

A PRELIMINARY SURVEY OF THE FISHERIES IN THE MALDIVES*

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ABSTRACT

Salient features of the marine fisheries of Maldives are presented in this paper. The tuna fishery is by far the most important fisheries of Maldives and constituted mainly by the Skipjack. The type of fishing boats, live-bait tuna fishery, system of sharing the catch and production of cured fishes are described.

Important reef and lagoon fishes, sharks and rays occurring in Maldivian waters are noted. The common tuna live-bait species in the Maldives are listed and their fluctuations in availability discussed. Notes are also made on important crustaceans and molluscs occurring in the Maldivian waters.

INTRODUCTION

THIS PAPER gives a short account of some of the important features of the Maldivian fishery, mostly from a fishery biological point of view. The Maldivian fishing industry, which has been and still is the basis of the economy of the country (Anon., 1976), undergoes in these years several structural changes due to motorization of the fishing vessels, which reduces the necessary crew and increases the fishing power; increasing foreign demand for whitefish and lobster resulting more effort being put into the fishery for these species and the export of cured tuna fish, which for centuries has been the main export article, faces in these years serious problems due to the export restrictions in Sri Lanka. Such changes will probably influence many aspects of social structure in the Maldives where the society is so marked by the fishing industry.

Most of the information given here is based on sampling and data collected from August

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to November 1977 in the southern atolls (Huvadhu, Fua Mulaku, Addu) and from October to November 1978 during a cruise in the northern atolls.

Obviously, for a country like the Maldives consisting of some 1500 islands (of which less than 1/3 is inhabited) scattered over such a vast area (Fig. 1) such two periods of sampling is not enough and therefore this account should be regarded as preliminary.

TUNA FISHERY

The Maldivian Islands are ideally situated for a fishery for oceanic tuna species and the major part (80-90%) of the total catch consists of tuna species (Table 1). The high quality dry-fish ('Maldivian Fish') which for centuries has been the main export article from the Maldives, is made from tuna.

As can be seen from Table 1, the main species is the skipjack tuna. The figures for this species may not seem impressive, but considering the four year period (1975-78) the Maldivian landings of skipjack constitute about 60% of the landings from the western Indian Ocean and about 2.5% of the world total.

The main fishing method which is the live-bait pole and line method, has remained practically unchanged for centuries as can be seen in the description from the 17th century of the Maldivian fishery by Pyrard de Laval (1619).

dhoni.' Both are elegant, slender carved-built boats. The material used is normally coconut wood except for the keel and gunwale which are made of harder types of wood.

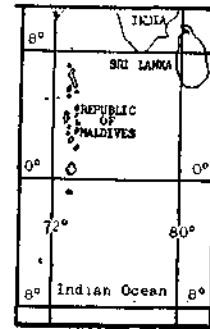
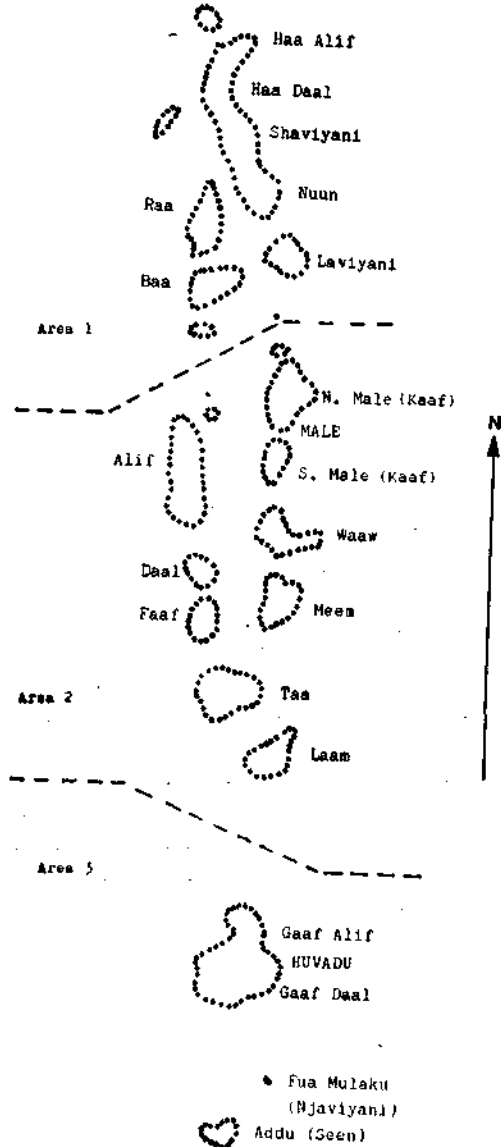


Fig. 1: Republic of Maldives

In case of the southern atolls (area) the old atoll names are still widely used instead of the names of administrative units

The fishing boats

Two types of fishing boats are used in the Maldives: the 'mas dhoni' and the 'wado

The 'mas dhoni' (mas = fish) is the larger of the 2 types and is the boat used for the live-bait pole and line fishery. The size of the boat varies, the length is between 10-15 m

TABLE 1. Total landings (in metric tonnes) by species in Republic of Maldives
(From : FAO yearbook of fishery statistics)

Year	Skipjack tuna	Yellowfin tuna	Frigate mackerels	Little tuna	Other fishes	Total
1966	15900	1500	3000	—	1000	21400
1967	17900	1700	3000	500	1000	24100
1968	16300	1700	3000	500	1000	22500
1969	18400	1800	3000	600	7300	31100
1970	27300	2100	3100	700	1300	34500
1971	28900	2300	2600	400	1400	35600
1972	16000	5000	3100	600	7500	32200
1973	20000	5200	6200	1000	1300	33700
1974	24000	4500	5900	800	2300	37500
1975	16000	4200	3900	400	3400	27900
1976	19900	4800	2700	1000	3900	32300
1977	14700	4300	3200	1000	3500	26700
1978	13800	3700	1900	800	5600	25800

and the width about 3 m. In general the largest boats are found in the northern atolls reflecting a better fishing in these waters.

The 'mas dhoni' has 1 mast and on each side there is provisions for 5-6 oars. In the stern there is a slightly raised platform, which extends beyond the sides of the boat and serves as a deck. In the motorized 'mas dhonies' the engine is placed in a compartment beneath this platform. The rest of the boat is normally open and divided into several compartments which function as bait wells during the fishing trip. Fresh sea water is provided through holes in the bottom of the hull. On the home-ward journey, these compartments can be covered with loose planks used for placing and counting the catch.

Those boats, which have been motorized, carry a crew of 8-12 while the sailboats need a larger number of crews (about 20) to row, when there is no wind.

The 'wadu dhoni' ('wadu' = feather, used as jig in the trolling and long line fishing) is

of similar construction as the 'mas dhoni' but is only 5-7 m long. The 'wadu dhoni' normally carry a crew of 2-8 persons.

Live-bait pole and line fishing

The principle in the Maldivian live-bait tuna fishery is the same as of the live-bait tuna fisheries carried out elsewhere (Godsil, 1938 ; June 1951, Imamura, 1949). It is a pole and line fishery, which is carried out while the schools of tuna are being attracted by the live-bait and by water-splashing. The main characteristics of the Maldivian fishery compared to other live-bait tuna fisheries today are the following :

1. The relative small size of the vessels (these normally return the same day as they left).
2. The lack of a mechanized waterspraying system.

A similar fishery is carried out from the island of Minicoy which has the same culture and language as the Maldives. A description

of this fishery is given by Jones and Kumaran (1959).

A normal fishing trip lasts about 12 hours (1 day). The fishing vessels ('mas dhoni') leave the islands shortly before sunrise and set out for the bait-fish grounds, which are situated inside the atolls. When the necessary amount of bait has been caught, the vessels proceed to the open sea outside the atolls and the search for the schools of tuna begins. The schools are usually found by searching for and observing the sea birds, which, when given the opportunity, take the same prey as the tuna.

ing, and this process further activates the biting of the tuna.

The fishing itself is carried out by 2-4 persons at a time headed by the 'Keolo' (chief fisherman). They are standing on the platform with their poles. The hooks are usually barbless and often unbaited, only when the tuna is unwilling to bite barbed hooks are used. Usually a school of skipjack consists of one size group only, but dependant of the size of the fish in the school several sizes of hooks are always available. Also, dependant of the distance of the fish from the boat, poles

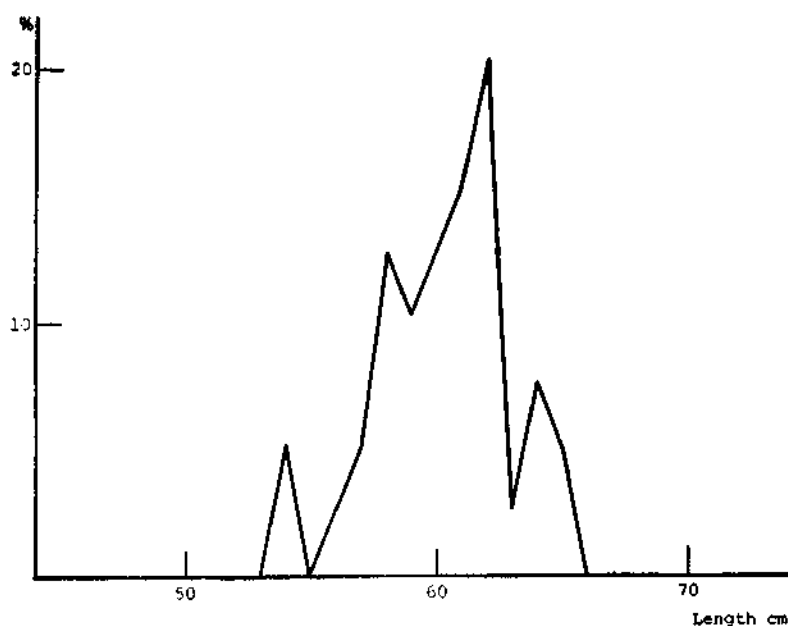


Fig. 2. Size distribution of 102 Skipjack tunas which made up the catch of one 'Mas dhoni' from Kandoludu (Raa Atoll) weight of the catch : 428 kg.

When the vessel approaches the school, live-bait is thrown out in the sea to attract the tuna; this important task is performed by the 'En Keolo' (chief bait fisherman). When it is apparent that the school has been attracted by the bait and is schooling around the vessel, two persons sitting on the platform in the stern of the boat begin the water-splash-

of various lengths are available. Double-poles are not used.

An encounter with a school normally lasts for less than 1/2 hour, but even during these short period it is possible to fill up the boat on 1-2 encounters, even when, as is often the case, several boats are engaged with the same

school. The vessels always return to the islands before night.

The main species caught in this fishery is the skipjack tuna (*Katsuwonus pelamis*) and smaller specimens of yellowfin tuna (*Thunnus albacares*) and to a lesser extent frigate mackerels (*Auxis thazard*) and little tuna (*Euthynnus affinis*). Often the boats return to the islands without any catch at all, either because no schools of tuna were found or because the fish were unwilling to bite. A catch of, for instance 100 'large skipjack' ('Godā mas'), each weighing about 1 kg, is considered a good catch for a day (Fig. 2) but catches upto 4-500 are frequently taken.

The live-bait tuna fishery is subject to large seasonal fluctuations. However, the only data available to the author are those given by Anon (1976), which show the landings in numbers of skipjack and yellowfin tuna by month by atoll for the years 1972, 1973 and 1974 (Fig. 3 a, b). Since about 90% of the skipjack is taken in the live-bait fishery, these data reflect the fluctuations in this fishery.

In the case of the northern atolls there are marked peak seasons during the north east monsoon period, especially in the northern most atolls, but in the case of the other atolls it is difficult to see any regular yearly pattern. Obviously, an important factor determining the success of this fishery is the abundance of skipjack tuna, but as for the migrational patterns of this oceanic species around the Maldives, no data is available. However, the northern atolls are the main area of fishing for both skipjack and yellowfin tuna, as can be seen from Table 2. Also the availability of a sufficient amount of live-bait is of prime importance to this fishery. Furthermore, because this fishery is conducted in the open sea from small vessels, the weather is also an important factor, although the increasing motorization in recent years of the 'mas dhonies' has reduced this factor.

TABLE 2. Percentage distribution of total catch of Skipjack tuna (S) and Yellowfin tuna (Y) in numbers by area

*Area	1972		1973		1974	
	S	Y	S	Y	S	Y
1	44.7	61.9	47.4	58.8	35.0	53.8
2	39.9	35.7	38.5	38.4	39.0	41.3
3	15.3	2.3	14.2	2.8	26.0	4.8

Area 1 (northern atolls): Haa Alifu, Haa Dhaalu, Shaviyani, Noonu, Raa, Baa, Laviyani.

Area 2 (middle atolls): Kaafu, Alifu, Vaavu, Meemu, Faafu, Dhaalu, Thaa, Laamu.

Area 3 (southern atolls): Gaaf Alifu, Gaaf Dhaalu, Ynaviyani, Seenu.

Other fishing methods

Trolling and long-line fishery for tuna and other Scombroid fishes takes place all year round. Trolling is carried out from all the various types of boats, whenever an opportunity is given. The artificial lure is a sort of jig made from chicken feather.

The long-line fishery for tuna is carried out especially when the pole and line fishery in some way or another is unsuccessful i.e. bad weather, no live-bait, etc. This fishery is most often conducted from the 'wadu dhoni'. Various fish species are used for bait including: clupeids, flyingfishes, silversides (*Allanetta* sp. and fusiliers (*Caesio* sp.), cf. sect. 4. The Acanthurid (*Acanthurus triostegus*) is considered a good bait for catching yellowfin tuna (Addu Atoll).

The long-line fishery contribute an important part of the total catch of yellowfin tuna.

Sharing of the catch

The system for sharing the catch varies from island to island and is often quite complicated. However, the owner of the boat always

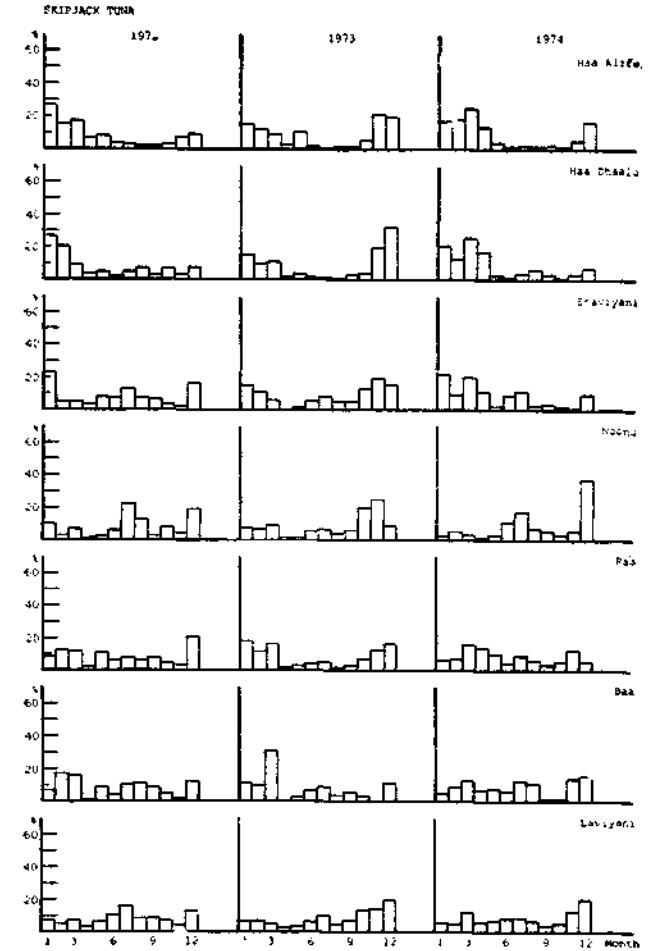
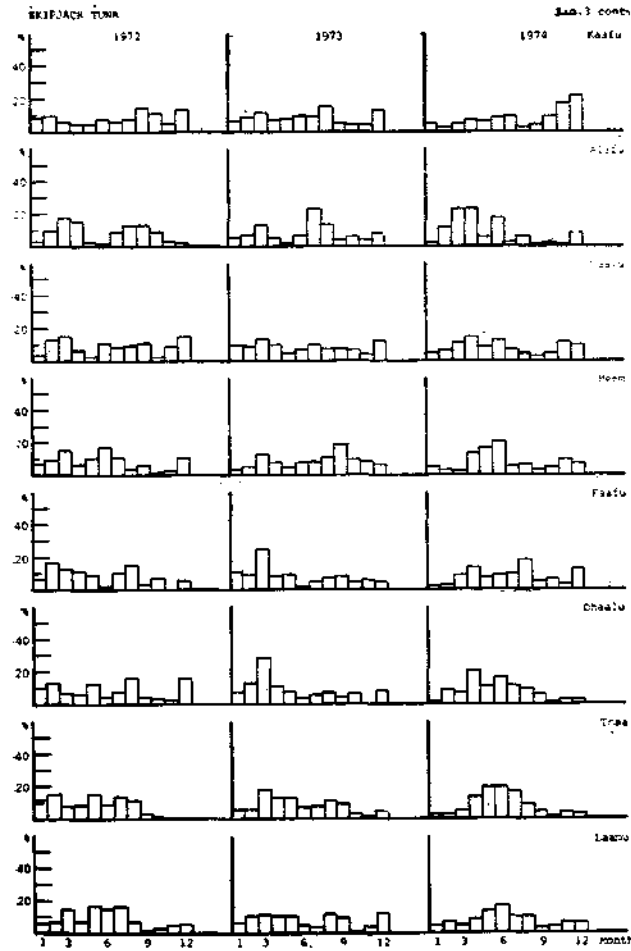


Fig. 3 a. Landings of skipjack tuna from 1971 through 1974.

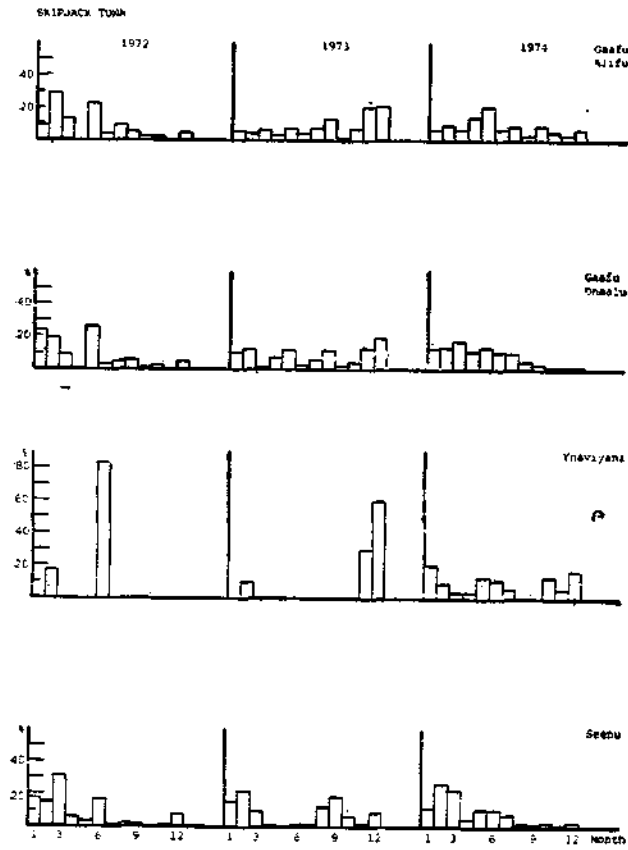


Fig. 3 a. (Continued).

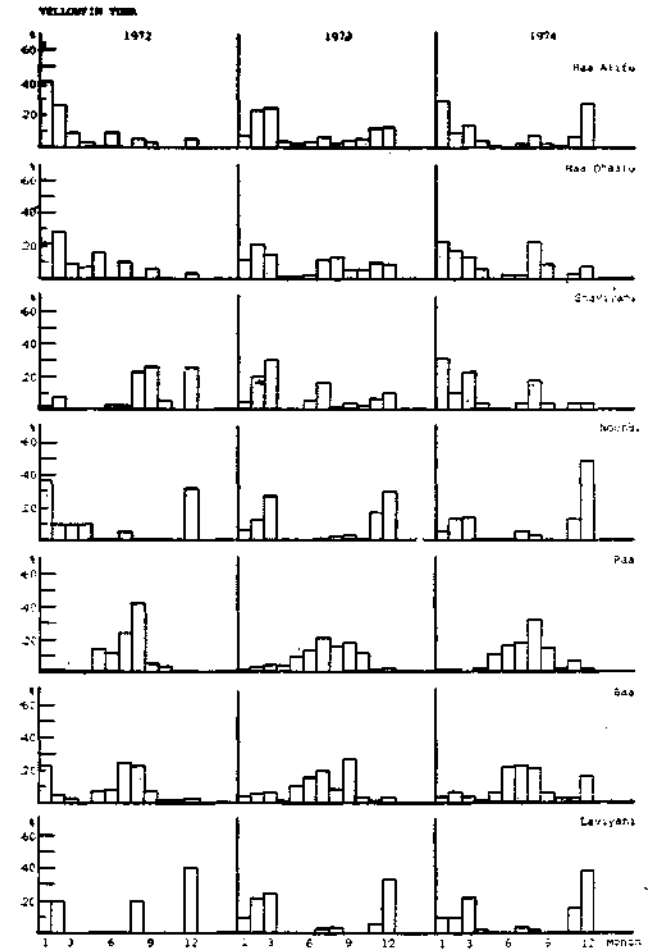


Fig. 3 b. Landings of yellowfin tuna from 1972 through 1974.

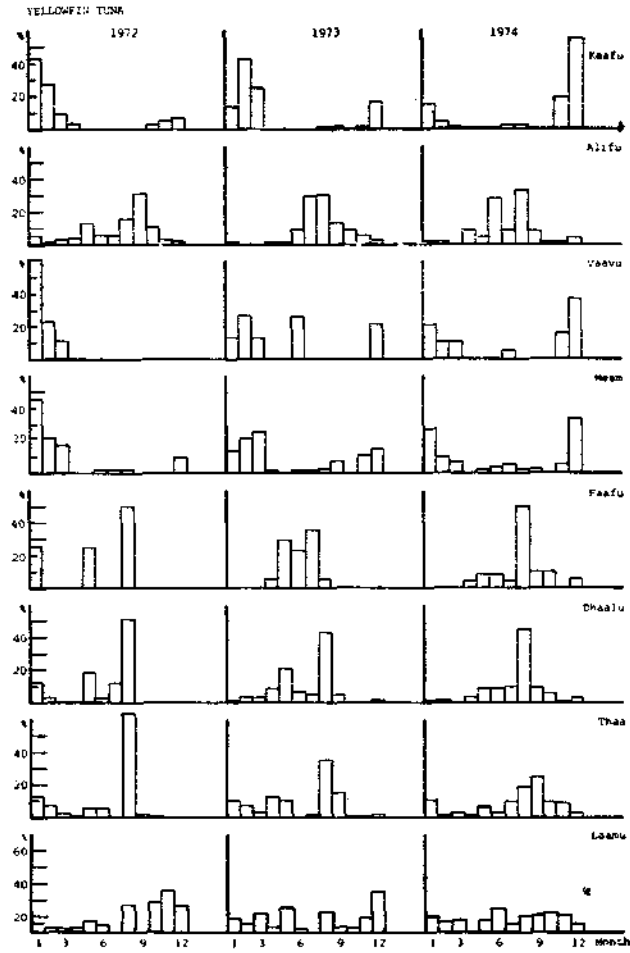


Fig. 3 b. (Continued).

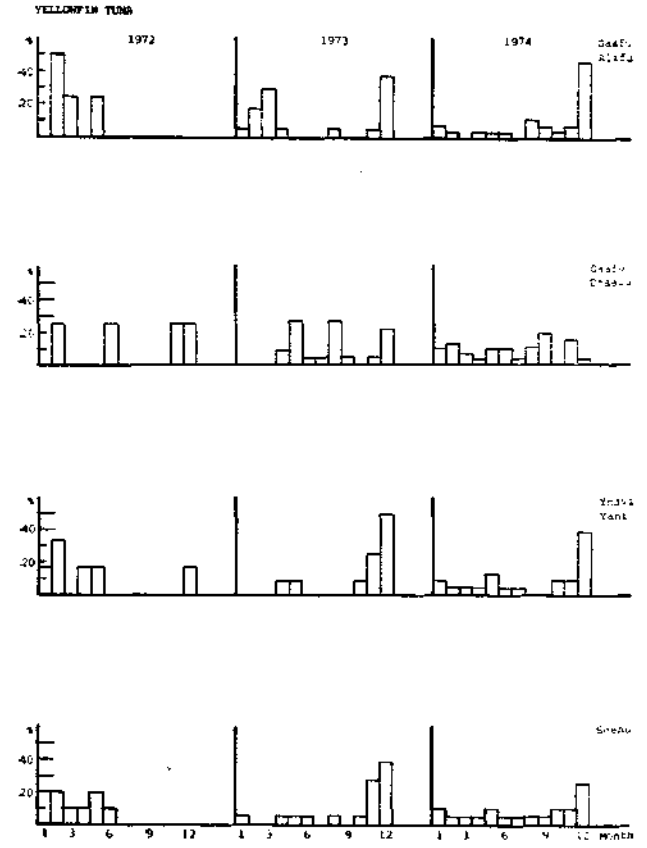


Fig. 3 b. (Continued)

get the largest part of the catch, for instance on Fua Mulaku (Ynaviyani Atoll) 20% and on Kandoludu (Raa Atoll) 36%. The sorting and sharing of the catch normally takes place during the trip back to the island.

On Kandoludu the catch of the examined boat was shared in the following way: The owner of the boat was given 36 fish per 100 fish. From the rest of the catch was taken 5 fish as payment for prayers for the boat and 8 fish as food to the following days fishing trip. The rest of the catch was then shared by the crew in such a way that Keolo, En Keolo and assistant was given $1\frac{1}{2}$ share for each share to the rest of the crew. An extra 1 fish per 25 was allotted those 2 fishermen who baled the boat.

Suppliers of various equipment are allotted special shares, *i.e.* suppliers of sail, bait-net and hooks. In some cases the magician is allotted shares for his 'fandita' (magic) to a good fishery.

In the Maldives the boats and gear usually are privately owned by individuals, whereas on Minicoy it was more common that the boat and gear belonged to the wards of the village (Jones and Kumaran, 1959).

Production of cured fish

Traditionally, most of the tuna catch is processed into cured products. After cleaning and filleting the fish this processing include the following 2 or 3 steps:

1. Boiling the fillets for 1/2 hour in a mixture (1:1) of sea water and fresh water.
2. The boiled fillets are smoked for about 10 hours over open fire.
3. The smoked product is then sundried, until it has a consistency like hard wood. Jones and Kumaran (1959) mentions that during the drying process a mould grows on the surface of the fillets probably increasing the dehydrating.

The product 'Walu-mas', which only has been through the first 2 steps (boiled and smoked), is the most common cured tuna product eaten locally.

Those fillets, which have been through all 3 steps, are known as 'Hikki mas' locally and exported as 'Maldivian fish'. This product is very durable and can be stored for a long time (upto 1 year according to Anon., 1976).

The recent export problems with 'Maldivian fish' is to some degree compensated for by selling the fresh tuna to the foreign fishing companies, which, through agreements with the Maldivian government, have freezing ships in the Maldivian waters. However, as the by-(waste-) products from the production of 'Maldivian fish' are utilized locally for consumption and as the production itself involves the participation of the women and other people who are not otherwise engaged in the fishery, a more permanent decrease in this production will undoubtedly result in changes in the local habits and trade patterns.

REEF AND LAGOON FISHES, SHARKS AND RAYS

General remarks

Among the reef-fishes occurring in the Maldivian waters only a few tuna and mackerel species are found. Whitefish species are abundant, but until recently exploited only to a very small extent, mainly because of the traditional Maldivian preference for tuna species (blood-fish). On most of the islands whitefish are caught and consumed only whenever tuna is not available (fresh or cured).

On some islands, however, the fishery for reef and lagoon fishes in general is of considerable importance because of the poor possibilities for a live-bait tuna fishery (this is the case for instance on Fua Mulaku in the south, and on many islands in the Alifu Atoll).

In some cases nets are used. Especially in very shallow water shore seines are often used for catching mullets (*Mugillidae*) and red mullets (*Mullidae*). Very often children (boys) are engaged in this fishery. In general, however, the fish are caught with hook and line and the usual boat type is the 'wadu dhoni' with a crew of 2-8 persons. The fishing method is, depending on the circumstances, either trolling or handlines (long lines). Handlining from 'bokura' (rowboat) or even pole fishing carried out from the shore may also locally be of some importance.

Common species

On basis of the collected information on the many different species of reef and lagoon fishes occurring in the Maldivian waters it is possible only to point out the most common and generally most important species.

Among the tunas and mackerels (*Scombridae*) at least 3 species are abundant: The Dogtooth tuna (*Gymnosarda unicolor*), the Wahoo (*Acanthocybium solandri*) and the Indian mackerel (*Rastrelliger kanagurta*). They are all considered good food fishes, but although the Dog-tooth tuna may be classified as a tuna, it is not esteemed as high as the 'real' tunas.

Of the many whitefish species some of the large carangid species are common and play an important role as food fishes, for instance the Bluefin and Yellowfin jacks (*Caranx melampygus* and *C. ignobilis*) and the Rainbow runner (*Elagatis bipinnulatus*). The latter species, together with the dolphin (*Coryphaena hippurus*) is frequently caught as 'by-catch' when trolling tuna. Numerous species belonging to the family Lutjanidae are found. Especially *Lutjanus gibbus* is extremely common and used whenever no better fish is available. *Lutjanus bohar* and *Aprion virens* are also very common. Among the Groupers (*Serranidae*) *Epinephelus fuscoguttatus* and *Variola louti* are very common on the reefs; *Aethaloperca rogaa* is also frequently taken.

In general, all of the edible reef and lagoon fishes found are utilized for human consumption, whenever no tuna is available.

Export

In recent years, however, an increasing production of salted, dried whitefish has developed, but almost solely for export purposes.

The first attempt to utilize the whitefish resources on a larger scale has now started with the inauguration in August 1978 of a fish processing plant on Mahibadu in the Ari Atoll. It has large freezing capacities and it operates solely for export purposes, but in contrast to other similar enterprises in the Maldives the activity is not only based on tuna fish, but on all valuable food fish species. The plant is owned by foreign capital and the headquarter is in Bangkok.

A two-days visit to this place in October 1978 rendered it possible to get some idea of the most common of the reef fishes occurring in that area, especially because, due to the recent opening of the plant, the fishermen still landed the catch unsorted (i.e. commercial species mixed with species not considered of commercial value by the company). Some of the more common food fishes in the Maldives are listed in Table 4. Table 3 shows a weekly mean of the main categories of species as defined by the commercial value. Unfortunately it was not possible to get the corresponding number of vessels (wadu dhonies), but most of the boats belonged to people living on Mahibadu and other islands in the vicinity.

From the Table it is seen, that the landings for that week of reef fishes mostly consisted of (1) Snappers and (2) Jacks, runners, jobfish and barracudas. Sampling of the catch from one days fishing showed, that the category 'Snappers' consisted mainly of the two species *Lutjanus bohar* and *L. gibbus*. In the category 'Jacks, runners, jobfish and barracudas' the species of *Caranx* were dominating (*C. ignobilis*

TABLE 3. Landings of reef-fish at the fish processing plant at Mahibadu. [(Mean values of 7 days (5, 7-12 October 1978)]

Category		Numbers landed per day	Weight landed per day (kg)
Jacks, runners, job-fish, barracudas	L	129	331
	M	126	155
	S	116	74
Snappers	L	83	249
	M	117	135
	S	283	154
Groupers (Rock-cods)	L	13	38
	M	32	41
	S	25	14
Dogtooth tuna	L	10	71
	M	8	10
	S	1	1
		Total :	1273

L (Large) : weight of fish more than 2 kg.

M (Medium) : weight of fish between 1 and 2 kg.

S (Small) : weight of fish less than 1 kg.

TABLE 4. List of the more common Maldivian food fishes. For most of the species one or more Dhivehi names are given

Chanidae		
<i>Chanos chanos</i> (Forsskal)	Baeki	
Belonidae		
<i>Ablennes hians</i> (Valenciennes)		
Sphyraenidae		
<i>Sphyraena forsteri</i> Cuvier & Valenciennes	Faru-toli, Hali-toli	
<i>Sphyraena</i> sp. (Small specimens)	Mora-taeli, Mirimas taeli	
Polynemidae		
<i>Polynemus sexfilis</i> (Cuvier & Valenciennes)	Kaela, Kaelo	
Scombridae		
<i>Auxis thazard</i> Lacépède	Ragondi	
<i>Euthynnus affinis</i> (Cantor)	Latti	
<i>Katsuwonus pelamis</i> (Linné)	Kalele, Kandu-mas, Goda-mas	
<i>Thunnus albacares</i> (Bonnaterre)	Kannelli	
<i>Gymnosarda unicolor</i> (Rüppell)	Woshi-mas	
<i>Acanthocybium solandri</i> (Cuvier & Valenciennes)	Kuru-mas	
<i>Rastrelliger kanagurta</i> (Cuvier)	Karaveri-mas	
Gempylidae		
<i>Rexea prometheoides</i> (Bleeker)	Ka-taeli	
Istiophoridae		
<i>Istiophorus gladius</i> (Broussonnet)		
<i>Makaira indica</i> (Cuvier)	Hibaru	
Coryphaenidae		
<i>Coryphaena hippuris</i> (Linné)	Vaboo-fiyalaa-(mas), Hiyala, Diguboo	
Carangidae		
<i>Decapterus macrosoma</i> Bleeker	Rin-maha-(mas)	
<i>Alectis ciliaris</i> (Bloch)	Narawaa-handi	
<i>Caranx ignobilis</i> (Forsskal)	Hudu-handi	
<i>Caranx melampygus</i> Cuvier & Valenciennes	Fani-handi	
<i>Ulua mandibularis</i> (Macleay)		
<i>Elagatis bipinnulatus</i> (Quoy & Gaimard)	Maane-mas	
Kuhliidae		
<i>Kuhlia taeniurus</i> (Cuvier & Valenciennes)	Kashi-fulu	
Serranidae		
<i>Aethaloperca rogae</i> (Forsskal)	Foniya-mas, Nashi-mas Gini-mas faana	
<i>Variola louti</i> (Forsskal)	Kandu-ha	
<i>Cephalopholis argus</i> Bloch & Schneider	Lava	
<i>Epinephelus fuscoguttatus</i> (Forsskal)	Kas-faana	
Priacanthidae		
<i>Priacanthus cruentatus</i> (Lacépède)		
Lutjanidae		
<i>Lutjanus kasmira</i> (Forsskal)	Hunboka-Iridili	
<i>Lutjanus gibbus</i> (Forsskal)	Gini-mas	
<i>Lutjanus bohar</i> (Forsskal)	Rai-mas	
<i>Apharus rutilans</i> Cuvier & Valenciennes	Giyulu	
Pentapodidae		
<i>Gymnocranius griseus</i> (Schlegel)		
Lethrinidae		
<i>Lethrinus harak</i> (Forsskal)	Fahudeke	
Gerreidae		
<i>Gerres oyena</i> (Forsskal)	Uniya, Odi	
Siganidae		
<i>Siganus oramin</i> (Bloch & Schneider)	Ori	

and *C. melampygu*) together with the jobfish *Aprion virescens*; the common barracuda was *Sphyræna forsteri*. Fig. 4 shows the size distribution of 3 of the above-mentioned species in the landings.

maintenance of the boats. In some cases the meat is salted for export purposes and in recent years an increasing production of dried shark fins has taken place, also solely for export.

Possibilities of increasing the whitefish production.

To assess the whitefish resources in the Maldivian waters a systematic sampling programme would be required. There is no doubt,

THE COMMON TUNA LIVE-BAIT SPECIES

Survey of species

The following data on tuna live-bait species in the Maldives are based on the sampling

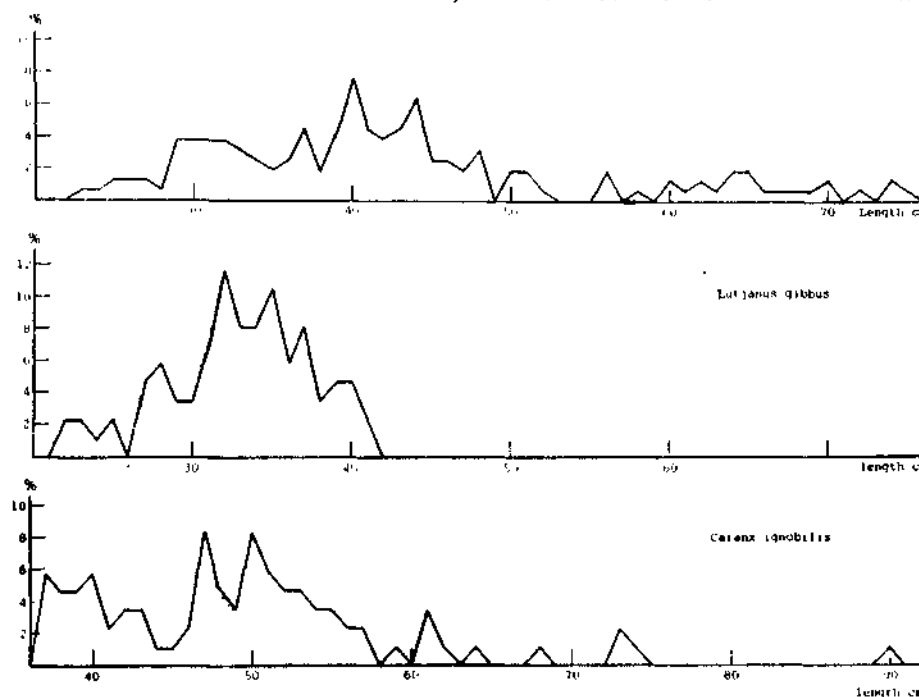


Fig. 4. Size distribution of three common species sampled in the fish plant at Mahibodu

however, that the resources of the free and lagoon fishes are being exploited at a rather low level at present the main reason being the national preference for bloodfish (tuna). Therefore, for the time being any increase in the whitefish production must somehow be based on increased export possibilities, which again would require many more freezing plants and an improved transport system.

Sharks and rays

Traditionally sharks and rays are caught primarily for the production of oil used for

carried out as described in the introduction. Therefore, due to the seasonal and spatial variation in availability of the important species the following survey of the species must necessarily be considered as preliminary. However, the only other information on print on tuna live-bait used in the Maldives is the sparse and sometimes misleading information in Anon. (1976) and that of Jonklaas (1967) which only covers Male during February-March 1964.

When comparing the following data with the data from Minicoy given by Jones (1964) and

Thomas (1964), it seems that most of the important species have been included. The local names (Dhivehi) given for each species are those gathered from the fishermen, who provided the samples. Not surprising, the dhivehi names are very similar to the 'Mahl' names used at Minicoy (Jones, 1964).

Family *Dussumieriidae* (Round Herrings)

At the Maldives 2 species of this family are important live-bait species: *Spratelloides delicatulus* Bennett and *S. japonicus* (Houttuyn). Especially the former one is considered one of the best live-bait species by the fishermen, and whenever available *S. delicatulus* is preferred to other live-bait species. June (1950) states that this species is the second most important used in the Hawaiian tuna fishery.

Unfortunately the *Spratelloides* species are not very tough and the survival rate in the bait wells is low. All the fishermen agree that these species must be used the same day as they are caught.

Both species are subject to seasonal fluctuations in occurrence. In general the highest availability of both species is during the autumn monsoon (October-January) (Jones, 1964).

a. *Spratelloides delicatulus* Bennett

Local names: 'Ha(n)deli' (Kandoludu,
Raa Atoll)
" (Male, Male Atoll)
'He(n)deli' (Hittadu,
Addu Atoll)

b. *Spratelloides japonicus* (Houttuyn)

Local name: 'Raehi' (Naifaru, Laviyani Atoll) (Hittadu, Addu Atoll)

Family *Engraulidae* (Anchovies)

Species belonging to this family are highly esteemed as tuna live-bait in the tuna fishery in the Pacific especially because of their good 'chumming' abilities. And in the Hawaiian

pole and line tuna fishery the anchovy *Stolephorus purpureus* is the most important live-bait fish (June, 1951).

S. indicus was found in a live-bait sample taken in Naifaru in Laviyani Atoll. The sample consisted mostly of other live-bait species, but as for the quality of *S. indicus* all the questioned fishermen agreed, that this is a very good live-bait fish (Anon., 1976). Apparently it is not common; it is not mentioned by Jones (1964).

a. *Stolephorus indicus* (van Hasselt)

Local names: 'Miyare' (Laviyani and Shaviyani Atoll)
'Merami' (Addu Atoll)

Family *Atherinidae* (Silversides)

Allanetta forskäli is used as live-bait at the Maldives. However, on the basis of the collected information it is not possible to specify the relative importance of this species. Large specimens are used for bait on hooks.

a. *Allanetta forskäli* (Rüppell)

Local names: 'Kaeraewala' (large specimens)
'Bo(n)do bo' (small specimens)
(Hittadu Addu Atoll)

Family *Apogonidae* (Cardinal fishes)

This family includes small shallow water and coral reef fishes. Some species enter brackish water and fresh water. Many of the species are widely distributed in the whole Indo-Pacific area.

At the Maldives several species belonging to this family are utilized as live-bait. Some of the species occur in large numbers and can be considered as important live-bait species. No data on seasonal fluctuations is available. The important live-bait Apogonids bear the local names 'Bodi' and 'Fata', each of which probably include more than one species. In the Laviyani Atoll the Apogonids are often

caught in a special way in which divers drive the schools into the bait nets (Anon., 1976).

- a. *Archamia lineolata* (Cuvier and Valenciennes) Local name : 'Fata' (Hinnawaru, Laviyani Atoll)
- b. *A. vuruensis* (Bleeker)
Local names : 'Bodi' (Hinnawaru, Laviyani Atoll)
" (Naifaru, Laviyani Atoll)
- c. *Apogon hyalosoma* Bleeker
Local names : 'Fata' (small specimens) 'Waiko' (large specimens) (Hittadu, Addu Atoll)
- d. *Paramia quinquelineata* (Cuvier and Valenciennes)
Local name : 'Raena Baendi' (Hittadu, Addu Atoll)

Family Anthiidae

The species *Anthias cichlops* is used as live-bait, but no information on the relative importance of this species has been collected.

- a. *Anthias cichlops* (Bleeker)
Local name : 'Rai Buroki' (Hinnawaru, Laviyani Atoll)
'Don Buroki' (Fua Mulaku)

Family Caesioididae (Fusiliers)

The species of the genus *Caesio* attain a relatively large size (upto some 30 cm) compared to the other live-bait species mentioned, and only the small specimens are utilized as live-bait. The larger specimens are used as bait on hooks (long lines, etc.) or sometimes used for human consumption.

Especially the species *C. caeruleus* and *C. chrysozona* are important. Jonklaas (1967) mentions *C. caeruleus* as the only live-bait species found in the bait wells he examined during his stay in Male February-March 1965. And Jones (1964) classified this species as a very important live-bait species on Minicoy.

Both species bear the common name 'Muguram' (*Dipterygonotus*).

- a. *Caesio caeruleus* (Lacépède)
Local names : 'Muguraami' (Hittadu, Addu Atoll)
'Kadu en Muguram' (Hinnawaru, Laviyani Atoll)
'Mas Muguram' (Male, Male Atoll)
- b. *Caesio chrysozona* Cuvier and Valenciennes
Local names : 'Hudu Muguram' (large specimens) (Kandolodu, Raa Atoll) 'Galu Mugurami' (Shaviyani Atoll)
'Mahamana Mugurami' (Addu Atoll)

Family Emmelichthyidae

A single species belonging to this family is utilized as live-bait, when the specimens are small. No data is available on the relative importance of this species as compared to the species of Caesioididae, but Jones (1964) mentions this species as an important live-bait species of Minicoy.

- a. *Dipterygonotus leucogrammicus* Bleeker
Local names : 'Kandu en Muguram' (Shaviyani Atoll)
'Laeikashi Muguram' (Addu Atoll)

Family Pomacentridae (Demoiselles)

Of this large family of coral reef fishes several species are utilized as live-bait, although only few of those can be considered as important; these include 2 species ('Nila Maha') of the genus *Chromis* and *Lepidozygus tapeinosoma*.

In general these species are hardy and can be kept alive for several days in bait wells. No information is available on seasonal fluctuations of the important species. Jones (1964) mentions *L. tapeinosoma* as the most important

live-bait species at Minicoy during the 1960-61 season.

- a. *Chromis caeruleus* (Cuvier and Valenciennes)
- b. *C. ternatensis* (Bleeker)
Local name for both species: 'Nila Maha' (All islands)
- c. *Lepidozygus tapeinosoma* (Bleeker)
Local name: 'Kalo Boroki' (Fua Mulaku)
- d. *Abudefduf biocellatus* (Quoy and Gaimard)
Local name: 'Nu mas' (Male, Male Atoll)
- e. *Pomacentrus tripunctatus* Cuvier and Valenciennes
Local name: 'Nu raezu' (Hittadu, Addu Atoll)

Fluctuations in availability of live-bait

The information obtained from fishermen indicate large seasonal fluctuations in the amount and occurrence of the more important live-bait species, but no quantitative data exist. For the northern atolls at least the pattern might be similar to that of the island of Minicoy (north of the Maldives). Here the occurrence and abundance was investigated quantitatively during the fishing season 1960-61 described by Thomas (1964). But when considering the Maldivian Archipelago as a whole the pattern of these seasonal fluctuations may differ from the north to the south or even between different islands in the same atoll. Therefore, to obtain an overall picture of such fluctuations, a much longer time period of investigation is necessary.

In the Maldivian Archipelago there is also great variation from island to island in the availability of suitable live-bait. This variation is one of the important factors determining the distribution of those islands, which traditionally are known as 'good fishing islands', because these islands in their vicinity all have

good locations for live-bait. The more important among these islands are: Male in Male Atoll, Kandoludu in Raa Atoll, Naifaru and Hinnawaru in Laviyani Atoll. And in contrast: Many islands in Alifu Atoll are known as poor fishing islands for tuna fishery because of their low availability of bait in their vicinity. This pattern may, however, to some degree change in the future because of the increasing motorization of the 'Mas dhonies', which makes the fishermen less dependent on good live-bait banks in their near vicinity.

INVERTEBRATES

Although several species of marine invertebrates are utilized for human consumption, it is in general considered a supplementary food source in addition to the fish. Only in extreme cases, when the fishery and agriculture fail, this food source may be of some importance.

In recent years, however, the growing tourist industry has created a demand for spiny lobsters which has resulted in an increasing exploitation of 2-3 species of spiny lobsters

Crustaceans

The only crustaceans which are subject to a permanent exploitation are the 3 species of spiny lobsters mentioned by Jonklaas (1961). They are abundant throughout the Maldivian Archipelago and are locally utilized as food, but traditionally they are not esteemed very high by Maldivians.

The fishery usually takes place in rather shallow water during night. First the animals are attracted by a light (usually a 'Petromax') in the boat. The fishermen dive and grab them by hand and bring them to the boat. Special gears such as lobster pots have been introduced on an experimental basis, but proved very unsuccessful (Jonklaas, 1961).

In recent years the fishery for spiny lobster has been increasing steadily along with the

developing tourist industry and the establishment of the previously mentioned fish processing plant on Mahibadu in 1978 will probably further accelerate the increasing fishing effort because of the increasing international demand for lobsters.

Thus for the time being (1978-1979) the Maldivian lobster fishery is in the expanding stage where the increasing demand and corresponding increasing fishing effort results in increasing catches. However, no data exist on which to base any assessments on stock sizes of spiny lobsters in the Maldives.

Another consequence of the increasing lobster fishery is the resulting change of the fishery pattern in relation to the daily household. This is because the effort put into the lobster fishery, especially during the tourist season is obtained at the expense of corresponding effort in the traditional fishery.

Apart from the spiny lobsters, the only other crustaceans used as food is a penaeid shrimp which at least is used in Addu Atoll. It is caught during night.

Family *Palimuridae*

Panulirus japonicus (von Siebold)

P. penicillatus (Olivier)

P. versicolor (Latreille)

Local name : 'Ihi'

Family *Penaeidae*

Penaeus japonicus (Bate)

Local name : 'Tahl ihi' (Addu Atoll)

In the Huvadhu Atoll crabs are known to be used for human consumption, but no specific information is available.

Molluscs

As is the case with the collected information on the tuna live-bait species, the collected data on molluscs can be divided in two parts : (1)

material collected during most of 1977 on Fua Mulaku and some islands in Addu and Huvadhu Atolls and (2) material collected during the cruise in the northern atolls October-November 1978. Because of the longer time period covered in 1977 and the permanent stay on Fua Mulaku, more detailed information is available from the southern atolls whereas during the cruise in 1978 the short stops on the various islands only allowed for registration of a few species.

In general it appears that the most commonly utilized gastropod in the Maldives is the Strombid snail *Strombus gibberulus*. Among the bivalves this status apparently can be given to the species *Atactodea striata* (Mesodesmatidae). Moreover, archaeological data suggest, that the use of these 2 species is very old and may extend back beyond the present culture.

Gastropoda

Family *Turbinidae*

Turbo argyrostomus (Linné)

This species is common in the tidal zone and collected during low tide. Information on this species is only available from the northern atolls where it is often eaten.

Local names : 'Handa' (Turakunu (Ha Alif Atoll))

'Handaburi' (Ihavandu (Ha Alif Atoll))

'Handa' (Wakaraidu (Ha Dall Atoll))

Family *Neritidae*

Nerita nigricans (Röding)

Nerita plicata (Linné)

Nerita polita (Linné)

These 3 species are the most common species of this family at the Maldives. Of these *N. polita* seems to be the preferred species as food. There seems to be great variation in the local names for these species.

- a. *N. polita*: 'Faen Gola', 'Gola' (Nadalla, Fiori (Huvadu Atoll))
 'Kachi Gola' (Fua Mulaku)
 'Ka Gola' (Hittadu (Addu Atoll))
 'Amati' (Turakunu (Haa Aliff Atoll))
- b. *N. plicata*: 'Kachi Gola' (Hittadu Addu Atoll)
 'Anga Kuda Gola' (Fiori, Huvadu Atoll)
- c. *N. nigricans*: 'Kalo Gola' Fiori (Huvadu Atoll)

Family Cassididae

Cassis cornuta (Linné)

On many islands the people claim that this species is sometimes used as food.

Local name: 'Fen Kaka boli' (All islands)

Family Strombidae

Strombus gibberulus L.

This species is probably the most frequently used for food. It is very common in the tidal zone, especially in areas covered with eel-grass. Collected during low tide.

Local names: 'Kuda Maha' (Fiori, Huvadu Atoll)

'Kuda Haka' (Nadalla, Huvadu Atoll)

'Kuda Alga' (Hittadu, Addu Atoll)

'Tilakoli' (Bāra (Haa, Daal Atoll))

'Tilayakoli' (Turakunu Haa, Aliff Atoll)

'Don-ama fu Goli' (Hirnawaru Laviyani Atoll),

'Kona' (Keyodu, Vaav Atoll)

Lambis chiragra var. *arthrica* Röding and *Lambis lambis* (Linné)

These species are abundant on the reef below the tidal zone. *L. crocata* and some other species of *Lambis* are also found, but only the

2 above mentioned species, which are the common ones can be considered of any importance. The meat is excellent.

Local name: 'Rākani' (Turakunu, Ihavandu, Haa Aliff Atoll)

Family Naticidae

Polinices simiae Deshayes and *P. tumidus* Récluz

On some islands both species are known to be edible, but in general not commonly utilized.

Local name (both species): 'Mura maha' (Nadalla, Huvadu Atoll)

Family Bursidae

Bursa bufonia (Gmelin)

This species was only seen on Fua Mulaku where it, when found, is utilized. Probably not very common.

Local name: 'Faro Gola' (Fua Mulaku).

Family Thaididae

Thais armigera (Link)

This is a very common species in the tidal zone on coral rocks. Large specimens have an appearance somewhat similar to that of *Vasum turbinellus*.

Local name: 'Kashi Gola' (Nadalla, Huvadu Atoll).

Family Vasidae

Vasum turbinellus (Linné)

This species is found on the reef below the tidal zone. Sometimes collected and used as food (Fua Mulaku). But as it is not very common, the use of it is limited.

Local name: 'Kashi Gola' (Fua Mulaku),

Bivalvia

Family Pinnidae

Athrina vexillum (Born)

Apparently this species is not very common. Occasionally used as food, but, according to

the people questioned, mostly in the northern atolls.

Local name : 'Ita' (Fua Mulaku).

Family *Mesodesmatidae*

Atactodea striata (Gmelin)

This small calm which is very common in the sand bottom in shallow water, is often collected and eaten boiled.

Local name : 'Rinda' (Turakunu, Muladu, Haa Aliff Atoll).

Squids and octopods

Both small specimens of squids ('Mas bova') and octopods ('Bova') are locally used for human consumption.

Other invertebrates

It should also be mentioned, that in the Thaa Atoll the sipunculid worm *Sipunculus indicus* is eaten (fried in oil). Apparently the use of this species is known only from Thaa Atoll.

Local name : 'Vaenboli' (Vilufushi, Thaa Atoll).

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