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by

Temakei Tebano
Tekirua Riinga

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ABSTRACT

The Muraenidae family belongs to the order Anguilliformes (Apodes) or true eels. Within the family are numerous genera that include *Gymnothorax*. The genus is quite widespread and common in the Indo-Pacific, east and south Africa, Australia, USA, Japan, Philippines, the Red Sea, the Australs, Micronesia, Melanesia and Polynesia.

Three eel species of the genus *Gymnothorax* dominated the catches from Tarawa lagoon (Fig. 2) where the traditional eel traps (locally known as te uu) were the principal fishing gear used. The species included *Gymnothorax javanicus* (te kairoro), *Gymnothorax flavimaginatus* (te kaimaii) and *Gymnothorax undulatus* (te ngabingabi) (Plates 1-3). A rarer species, *Gymnothorax meleagris* (te kaibiki) is occassionally found among the catch (Plate 4). Both *Gymnothorax javanicus* and *Gymnothorax flavimaginatus* are among the large species in the genus. The former may grow to a length of more than 2 m and weighing more than 29 kilograms wet weight. The latter may attain a tail length of 1.2 m and weighting 8 kilograms or more. *Gymnothorax undulatus* and *G. meleagris* are smaller species and may grow to around 1 m with wet weight of around 2 kg.

The spawning seasons of *Gymnothorax flavimarginatus*, *Gymnothorax javanicus* and *Gymnothorax undulatus* were also investigated. *Gymnothorax flavimarginatus* spawns in the last quarter while *Gymnothorax javanicus* and *G. undulatus* spawn around fullmoon and continue into the last quarter. *Gymnothorax flavimarginatus* and *G. javanicus* mature and spawn at tail length ranging from 90 - 100 cm with wet weight ranging from 2 to 7 kg while *Gymnothorax undulatus* matures and spawns around tail length of 80 cm with wet weight of around 1 kg. Immature individuals measure up to around 80 cm in the former two species and around 70 cm in the latter. The higher proportion of gravid females in the samples implicates a possible change of sex from male to female but this preliminary observation needs to be further substantiated.

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INTRODUCTION

Moray eels belong to a family Muraenidae in the order Anguilliformes (Apodes) under a class Osteichthyes. Some of the genera in the Muraenidae family that are common in the lagoons and reefs of Kiribati include *Gymnothorax flavimarginatus*, (Rüppell), *Gymnothorax javanicus* (Bleeker), both are also found in the Indo-Pacific and east Africa; *Gymnothorax undulatus*, also common in the Indo-Pacific, east Africa and the Red Sea. More than 80 species in the Muraenidae family are known with at least 53 species and 12 genera from Micronesia (Mayers, 1991).

Moray eels are a group of savage, moderate-sized marine fishes. Their bathymetric range extends from inter-tidal reef flats to depths of several metres (m). They are found throughout the tropical and sub-tropical seas (Halstead, 1967; Grant, 1978). These vicious fish inhabit a large variety of ecological biotopes, in surge channels, coralline ridges, inter-islet channels, reef flats, and lagoon patch reefs. They are nocturnal in their habits, hiding in crevices, holes, and under rocks or coral during the day, and coming out at night. They are able to strike with great rapidity and ferocity (Halstead, 1967; Grant, 1978). Their long, fanglike, depressible teeth are exceedingly sharp, and can inflict serious lacerations. Their powerful muscular development, tough leathery skin, and dangerous jaws make them formidable animals (Halstead, 1967). Some individuals may attain a length of 3 metres (m) and weigh more than 7 kilogrammes (kg) wet weight. Morays are carnivorous and predacious. They can be lured out by placing dead fish or octopus in front of their lair. It is

possible for a large grouper to eat a moray eel. Some species of morays eat other smaller species.

I-Kiribati (the inhabitants of Kiribati) catch moray eels using spears, hook and line, snares and traps. The latter requires specially constructed traps, locally known as te uu, made of hard wood, te ngea *Pemphis acidula* knitted with coconut string and baited with fish or octopus. Trapping is the safest method but requires very special skills.

These animals remain a delicacy and highly esteemed seafood especially in the southern Gilbert group (Nonouti and Tabiteuea), Kiribati, where the art of trapping them remains competitive and family-owned. They are usually collected in large quantities for very special occasions such as weddings, birthdays, visitation by government authorities and other distinguished guests.

All morays in Kiribati are edible but may be ciguatoxic in areas well known for their toxicity. The flesh is agreeable and the oily skin makes it a delicacy by Pacific islanders. If properly boiled or baked in earthen-oven the meat and fat may last a day or so. Eel meat is highly priced in "mwaneabas" - communal meeting houses, in special gatherings and functions. Its nutritional importance in providing certain nutrients including vitamins is being promoted in the islands. The flesh is also often regarded as equivalent to pork, lamb chops and beef stake. The meat could be preserved by salting and sun-drying. It may last 3 to several months.

The art of moray eel trap construction and the distinguished shapes point to the island of origin or where the trapper picked up the art. Eel trapping is not only common in Kiribati but also in its neighboring island, Marshall Islands. Whether the art originated from Kiribati and spread to Marshall Islands during migration prior to the Second World War or vice versa no one knows for sure. But the Kiribati legends and myths tell of the origin of the art is from Kiribati. As far as Kiribati is concerned the art has developed and evolved over time since time immemorial.

The trap is traditionally and architecturally constructed from a local hardwood 'te ngea' or *Pemphis acidula*. The process is tedious and only specialized trappers and experts are required to oversee the whole process. There are specific rituals to be performed right from the gathering of the woods till the completion of the trap (Figure 1).

The baiting, magic and appropriate rituals are some of the crucial components that need to be acquired without which an eel trapper apprentice would never qualify. Although the latter two have been suppressed by early Christian missionaries they are still practiced.

Synthetic materials have been introduced in the making of traps. These include a monofilament line to make a flexible net-like entrance but more importantly for sinnetting (holding together) the whole structure in place of local string from coconut husk fibre. In very renovative cases where iron rods and plastic mesh were used with the hope that they will last longer than the local materials catch performances have been discouraging. The synthetic monofilament is more economical and durable in seawater and its use has spread widely throughout the islands particularly in South Tarawa. Despite innovation to the art old trappers still prefer local materials claiming that moray eels are more attracted to local materials than synthetic materials.

Figure 3: Te Uu

On the island of Tarawa, the capital of Kiribati, fishing for eels is practiced mostly by people coming from the two southern islands as mentioned above. But the art has spread in uncontrollable proportions that the southerners are no longer the master trappers especially on the island of Tarawa. They are finding themselves competing with those who have acquired the art and knowledge via traditional and customary approaches.

There are no comprehensive studies being conducted on moray eels in the Republic of Kiribati. But the human population is increasing very rapidly and the marine resources, especially in Urban Tarawa, are being driven to their maximum threshold. Giant clams, *Tridacna gigas*, are a good example of rare and endangered marine species. Moray eels are being fished endlessly in Tarawa Lagoon. The statuses of their population sizes, spawning season and other important biological aspects have not been fully investigated. To ensure that these resources are utilized within their limits aspects of their biology and ecology need to be researched. It is for this reason that this preliminary study was carried out to look into the spawning season of some moray eel species in Tarawa, the *Gymnothorax* species in particular, that are heavily fished by trappers.

Information on aspects of the biology and ecology of eels in Kiribati are very scarce. The need to manage our diminishing and ov

frequencies. Encouragingly several species of eels have been documented for the Pacific rim (refer to Myers, 1991, Micronesian Reef Fishes; Halstead, 1967, Poisonous and Venomous Marine Animnals, and others). The four species reported here may be expanded in future as research on the genus continues. The specific aims of this paper are:

1. To document moray eel species that are commercially fished on a small scale from Tarawa lagoon for domestic consumption with the use of traditional eel traps;
2. To determine the spawning seasons of the deep water eels of Tarawa Atoll.

METHODS AND MATERIALS

Samples were collected using locally made traps called "uu" Eight to ten traps were set on the western reef edge of North Tarawa. The traps were baited with either a flying fish or other reef fish bought off the fish markets or caught by the trappers themselves. The initial trapping excursions or pilot surveys were executed in March, 2000, and targeted at the first and last quarter moons (twice a month) when weather conditions especially water current and wind patterns are believed to be most favourable on average based on traditional navigation information and knowledge. The pilot surveys showed that only one species appeared to be gravid during the last quarter. Therefore, the sampling times were increased during the next months to cover other major phases of the moon, new and fullmoon periods, to ensure all spawning activities that coincide with any phase are investigated.

'Te uu' or eel traps constructed from local materials were the principal gear used in the collection of eel samples in the survey. A 5-meter wooden skiff powered by a 40hp Yamaha outboard motor carried 6 to 9 traps and 3 to 4 trappers per fishing trip. Flying fish is the main bait used complimented by reef fish caught during the excursions. The bait and catches were stored in eskies with crushed ice.

The fishing ground extends from the western reef adjacent to Abaokoro village up to Buariki village at the northernmost of the atoll (Figure 1). The distance from the research station is approximately 30-50 km. Each excursion lasted 24 hours on average commencing from early morning on the first day until the following morning on the second day. Two methods of fishing were used namely *te taeua* and *te kamatu* . The former refers to the deployment of the traps or "te uu" for short intervals (2-3 hours) while the latter refers to the setting of the traps before sunset and left overnight till the following morning. Different baiting techniques called 'te taboaa'

are used consecutively (details omitted). The average depth of the fishing grounds vary from tide to tide and from location to location but within the 7-10 meters.

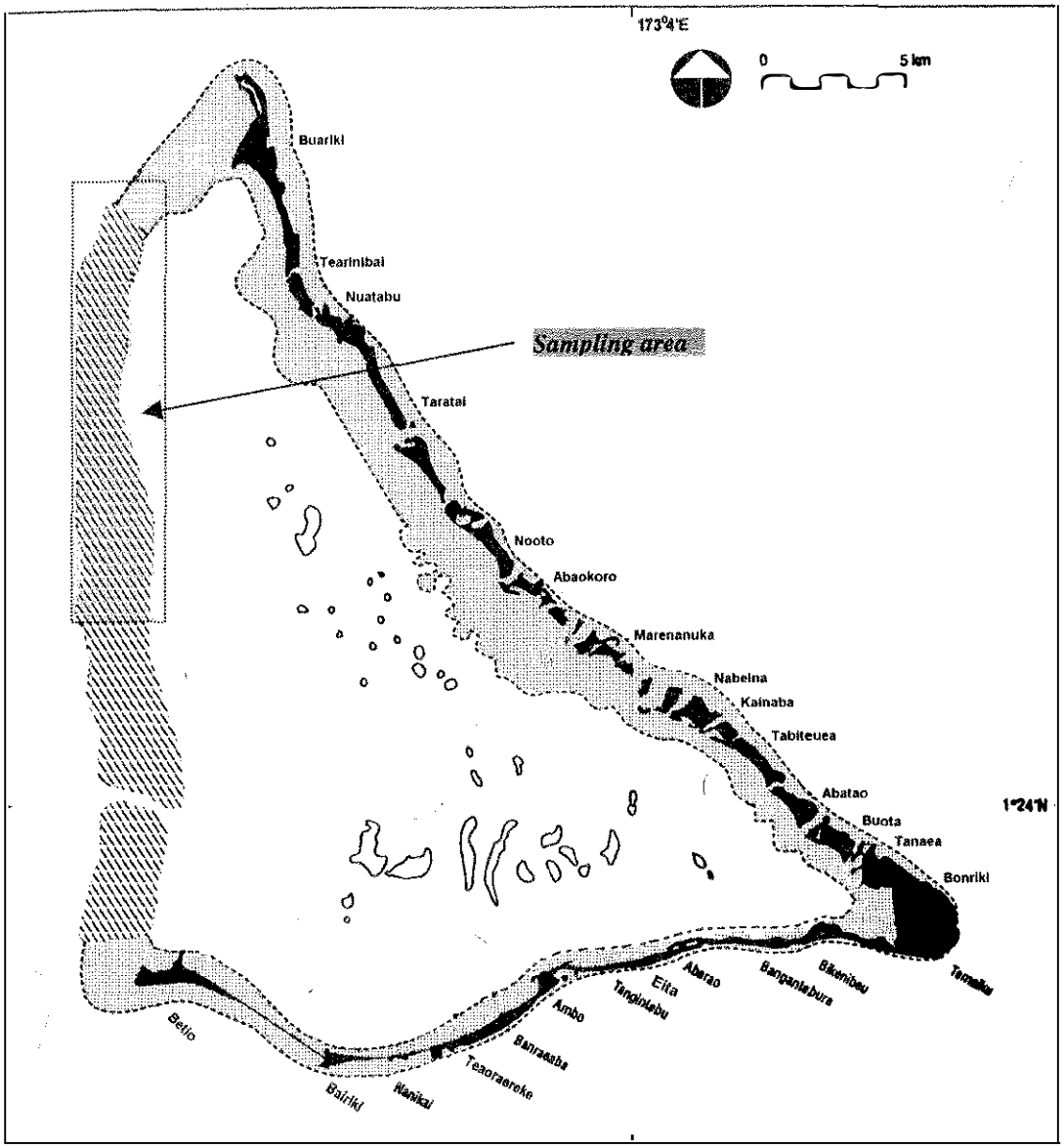


Figure 2: Map of Tarawa atoll showing sampling area

The specimens were sorted as soon as they were brought in to the laboratory. The identification process took place. Morphological characteristics specific to the genus *Gymnothorax* were checked using color reference books. The specimen were also measured for tail length, weighed and gutted. The gonads were examined for developmental stages.

Each individual animal was identified to a species level using colour pictures (Myers, 1991; Randall in Fish Base, 1998) and physical descriptions (Halstead, 1967). Each specimen was weighed (kg) using a 10 kg weighing scale. Tail length (total length) was taken (centimetres) using a centimetre-graduated (20 mm diameter) PVC

piping of more than 100 cm long. The sex, gonad stage and date of sampling were also noted (Appendix 1). The staging of the gonads were determined under the guidance of a fish specialist. The four stages considered were 1 = developing, 2 = maturing, 3 = ripe/gravid, 4 = spawning/spent.

RESULTS

SPECIES

There are several species of eel that are known by their local names and recognized by the specific patterns that they bear on their body. The common deep water species are presented in Table 1 below:

Table 1: Deep water moray eel species found in Tarawa Lagoon.

Local Name	Latin Name
Te ngabingabi	*Gymnothorax undulutus* (Plate 1)
Te kairoro	*Gymnothorax javanicus* (Plate 2)
Te kaimaii	*Gymnothorax flavimaginutus* (Plate 3)
Te kaibiki	*Gymnothorax meleagris* (Plate 4)

Based on meristematic descriptions presented by Myers (1991), the corresponding *Latin* names are given above. The genus *Gymnothorax* can be distinguished from other Muraedinae genus by the presence of one or more depressable fangs in the middle of the front upper jaw with vomerine teeth in a single row, Myers, 1991 (**see Figure 3**).

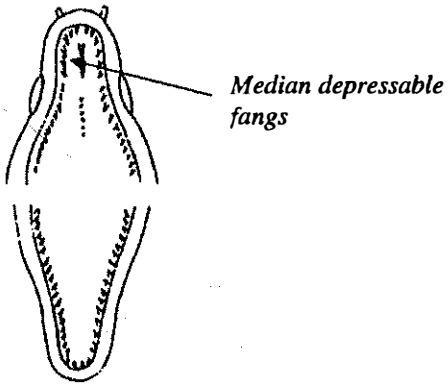


Figure 3. Internal view of eel mouth showing teeth arrangement

However, other features of importance in the identification of the genus include the following:

i. Body is not elongate with length usually less than 30 times body depth

ii. Fins well developed in this genus

iii. Teeth usually sharp, pointed, conical but never molariform.

iv. Lower jaw never longer than upper jaw with eyes closer to corner of mouth than tip of jaw. Jaws slightly or not curved with posterior nostrils not enlarged.

SPAWNING

Three species of moray eels (locally and generally called *'rabono'*) that dominate trap catches in deep waters between 10 to 30 metres are shown below (Plates 1, 2, 3). Other species that belong to the same genus are also known to exist and may occupy a slightly different niche from these deep water species. The smaller species that inhabit reef flats and shallow water pools are locally known as 'rabono-maii' reflecting their silvery, whitish and black/brownish spotted skin but considered belonging to a different genus or genera.

A visual examination on the stages of the gonads Appendix 1 shows that *Gymnothorax flavimarginatus* appears to spawn in the last quarter while *Gymnothorax javanicus* and *G. undulatus* (that are easily confused) appear to spawn around fullmoon and continue into the last quarter (Figure 4). Immature individuals measure around <80 cms tail length. Spawning occurs in *Gymnothorax flavimarginatus* and *G. javanicus* at tail length of 90 - 100 cm with wet weight ranging from 2 to 7 kg. A smaller species, *Gymnothorax undulatus* spawns around tail length of 80 cms and wet weight of 1 kg. Immature individuals measure less than 70 cm tail length.

A high proportion of gravid females in the samples implies that there may be a change in sex in favour of females. More data is required to substantiate this claim.

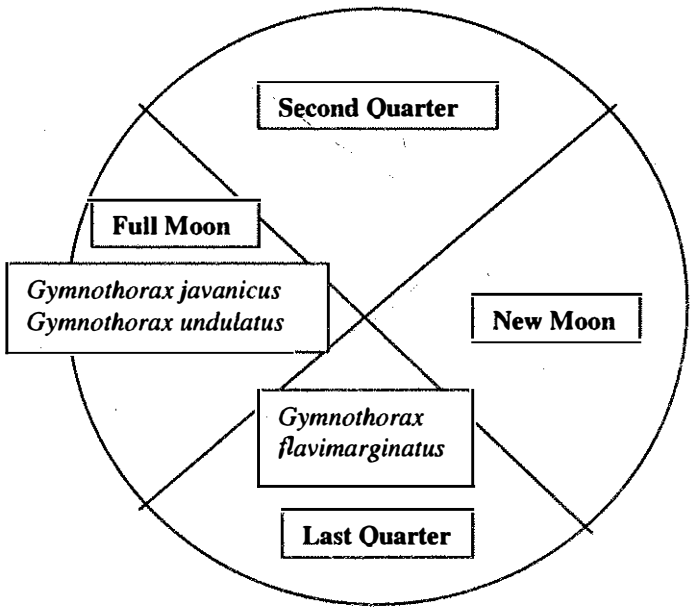


Figure 4: Spawning seasons of the three deep water eel species.

PLATES

Local	FishBase

Plate 1: Te ngabingabi, *Gymnothorax undulutus*

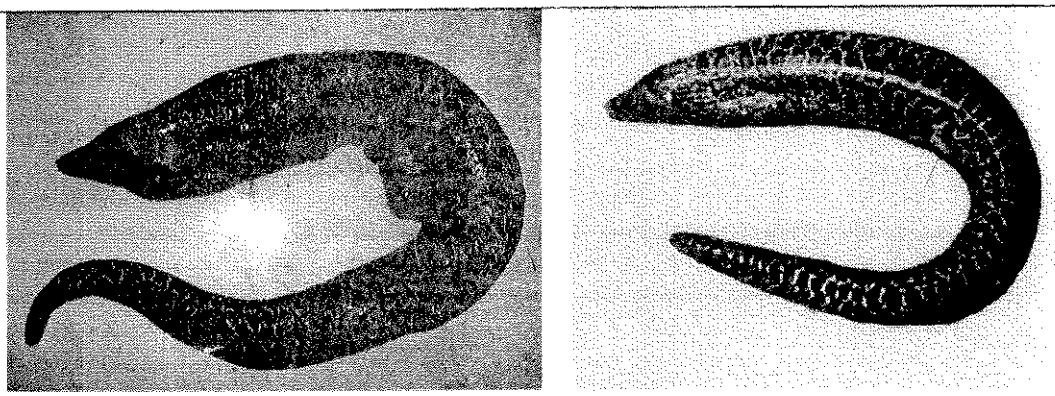


Plate 2: Te kairoro; *Gymnothorax javanicus*

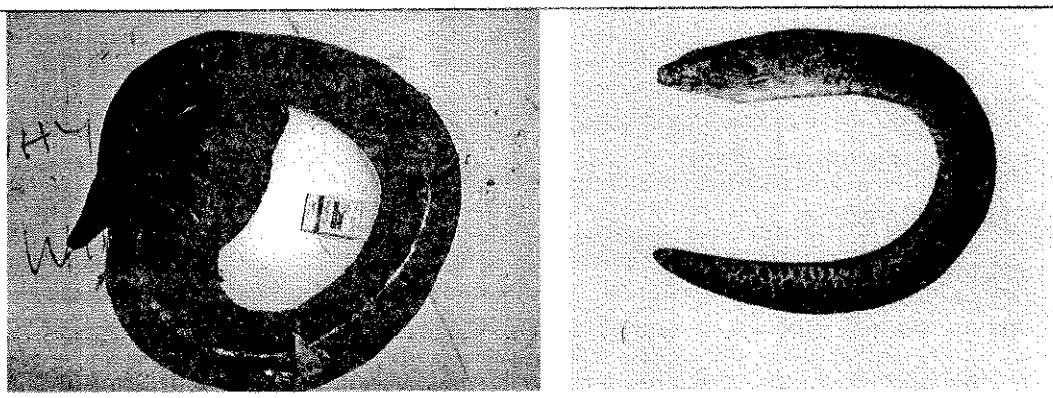


Plate 3: Te kaimaii; *Gymnothorax flavimaginutus*

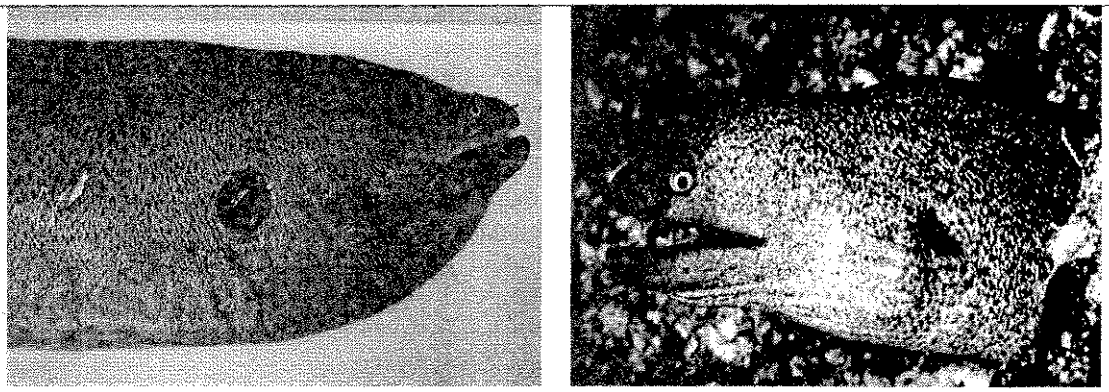
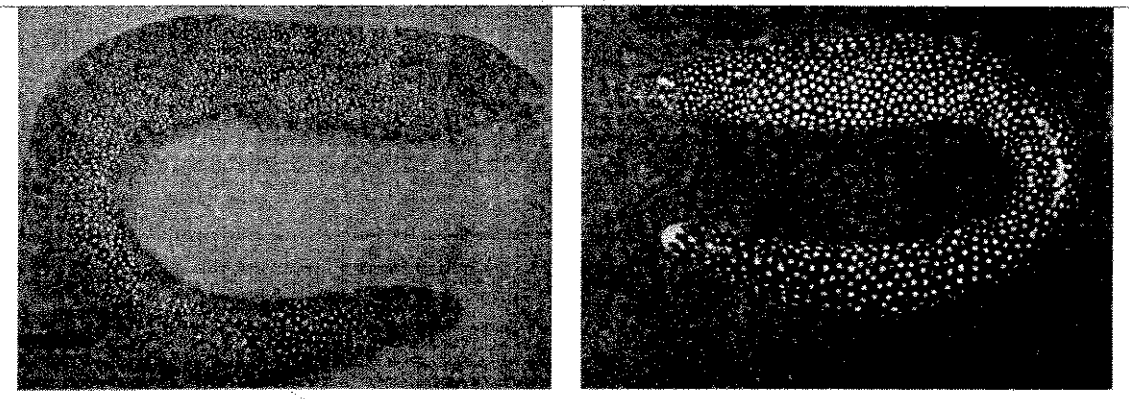


Plate 4: *Te kaibiki Gymnothorax meleagris*



DISCUSSION

Moray eels have been described by many authors as vicious and dangerous marine animals. This perspective needs to be re-oriented in light of the environment and the actual role these animals play. Here is one description derived from a MetaCrawler website:

Infoseek Moray eels really aren't as ferocious as they look - they aren't trying to eat you or bite you - they're just trying to breathe! Eels really are cool to see, especially when you catch a glimpse of one... Bonaire, Netherlands.

In order to survive and continue with their progeny and other processes moray eels possess distinct adaptation strategies in all aspects of their biology, ecology, morphology and physiology. These also enable them to occupy a wide range of habitats, rocky and reef areas to depths of 100m+.

Gymnothorax flavimarginatus inhabits coral or rocky areas of a variety of zones ranging from reef flats and protected shorelines to seaward reefs to depths of 150 m. It feeds on fish and crustaceans. Its range is from the Red Sea to Panama in the north to the Ryukyu and Hawaiian Islands, and to New Caledonia to the Tuamotus in the south and the Australs, and throughout Micronesia (Halstead, 1967).

Gymnothorax javanicus is probably the world's largest but not the longest, species of moray. It occurs on both lagoon and seaward reefs to depths of at least 46 m. Juveniles are more secretive and occur as shallow as 0.2 m on reef flats. The leopard moray is relatively common throughout most of its range where is among the species most likely to be encountered by divers. It is somewhat more active at night and feeds primarily on fishes and occasionally on crustaceans. Its position at the top of the reef's food chain make it one of the most frequently and severely ciguatoxic of fishes. Its range stresses from the Red Sea to the Marquesas and Oento Atoll (Pitcairn group) in the north to the Ryukyu and Hawaii Islands, and in the south to the Australs and New Caledonia, and throughout Micronesia (Halstead, 1967).

Gymnothorax undulatus is a common inhabitant of reef flats among rocks, rubble, or debris and also occur on lagoon and seaward reefs to depths of 26 metres or more. It is primarily nocturnal and feeds on fishes, octopuses, and probably crustaceans. The range is from the Red Sea to Panama in the north to South Japan and from Hawaiian Islands in the south to the south of the Great Barrier Reef, Rapa and the Australs and throughout Micronesia (Halstead, 1967).

Gymnothorax meleagris is a common inhabitant of reef flats among rocks, rubble, or debris and also occur on lagoon and seaward reefs to depths of 26 metres or more. It is primarily nocturnal and feeds on fishes, octopuses, and probably crustaceans. The range is from the Indo-Pacific to Philippines, Japan, Ceylon and south Africa (Halstead, 1967).

Like most eels, morays undergo a lengthy pelagic leptocephalus larval stage resulting in most species being widely distributed. At least 53 species in 12 genera are known from Micronesia (Myers, 1991). Little is known on the spawning migration and other related activities in these species. But in the European yellow and silver eels spawning migrations have been observed (Norman and Greenwood, 1975).

The increasing amount of fishing effort on moray eels will soon drive their populations to their lowest. Because moray eels take sometime to reach maturity there ought to be some management plan that will ensure the populations are unnecessarily overexploited. With the spawning season and size at maturity now available perhaps the exploitation of these fish during their spawning season and the release of the under size ought to be regulated not only in Tarawa Lagoon but also in other lagoons and reefs in the Republic. The likely modern and more efficient methods should be banned.

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APPENDIX 1

Eel Samples collected from the lagoon of Tarawa Atoll, April - August, 2000.

Gymnothorax javanicus

Date	Length (cm)	Weight (kg)	Sex	Gonad Stage	Moon Phase
28-Apr-00	140	7.8	m	2	
28-Apr-00	120.25	5.5	f	1	
28-Apr-00	120.25	4	f	1	
28-Apr-00	120.25	4.1	f	1	
28-Apr-00	120.75	6.5	m	1	
28-Apr-00	110	2.5	f	1	
28-Apr-00	100	2.5	m	1	
28-Apr-00	110	2.5	f	1	2 days after LAST QUARTER
28-Apr-00	90	1.4	m	1	
28-Apr-00	80.75	1.5	f	1	
28-Apr-00	100	1.7	f	1	
28-Apr-00	90.5	1.6	m	2	
28-Apr-00	80.75	1.1	f	1	
28-Apr-00	90.5	1.7	f	1	
28-Apr-00	90.75	2.1	m	2	
28-Apr-00	70.75	0.7	m	0	
06-May-00	140	7.9	m	2	
06-May-00	100	2.6	f	1	
06-May-00	120	4	f	1	1 day after NEW MOON
06-May-00	110.5	3.5	f	4	
06-May-00	130.5	6.5	m	2	
20-May-00	110.25	4.2	f	4	
20-May-00	110.25	2.4	f	3	
20-May-00	110.25	3.6	m	1	
20-May-00	70	0.6	f	1	
20-May-00	130	7	f	1	
20-May-00	100	2.4	f	1	two days after FULL MOON
20-May-00	100.25	2.1	m	3	
20-May-00	100.25	3	f	4	
20-May-00	80	2.3	im	im	
20-May-00	130.5	7.5	f	1	
20-May-00	140.25	6.1	f	1	
20-May-00	130	5.9	m	1	
20-May-00	120	3.4	f	3	
20-May-00	110.75	5.1	f	im	
25-May-00	120.25	4.3	f	2	
25-May-00	150	8.4	m	1	
25-May-00	110.5	4.6	m	2	
25-May-00	120.5	4.4	f	4	
25-May-00	120.5	5	f	4	
25-May-00	110.75	3	f	3	
25-May-00	100.75	2.7	f	3	
25-May-00	110.25	2.7	f	3	
25-May-00	120	3.6	f	1	
25-May-00	140	7.2	m	1	
25-May-00	100	2	f	1	
25-May-00	100	1.8	f	1	
25-May-00	130.25	5.3	m	2	
25-May-00	110.5	2.7	f	4	1 day before
25-May-00	120.25	3.8	m	2	LAST QUARTER

25-May-00	130	6	m	2	
25-May-00	120.25	3.6	f	4	
25-May-00	110.5	2.3	f	4	
25-May-00	100	1.9	f	2	
25-May-00	100	1.8	f	1	
25-May-00	100.5	2	f	1	
25-May-00	100	1.9	f	2	
25-May-00	90.5	1.6	f	2	
16/17-Jun-00	140	6.8	m	1	
16/17-Jun-00	140.5	6.2	m	1	
16/17-Jun-00	130.25	6.6	f	1	
16/17-Jun-00	140.25	6.3	f	1	
16/17-Jun-00	150	8.4	f	3	
16/17-Jun-00	120.75	5.4	f	2	
16/17-Jun-00	110.75	3	m	1	
16/17-Jun-00	110.75	3.6	m	1	
16/17-Jun-00	100.75	2.5	m	1	FULL MOON
16/17-Jun-00	100.25	2	f	4	and 1 day after
16/17-Jun-00	100.75	2.5	m	4	
16/17-Jun-00	110.75	2.5	m	3	
16/17-Jun-00	110.25	2.8	f	4	
16/17-Jun-00	80.75	2	f	4	
16/17-Jun-00	80.75	1	f	im	
16/17-Jun-00	100.5	2	f	1	
16/17-Jun-00	90.5	1.2	f	1	
16/17-Jun-00	80.5	1	im	im	
8/9-Jul-00	148	8.5	m	1	
8/9-Jul-00	110	2	f	3	
8/9-Jul-00	130	3.9	m	1	
8/9-Jul-00	100.25	2.6	m	1	
8/9-Jul-00	110.5	3	f	2	
8/9-Jul-00	90	1.2	m	1	
8/9-Jul-00	110.75	4	m	1	FIRST QUARTER
8/9-Jul-00	100.75	2.1	f	2	and 1 day after
8/9-Jul-00	100.75	2.8	f	4	
8/9-Jul-00	140	7.8	f	1	
8/9-Jul-00	130	5.3	f	1	
8/9-Jul-00	130	5.3	m	2	
8/9-Jul-00	80.5	1	m	im	
16-Aug-00	130.25	6.3	m	1	
16-Aug-00	110.5	3.8	m	1	
16-Aug-00	100.75	2.8	f	4	
16-Aug-00	120.5	4.3	m	1	1 day after FULL MOON
16-Aug-00	110	3	f	1	
16-Aug-00	120	4.9	m	1	
16-Aug-00	100.25	2.2	f	4	

LQ = LAST QUARTER; NM = NEW MOON; FQ = FIRST QUARTER; FM = FULL MOON
m = male; f = female; im = immature

Gymnothorax undulatus

Date	Length (cm)	Weight (kg)	Sex	Gonad Stage	Moon Phase
28-Apr-00	80	1.1	f	1	
28-Apr-00	80	1.2	f	1	

28-Apr-00	70.75	1.1	m	1
28-Apr-00	80.25	1.2	f	1
28-Apr-00	80.5	1	m	2 2 days
28-Apr-00	80.25	1	f	0 after LAST QUARTER
28-Apr-00	80.25	1	m	2
28-Apr-00	80.25	0.9	f	1
28-Apr-00	70.25	0.9	f	2
28-Apr-00	70	0.9	f	1
28-Apr-00	70.25	0.7	m	2
6-May-00	90	1.5	f	1 1 day after
6-May-00	90	1.3	f	1 NEW MOON
20-May-00	80.5	1.3	m	1
20-May-00	90.5	1.4	f	1
20-May-00	80	1	f	1
20-May-00	70.75	6.8	im	im
20-May-00	90.25	1.8	im	im
20-May-00	90	1.5	im	im 2 days after
20-May-00	80.5	1.1	f	1 FULL MOON
20-May-00	80.75	1.6	im	im
20-May-00	80.25	1.3	f	im
20-May-00	90.25	2	f	im
20-May-00	80.25	1.2	im	im
20-May-00	80	1.2	im	im
25-May-00	90.5	1.4	m	1
25-May-00	90	1.4	f	1
25-May-00	90.5	1.4	f	1
25-May-00	90	1.4	f	1
25-May-00	80.75	1	f	1
25-May-00	90	1	m	1 1 day b4
25-May-00	80.75	1.3	im	1 LAST QUARTER
25-May-00	80.25	0.9	m	1
25-May-00	80.5	0.8	m	1
16/17-Jun-00	80.25	1	f	1
16/17-Jun-00	90.25	1.2	m	1
16/17-Jun-00	80.75	1	m	1
16/17-Jun-00	80.5	0.75	m	1
16/17-Jun-00	80.75	1.3	f	1
16/17-Jun-00	80.5	1.1	f	1 FULL MOON
16/17-Jun-00	80	0.9	f	1 and 1 day after
16/17-Jun-00	80.5	1	f	1
16/17-Jun-00	80.75	1.2	m	1
16/17-Jun-00	90	1.4	f	1
16/17-Jun-00	70.75	1.2	m	1
16/17-Jun-00	80	1	m	im
8/9-Jul-00	70.25	1	m	2
8/9-Jul-00	70.75	0.9	m	2
8/9-Jul-00	70.75	0.6	f	1
8/9-Jul-00	70.75	0.9	f	1
8/9-Jul-00	80	1	f	2
8/9-Jul-00	70	0.6	m	1
8/9-Jul-00	80.5	1.2	m	1 FIRST QUARTER
8/9-Jul-00	70.75	1.3	f	1 and 1 day after
8/9-Jul-00	70.25	0.8	m	1
8/9-Jul-00	60.5	0.4	f	3

8/9-Jul-00	70	0.1	m	1
8/9-Jul-00	70.25	0.75	m	1
8/9-Jul-00	80.5	1.1	f	1
8/9-Jul-00	80.25	0.75	f	im
16-Aug-00	80.75	1.2	f	1
16-Aug-00	90	1.5	f	1 1 day after
16-Aug-00	80	1.1	f	1 FULL MOON
16-Aug-00	80.5	1.1	m	1

LQ = LAST QUARTER; NM = NEW MOON; FQ = FIRST QUARTER; FM = FULL MOON
m = male; f = female;
im = immature

Gymnothorax flavimarginatus

Date	Length (cm)	Weight (kg)	Sex	Gonad Stage	Moon phase
28-Apr-00	110.25	2.3	f	4	
28-Apr-00	100	2.2	f	1	
28-Apr-00	100.5	2.6	f	3	2 days after
28-Apr-00	120	2.4	m	4	LAST QUARTER
28-Apr-00	110	2.4	m	2	
6-May-00	90	2.1	f	3	1 day after FULL MOON
6-May-00	90.5	2	f	3	
20-May-00	100	2.2	f	3	2 days after
20-May-00	100.5	2.6	f	3	FULL MOON
20-May-00	120	2.4	m	2	
20-May-00	110	2.4	m	3	
25-May-00	90.5	2	m	1	
25-May-00	90	2.4	f	3	1 day before
25-May-00	90.5	2.3	m	4	LQ
25-May-00	90	2.1	f	4	
16/17-Jun-00	120.25	2.5 f		2	
16/17-Jun-00	110	2.3 m		2	
16/17-Jun-00	100.5	2.6	f	3	FULL MOON
16/17-Jun-00	120	2.4	m	3	and 1 day after FM
16/17-Jun-00	110	2.4	f	2	
8/9-Jul-00	70.25	1	m	2	
8/9-Jul-00	70.75	0.9	f	2	FIRST QUARTER
8/9-Jul-00	70.75	0.6	f	2	and 1 day after FQ
16-Aug-00	110.25	2.3	f	2	
16-Aug-00	100	2.2	f	3	1 day after
16-Aug-00	100.5	2.6	f	3	FULL MOON
16-Aug-00	120	2.4	m	2	
16-Aug-00	110	2.4	m	4	

LQ = LAST QUARTER; NM = NEW MOON; FQ = FIRST QUARTER;
FM = FULL MOON
m = male; f = female;
im = mmature