the reef.
Taroa: *Cetoscarus bicolor* (Bicolour parrotfish, TP).
Ulavi: *Hipposcarus longiceps* (Pacific longnose parrotfish).
Uvu raungali: Initial phases of *Scarus oviceps* (Egghead parrotfish), *S. psittacus* (Palenose parrotfish), *S. pyrrhurus* (Redtail parrotfish), *S. dimidiatus* (Yellowbarred parrotfish), *S. globiceps* (Globehead parrotfish) and *Calotomus carolinus* (Stareye parrotfish). Etymology: **Uvu** = sandy soil; **raungali** = leaf of **ngali** tree (*Canarium indicum*).
Vanga udu: *Scarus rubroviolaceus* (Ember parrotfish) and *S. rivulatus* (Surf parrotfish). Etymology: **Vanga** = to eat; **Udu** = together, in company (these species usually feed in aggregations).

Opistognathidae – Jawfishes or Smilers

Iga tao: *Opistognathus* spp. (Jawfishes gen.). Etymology: **tao** = face down, flat on belly.

Trichonotidae – Sand-divers

Iga huhu: *Trichonotus* spp. (Sand-divers). Etymology: **hu** = to dive.

Pinguipedidae – Sandperches

Koesonggavu: *Parapercis* spp. (Sandperches gen.).

Blenniidae – Blennies

Iga kuikui: *Aspidontus taeniatus* (Mimic blenny) and *Plagiotremus rhinorhynchos* (Bluestriped fangblenny). Etymology: **kuikui** = lizard.
Kakau pilo: Blennies (generic) including, and especially, *Istiblennius* spp. (Rockskippers). Etymology: **Kakau** = crab; **pilo** = to wave about.

Gobiidae – Gobies

Bili gere tuguru: *Eviota bifasciata* (Doublebar goby). Etymology: **Bili** = black; **gere** = write, writing; **tuguru** = stand up, standing up.
Iga beto *Valenciennea* spp., *Vanderhorstia* spp., *Yongeichthys nebulosus.* Etymology: **beto** = quiet.
Iga bili vuna: *Bryaninops ampulus* (Large whip goby). Etymology: **bili** = black; **vuna** = to throw, lob.
Iga daro geregere: *Valenciennea longipinnis* (Longfinned goby). Etymology: **daro** = long; **geregere** = write, writing.
Iga gere tuguru: *Amblygobius rainfordi* (Old glory). Etymology: **gere** = write, writing; **tuguru** = stand up, standing up.
Iga kukulu mana: *Periophthalmus argentilineatus* (Silverlined mudskipper). Etymology: **kukulu** = short; **mana** = 1. quicksand, bog; 2. worthy, fitting.
Iga ni kolo *Trimma* spp. Etymology: **kolo** = strait.
Iga ni pari: *Priolepis cincta* (Girdled goby). Etymology: **pari** = ground, earth, soil.
Iga pile matana: *Gobiodon micropus* (Small-eyed goby) and *Paragobiodon xanthosomus* (Yellowskin goby). Etymology: **pile** = small; **mata** = eye (**Matana** = its eye).
Iga pohaha: *Ctenogobiops tangaroae* (Masted shrimp goby). Etymology: **pohaha** = spotted, blotched, grey and white, as a banana leaf.
Iga sagalea: *Fusigobius neophytus* (Sand goby). Etymology: **sagalea** = beach, sand.
Iga tao tana sagalea: *Istiogobius decoratus* (Decorated goby). Etymology: **tao** = face down, flat on belly; **tana sagalea** = on the beach, sand.
Iga taotao: *Amblyeleotris wheeleri* (Wheeler's shrimp goby). Etymology: **taotao** = face down, flat on belly.
Iga tubumata: *Cryptocentrus cinctus* (Yellow shrimp goby). Etymology: **tubu** = to swell, expand; **mata** = eye.
Iga tunutunua: *Gobiodon histrio* (Broad-barred goby). Etymology: **tunutunua** = spotted.
Iga tunutunua bili: *Fusigobius* spp. (Blotched sand goby). Etymology: **tunutunua** = spotted; **bili** = black.
Pomo: *Amblygobius sphynx* (Sphynx goby). Note: **Pomo** appears to be a generic term for gobies.

Pomo bili: *Callogobius sclateri* (Tripleband goby). Etymology: **bili** = black.
Pomo ni tahi: *Bathygobius fuscus* (Common goby). Etymology: **tahi** = sea.
Pomo vuruga: *Callogobius maculipinnis* (Ostrich goby). Etymology: **vuruga** = possessing scales.
Sisi mata *Bryaninops erythrops* (Erythrops goby) and *B. natans* (Redeye goby). Etymology: **Sisi** = red; **mata** = eye.
Tagulu pohaha: *Ctenogobiops pomastictus* (Spotfin shrimp goby). Etymology: **pohaha** = spotted, blotched, grey and white, as a banana leaf.
Tavi lade: *Gobiodon citrinus* (Fourbar goby) and *G. okinawae* (Okinawa goby). Etymology: **Tavi** = to slip, stumble, turn suddenly; **lade** = coral.

Microdesmidae – Wormfishes and dartfishes

Iga daro geregere: *Nemateleotris decora* (Elegant firefish) and *N. magnifica* (Fire dartfish). Etymology: **daro** = long, **geregere** = write, writing.
Iga hinapi: *Gunnellichthys* spp. (Wormfishes, gen.). Etymology: **hinapi** = lime stick.
Iga labe: *Gunnellichthys curiosus* (Curious wormfish). Etymology: **labe** = weak.
Iga sigere: *Ptereleotris* spp. (Dartfishes, gen.). Etymology: **sigere** = skinny, thin.

Acanthuridae – Surgeonfishes

Bagata: *Acanthurus mata* (Elongate surgeonfish), *A. blochii* (Ringtail surgeonfish), and *A. dussumieri* (Eyestripe surgeonfish).
Bagata ni horara: *Acanthurus albipectoralis* (Whitefin surgeonfish).
Bobona: *Acanthurus nigrofuscus* (Brown surgeonfish), *Acanthurus pyroferus* (Mimic surgeonfish), *Ctenochaetus striatus* (Lined bristletooth), *Ctenochaetus strigosus* (Goldring bristletooth), and *Zebrasoma scopas* (Brushtail tang). Etymology: **Bobona** = wet, damp.
Bobona pura igu: *Acanthurus grammoptilus* (Finelined surgeonfish). Etymology: **pura** = white; **igu** = tail.
Bolobolo: *Ctenochaetus binotatus* (Twospot bristletooth). Etymology: **Bolo** = 1. pig, 2. meat of any sort, 3. epilepsy, 4. to foam from the mouth.
Gule: *Acanthurus triostegus* (Convict surgeonfish).
Havalago: *Naso lituratis* (Orangespine unicornfish).
Iga balo: *Acanthurus guttatus* (White-spotted surgeonfish). Etymology: **Balobalo** = to fish at dusk.
Iga bili: *Acanthurus bariene* (Roundspot surgeonfish). Etymology: **bili** = black. Note: Sometimes also called **Bagata.**
Iga bili igu pura: *Acanthurus nigricauda* (Blackstreak surgeonfish) and *A. thompsoni* (Thompson's surgeonfish).
Iga vila: *Zebrasoma veliferum* (Sailfin tang). Etymology: **vila** = flash, flashing. Refers to the striking, striped pattern of this fish.
Igu pura: *Acanthurus auranticavus* (Orange-socket surgeonfish) and *A. nigroris* (Bluelined surgeonfish). Etymology: **Igu** = tail; **pura** = white.
Kavaga: *Naso annulatus* (Whitemargin unicornfish), *N. brachycentron* (Humpback unicornfish), *N. brevirostris* (Spotted unicornfish), *N. lopezi* (Elongate unicornfish), *N. thorpei* (Thorpe's unicornfish), *N. unicornis* (Bluespine unicornfish) and *N. hexacanthus* (Sleek unicornfish).
Kavaga boila: *Naso tuberosis* (Humpnose unicornfish). Etymology: **boila** = *Bolbometapon muricatum*. The name refers to the bulbous head of *N. tuberosus*, which is similar to that of *B. muricatum*.
Kura korade: *Acathurus lineatus* (Striped surgeonfish). Etymology: **Kura** = the 'pepper' leaf usually chewed with betelnut (Bua); **Kura korade** = a darker variety of **Kura**. Local knowledge: Wounds from the caudal 'scalpel' of this species are particularly painful.
Maluli: *Naso vlamingi* (Vlaming's unicornfish). Note: this species is often referred to as **Bagata,** and sometimes as **Iga ni vane** (**Vane** = large ripples made by a fish underwater. Probably connotes the high dorsal fin of this species).
Moemole: *Acanthurus olivaceus* (Orangeband surgeonfish).
Seliseli: *Acanthurus nigricans* (Whitecheek surgeonfish) and *A. xanthopterus* (Yellowfin surgeonfish).
Simusimu: *Paracanthurus hepatus* (Palette surgeonfish). Etymology: **Simusimu** = to twinkle, as a star; a cluster of small stars. Connotes the brilliant contrasting colours of this fish, which usually occurs in aggregations in clear water.

Zanclidae – Moorish idol

Iga gautago: *Zanclus cornutus* (Moorish Idol). Etymology: **gau** = knife; **tago** = to fish, go fishing.

Siganidae – Rabbitfishes

Borode: *Siganus punctatissimus* (Finespotted rabbitfish), and *S. punctatus* (Goldspotted rabbitfish).
Ginava: *Siganus corallinus* (Coral rabbitfish), *S. doliatus* (Barred rabbitfish), *Siganus javus* (Java rabbitfish), and *S. puellus* (Bluelined rabbitfish).
Iga piu: *Siganus vulpinus* (Foxface). Etymology: **piu** = a species of small bird. The name refers to the elongate, beak-like mouth of the fish.
Kaekale: *Siganus argenteus* (Forktail rabbitfish), *S. fuscescens* (Dusky rabbitfish) and *S. vermiculatus* (Vermiculate rabbitfish). Etymology: **Kaekale** = spine. The name refers to the venomous spines in the dorsal, anal and pelvic fins of these fishes which can inflict very painful wounds. Note: *S. argenteus* is commonly taken by the traditional leaf sweep technique known as **Kwarao**. It is also commonly taken by hand spear at night on the reef flat where it sleeps. **Kaekale** can be regarded as the generic term for rabbitfishes. Local knowledge: Stings from the spines of fishes in the Kaekale group can be treated with the leaves of the **Dirigi** tree (no identification).
Kaekale pile *Siganus spinus* (Spiny rabbitfish). Etymology: **pile** = small.
Olana: *Siganus lineatus* (Goldlined rabbitfish)

Scombridae – Tunas and mackerels

Atu: *Katsuwonus pelamis* (Skipjack tuna). Note: Atu can be regarded as the generic term for this group. Note: Traditional tuna fishing is known as **Daoli**. **Daoli** is no longer practiced on Nggela and has been replaced by trolling from outboard-powered fibreglass canoes (and sometimes paddle-powered dugout canoes), using modern hooks with various types of lures.

Atu igu mera: *Thunnus albacares* (Yellowfin tuna) and *T. obesus* (Bigeye tuna). Etymology: **Igu** = tail; **mera** = blue.

Atu livoga: *Gymnosarda unicolor* (Dogtooth tuna). Etymology: **livo** = tooth, teeth; **livoga** = having teeth.

Atu pari longa: *Euthynnus affinis* (Mackerel tuna, Island bonito). Etymology: **pari** = ground, earth; **longa** = shoreward, inland. The name could broadly be translated as 'shore tuna', as it is rarely found far out to sea. This species is commonly taken by trolling light gear from paddle-powered dugout canoes.

Ili: *Acanthocybium solandri* (Wahoo). Note: This species is commonly called Malahau, due to its similarity to *Scomberomorus commerson*.

Kai: *Grammatorcynus bilineatus* (Double-lined mackerel). This species is also known as **Iga vuruvuru** (**vuruvuru** = smelly) due to the strong smell of its flesh. It is a popular bait fish for this reason. Juveniles are known as **Siubu**.

Malahau: *Scomberomorus commerson* (Spanish mackerel). Etymology: **Mala** = 1. occupation, rank; 2. as, like; **hau** = 1. far, old; 2. to stretch, raise up.

Rumaga: *Rastrelliger kanagurta* (Long-jawed mackerel, Indian mackerel). Note: Until the late 1980s, **Rumaga** were often fished using 'dynamite', but this practice has been banned, and is never seen anymore at Nggela. **Rumaga** can still be caught using nets, and juveniles are often caught at certain spots in protected bays (at around 40 m or more) using strikeline.

Viluvilu: *Istiophorus platypterus* (Indo-Pacific sailfish). Etymology: **Vilu** = a species of palm with umbrella-like leaves. The name connotes the palm-leaf like appearance of the dorsal fin of this species.

Note: Nggela names were not obtained for the swordfish (*Xiphias gladius*) or the marlins (*Makaira* spp.).

Paepangge pana – Flounders and soles

Paepangge pana:
(Bothidae - Lefteye flounders): *Bothus mancus* (Flowery flounder) and *B. pantherinus* (Panther flounder);
(Pleuronectidae – Righteye flounders): *Samariscus triocellatus* (Threespot flounder);
(Soleidae – Soles): *Paradachirus pavoninus* (Peacock sole).
Etymology: **pangge** = to skin, skin of (yam or pana); **pana** = the yam, *Dioscorea esculenta*.

Balistidae – Triggerfishes

Barubaru: *Balistoides conspicillum* (Clown triggerfish). Etymology: **Baru** = shell inlay on traditional carvings. The name connotes the white spotted pattern on this fish.

Bibigo: *Rhinecanthus aculeatus* (Whitebanded triggerfish), *Rhinecanthus lunula* (Halfmoon triggerfish), *R. rectangulus* (Wedgetail triggerfish) and *R. verrucosa* (Blackpatch triggerfish). Etymology: **bigo** = to crush shellfish for cooking—probably refers to the feeding behaviour of these species; their diet includes small molluscs and other benthic invertebrates.

Buli vau: *Sufflamen chrysopterus* (Flagtail triggerfish), *Sufflamen fraenatus* (Bridled triggerfish). Etymology: **Buli** = generic term for cowries; **vau** = to weave, plait, as a mat or basket. Latter part of the name may refer to the woven appearance of the scale pattern of these fishes.

Igu pura: *Melichthys vidua* (Pinktail triggerfish). Etymology: **Igu** = tail; **pura** = white.

Kukupi *Balistoides viridescens* (Titan triggerfish) and *Pseudobalistes flavimarginatus* (Yellowmargin triggerfish). Etymology: **Kukupi** = thick lips.

Kukupi horara: *Canthidermis maculatus* (Spotted oceanic triggerfish). Etymology: **Kukupi** = thick lips; **horara** = open sea. This species only occurs around floating objects in the open ocean or near current swept points of small islands. It nests around the new moon.

Logeloge: *Odontus niger* (Redtooth triggerfish) and *Xanthichthys auromarginatus* (Gilded triggerfish).

Mumuku: *Abalistes stellatus* (Starry triggerfish) and juvenile *Balistapus undulatus* (Orange–lined triggerfish). Local knowledge: **Mumuku** are notorious for stealing bait from hooks.

Mumuku horara: *Sufflamen bursa* (Scimitar triggerfish) and *Pseudobalistes fuscus* (Yellow-spotted triggerfish). Etymology: **horara** = open sea.

Toetole: *Balistapus undulatus* (Orange-lined triggerfish). Etymology: **Tole**, **toletole** = stains of chewing betelnut on face and body. Name refers to orange striped pattern of this fish. Note: Juveniles of this species are called **Mumuku**.

Monacanthidae – Leatherjackets

Iga kamau / Iga kakamau: generic Monacanthidae. Etymology: **kamau** = a species of tree with large leaves which are eaten.

Ostraciidae – Boxfishes

Pava: generic Ostraciidae.

Tetraodontidae – Puffers

Boebote: generic Tetraodontidae. Note: This whole family is widely regarded as poisonous to eat and is not eaten on Nggela.

Diodontidae – Pocupinefishes

Kaku: generic Diodontidae. Note: **Nggani** when small.

Toxotidae – Archerfishes

Puhuduki / Kaulau: *Toxotes jaculatrix* (Archerfish). Etymology: **Puhu** = to blow, spout, shoot (a jet of water); **duki** = a common species of ant, yellow in colour, which the archerfish commonly preys upon by knocking them off mangrove roots with a jet of water.

Chirocentridae – Wolf Herrings

Sego: *Chirocentrus dorab* (Wolf Herring). Note: This species is often caught by trolling with light gear from dugout canoes, near mangroves, especially after rain. It is very bony and usually fed to pigs. It is edible if baked very dry.

Mauvo: (Freshwater eels {generic})

Other baitfishes

Soba: (No identification).
Meme: (small Soba).
Kuaba: (No identification).
Belea: (No identification).
Marumo: (No identification; described as being like small **Kepo**).

Iga mela: A fish commonly caught by droplining in water deeper than about 60 metres. (No identification—may be a Lutjanid). Etymology: **Mela** = red spittle from betelnut chewing. Name refers to the colour of the fish.

Mammals

Puhu: (Whales {generic}). Etymology: **Puhu** = to blow, spout.
Sausau: (Dolphins {generic}), e.g. *Delphinus delphis* (Common dolphin). Etymology: **Sau** = to wash.
Vena: *Dugong dugon* (Dugong).

Reptiles

Kolage: *Varanus* sp. (Green monitor lizard, 'Iguana'). Note: These beautiful green arboreal lizards are usually found in mangroves, but also can be found inland. Their preferred food appears to be fish. They are regularly caught and sold to wildlife dealers who sell them overseas. This trade represents an important source of cash for many people at West Nggela. No studies have been done on the population of this species, but it appears to be in decline.
Bokili mola: (Seasnakes {generic}).
Rombiu: *Dermochelys coriacea* (Leatherback turtle).
Vonu: (Turtle {generic}). Includes *Eretmochelys imbricata* (Hawksbill turtle) and *Chelonia mydas* (Green turtle).
Vua: *Crocodilus porosus* (Salt-water crocodile).

Invertebrates

Cnidaria

Bubula: *Entacmaea quadricolor* (Bubble-tentacle sea anemone).
Gavoro: *Heteractis magnifica* (Magnificent sea anemone).
Masao: *Stichodactyla gigantae* (Gigantic sea anemone).
Raerade: *Stichodactyla mertensii* (Mertens' sea anemone).
Lade: Corals (generic).
Kova: Plate coral (generic).
Sisiri: Jellyfishes (generic). Etymology: **Sisiri** also means to sting, a sting from something.
Lumaluma: *Linuche unguiculata* (Thimble jelly). Note: This jellyfish forms large and dense aggregations or 'blooms' near the surface of the sea every year around September. The blooms always precede the emergence of **Palolo** worms (**Odu**) which usually happens in October. Many species of fish (and especially **Rumaga** {*Rastrelliger kanagurta*}) feed on **Lumaluma** when it blooms, and Nggela people say that the flesh of these fish always stinks of the jellyfish at this time. Small **Lumaluma** are called **Niro** or **Niroa.**

Polychaeta

Odu: *Eunice viridis* (Palolo worm). Note: **Odu** usually emerges in large numbers from its burrows in the reef, about one hour after dark, on the first or second night after full moon (**Galaga pungihia**) in October or November. If they do not emerge in abundance in October, that means they will be abundant in November. The Nggela name for the month of October is **Odu Lade** (**Lade** = coral) and the name for November is **Odu Tina** (**Tina** = mother). Swarming of **Odu** is usually preceded by swarms of another, smaller and non-edible species called **Rau ni Aru** (**Rau** = leaf, **Aru** = *Casuarina equisetifolia*—the name connotes the similarity of the worms to the *Casuarina* needles). NB: What is known as **Odu** is actually the reproductive 'epitoke' of the worm, which breaks off to swim up into the plankton, disintegrate and liberate its sperm or eggs for external fertilisation. The head and front end of the worm remain in the burrow. In recent years the abundance of **Odu** at Ravu Sodukosi Village on Sandfly seems to have declined, but it is hard to know what might be the reason for this.

Mollusca

Cephalopoda

Gilio: *Nautilus scrobiculatus* (Nautilus{shell}).
Kiko/ Iroiro: *Nautilus pompilius* (Nautilus {shell}).
Mananggi: *Sepia* spp. (Cuttlefish {generic}).
Nuho: *Sepioteuthis* spp. (Reef squids {generic}).
Sipiu *Octopus cyanea, Octopus* spp. (Octopus {generic}).

Gastropoda

Areho: *Nerita albicilla* (Periwinkle)
Boru: *Potomididae* (Mud whelks {generic}) and *Terebralia palustris* (a commonly harvested whelk).
Eo: *Tectus pyramis* (Trochidae).
Gombu: *Strombus* sp. (a stromb shell, smaller than **Ngau**).
Kalulu pale: *Haliotis asinina* (Reef abalone).
Kome: *Strombus canarium*.
Lage (vi)vindi: *Conus geographus* (Geographic cone).
Lala: *Trochus niloticus* (Trochus). Note: **Lala** can be most easily found during the period of '**Dantega**', which is between two and four days after full moon. Etymology: **Dani** = daytime; **tega** = to perch, perched. This term refers to the fact that the moon can be seen 'perched' above the horizon early in the day. Trochus are often subjected to fishing prohibitions or restrictions, by placing a '**tambu**' over the reef, until the reef

owner considers the **Lala** population has had enough time to build up and can be harvested.
Lili: *Turbo* spp. (Turban shells {generic}).
Lili taringa: *Turbo petholatus.*
Lili tinoni: *Turbo crassus.*
Lili vangavanga: *Turbo argyrostomus.*
Mbei mbei: *Terebra maculata.*
Mbuli: *Cypraea* spp. (Cowrie {generic}).
Mbuli siwa: *Cypraea mauritiana.*
Mbuli vuare: *Cypraea tigris* (Tiger cowrie).
Meko: *Strombus canarium.*
Ngau: *Strombidae* (Strombs {gen.}) & *Lambis crocata.*
Ngau dalesamu: *Strombus scorpius.* Etymology: **dalesamu** = orphan. Refers to the fact that this shell is usually solitary, in contrast with many other strombs which are found in groups.
Peo-peo: *Charonia tritonis* (Triton shell).
Sagu: *Neritidae* (Nerites {generic}) and *Nerita polita.* Note: *N. polita* is sometimes harvested by women at night during spring tides when the tide is half out.
Sura: *Strombus luhuanus.*
Tadugu: (Chiton {generic}).
Tanggili pou: *Lunella cinerea* (a turban shell).
Tangi vagale: *Oliviidae* (Olive shells).
Tavuli: *Cassis cornutus* (Helmet shell).
Vanguda: ('Shellfish' {generic}). Note: this term may include crustaceans and echinoderms but is usually only used with reference to molluscs.

Giant clams

Gima: *Tridacna gigas.*
Hihi: *Tridacna derasa.* Note: also called **Boroboro** or **Kamumu** by some people.
Kunungga: *Tridacna crocea.*
Masiravu: *Hippopus hippopus.*
Pukumau: *Tridacna maxima*
Talinga: *Tridacna squamosa.*

Other bivalves

Aro: *Pinctada margaritifera* (Black-lip pearl-shell).
Ihu: *Crassostrea* sp. (Common oyster)
Kaluha: (No identification).
Karaguna:(No identification).
Kuta:(No identification).
Lombio: *Teredo* sp. ('Shipworm'). Note: Can be harvested from the wood of some types of mangroves. There are traditional restrictions on the consumption of this animal in some parts of West Nggela.
Opaopa: (No identification). Note: This shell is known to harbour a species of pearlfish (**Iga ni Opaopa**).
Tue: *Batissa* sp. (perhaps *B. unioniformis*). A small, commonly harvested bivalve. Note: The shell of this bivalve has traditionally been used at Nggela to scrape the meat of coconuts for cooking.

Crustacea

Kakau vula: (*Carpilus maculatus*).
Lingamo: *Scylla serrata* (Mud crab).
Mapa: (Slipper lobster {generic}) (*Parribacus antarcticus*).
Pouporu: *Hippa pacifica* (Pacific mole crab). Note: These animals can be abundant around the waterline on sandy beaches, and are harvested by small children who thread them onto coconut leaf midribs and roast them.
Tarika: Squillidae, Harposquillidae, Lysiosquillidae (Mantis shrimps {generic}).
Ura: *Panulirus* spp. (Crayfish {generic})
Urepa: *Birgus latro* (Coconut crab).

Land crabs

Kakau tina: *Cardisoma hirtipes* (Common black land crab). Etymology: **Kakau** = generic for crabs; **tina** = mother. Note: This crab is harvested in large numbers when it migrates to the shore to 'wash' ('**Sapa toga'**—usually starting an hour or so after dusk, from about three days to one week after the full moon during the early wet season {October to January}) prior to mating and ovulation in the females. The harvesting is usually done by women using torches made from bundles of dried coconut leaves (**Pahu**). The crabs can also be dug up at other times. The berried females go down to the sea to spawn ('**Sau lami**'—**Sau** = wash; **Lami** = land crab eggs) either around dawn or shortly after sunset during the three days preceeding full moon. The start of the **Kakau tina** breeding season is signalled by the flowering of the **Bobolo** tree (*Euodia elleryana*). The Nggela name for the month of December is **Kakau.**
Koba: several genera (Hermit crab {generic}). Note: Hermit crabs are a very reliable source of bait when no fish is available. Local knowledge: Around full moon, some of the larger varieties of koba can be seen in large numbers coming out onto beaches. The females have eggs at this time.
Tubala: *Cardisoma carnifex* ('White' land crab). Note: This species does not appear to display the spectacular synchronised spawning or 'washing' migrations that **Kakau tina** does, but is still commonly harvested for food, though it usually has to be dug up.

Echinodermata

Veitugu: (Starfish {generic}). Etymology: **Veitugu** = star.
Vula: (Cushion starfishes {generic}). Etymology: **Vula** = moon.
Uta mela: *Acanthaster planci* (Crown of thorns starfish). Etymology: **Mela** = red spittle from betelnut chewing. Refers to the reddish colour of many individuals of this species.
Aloalo vilua: (Brittle stars {generic}). Etymology: **Aloalo** = the vine of a yam; **vilu** = a species of palm with umbrella-like leaves. The writhing arms of brittle stars do indeed resemble yam vines.
Baraso: (Spiny urchins {generic}).
Konola: (Short-spined urchins—edible{generic}).
Gila sou: (Slate pencil urchins {generic}). Etymology: **Gila** = 1. to know, 2. a stone adze; **sou** = 1. a species of heron, 2. jagged.
Pou: (Beche-de-mer {generic}).
Pou luluhi: (Beche-de-mer that eject cuverian tubules{generic}). Etymology: **luluhi**: to squeeze milk from a woman's breasts.
Poli titivi: *Synapta maculata* (Spotted Sea Cucumber). Etymology: **tivi** = 1. a sling for carrying a baby;

2. clothing. Name probably connotes the long, bending appearance of this soft-fleshed sea cucumber.

Plants

Ahoaho: *Premna corymbosa* (Family Verbanaceae). A beach-side tree, the leaves and small branches of which are often taken by women on long canoe trips to ward off sea-devils (**Asi**).
Alite: *Terminalia catapa*. Also called **Tahile** and **Lengga**. A calendar plant. The presence of red leaves on this semi-deciduous species (usually twice a year—around June and December) indicate a time when 'red fish' aggregate and/or have oily flesh (**mona**). This might include holocentrids (**Sori**, **Talaa**, etc.), serranids (**Sivari**, **Taburara**, etc.) and lutjanids (**Koukoru**, **Uvoro**, etc.).
Buburupoto: *Oplismenus compositus* (A grass which is common in disturbed areas, such as the fringes of gardens). A calendar plant. The presence of the sticky seeds of this species (March, April, May) indicate a bad time for fishing. Etymology: **Buburu** = grass; **poto** = generic for some types of Damselfishes. The name connotes the sticky, clinging nature of the seeds of this grass, which is likened to the pugnacious behaviour of **Poto.**
Koga: a species of mangrove (No identification)
Kulikuli: (Seagrass {generic}).
Busu: a type of green alga preferred by hawksbill turtles (possibly *Chlorodesmus chloroticus*).
Tongo: (Mangrove {generic}).
Tongo bua: a species of mangrove (No identification).
Tingale: a species of mangrove with small leaves.

The use of optimal foraging theory to assess the fishing strategies of Pacific Island artisanal fishers: A methodological review

by Shankar Aswani [1]

In this paper, foraging theory and its methodology are presented as a complementary framework to the study of Pacific Island artisanal fisheries. It is expected that such inclusion will allow for the development of a clearer anthropological model describing the relationship between human foraging and fishery management.

Introduction

Artisanal fisheries play a major role in the social, cultural, and economic life of most Pacific Islanders, particularly in rural communities where people are highly dependent on marine resources for subsistence and commercial purposes. Yet, marine resources are being threatened by pressure from exploding human populations and the increasing commercialisation of the subsistence fishery—circumstances which are now forcing researchers to find novel ways to examine issues of coastal management and marine resource conservation. Among the most recent approaches to coastal management has been to study marine ecological processes in conjunction with those of the contiguous shoreline and upland habitats, or what has been termed Integrated Coastal Zone Management (ICZM).

From the standpoint of maritime anthropology, any comprehensive study of the integration of marine and terrestrial biotic components requires the parallel consideration of human activities, including existing property regimes, resource access and distribution rules, and resource exploitation strategies. Although numerous studies have concentrated on the social aspects of Pacific Island artisanal fisheries (e.g. Johannes, 1981; Hviding, 1996; Lieber, 1994), few have dealt explicitly with the micro-ecology of daily human-marine interactions (see Aswani, 1997; Bird & Bird, 1997). Such neglect has hampered attempts to fully integrate studies of environmental coastal processes with those of human activities.

In this paper, I examine the utility of optimal foraging theory and its methodology, as applied to the study of Pacific Island artisanal fishers. The inclusion of foraging theory can contribute to

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building a clearer anthropological model to describe the relationship between human foraging and fishery management.

Theoretical review

Since the mid-1970s, a growing number of anthropologists have employed optimal foraging theory as developed in evolutionary ecology to study the subsistence practices of indigenous peoples. Evolutionary ecology explains human behavioural adaptations in ecological context through the use of natural selection theory. Briefly summarised: individuals exhibit genotypic variation that affects their capacity to survive and reproduce. Certain adaptive traits will dominate over time and become prevalent in a population. The objective of evolutionary ecology is to examine the phenotype of an organism (i.e. biological and behavioural traits) and to explain *why* certain phenotypic traits (e.g. foraging strategies) evolve in a given ecological context (Smith & Winterhalder, 1992).

Evolutionary theory is too abstract to explain the presence of specific human traits, so a 'middle-range theory' is required to link observed behaviour and general theory (Smith, 1991). In this respect, optimal foraging theory provides a conceptual link between empirical reality and theory. The purpose of foraging theory is to formulate testable predictions that can account for foragers' decisions (choices) with regards to the types and abundance of food they consume (diet breadth), the areas utilised (patch choice), and the time spent foraging in these areas (patch use). Optimal foraging models assume that a forager's decisions made *during foraging* are formulated to maximise short-term energy gains (Stephens & Krebs, 1986). This is an evolutionary approach, because if foragers successfully adapt to a long-term foraging strategy that maximises food returns and minimises resource harvest time, their Darwinian fitness may be enhanced. (For readers feeling uncomfortable with the Darwinian fitness postulate, stripping foraging theory from its evolutionary implications still leaves a operationally-defined set of cost-benefit models capable of empirically measuring particular foraging choices.)

Foraging models have four identifiable elements (Stephen & Krebs, 1986):

- the participating actors,
- a set of choices made by the foragers,
- a currency, and
- a set of intrinsic and extrinsic constraints faced by the forager.

All participating actors display a set of decisions and/or choices while foraging. Ordinarily, foraging theory models have examined two decisions:

- what prey (or patch) to consume, and
- when to abandon a patch.

The former choice is examined by diet breadth and patch choice models (Charnov & Orians, 1973; MacArthur & Pianka, 1966; Stephen & Krebs, 1986) which solve for the decision component of food harvest, or the probability that a forager will select a given prey or patch upon encounter. The two main model components are *search time*, or time spent looking for prey or patches, and *handle time* or time employed following, capturing, and processing prey.

The second choice, time spent in a patch, is addressed by the patch time allocation model (Charnov, 1976) which examines the decision variable for how long to forage. The two main components of this models are *travel time*, or time spent looking for adequate patches, and *residence time*, or time spent in a given patch (Stephens & Krebs, 1986).

Another significant axiom of optimal foraging theory, and perhaps the most polemical, is the model's currency assumption. In determining the optimal choice facing a forager, a currency, or the cost and benefit decision variable, must be selected for the model.

Typically a currency can be expressed as units of maximisation (e.g. kcal per hour of foraging), minimisation (e.g. time, risk), or stability (e.g. energy versus risk). Most researchers using foraging theory have employed a maximisation criterion to evaluate foraging decisions (Stephens & Krebs, 1986).

If maximisation is the criterion, however, what are foragers maximising? (e.g. survivorship, fertility, energy or protein intake, or even money). Anthropologists have commonly used energy optimisation as a proxy for reproductive fitness (e.g. Alvard 1995; Hames & Vickers 1982). Energy optimisation can be expressed as 'net acquisition rate,' 'net rate of energy capture,' 'return rate,' or 'foraging efficiency' (Smith, 1991: 46). Following Smith (1991), this concept is best expressed as the 'net return rate' per capita, or equivalent to the energy gained during foraging (the kcal value of the catch) minus the labour input (labour cost incurred during foraging including travel, search and handling times) divided by the total residence time at a patch. The utilisation of calories as units of energy maximisation permits the operationalisation of the foraging models without relying on nebulous concepts like 'utility' and 'fitness' (Smith & Winterhalder, 1992).

Notwithstanding the conceptual value of energy as a unit of maximisation, numerous social anthropologists have vehemently opposed the idea of reducing human food disposition to mere caloric values. The general complaint is that foraging models do not account for cultural and ideological preferences of food (e.g. taste, or prestige foods) (Smith, 1991). The objective of foraging models is not to determine human proximate decisions (i.e. food choice based on ideology) but to elucidate the underlying causal structure of those decisions. In fact, the idea of calories as the unit of maximisation may not be so removed from the indigenous view of prey value. For instance, Pacific Island fishers generally rank prey desirability according to its fat content.

A more problematic and challenging issue is selecting a unit of maximisation in a monetised economy. The classical foraging models focus on energy as a proxy for 'reproductive fitness,' and do not include 'utility' measured in a monetary currency in their predictions. Yet it seems unrealistic to deal exclusively with energy when evaluating foraging practices in an increasingly monetised global economy. Time spent foraging for food is time that could be employed to produce income.

This raises an important question: which currency are foragers actually trying to maximise when foraging—cash (per unit of effort) or calories? If the population under study, as is the case with some Pacific artisanal fishers, primarily engages in subsistence fishing, then calories are an appropriate currency. Alternatively, if fishers equally engage in subsistence and commercial fishing (i.e. small-scale) a common currency can be developed by converting all foraging inputs and outputs (including cash) into a single currency such as net energy capture per hour of labour (for further discussion see Smith, 1991, 357–397).

The final tenet of optimisation models is of *constraint* assumptions. Briefly defined, constraints 'are all those factors that limit and define the relationship between the currency and the decision variable(s)' (Stephens & Krebs, 1986: 9). Constraints can be extrinsic and/or intrinsic to an organism. Extrinsic factors which limit a fisher's foraging ability include constraints such as changing patch productivity, changing weather patterns, and even social constraints such as religious bans on working on Sundays. Intrinsic constraints are those which physiologically limit the capacity of an organism to interact or tolerate environmental variables.

The foraging models: two examples

Foraging theory's analytical value is evaluated in this paper by presenting two complementary models: the patch choice (MacArthur-Pianka, 1966; Charnov & Orians, 1973), and the marginal value theorem (Charnov, 1976) patch time allocation models.

The general theoretical objectives of these models, as applied in a marine context, are to understand the daily and seasonal movement of marine foragers. The first model is designed to forecast a fisher's habitat selection, whereas the second complements the former by predicting the time that a fisher should spend harvesting prey in a fishing ground or set of grounds. These models, although similar in several respects, differ because they analyse different decisions: where to forage versus for how long.

The patch choice model predicts that patches (e.g. habitats) will be selected by a fisher according to the mean productivity of that patch. Patches are added to the foraging range until an increase in travel time (i.e. a cost) lowers the mean return rate for foraging in that patch (Winterhalder, 1981).

The marginal value theorem predicts that if a fisher is foraging optimally, a patch (e.g. fishing ground) should be abandoned when the marginal rate of return for fishing in that ground is equal to the mean return for the entire habitat or set of visited patches. The model also forecasts that if habitat productivity decreases without affecting the yield of a specific patch (i.e. within the habitat), then foragers should spend more time on that patch, and that if productivity increases, less time should be allocated to each ground (Smith, 1991).

The combined predictions of the models suggest that as seasonal productivity of a habitat type (e.g. outer-reef drops) increases, more overall time is assigned to the habitat, but less time is spent at each particular fishing ground within it. Frequent mobility between accessible grounds allows fishers to sustain considerable catches before any of the visited grounds undergoes resource depletion. Conversely, as seasonal habitat productivity decreases, less overall time is assigned to the habitat and, when visited, more time per bout is spent at a fishing ground. It does not pay for fishers to move elsewhere within the habitat if they cannot do better. Alternatively, fishers can search for more productive habitat types (e.g. inner-lagoon reefs) as long as they are accessible and travelling costs are not to high.

Analysing Pacific Island artisanal fishers: A case study

This section describes the methodology employed to test the foraging models outlined in this paper. The case study presented here is based on my own research conducted at the Roviana and Vonavona Lagoons in South West New Georgia, Solomon Islands from April of 1994 through December of 1995 (see Aswani, 1997).

A major objective during this research was to describe the behaviour of fishers and to account for the temporal variability of their activities. This required my direct participation in fishing forays as well as that of my assistants. Participation in the fishing activities of Islanders allowed me to understand the complexities involved in their daily choices, which could never have been attained by interviewing alone.

To elicit detailed comparative behavioural data for other fishers, self-reporting diaries were handed out to men and women[2] in villages across the lagoons. These were important to understand regional variation in foraging strategies.

Direct participation by my assistants and me in fishing forays produced records on 372 fishing trips to 978 fishing grounds, encompassing a total of 751.4 hours of fishing. Including the self-reporting diaries, a total of 2,203 fishing trips encompassing 5,920.7 hours of fishing in 4,445 visits to fishing grounds were collected. Data compiled during fishing forays included data categories such as:

- name, sex, and age of participants,
- date and village,
- total time allocation and time-motion records for all behavioural categories conducted at each ground,
- name and environmental characteristics of exploited grounds,
- name and number of captured species,
- total weight of catch by species and areas visited,
- fishing methods employed,
- mode of transportation,
- expenses incurred (e.g. petrol cost when using outboard motors, hooks lost, etc.),
- income, if any, and
- weather patterns, including tidal cycle, lunar stage, wind direction, and other environmental variables.

Moreover, during fishing trips I was able to elicit other types of information such as the ethnohistorical characteristics of the seascape, localised temporal events (e.g. fish aggregations), and specific data on prey species.

The data collected during the focal analysis and foraging diaries form the basis to test the foraging models presented in this paper. Foraging effort (labour input) and foraging outputs (the catch) data are essential to estimate the foraging efficiency of Roviana fishers. Although measuring the output of fishing activities was not too difficult, figuring out the labour input of fishers was more complex. The primary analytical tool employed to calculate labour inputs was time-motion analysis (see Nydon & Thomas, 1989).

Time motion analysis

Time motion analysis is a research strategy used by ecologists and some anthropologists to determine the time and energy that an organism spends in an activity. The first analytical step is to break down observed patterns of behaviour into work categories (e.g. paddling, walking, etc.) and to measure the specified behaviours by timing individuals while they conduct them (e.g. sitting in a canoe). In figuring expenditure rates for labour input, the recorded times for behavioural categories are multiplied by standardised indirect calorimetric measures. This procedure will be explained below. During analysis of fishing forays, work categories for each participating individual were broken down into two groups: travel and within-ground activities. These two were further subdivided into their respective behavioural categories. Several stop watches were used concurrently to time observed behaviours.

In addition to recording the behaviour of observed fishers, these detailed measurements served to calculate the behavioural ratios for each fishing method. These, in turn, were used as a proxy to figure out the behaviour of fishers in trips that neither me nor my assistants had observed (i.e. foraging diaries). For instance, anglers generally spend 27 per cent of their within-patch time in some handling activity (casting, bating, unhooking fish etc.) whereas 73 per cent is spent waiting. This ratio was applied to the foraging diaries, which did not have as much detailed information as the focal diaries. If a fisher stayed 50 minutes in a patch, it was assumed that 13.5 minutes had been employed in handling, while 36.5 minutes were used in waiting (search time).

The diary method

To complement my own observations and to attain detailed comparative behavioural data for other fishers in different areas of the Roviana and Vonavona Lagoons, the diary method was employed. This method was indispensable in accessing data on regional variation in habitat selection, differences in methods used, seasonal influence on fishing strategies, and the 'foraging histories' of particular individuals. Most importantly, the use of this method allowed for the examination of seasonal cross-regional time allocation to various habitat types and the correlation between time allocation and relative resource abundance (i.e. as measured from recorded yields).

The diary method consists of randomly selecting subjects to keep diaries of their foraging activities. In this study, random selection of informants was not always achievable. Selecting the appropriate subjects was hard because many fishers were either unwilling to keep a log of their activities or simply could not handle the provided materials. Also problematic was the fact that many fishers were only interested in the provided materials and did not care about the project. Those fishers willing to cooperate were given a watch, a scale, a pen, and a set of standardised forms. Approximately one hundred wrist watches and

2. Only nine women participated in writing the foraging diaries. Nevertheless, my assistants and I recorded the activities of over one hundred women across the region.

scales were handed out in hamlets throughout the Roviana and Vonavona Lagoons. Each subject kept the material if they satisfactorily completed at least 25 fishing events. Fishers were not told that they could keep the materials to prevent people from falsifying their diaries. Diaries where I suspected cheating (e.g. a record of ten full moons in a single month!) were discarded. Notwithstanding the possible sampling bias, my own observations of fishing patterns indicates that the chosen fishers (both male and female) were a representative sample of the fishing population. Despite the problems, many fishers were interested and keen to cooperate in this project. In the 20-month duration of this project, 1915 foraging diaries were collected from more than one hundred participating fishers. To make sure that fishers in my village were being accurate in their self-reporting, I frequently recorded their movements while out fishing to cross-check their reported times.

Estimating the 'foraging efficiency' of fishers

Energy maximisation as a unit of foraging efficiency is best expressed as the 'net return rate' per capita. This rate (R) is equivalent to the energy acquired (E_a) during fishing (the kcal value of the catch) minus the labour input (E_e) (labour cost incurred during foraging including travel, search, and handling times) divided by the total residence time (t) at a patch multiplied by the number of participating foragers. This is mathematically expressed in the following equation (Reproduced from Smith, 1991: 186):

$$R = \sum_{i=1}^{n} (E_a - E_e) / (t)\,(n)$$

Estimating labour costs

The labour energy expenditures were calculated by taking the time-motion records for each visited fishing ground and multiplying them by established calorimetric values.[3] Estimating energy expenditure rates from time-motion data is a proxy method to calculate human energy expenditure. Reliable energy expenditure rates for a Melanesian population have been provided by Norgan, Ferro-Luzi, and Durnin's (1974) study of energy expenditure amongst the Kaul, a Papua New Guinea coastal population. Measures attained from this study were complemented with FAO's (1985) energy expenditure tables for subsistence societies. Because these tables only offer mean energy expenditure measures, it was necessary to calibrate for age, weight, and sex of each participating individual. To do that, the standard measures for BMR, or 'basal metabolic rate,' for different age, sex, and weight groups in the FAO report (1985) were utilised. For instance, if the Papuan study tables indicated that the energy expenditure for 'paddling canoe' for a male between 25- and 65-years-old weighing 65 kg is 3.2 kcal per minute of labour, and I had to correct for a woman weighing 50 kg and 32-years-old, the following was carried out. If the BMR for that individual was 1,290 kcal per day (FAO, 1985: 72), this number was divided by the number of minutes in a 24-hour period, or by 1,440. The result was then multiplied by the standardised expenditure rate for males to adjust for the age, weight, and sex of the subject. Therefore, the energy expenditure for 'paddling a canoe' for a 32-year-old female weighting 50 kg was equal to 1,290 ÷ 1,440 x 3.2 = 2.87 kcal per minute. Using the Papua New Guinea study and other sources, coupled with the BMR calibration for specific age, sex, and weight provided by the FAO (1985) tables, a range of energy expenditures for Roviana and Vonavona fishers was determined.

Estimating output—catch values

Energy outputs harvested during fishing are equivalent to the edible weight of the catch multiplied by standardised caloric values. In this study, the energy returns of each catch varied according to the caloric value of the constituent species. When possible, the catch harvested at each visited fishing ground was separated by species. For small catches dominated by multiple species of small reef fish, an averaged measure was used to determine the energy value of the catch. The literature on fish nutrition and seafood (e.g. Nettleton, 1985) indicates that the edible portion of a whole fish is about 60 per cent (for shellfish and crustaceans this measure varies between 10 and 40%). However, these measures are for edible portions considered by Western consumers, and do not include parts of fish and crustaceans eaten by other populations (e.g. head, liver, eyes etc.). To adjust for difference in feeding habits between Western and Melanesian populations, a 10 per cent edibility portion was added to fish, crabs, and crayfish.

Estimating the net return rate

Once the energy input (labour costs for an activity) and the energy outputs (value of the catch) were solved, the unit of foraging efficiency, or 'net return rate,' was determined algebraically. As an example, if a male in his 40s weighing 65 kg

3. Labour expenditure for fishing at a fishing ground also includes energy expenditures incurred during searching for bait. If the fisher visited more than one ground, bait-search labour expenditure was factored among all visited grounds.

paddled for 12 minutes, stayed in a fishing ground angling for 47 minutes, and caught a barracuda weighing 2.3 kg, and then paddled back to the village in 10 minutes, the net return rate was calculated as follows: The labour cost is equal to a total of 22 minutes x 3.3 kcal per minute of paddle (at regular speed) + 47 minutes x 2.1 kcal per minute of angling time. This is equal to a labour cost of 171 kcal.

The next step was to calculate the energy output of the catch. If the barracuda weighed 2.3 kg but only 70 per cent of it was edible, the actual usable portion was equal to 2.3 x 0.7 or 1.61 kg. The caloric value was then calculated by multiplying 1,610 g (1.61 kg) by the energy value for Pacific barracuda, or 118 kcal per 100 g edible portion, so that 1,610 x 118 ÷ 100 = 1,899 kcal. Subsequently, the labour output was subtracted from the input to figure the net energy return, or 1,899 – 171 = 1,728 kcal. To convert this measure into a rate, the net return was divided by the time spent foraging, so that 1,728 ÷ 47 minutes = 37 kcal per minute of foraging, is the *net return rate*. This, in turn, was multiplied by 60 minutes to find the hourly rate. Whereby 37 x 60 = 2,206 kcal would be the hourly rate gained for fishing in this fishing ground of a habitat type at that specific season and time of the day.

Calculating mean return rates for fishing methods, habitats and fishing grounds

The previous section has shown the general method employed in this study to factor the net return rate. In this section the methodology employed to calculate *mean* net return rates for all fishing methods, habitat types, and grounds are outlined. The initial step to was to code all foraging events and to enter each respective visit to fishing grounds as separate cases (4,445 cases). Once the data was coded, the next step was to find out the seasonal mean net return rates for each fishing method, the major habitats, and for specific fishing grounds within each habitat. Finding the seasonal return rates for each method revealed the effectiveness of each technique, and the geographical disparities in yield and effort for each method. The environmental productivity (i.e. measure of relative abundance only) of each habitat was assessed by sorting all bouts by habitat type and attaining their mean return rates. Subsequently, each habitat type was sorted by the three main tidal seasons in Roviana (see Aswani, 1997) to attain seasonal yields and overall foraging effort allocated to each. The overall time allocation results for each habitat type illustrated whether fishers were allocating more fishing effort to habitats experiencing an increase in seasonal productivity. In fine tuning the analysis of seasonal pattern, individual fishing grounds within a habitat type were sorted by indigenous name and their mean return rates determined. Each ground was further sorted by tidal season to see if patterns of time use simultaneously changed with seasonal shifts in localised mean productivity. A Pearson correlation coefficient test was utilised to analyse return rates and concurrent time use across seasonal variation for habitats and specific grounds to check for negative and positive correlations in the data. A positive correlation between overall time allocation and habitat seasonal productivity indicated that the most productive habitats received the most attention in a given season. Concurrently, a negative correlation between per-bout foraging time in fishing grounds within the habitat type and their seasonal mean productivity indicated an inverse relationship between time spent in a ground and its yields. A *t*-test was conducted on all data sets to check for statistical significance.

It should be noted that to uncover the behavioural patterns of Roviana and Vonavona fishers, data sets for each village were sorted in many different ways. For instance, data were sorted by ‘special events’ (e.g. fish aggregations) to explore the effects of sudden changes in patch productivity on indigenous selection of fishing grounds and subsequent uses of time. In assessing individual responses to changing productivities, several fishers were analysed to trace their monthly selection of fishing methods, habitats, and fishing grounds. Additionally, events that included income returns were sorted independently to see if a changing currency (i.e. kcal to cash unit) resulted in differences in time allocation.

Implications for the analysis of Pacific Island artisanal fishers

A question that remains to be answered is what does confirmation or refutation of optimal foraging theory hypotheses tell us about the foraging strategies of Pacific Island artisanal fishers? The first implication is a theoretical one. Confirmation of the foraging hypotheses suggests that fishers optimise their short-term self interests by harvesting resources as efficiently as possible. The models presented in this paper hypothesise that individuals chose habitat types and the foraging times allocated to them according to changes in habitat seasonal productivity. Such a strategy can result in the conservation or depletion of resources, depending on changing environmental conditions. Resource depletion may occur during periods of resource scarcity when fishers increase pressure on specific grounds (i.e. if there are no alternatives), whereas conservation may occur during periods of resource abundance when fishers’ movement between fishing grounds, to increase short-term foraging efficiency, results in the abandonment of remaining prey. Foraging theory shows that the consequences of human foraging behaviour are conditional and dynamic.

On the other hand, rejection of the foraging hypotheses can indicate inconsistencies with the models' assumptions (e.g. need for a new currency), or can show that fishers are indeed practising a resource management strategy. Fishers can mitigate resource scarcity by controlling their short-term intake rates (i.e. stop resource exploitation) to increase long-term sustainable harvests. In this scenario, fishers will actively restrain their efforts, whether aware or not, to reduce pressure from habitats and fishing grounds experiencing a perceived or absolute decline in productivity (Aswani, in press).[4] Regardless of the results, the utilisation of foraging theory reveals foraging patterns that cannot be revealed by conventional qualitative ethnographic field methods alone.

A second implication is a methodological one. A major problem faced by some anthropologists in the field is the lack of an organised methodology and theoretical framework. In this respect, optimal foraging theory offers researchers a sound body of theory and a systematic set of field research methods. As foraging models focus on human daily actions, rather than exclusively on human beliefs and ideologies, they permit a detailed analysis of human foraging practices. Besides acquiring quantitative measures of time use and yields, the application of foraging models necessitate the investigation of indigenous foraging choices and the extrinsic environmental and social forces shaping them. This requires, among other data sets, the collection of indigenous ecological knowledge, the mapping of regional ecological characteristics, and the study of the local social-economy—data that can be useful for management purposes.

The final implication is a managerial one. Because foraging models are able to predict the types and abundance of fish that fishers prey on, the frequency of visits to marine habitat, and the changing intensification of fishing activities, they are useful in linking anthropological studies with coastal management plans. Foraging data together with local and western biological knowledge can be incorporated into management blueprints which mimic local seasonal resource exploitation patterns. For instance, during periods of declining exploitation, certain habitats could be temporarily closed. Access restrictions to habitats or grounds that are temporarily considered less desirable than other fishing grounds would likely be more acceptable to local fishers than closing prime areas (Aswani, in press). Finally, data on the relative productivity of habitat types and specific fishing grounds, can assist fishery researchers in regional stock assessment.

Conclusion

For all its merits, optimal foraging theory is not a theoretical and methodological panacea, and much can be said about its shortcomings. However, a growing number of anthropological studies employing this approach are showing that it is robust enough to understand the foraging practice of subsistence and mixed economy societies. It is hoped that the integration of optimal foraging models to the study of Pacific Island artisanal fisheries will result in a clearer understanding of human foraging activities and their impact on the coastal ecosystem.

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4. An important distinction needs clarification. When fishers allocate less overall fishing time to habitats undergoing a seasonal decrease in yields, the behaviour suggests that they are either practicing a resource management strategy or an optimisation one. To distinguish the actual strategy, it is crucial to analyse time-use of fishers while foraging in specific grounds within the habitat experiencing a decrease in yields. An increase in per-bout time suggests a foraging strategy designed to maximise foraging efficiency (i.e. only if there are no alternative areas, or travel times elsewhere are too high), while a decrease in time suggests a strategy designed to manage resources. This is counterintuitive to the common notion that fishers decrease time during seasonal lows and increase per-bout foraging time during seasonal highs (Aswani, in press).

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Native title recognition of CMT and the implications for the GBRMPA and future management of marine areas

by Julie Lahn[1]

Introduction

The Great Barrier Reef Marine Park (GBRMP) stretches along the Queensland coast of Australia. It has often been showcased both locally and internationally as the world's most successfully managed marine park. However, in its management of this park, the Great Barrier Reef Marine Park Authority (GBRMPA) has come under scrutiny by researchers and indigenous people alike. This paper presents an update on issues concerning indigenous rights, management strategies and GBRMPA.

Indigenous interests in the Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park Authority has initiated research and workshops to examine Aboriginal and Torres Strait Islander interests in the marine park area. One workshop (Gray & Zann, 1985) concluded that traditional knowledge and use of the marine environment could be a solid basis from which to build management strategies. Traditional knowledge is acknowledged as useful and the study suggested that further research and consultation should be carried out around Australia to 'take stock' of the information held by indigenous people and to listen to current concerns.

Other research funded by GBRMPA also stresses the importance of Aboriginal interests in marine areas (Smith, 1987). Ethnobiological research carried out by Andrew Smith (ibid.) in two Cape York communities, Lockhart River and Hopevale, documented Aboriginal interests in the Cairns and Far Northern Sections of the Marine Park. Smith carried out a comparative study of marine hunting and fishing practices of the Hopevale and Lockhart River communities and at the completion of his research, made suggestions for future directions GBRMPA should take with regard to Aboriginal and Torres Strait Islander peoples.

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Smith's lengthy investigation recommended the recognition of Aboriginal interests in the two marine zones and the incorporation of their interests into management strategies. As part of this, Aboriginal people from the two communities should be employed as rangers and liaison officers and have a formal role in the Great Barrier Reef Consultative Committee. Smith (ibid.) recognised the need for Aboriginal interests to be formally recognised by the GBRMPA in the planning and implementation of management plans for the Cairns and Far Northern Sections. The report highlighted the need for anthropological studies in the region, so that Aboriginal perceptions of the Marine Park can be understood, in an effort to facilitate communications and understanding between the GBRMPA and communities (ibid.).

More recently, GBRMPA (1992) outlined a draft strategy for managing the area. Their twenty-five-year objective is 'To have a community which recognises the interests of Aboriginal and Torres Strait Islander people so that these people can pursue their own lifestyle and culture, and exercise control over issues, areas of land and sea, and resources relevant to their heritage within the bounds of ecologically sustainable use' (GBRMPA, 1992: 18).

Aboriginal and Torres Strait Islander needs were to be heard in consultation, and representatives would be placed on committees and in research projects to protect their 'social, cultural and economic interests' (GBRMPA, 1992: 19). Despite its intentions, 'the 25-year strategy . . . may not adequately accommodate Aboriginal interests in ownership and total control of some marine environments' (Smyth, 1993: 197). A common problem with such research 'is that they generally ignore, undervalue or misrepresent pre-existing relationships between indigenous people and the places being cared for' (Smyth, 1993: 189).

As part of the Coastal Zone Inquiry, Smyth's (1993) appraisal of indigenous interests in Australia's coastal zones in part highlighted the concerns Aboriginal and Torres Strait Islander people had concerning their lack of control over resources and sites on their 'traditional' lands and seas.

In a recent consultancy report commissioned by the GBRMPA, Anthony Bergin (1993a) recommends actions that GBRMPA could take in incorporating Aboriginal and Torres Strait Islander interests in the marine park. Herein (ibid.) are examined previous report recommendations made to the Authority including those by Smith (1987) and Smyth (1993), as mentioned above.

The report examined international legal and political advancements that recognised indigenous marine rights and highlighted the implications of these movements for GBRMPA. International legal precedents will impact on the future involvement of indigenous people in marine areas. Bergin (1993a:23) suggests that:

'In framing its policies the GBRMPA should be aware that . . . the broad political and legal trends overseas exhibit a respect for the existence of genuine, and possibly extensive marine resource rights and a commitment by government to enable aboriginal communities to prepare for co-management negotiations.'

In a conference paper based on Bergin's (1993a) consultancy, Bergin and Lawrence (1993) stress that Aboriginal relationships with land have been significantly documented, but that the 'knowledge and recognition of the cultural, economic and political importance of Aboriginal "sea country" has not been given as much emphasis or attention' (ibid:26). My PhD research will, in part, address this issue by providing detailed anthropological documentation of Customary Marine Tenure.

Despite this lack of documentation, the GBRMPA allows for indigenous fishing and hunting in the Marine Park, but has yet to act on previous recommendations from its commissioned reports. The above mentioned report then presented a number of actions the GBRMPA could take on indigenous marine rights in light of previous recommendations and international legal and political movements (Bergin & Lawrence, 1993). The authors felt that for GBRMPA to actively involve indigenous interests in the Marine Parks, they must act on these previous recommendations. The recommendations made a call for:

'Aboriginal positions on the Great Barrier Reef Consultative Committee. Aboriginal management zones, recognition of cultural and lifestyle issues including dugong and turtle hunting, community-based management strategies, and strengthening links between the Authority and communities'(Bergin & Lawrence, 1993b: 27).

Recent initiatives of the GBRMPA regarding indigenous Australians

In 1994, preliminary discussions took place at the Pajinka Workshop about joint planning of the Far Northern Section and the newly-proposed State Marine Park by GBRMPA, DEH and Aboriginal peoples (Swartz, 1995). Follow-up workshops were held in 1995 at Hopevale, Coen, Lockhart River, Irginoo and Horn Island. The Far Northern Section was again up for management review, and now 'GBRMPA want[ed] strong indigenous input into planning the marine parks' (Swartz, 1995:7). From the initial Pajinka meeting, community rangers were put in place and given powers under the GBRMPA. From the subsequent workshops, Aboriginal views were heard, and the GBRMPA will now begin to jointly draft plans for future management and continue to support community rangers by providing them with further training and resources to keep the communication lines open with their communities (Swartz, 1995).

In 1996, GBRMPA went further to suggest the idea of a 'Sea Council' for the north east Cape York region (anon., 1996). The proposed Sea Council is said to be 'a big step toward recognising indigenous sea rights, and would also be a practical way to bring traditional owners into the management of their sea country' (ibid.). In this way, it will provide them with decision-making powers, a forum for negotiating with commercial and recreational fisheries, and resources for training programmes (ibid.). Aboriginal and Torres Islander peoples were, however, wary of this new body and concerned that it may simply be a token act by GBRMPA. At the 1996 Cape York Summit, participants supported the idea of a Sea Council, but insisted that it must have bargaining powers to ensure fair dealings with State and Federal Governments and other interested parties in the Far Northern Section of the Marine Park.

The Cape York Summit at Wujal Wujal drew up a number of recommendations regarding sea rights and the GBRMPA. Resolutions on Sea Rights included supporting the Umpila sea claim and stressing that until other sea claims go through under the Cape York Land Council's (CYLC) funding, the CYLC 'should liaise with GBRMPA and government agencies to protect and negotiate for recognition of native title rights in sea country' (Calley, 1996a).

When discussing the GBRMPA and their zoning sections, it is reported that people at the summit were angry at having restrictions placed upon them by the Authority (Calley, 1996b). What particularly upset summit participants was GBRMPA's decision not to go against the new Federal Government's decision to oppose Native Title rights in the sea (ibid.). The CYLC has recalled information about native sea rights given to the GBRMPA which was to be used in future joint planning initiatives. This recent stance has angered communities, and the summit drafted two resolutions regarding this issue:

The 1996 Cape York Summit at Wujal Wujal:

1. is disappointed that GBRMPA is not recognising Native Title in the sea. We insist that GBRMPA stand firm in its previous commitments to recognise Native Title and we insist that GBRMPA, as an independent statutory authority, comes to its own decision to recognise Native Title in sea country off Cape York Peninsula, and
2. demands that any GBRMPA Far Northern Section Rezoning and Management Plans must not extinguish or reduce our Native Title rights in sea country. We must be entitled to carry out our Native Title rifts without permits. Our Native Title rights are rights that exist under Aboriginal Law. We do not need Government permission to fish, hunt and gather in our sea country (Calley, 1996b).

GBRMPA's recent shift in attitude toward sea rights may be detrimental to the previous work carried out in communities in an attempt to open up communication between the Authority and indigenous communities. Summit participants are clearly disappointed with the GBRMPA and are suspicious of their actions. Much of the extensive work carried out by GBRMPA's Aboriginal Liaison Officer and other GBRMPA staff may have been in vain, and it appears that relations have been set back by the Authority's recent stance on sea rights.

Mabo and its implications for sea rights

The Mabo case has potential applications for CMT claims, and for marine management. The Native Title Act 1993 allows for rights to land, which also provides a space for rights to marine estates. The Mer Island case initially included CMT claims but the 'lack of evidence regarding traditional knowledge and use of this marine component of the Murray Islander's domain' (Allen, 1993: 61) forced the withdrawal of sea claims from the court (Keon Cohen, 1993). Native claims to land are ' . . . undeniably within a class of proprietary interest recognisable at common law' (ibid.) but a similar determination regarding marine estates has yet to be tested in the High Court. Thus, CMT claims may be legally accessible, but Aboriginal and Torres Strait Islander needs and interests must be thoroughly addressed and CMT documented to educate the wider Australian community.

The overseas situation has raised expectations in Australia that customary marine tenure may in the future be legally recognised. At this time, there is a test case over indigenous marine rights over the seas surrounding Croker Island in the Northern Territory. A determination on this test case is expected to be handed down in April 1997. The feeling in Australia signifies that the GBRMPA should not wait for future High Court determinations, and legislation that may require that they incorporate indigenous interests in the Marine Park at a 'high level' (Bergin, 1993a: 40).

In the case of Torres Strait CMT systems (which are outside of GBRMPA jurisdiction) there are legal barriers to proving the existence of native title. The International Law of the Sea (LOSC) and the Torres Strait Treaty (TST) are two such barriers (Haigh, 1993). Haigh (ibid.) describes the Torres Strait seas as the most complex in Australian law, and any Court making a determination on CMT would have to take into account the limits placed by the LOSC and the TST.

Haigh (ibid.) calls for a review of the use of Torres Strait as an international passage where it interferes with the CMT of Torres Strait Islanders. Secondly, the Torres Strait Treaty needs to be returned to in order to give people control of their seas, even though it may be risky to start any review process, as Torres Strait Islanders may not achieve any benefits from the process and it may, according to Haigh (1993) be detrimental to their present situation. He finishes by stating that review processes must be implemented, as the current European system of control conflicts with Islander CMT, and for that matter, with mainland indigenous laws. These issues need to be addressed before Torres Strait Islanders obtain greater controls over their future.

Post-Mabo Sea Claims – Australia

Other than the Croker Island test case, there have been a number of recent claims over Australia's coastal seas. Some of these have been placed over the Great Barrier Reef Marine Park. At present there are seven accepted claims in the region that take in areas including Lizard Island, Fitzroy Island, Low Isles, and areas south of Lockhart River claimed by the Ompela people.

Other applications have come from Wik, Dingaal and Kuku Ya'u claims. Some areas are subject to overlapping claims by Aborigines from Yarrabah. Claims outside GBRMPA'a jurisdiction have also been lodged. One of these includes a claim over the Arafura Sea that stretches into Indonesian waters. In Torres Strait, there have been (at last count) 63 claims over lands and seas lodged with the National Native Title Tribunal (NNTT).

Indigenous peoples are taking the initiative in laying claims to marine areas they are customarily responsible for, and as a preliminary attempt (in some cases) to control movements through their waters (especially by commercial fishing vessels). If any of these and other claims receive a favourable determination, especially mainland Aboriginal peoples, the GBRMPA will have to accept the decision as the claims are concerned with State and Federal issues.

The GBRMPA have been increasingly concerned with the level of involvement Aboriginal and Torres Strait Islander peoples have had in the running of the Marine Park. However, these concerns are difficult to implement in a relatively short space of time and the lack of control Aboriginal peoples have in the planning and management of the Marine Park has left many disgruntled.

The GBRMPA had many recommendations put to them from different scholars. The continuance of their implementation will provide the institution the benefit of Aboriginal and Islander knowledge and 'on the ground' expertise that will, in the future, improve the management of the marine park and raise its profile in the eyes of indigenous and other Australians.

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Global survey of marine and estuarine species used for traditional medicines and/or tonic foods

by Allison Perry [1]

According to the World Health Organization (WHO), an estimated 80 per cent of the population of developing countries use traditional medicines for either economic or cultural reasons. Although traditional healing practices are highly varied, measures in many cultures involve the use of plant and/or animal species for medicinal purposes. As a result, harvest and trade of species for traditional medicines may pose a threat to their survival.

Whereas the case of large, terrestrial mammals threatened by trade for traditional medicine, especially traditional Chinese medicine, is well-known, the use of marine species has not been equally studied. Accounts tend to outline uses by only one culture, and even then are not necessarily complete. Moreover, present-day uses often involve species that were not historically part of traditional *materia medica*; the use of technologies such as deep-sea trawling has presented traditional medicine with marine resources which were previously unattainable or unknown. Likewise, people are turning to alternative species as the availability of those that have been over-exploited declines.

Marine medicinals represent a potentially enormous and economically important activity with serious implications for conservation. An analysis of the use of seahorses and pipefish for traditional Chinese medicine revealed an extensive international market, rising demand, and declining seahorse populations. There is no reason to expect that a similar situation of exploitation for wholesale trade does not exist for other marine species. However, as the extent and range of marine medicinal use has not been determined, the conservation status of marine species cannot be properly assessed, and thus management strategies cannot be undertaken.

In collaboration with Dr Amanda Vincent of McGill University, I am conducting a study of the global use of marine species for traditional medicines and tonic foods. The main focus is to determine the taxonomic distribution of use. However, information is being collected on all of the following variables:

- which species are used and by whom,
- history of use,
- which parts are used in what quantities,
- which conditions and/or illnesses are treated with marine medicinals,
- rationale for use (i.e. therapeutic value, folklore, etc.),
- within-species preferences (i.e. colour, size, gender, stage of development, etc.), and
- sources of supply.

In addition, I am gathering information regarding the basic biological characteristics of species which are used, such as population range, habitat requirements, and reproduction. Any additional anecdotal information regarding such factors as market value, harvesting techniques, and trade dynamics is also valuable; these may prove useful for future investigations.

Ideally, this study will allow for the prediction of trends within the marine medicinal market, with respect to future demand, and those potential sources of supply likely to be exploited. This information could eventually be used to help determine the need for marine conservation initiatives for species used for traditional medicine.

Because an analysis such as this has not previously been attempted, it is essential that information be gathered from as broad a base as possible. Therefore, I am depending heavily on information which people can provide me, based on their own knowledge and experience. Please find attached a questionnaire. I will be very grateful for any information which you can contribute. I would also be most grateful if copies could be made available to others who might also be able to assist.

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Information on traditional medicine and tonic food sources from seas and oceans

Please fill in any information possible, even if it is only the name of a species used.

Name:
Date:
Contact address:

1. **Type of organism:** [e.g. algae, plant, mammal, fish, bird, reptile, crustacean, mollusc, other invertebrate, other (please specify)]

2. **Species:** Local name (if known), scientific name (if known), Western name (if known). Any photographs or drawings would be greatly appreciated.

3. **Geographical region of use:** Name the area as specifically as you can (e.g. country, province or region etc.)

4. **Typical use:** What conditions or illness is it typically used to treat? Are these conditions or illnesses acute or chronic?

5. **History of use:** For how many years has this method of treatment been practised? (e.g. within the past 10 years, within the past 10–100 years, longer than 100 years etc.)

6. **Frequency of use:** How often would the average individual use this treatment? (e.g. how many times per day, per week, or per year)

7. **Preparation of treatment:** How is the treatment prepared? (e.g. dried, ground, etc.). Is the whole organism used, or only part? (be as specific as possible). What quantity is needed for one treatment? (e.g. mass, length)

8. **Rationale for use:** Why is this treatment used? (e.g. therapeutic value, folkloric belief)

9. **Source of supply:** Where is the organism caught, purchased, or traded? [e.g. locally, other (please specify)]

10. **Natural habitat:** Where does the organism live in the wild? (e.g., open ocean, rocky bottom, sandy bottom, coral reef etc.)

11. **Harvest:** How is the organism captured or harvested? At what time of the year is the organism caught or harvested?

12. **Species reproduction:** At what time(s) of the year does the organism reproduce?

13. **Preferred characteristics:** Are there any preferences with respect to stage of development, sex, colour, size etc? (Please be as specific as possible)

14. **Additional information.** I would be very grateful for any other information regarding the use of marine species for traditional medicines or tonic foods.

Thank you for your time and for sharing this valuable information. Please return the questionnaire and any other information to:

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Useful information in electronic media

Traditional marine resource management and knowledge

New software available: ICONS (International Conservation Networking System)

The software is available from: http://www.iucn.org/icons

ICONS for Windows (beta), software is produced by a team of conservation and information professionals supported by the Information Management Group IUCN – The World Conservation Union, the International Development Research Center (IDRC) and the Norwegian Agency for Development Cooperation (NORAD).

This is an easy-to-learn software programme designed to support community-based conservation, biodiversity information management and networking.

ICONS provides modules for managing conservation-related information for the following categories:

- organisations;
- persons;
- peoples;
- sources (bibliographies; metadatabases; etc.);
- laws;
- projects and events;
- Internet sites and services;
- geographic areas;
- species;
- data custodians;
- metadata; and
- multimedia encyclopaedia.

In addition, ICONS provides you with a number of 'look-up' tables that contain terms used in the other modules which you can use to create authority files, including tables for:

- acronyms;
- countries;
- GeoKeys (Geographic keywords);
- habitats; and
- taxonomic ranks.

ICONS is effective for managing bibliographies, e-mail and personal notes; organisation and expertise data; detailed project histories; legal information, species life history data and their uses; and for the other categories listed above.

ICONS makes extensive use of transactions, which allows you to create new categories of information and attach them to records in your database: data values, cross-classifications, notes and binary objects such as word processed files, graphics, map files, and sound files. You can perform full-text searches, and the system comes with tools that will help you to index, filter and sort your records.

Within the flexible structure for adding your own classifications and data, ICONS provides a fixed underlying data structure that allows users adopting the software to easily share files, either through diskettes, zip disks and other storage media, or by using the Internet. Data entered into ICONS may also be exported in a number of common formats so that they may be shared with other programmes, and the tables containing the data are left accessible for easy attachment or export.

ICONS can be used:

1. to assemble and store electronically the materials related to meetings, with the full text of the materials, scanned images, and a participant's list, which can be distributed at a meeting to provide the basis for further networking;
2. to manage membership lists, track office activities, organise information on projects, and other daily tasks in conservation organisations;
3. by conservation organisations to maintain conservation networks with contact and expertise information, a document clearinghouse, project information, and detailed legal and biological information on particular issues and regions;
4. by students or professionals to manage research and education-related information and distribute it in the classroom; and
5. to provide a database system that can be used to store information that can be used in geographic information analysis (GIS).

The system is being developed for use in a number of indigenous knowledge, sustainable development and biodiversity initiatives with IUCN – The World Conservation Union and others. The software is being made freely available over the Internet in order to invite others to evaluate ICONS and help us improve it, and to provide a tool that can be used in others' conservation and sustainable development efforts.

ICONS comes with a small sample database to provide some authority information and help guide you to some useful formats for entering data. A database has been prepared with over 100,000 records on bibliographic references, organisations, Internet sites, acronyms, encyclopaedic terms, and species on the issues of biodiversity, indigenous knowledge, community-based conservation, conservation biology and sustainable development. The database will be made available for low-cost distribution on CD-ROM and as a searchable database on the Internet. The ultimate intention is to foster the development of federations of organisations which maintain locally controlled, high quality information sources in special interest networks.

A run-time version of Access 2.0 is installed, so that you can use ICONS on any personal computer running Windows 3.1 or higher operating system. If you have a full copy of Access and other tools, you can mount ICONS on a local area network (LAN) or on an Internet server. ICONS has been designed to allow users with the full version of Access to modify ICONS for their own uses, such as constructing a user interface in a local language. ICONS is fully compatible with GIS software capable of accessing the ICONS data tables. Direct interfaces to GIS are now under development. This version will also run under Windows 95, and a following version written for Windows 95 and incorporating advanced Internet features is being developed.

A manual accompanies the software with basic instructions on installation and use. This is a Beta release, without on-line help. However, an integrated help system is being developed for the full release version.

The developers are a small group and so cannot offer full support for users. But an ICONS Mailing List for software support is available. (See the ICONS section on the IUCN website.)

The installation package is 5.1 Mb, and needs at least 11 Mb of hard disk space to install. It requires a 386 (or higher) PC, running Windows 3.1 (or higher) operating system.

ICONS is copyrighted for free educational and non-profit use. If you elect to download the Beta release of this software and accept the End User's License Agreement, you will be asked to fill out and return the reader's survey form that accompanies the manual, either electronically or through surface mail. Inquiries for developing full-scale projects using the ICONS software or for supporting ICONS mirror sites are welcomed.

This information was provided jointly by Kevin Grose (Project Manager, Head, Information Management Group, IUCN), Julian Inglis (Project Coordinator), Bill Harp (System Co-Designer), and Preston Hardison (System Co-Designer).

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ICONS web site:

http://iucn.org/icons

or join the ICONS_L e-mail discussion group.

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Workshops and Meetings

Traditional marine resource management and knowledge

International Workshop on Community-Based Natural Resource Management

The World Bank, Washington, D.C., 10–14 May 1998

First announcement and call for cases

The Economic Development Institute of the World Bank, in conjunction with the International Development Research Centre (Canada), is organising an international workshop on community-based natural resource management that will be held in Washington, D.C., from May 10 to 14, 1998. This workshop is the second in an annual series of international workshops on Institutional Reform for Sustainable Rural Development. The first workshop was held on the topic of rural infrastructure, in Washington, D.C. in May 1997.

The workshop is intended for policy-makers, practitioners, and disseminators (including academics and journalists) who are involved with some aspect of community-based natural resource management in developing and transition economies.

The workshop will focus on institutional innovations that enhance the community-based management of renewable natural resources (such as watersheds, forests, rangeland, soils, water, fisheries, and biodiversity), and that help to alleviate poverty among the world's poorest peoples.

The objectives of the workshop are:

- *To facilitate a learning dialogue* among participants from all over the world concerning effective institutional arrangements that enhance the community-based management of natural resources;
- *To identify and to promote awareness* of key institutional issues with respect to the community-based management of natural resources;
- *To generate information and to learn about* viable institutional options for the community-based management of natural resources; and
- *To enhance the capacity of existing networks*, stakeholder groups, and international donors to bring about positive institutional reforms with respect to community-based management of natural resources.

The four, closely-related themes that provide the conceptual framework for the workshop are:

1. **The process of establishing an enabling policy and institutional environment**, at both the macro and micro levels, that fosters the emergence of community-based institu-

tions to manage natural resources locally. This includes the establishment or codification of well-defined property rights and responsibilities—whether state, individual, or common—with respect to natural resources.

2. **The participatory process of organising effective community-based groups**, both at the local level and scaling up to the regional level. This includes the role of catalytic organisations in building and facilitating local organisational capacity, effective community participation, and local control and authority over decisions and resources.
3. **Effective operational linkages** between the public sector, the private sector, and community-based groups in the management of natural resources. This includes fiscal and other institutional arrangements between public sector agencies and communities that are oriented towards community demand, and monitoring and evaluating the impacts of these institutional arrangements, in particular on the welfare of the poor.
4. **Alternative approaches to resolving conflicts** in the use of natural resources at all levels—local, regional, and national. This includes conflicts within and between communities, and between different, competing users of a given natural resource such as a river system or a watershed.

The workshop will be conducted in English, with simultaneous interpretation into French, Russian and Spanish.

The week-long programme will consist of overview and framework presentations, case studies, a field trip, and action planning that are geared towards discovering and learning about viable institutional innovations with respect to the various dimensions of community-based natural resource management.

Visit the workshop website: <http://www.worldbank.org/html/edi/conatrem/index.htm> to be kept informed of ongoing preparations for the workshop.

Format and submission of case studies

The principal purpose of this first announcement is to solicit case studies of viable institutional innovations with respect to community-based natural resource management in developing and transition economies. Workshop organisers will select up to 20 case studies for presentation at the workshop. **The Economic Development Institute of the World Bank will pay for the travel and subsistence expenses for those participants that are selected to present case studies.**

Each case study should focus on an institutional innovation or innovations with respect to one or more of the four themes listed above. Institutional innovations are broadly conceived to include changes in laws and practices that coordinate human activity, as well as changes in formal organisations.

Workshop organisers will consider case studies in relation to any renewable natural resource that contains a significant common property dimension, such as watersheds, forests, rangeland, soils, water, fisheries, and biodiversity.

Workshop organisers will also attempt to select a geographic distribution of case studies from around the world.

The initial write-up of the case should not exceed four pages and should follow the following format:

1. ***Identification of the case***.
   Which country, or which region of which country? What type of renewable natural resource? What are the important contextual factors (political, economic, or social) that are relevant to this case? How were the authors involved in the case?
2. ***The initial situation***.
   What was the situation before the institutional change occurred that is the focus of the case? What was unsatisfactory about the initial situation in terms of, say, efficiency, equity, sustainability or accountability? How long had the problem been apparent, and to whom? Who or what would continue to suffer if the problem went unaddressed?
3. ***The change process***.
   What was the process by which the institutional change came about? How did the issue emerge onto the public (or private) agenda? Who were the key actors in the change process, and what were their interests in bringing about change? Who took the initiative and the responsibility for bringing about the change?
4. ***The outcome***.
   What were the key institutional changes that were adopted and implemented? Who is responsible for administering the new institutional arrangements? If available, what has been the impact of these changes on the management of natural resources and on the welfare of the poor? If this information is not available because the changes are so recent, what is expected impact of the changes?
5. ***The lessons learned***.
   What are the principal lessons that the authors of the case derive from the case? Are these lessons replicable in other situations? In the opinion of the authors, what was universal or what was unique about this case that would have an impact on its replicability in other situations?

Cases may be written in English, French, Russian, or Spanish. Authors should submit the first draft of their case (along with their address, phone, fax, and e-mail information) to the following address by February 1998.

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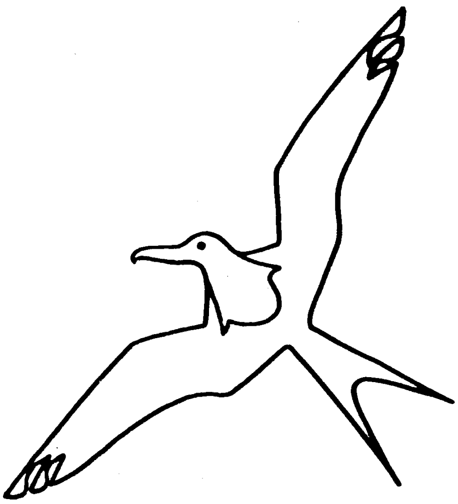
Workshop organisers will inform those authors who have been selected to present their case studies at the workshop by 20 March 1998, after which time the authors will have the opportunity to revise their drafts for presentation at the workshop and for inclusion in the workshop proceedings.



PIMRIS is a joint project of 5 international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the South Pacific Commission (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific (USP), the South Pacific Applied Geoscience Commission (SOPAC), and the South Pacific Regional Environment Programme (SPREP). Funding is provided by the Canadian International Development Agency (CIDA) and the Government of France. This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ('grey literature'); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

Pacific Islands Marine Resources Information System