Review of the Reef Fishery of Maldives

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Reef Fishery Survey 2006 – 2007

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Executive Summary

A comprehensive reef fish review of this nature was last carried out 16 years earlier. Henceforth the developments which the reef fishery has undergone during this time period are clearly obvious in this report. The difference in approach and methodology used in this study could also be a contributing factor towards this difference.

The reef fishery being largely targeted towards supplying tourist consumption has undergone large expansion over the years with the expanding tourism industry. Furthermore, realization of its export value increased the fishing pressure on high valued reef fish varieties. This demand for reef fish both by the domestic market and for export markets is expected to further increase over the next years. It is therefore critical that some sort of management be implemented before these resources are over exploited or exploited at levels which would bring about their eventual over exploitation.

This report highlights the current status of the reef fishery, i.e. methodology being used, species and size composition of catch, selling procedures to the resort, reef fish purchase by resorts, reef fish exports and income earned through these exports.

To sum up the results, the review shows that *Elagatis bipinnulata* is the most commonly caught species in the current reef fishery. However, being a transient species, a look at the data excluding this species shows that *Aprion virescens* is the most commonly caught species of reef fish. Species such as *A. virescens* also show a decrease in size, i.e. weight from those caught in the earlier survey. This could be a cause for alarm, as it is a well known fact that intense exploitation of certain size classes of a species over a long time could lead to its decreased sizes. Having remained at a stable level for a period of time, reef fish exports have been on a decreasing trend, the last few years. However, prices paid for exports show an increasing trend which by giving an incentive for the fishermen to continue the fishery, brings about potential adverse effects to the population.

Reef fish purchase by resorts per tourist night has decreased since the last survey; i.e. 1.29 kg per tourist night in comparison to 1.67 kg per tourist night in the previous survey. However total reef fish purchase quantity has increased three-fold mainly due to the

large increase in the number of tourist resorts. Purchase of reef fish by all tourist resorts is currently estimated to approximate 7000 metric tonnes per year.

It is believed that reef resources are currently being exploited at levels below their estimated MSY (Anderson 2006). However, given the biology of most reef fish species, it is quite possible to exploit them on an atoll-basis even without reaching their national MSY. Therefore it would be best to carry out the reef fishery under a management scheme, recommendations for which are included at the end of this report.

1 Introduction

Tuna fishery has played a major role in the Maldivian economy from the time of our ancestors. It was and still is the most important fishery, providing the main source of dietary protein plus visible export earnings. Less important until the introduction of tourism industry was the reef fishery. A small-scale reef fishery was carried out in the Maldives prior to tourism, for the purpose of local consumption. In a short time this fishery which was previously on a small-scale expanded to provide for the tourism industry as well as the export industry which had by then been established. The export-oriented fishery was providing for South-East Asian markets in the form of both fresh/chilled and live exports.

Previous studies of the reef fishery was carried out in two phases (1988/1989 and 1990/1991) (Van Der Knaap et al. 1991; Anderson et al. 1992). In 1985, the Maldivian government sought the assistance of the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO) for assessing the reef fish resources at the time when fishery was not so much developed. A major result of these surveys was the estimation of a maximum potential yield of 30,000 $\pm$ 13,000 tonnes/year for commercial reef fish (Anderson et al. 1992). No further assessments of the general reef fishery and reef resources have been carried out since the above mentioned two initial surveys. As prior mentioned the reef fishery has since then expanded over the years with the expansion of the tourism industry. A separate grouper fishery especially targeted towards the export industry was also initiated in 1994 (Shakeel and Ahmed 1996; Sattar and Adam 2005). A review of this fishery in 2005 showed declined catches and smaller sized individuals (Sattar and Adam 2005). Hence the importance of assessing the status of other reef resources is quite apparent.

Exploitation of reef fish was carried out in a similar manner to that of tuna, with little regard to what could happen to the reef resources in the future. The main reason for this is the long-established tuna fishery which has continued to yield even under long-term intense exploitation. However tuna and reef fish have comparably different life histories; tuna have high fecundities and relatively quick population doubling time, whereas reef fish are long-lived, late maturing and have a low fecundity in comparison to tuna. Many species of reef fish form spawning aggregations and it is evident from data that at times

of spawning fishermen specifically target these aggregations, hence removing a large part of the breeding population. Furthermore reef fish are also hermaphrodites (i.e. sex changers) which could have added effects on their population dynamics. Inflicting high levels of exploitation on species with reef fish life histories could have worse effects on their populations than such levels of exploitation would have on tuna-like species.

In comparison to tuna fishing where fishermen have to travel long distances and spend long hours and sometimes days away from their home and families, reef fishing could be carried out close to the islands and on daily trips. This reduced effort and high abundance of reef resources at the beginning of the export oriented fishery was another reason for many fishermen switching from tuna to reef fish. Although fishing was carried out on a small-scale on the islands it still played an important role in the livelihoods of the island community; many go reef fishing on an opportunistic basis whereas others carry out reef fishing as a part-time employment. However there were and still are a few island communities which carry out reef fishing as their primary income earning activity. There are also a few communities which target a specific reef resource (e.g. groupers) and carry that out as their main income-earning activity.

As mentioned above the expanding tourism industry has resulted in a fast-expanding reef fishery. Additionally the development of the fishery for large yellowfin tuna has opened additional doors for the export of reef fish. The fishery for large yellowfin tuna is seasonal and during its low season, exporters turn towards reef fish.

Another factor which cannot be accounted for neither ignored is the effect of climate change on reef resources. Maldives has previously suffered bouts of coral bleaching (amongst other natural causes) which caused devastating damage to our reefs and its inhabitants.

Due to its ecological and socio-economic importance, reef fishery in the Maldives needs to be managed properly for it to be sustainable. However, for a fishery which is being carried out on this large-a-scale, the amount of monitoring which has been done to date and the collection of both fishery-dependent and fishery independent data has been poor. Currently, MoFAMR collects fisheries catch data for reef fish which are divided into

3 groups based on their weight. From these the main species caught in the commercial fisheries would fall into the second group:

Group 1 – large fish like wahoo and shark (average weight estimate, 20 kg)

Group 2 – medium-sized fish like groupers and jacks (average weight, 1.1 kg)

Group 3 – small fish like scads (average weight, 0.15 kg)

However it is believed that there is serious under reporting of catch under these groupings. Additionally pelagic or transient species such as rainbow runners are also included in group 2 of this data, therefore adding serious error to the true reef fish catch quantities. To enable proper management, we need to have a thorough understanding of the extent of the fishery, the catch, i.e. quantity and composition, the gear and methodology used as well as the fate of the catch, i.e. whether it is sold to resorts or exported.

Implementation of management in the near future is of utmost importance. It is for this purpose that MRC initiated this reef resources survey. The main aim of this survey is to improve our understanding of the extent of the fishery, the catch, gear and methodology. In this respect the review involves 3 components:

1) Survey trips with fishermen to obtain all fishery related data

2) Collection of reef fish purchase data from all tourist resorts in Maldives

3) Analysis of reef fish export trends based on export data collected by Maldives Customs Services.

It is hoped that results from the survey would be useful in the implementation of a reef resources management plan in the near future.

2 Methodology

2.1 Fisheries catch data

Component 1 of the reef fish survey aims to assess the status of the existing reef fishery in the Maldives. This component of the reef fish survey was carried out by joining fishermen on their fishing trips. Data obtained on these trips include fishing locations and methods, catch statistics, main catch species and size compositions of species caught in the reef fish fishery. An example of the survey form used for data collection is shown in Appendix 1.

As the tourism industry plays the central role in the reef fisheries industry, atolls to be visited were chosen based on the number of currently functional tourist resorts present in the atoll (i.e. the central atolls where there are a high number of resorts). From these atolls, specific islands were chosen based on phone surveys. These phone surveys enabled us to identify islands in these atolls where reef fishery was being carried out on a regular basis and as a means of primary income earning-activity. Less attention was paid to islands and atolls where reef fishery is carried out on an opportunistic basis.

The targeted number of fishing trips was 100 for 2006 and 100 trips in 2007. However due to various reasons MRC teams were unable to complete this number of trips. A total of 102 trips were made within the periods of 2 years, together with fishermen from these islands. Islands visited during this survey and the numbers of trips made from each island are listed in table 1.

Table 1. Atolls/Islands visited and number of trips made from these islands

Atoll	Island	Number of trips	
		2006	2007
Alifu Alifu	Rasdhoo	8	
Alifu Dhaalu	Mahibadhoo	11	17
Baa	Kudarikilu	13	11
Kaafu	Male'	6	3
Vaavu	Felidhoo	8	12
Vaavu	Fulidhoo	5	7
Dhaalu	Meedhoo		1
	Total	**51**	**51**

Data collected on these fishing trips are presented in the results section of the report. Length frequency data for different reef fish species was also obtained from the Male' fish market on an opportunistic basis in 2007.

2.2 Reef fish purchase and consumption by tourist resorts

The reef fishery in the Maldives currently caters mainly for the tourism industry. Majority of the reef fish catch is sold to the tourist resorts and various hotels. Hence to get an idea of the total catch and how much is being consumed on an annual basis it was important to survey all tourist resorts and obtain their purchase records.

Under the second component of the reef fishery survey, survey forms were sent out to all operational tourist resorts in the Maldives to obtain data on their reef fish purchases for 2006 and 2007. Resorts were requested to provide data on their reef fish and lobster purchase quantities and prices on a species level and on a daily basis. However the difficulty in obtaining data in this format was soon apparent. When purchasing reef fish, most resorts pay a set price per kilo of reef fish. As a result their records show aggregate reef fish purchase in contrast to our requirement of species level purchase records. Therefore, data from resorts were obtained on a monthly basis and for aggregate reef fish purchases (i.e. total weight of reef fish purchased). Data on lobster purchases were provided in a similar manner (i.e. aggregate number of lobsters purchased). Due to the lack of data on the lobster catch and purchase by resorts, this has not been included in the report.

Data obtained from these surveys is taken as a representative set of data for all resorts in Maldives. The amount of reef fish purchased per day was obtained based on a single resort's reef fish purchase and this value together with resort occupancy rates and total number of beds in all operational resorts was then used to get an estimate of reef fish purchase by all operational tourist resorts.

2.3 Exports of reef fish

Basic Fisheries Statistics published annually by MoFAMR reports export values and prices of reef fish by both government and private sectors. Reef fish is exported fresh/chilled, dried or salt dried. Additionally grouper exports are reported separately both in the fresh/chilled and live forms.

3 Results

3.1 Fisheries catch data

3.1.1 Fishing trips

Teams of 2-4 staff of MRC joined fishermen on their daily fishing trips. Fishing was carried out on standard mechanized *mas dhonis* with an average of 5 crew per trip. The fishermen left on their trips in the early morning, most commonly around 6 am. After leaving port they first head to collect bait, time spent on which could last from as little as 30 minutes up to 3 hours. The fishermen then head towards the fishing grounds where they spend from 3 hours up to 9 hours fishing. On occasion fishermen visited two to three fishing locations in one trip. Whether to move from their location or not was decided based on the catch, i.e. if fishing was not good at the site then the fishermen look for better locations. It was observed that there were particular sites which fishermen chose to return to on a regular basis. When the day's fishing is over, the fishermen then head to their buyers i.e. tourist resorts, where they sell their catch for the day. On rare occasions, if there is no demand from the resorts, fishermen also sell their catch to small-scale fish processors (e.g. those who cook and salt/dry the fish). Fishermen return to their island in the late afternoon or early evening. On average the whole trip can last up to 12 hours. Refer to photo plates in Appendix 2 of the report for the various procedures carried out during the reef fishing trips.

Fishing trips from Male' which were joined by MRC staff were slightly different from those in the islands. Fishermen departed on their trips in the early hours of the morning (between 2 am and 5 am). Bait was pre-arranged; mostly chilled mackerel scad, (*Decapterus macarellus*, rimmas) and kawakawa (*Euthynnus affinis*, latti). In contrast to the trips from other islands, trolling for sailfish was carried out to a large extent on the fishing trips from Male'. If this proved unsuccessful the fishermen then settle to carry out hand-lining. At the end of these trips fishermen sell their catch either to nearby tourist resorts (depending on demand from the resort) or at the Male' Fish Market.

In comparison to the above fishing trips, fishing trips made from V. Felidhoo were solely targeted at groupers. The main difference between these grouper fishery trips and those targeting general reef fish was the gear used in the fishery, i.e. grouper fishing was

mainly carried out using visually-aided handlines (Photo plate 03). On these fishing trips, fishermen are dropped at different points in an area, and they enter the water with a basket which is used to hold the catch. Once a grouper is spotted they drop the baited line (live bait) in the vicinity of the grouper. Although visually-aided handlines are commonly used in the grouper fishery, there are some grouper fishermen who still target individuals of the Plectropomus genus (*Molhu faana*) and catch these using drop-lines. Those which carry out fishing using visually aided handlines target the Plectropomus genus as well, as they fetch a better price. However if they do spot individuals of other genera, these are also caught. At the end of the day, the catch is sold to the grouper cage located within the atoll (should be noted that this is the fishery in Vaavu atoll, and is different to what has been previously observed in Faafu Atoll, where fishermen head out for a week or month and sell their catch at the end of the week to cages in other areas, mainly Kaafu atoll). One thing to note is that these fishing trips are always ended before sunset, in contrast to the reef fishery trips, on which best fishing is carried out at dusk, just after sunset.

3.1.2 Fishing locations

For every trip which was made by the MRC teams, the exact location of fishing was noted with the aid of a GPS. These locations have been plotted on a map of Maldives and are shown in Figure 1. The fishing locations have been separated based on the atoll of the fishermen (i.e. each type of marker indicates the atoll of origin of the fishermen). As seen from this figure, in most cases fishermen do not venture out of their atolls on these reef fishing trips and in the instances they do so, the fishermen still remain close enough to their atolls to be able to return to their islands on a daily basis.

The identification of fishing locations is a very critical part of this survey. Many reef fish species are known to form spawning aggregations which are targeted by fishermen throughout the world, on a regular basis. Over-fishing from such aggregations has affected many commercial reef fish species throughout the world (Colin 2003) and brought about the depletion of a large number of aggregations in the Caribbean (Colin 2003). Identification of the fishing locations visited by the reef fishermen of Maldives would aid in the identification of spawning aggregations which is a very important management tool when the need for management of the fishery arises. As noted above

and as seen in figure 1, there are particular areas in the atoll which are being visited by all fishermen and on a continuous basis indicating that these areas are profitable areas in terms of catch quantities. Some of these sites are areas which have been identified by fishermen as areas of high catch and possible spawning aggregations (survey to identify reef fish aggregations). However areas of high catch could also be indicative of reef fish aggregations for feeding. Whatever the reason for these aggregations, the important thing to note is that they need to be paid special attention.

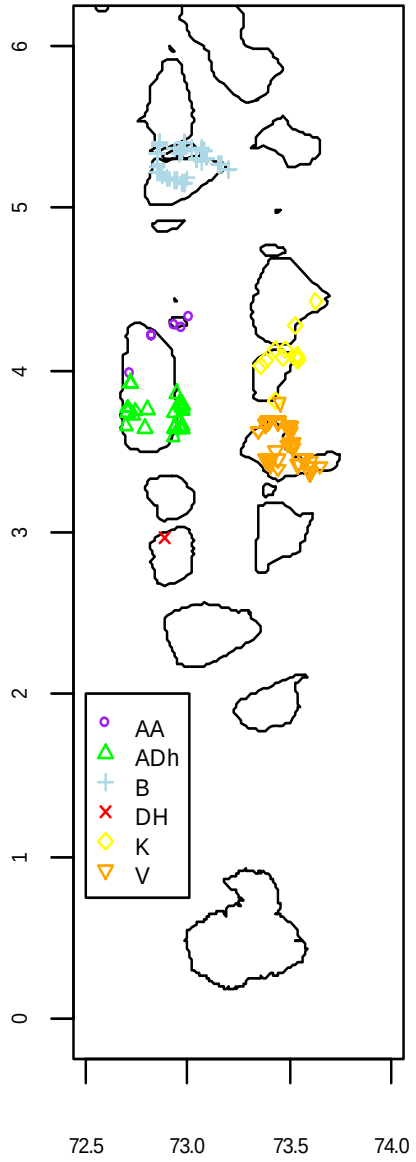


Figure 1. Reef fishing locations

3.1.3 Bait fishing locations

Although the fishing trips conducted in 2006 did not take note of the bait fishing locations, starting from 2007, GPS positions of all bait haul locations were also noted on the trips. Depending on the bait availability and species found, fishermen could visit 1 – 3 sites to obtain their bait prior to heading off to the fishing grounds. Figure 2 below shows the bait haul locations visited by fishermen of the different atolls. There are no locations for Kaafu atoll, as on their fishing trips, the fishermen use pre-arranged bait such as mackerel scad (*rimmas*) or kawakawa (*latti*). No sites are recorded for Alifu Alifu atoll, as this atoll was not visited in 2007, which, as previously mentioned, was when the recording of bait haul locations was started.

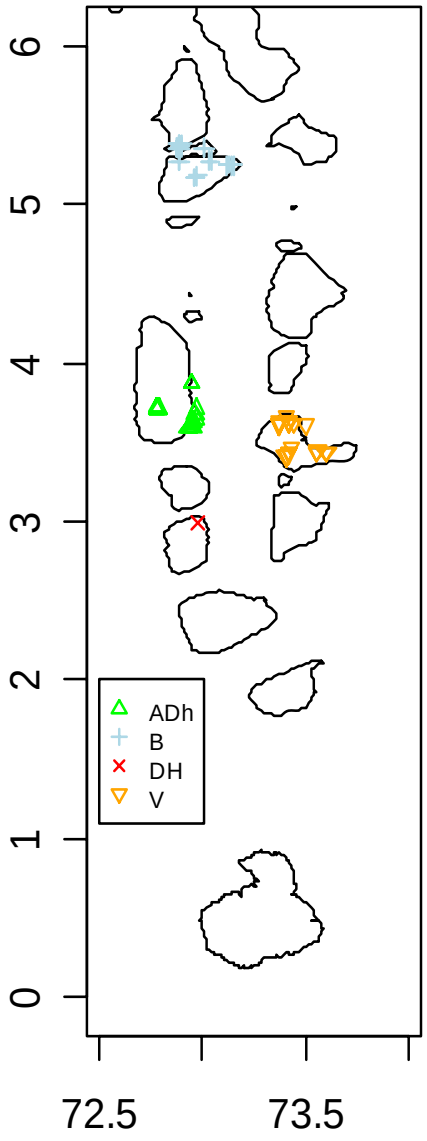


Figure 2. Bait haul locations

3.1.4 Fishing methods and gears

Bait collection:

When collecting bait, fishermen enter the water and look for bait schools with the aid of snorkeling gear. Once a bait school is spotted bait nets are sunk into the water to capture the school within the net. When the net has encircled the school the net is then hauled on board. This is a combined effort of all; while the crew members on board haul the net, the fishermen in the water ensure that the bait remains captured within the net. Sometimes fishermen use fish flesh scrapings (fili jehun) to attract the bait into the net. Fish species most commonly used for this purpose is that of kawakawa (latti) which are caught by trolling on the way to the bait haul location.

Fishing methods:

Fishing was carried out using a variety of gears, depending on the species being targeted; hand-lines, drop-lines, trolling and pole and line.

Hand-lining:

Hand-lining was the most common method observed on all trips. Once fishermen locate a school of fish, they take their positions on the boat and set out their lines for fishing. Hand-lines are baited with live bait and released into the water. Since these lines do not have any weights on them they do not sink to the bottom, but are used to catch fish schools in the upper layers of the ocean.

Drop-lines:

Drop-lines are similar to hand-lines, with the difference being that they include a weight which causes them to sink to the bottom. These lines are also baited with live bait and sunk to the bottom to capture species living close to the bottom. Another situation where drop-lines were used was when fish could be spotted by snorkeling (visually aided handlines), especially in Vaavu Atoll where there was an established grouper fishery. This corresponds with what was observed in an earlier study of the grouper fishery, where it was noted that drop lines with the aid of snorkeling gear have become the more favored means of fishing gear used by grouper fishermen (Sattar and Adam 2005).

Trolling:

On most of the trips, trolling for species such as kawakawa was carried out during the journey to the bait location or fishing location. This was not the main method of fishing. However on fishing trips in Male', trolling was carried out as the main method of fishing where they mainly targeted species like wahoo (*Acanthocybium solandri,* kurumas) and sailfish species (hibaru). Two forms of trolling were observed on these trips. On the trips from Male', long nylon wires with artificial lure were set out from poles by the side of the boat (*Olhey vadhu*). In contrast, on the trips in Baa atoll when the fishermen set out for sailfish fishing, they set out lines with floaters at the end. These lines were baited with live bait (mackerel scad or rimmas) and set out in the water. Approximately 6 to 7 lines were set out in the same area and the vessel remained in sight of all lines. Once a sailfish gets caught on any of the lines, this line is then hauled in with the catch. If trolling proved unsuccessful on these trips, the fishermen then settled at one spot and carried out either hand-lining or drop-lining.

Pole and line:

On the few occasions where pole and line was used, it was targeted for various tuna species.

3.1.5 Catch data analysis

General summary:

Catch quantities of the species was recorded according to the codes listed in the survey form shown in figure A1. As seen from these codes, some refer to individual species while others refer to groups or families. Table 2 below shows the codes, families or species referred to by these codes and the major species caught/included within the umbrella of the family groups.

Table 2. Codes used in the survey and the families/species referred to by the codes

Code	Scientific name	English name	Dhivehi name
	Snapper (Lutjanidae)		
JBF1*	*Aprion virescens*	Green jobfish	Giulhu
JBF2*	*Aphareus rutilans*	Rusty jobfish	Rankarumas
HSN*	*Lutjanus gibbus*	Humpback red snapper	Ginimas
RSN*	*Lutjanus bohar*	Red snapper	Raiymas
FON	*Macolor niger*	Black and white snapper	Foniyamas
FON	*Macolor macularis*	Midnight snapper	Kalhu foniyamas
	Jack (Carangidae)		
RNB	*Elagatis bipinnulata*	Rainbow runner	Maaniyamas
JCK		Jacks (species level data absent)	Handhi
SBR	**Emperor (Lethrinidae)**	Seabreams (species level data absent)	Filolhu
	Grouper (Serranidae)		
GRP	*Aethaloperca rogaa*	Redmouth grouper	Ginimas faana
GRP	*Anyperodon leucogrammicus*	Slender grouper	Boalhajehi faana
GRP	*Cephalopholis argus*	Peacock hind	Mas faana
GRP	*Epinephelus fuscoguttatus*	Marble grouper	Kas faana
GRP	*Plectropomus areolatus*	Squaretail grouper	Olhu faana
GRP	*Plectropomus pessuliferus*	Roving coral grouper	Dhon olhu faana
GRP	*Plectropomus laevis*	Black-saddled coral grouper	Kula olhu faana
GRP	*Variola louti*	Moontail seabass	Kanduhaa
	Tuna (Scombridae and Xiphiidae)		
KAW*	*Euthynnus affinis*	Kawakawa	Latti
WHO*	*Acanthocybium solandri*	Wahoo	Kurumas
DOG*	*Gymnosarda unicolor*	Dogtooth tuna	Voshimas
SL	*Istiophorus platypterus*	Indopacific sailfish	Fangandu hibaru
THL	Cornetfish (Fistularidae)	Cornetfish (species level data absent)	Tholhi
	Barracuda (Sphyraenidae)		
THL	*Sphyreana forsteri*	Bigeye barracuda	Faru tholhi
THL	*Sphyreana barracuda*	Great barracuda	Maa tholhi
	Others		
FIY*	*Coryphaena hippurus*	Dolphinfish	Fiyala
SQR	Holocentridae	Mainly sabre squirrelfish	Raiverimas

*Note: * indicates those species for which data was taken on a species level.*

The reef fishery being mainly catered towards the tourism industry, it was observed that all fishermen sold their catch to tourist resorts within their atoll or nearby atolls. Catch from the fishing trips within Kaafu atoll, are either sold to nearby resorts or if there is no demand from the resorts, at the Male' fish market. Selling to resorts fall under three categories:

- Vessels which are contracted by resorts and sell their catch solely to that resort. Under these contracts, vessels have to provide a certain quantity of reef fish on a monthly basis.
- Vessels who visit 3 to 4 resorts at a time and the resort to be sold to is chosen depending on demand or requests from the resort. If no requests are made, then the fishermen will visit one of the resorts at random. Sometimes the resorts also inform the fishermen of the species or group of fish they would like to obtain (e.g. either all jacks or rainbow runners).
- Resorts have their own staff who head out fishing every day. These fishermen are on the payroll of the resort.

Purchase rates of resorts show that all reef fish are bought at an average rate of MRf 10 per kilo of fish. However some resorts in Kaafu atoll pay higher rates for sailfish and wahoo, either depending on the weight or per individual. Species such as kawakawa, if brought to the resort in large quantities are bought at lower prices than that being paid for reef fish. When sold at the market the fishermen earn more than if they were to sell to the resorts, as the prices vary depending on the species and the size of the individual. The fishermen earn an average income of approximately MRf 1800 per fishing trip. On the one fishing trip, where the fishermen sold their catch to a small-scale processor in B. Kendhoo, all individuals were bought at a flat rate of MRf 5 per kg which is less than what is paid by the resorts.

Selling procedures for grouper fishermen differ from the above procedure. These fishermen sell their catch to the nearest cage or cage which offers the best price. The grouper fishermen of V. Felidhoo sell their catch to a grouper cage located within the atoll (near V. Keyodhoo). When visited in 2006, the cage was owned by Aeroseafood Pvt. Ltd. However when we returned in 2007, ownership of the cage had changed and the cage was then being operated by Marine Coral Pvt. Ltd. This is a common occurrence amongst grouper exporters, as not all of them are able to run a successful

business over a long term. Along similar lines, difficulty in obtaining their payment for the fish sold to the cages is a common complaint by the grouper fishermen. Purchase records from the grouper cage show that they class groupers into different price categories depending on species and weight of individuals (refer Sattar and Adam (2005) for details of price categories). On average each grouper fishing trip yielded an average income of MRf 1000 per trip.

Catch composition:

Classification of the catch into the various families shows the following total composition (over 2 years): *Carangids* (41.63%), *Lutjanids* (21.56%), *Scombrids* (13.66%), *Fistularids* and *Sphyraenids* (9.11%), *Lethrinids* (6.79%), *Serranids* (5.85%), *Coryphaenids* (0.25%) and *Xiphiids* (0.22%) (Figure 3).

The total composition for the two year survey period is shown by the black bars, while the yellow bars show the family composition for 2006 and blue bars show that for the catch for 2007. An interesting point to note in this figure is the contribution of carangids towards the catch in 2006 and 2007. Carangids contributed more than 50% towards the catch composition in 2006, whereas in 2007 they contributed only approximately 30% towards the total. Reasons for this are explored with reference to figure 4. This large difference in contribution by carangids in 2006 marks the main difference between catch compositions in 2006 and 2007.

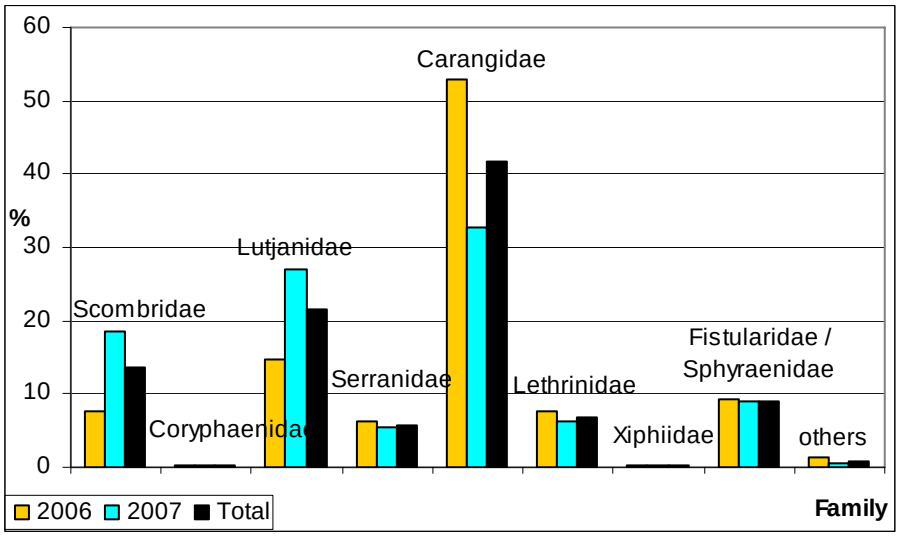


Figure 3. Family-wise catch composition

Another point to be noted is the grouping of fistularids and sphyraenids together, which is due to an error in data collection. Data collection was based on local names, and since individuals belonging to both families are known as 'tholhi' in Dhivehi, species of both families are classed under this code and cannot be separated into the two families. However individuals of both families could be separated by looking at the length frequency plot of the collective group and this will be shown later in the report. This error in data collection was rectified in 2007, and species-wise data was collected for both families. However all data was entered under the general code of THL due to this having been the format of data collection and entering since the beginning of the survey.

A look at the catch composition on a species and genus level show that on a whole for the 2 years and for 2006, Rainbow runner (*E. bipinnulata,* Maaniyamas) dominated the catch (approximately 25% and 40% respectively) (Figure 4). However, in 2007 the contribution by *E. bipinnulata* to the total catch was considerably lower (approximately 15%) and the catch that year was dominated by Jacks and Green jobfish (18% and 15% respectively). The high contribution by *E. bipinnulata* and different species belonging to jacks, therefore explains the high percentage contributed by carangids (86%) towards the total.

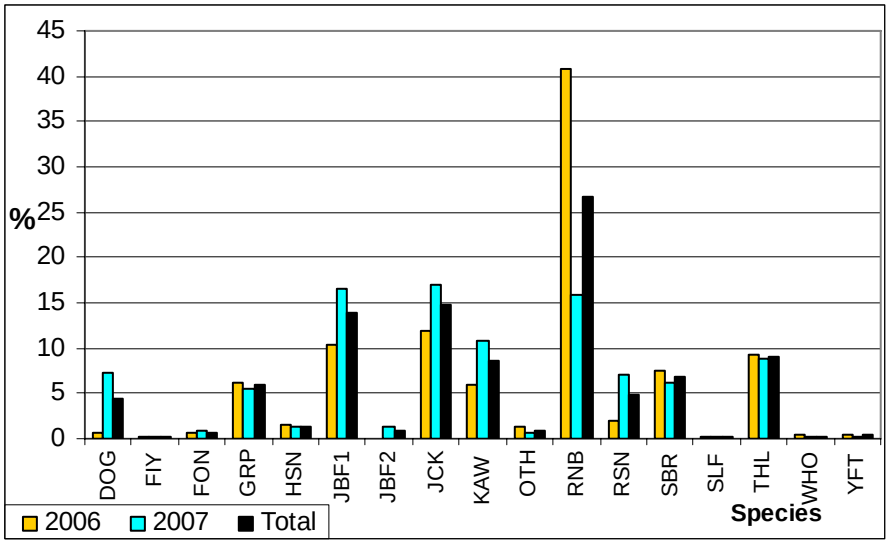


Figure 4. Species- and genera-based catch composition

In the survey carried out in 1989-1991, the most important species then caught was the lutjanid, Green jobfish (*A. virescens,* Giulhu) which then contributed about 32% towards the total catch. In comparison, in the present survey this species contributed only 13.9%

towards the total catch (i.e. over the 2 year period). The large catch numbers of Rainbow runners is due to the fact that at times fishermen target schools of rainbow runners, when they are not successful in getting other species. Rainbow runner has a short shelf-life and gets spoilt very easily. Therefore most resorts do not have a preference for it and discourage fishermen from bringing large quantities of this species at a time. However, if the fishery is low then the resorts will buy these even in large quantities.

An important point to note here is that individuals belonging to the jacks and emperors were not identified on a species level in 2006. However, species-level data was taken for these two groups in 2007, although when entering the data, all were entered under the general codes of JCK and SBR respectively. This is similar to the case for the fistularids and sphyraenids, although as mentioned above, both these families were included in the general code for THL. Main species caught in these two groups are listed in table 3 below:

Table 3. Main species caught under the family groups of jacks and emperors

Species Name	English Name	Dhivehi Name
Jacks		
Alectis ciliaris	African pompano	Naruva handhi
Carangoides caeruleopinnatus	Coastal trevally	Vabboa handhi
Carangoides ferdau	Blue trevally	Dhabaru handhi
Carangoides gymnostethus	Bludger trevally	Mushimas handhi
Carangoides orthogrammus	Island trevally	Thumba handhi
*Caranx ignobilis**	Giant trevally	Muda handhi
*Caranx lugubris**	Black trevally	Kalha handhi
*Caranx melampygus**	Bluefin trevally	Fani handhi
*Caranx sexfasciatus**	Bigeye trevally	Haluvimas
Gnathodon speciosus	Golden trevally	Libaas handhi
Scomberoides lysan	Doublespotted queenfish	Kashi vaali
*Seriola rivoliana**	Almaco jack	Andhun handhi/ Andhun mas
Emperors		
Gymnocranius griseus	Grey large-eye bream	Kandu uniya
*Lethrinus conchyliatus**	Redaxil emperor	Thun raiy filolhu
Lethrinus harak	Thumbprint emperor	Lah filolhu
*Lethrinus microdon**	Smalltooth emperor	Thundhigu filolhu
*Lethrinus olivaceus**	Longnose emperor	Filolhu
*Lethrinus rubrioperculatus**	Spotcheek emperor	Kalhihi
*Lethrinus xanthochilus**	Yellowlip emperor	Reendhoo thun filolhu

*Note: * denotes those species which were most commonly caught.*

Fishermen observed that Golden trevally (*G. speciosus,* Libaas handhi) which used to be abundant has decreased in numbers in the last 2 years. This was also observed by the MRC team members on one fishing trip where fishermen visited a site where this species is caught in large numbers. However on this particular day only 3 individuals of this species were caught from the area. MRC team members also noted that this species was being caught in much less numbers in 2007 than they were in 2006. However, as there is no species wise data for jacks for 2006 we are unable to make a comparison. It should be noted that only 1 individual of this species was noted on the 51 fishing trips made in 2007.

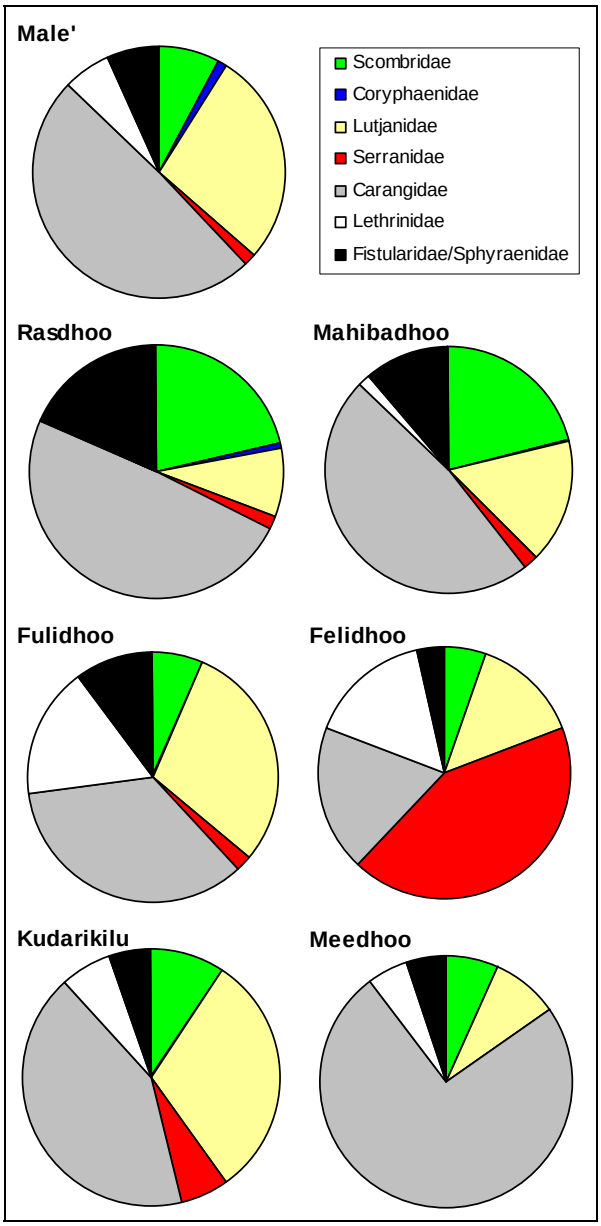
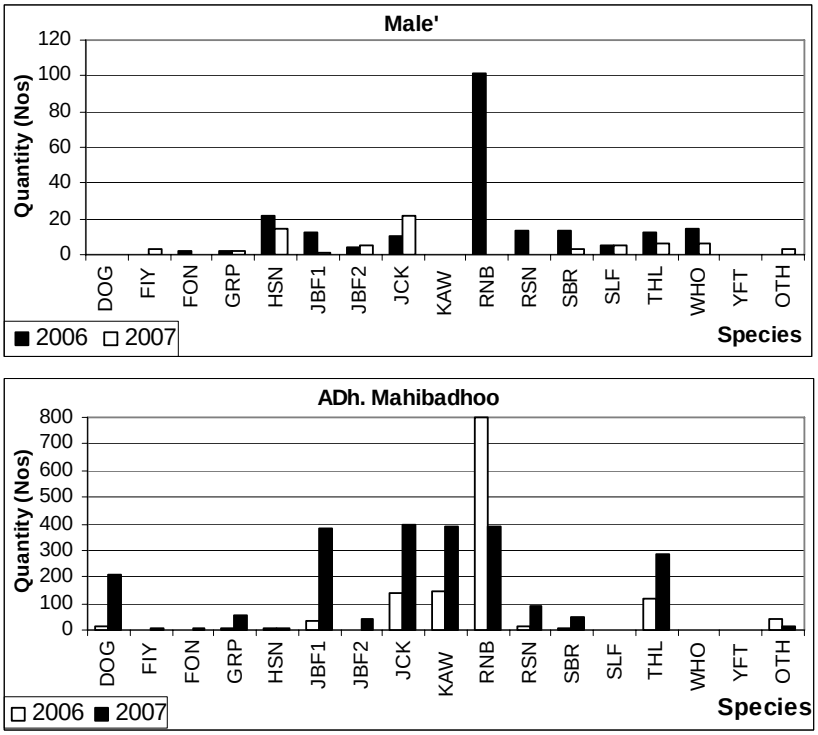


Figure 5. Island-based breakdown of catch represented by the main families caught

An island-based breakdown of total catch quantities over the 2 year survey period is shown in Figure 5 above. It should be noted that from the above, the islands which show data for both years are Male', Mahibadhoo, Fulidhoo, Felidhoo and Kudarikilu. Similar to figure 3, carangids form the larger group in the catch of all islands except V. Felidhoo. The catch in V. Felidhoo is dominated by serranids, which is explained by the established grouper fishery in the island. When visited in 2006, all vessels went for grouper fishing. However in 2007, there was one vessel which went for reef fishing and this is represented by the data for families other than serranidae in the figure for V. Felidhoo.

A more detailed catch comparison for all atolls is shown in Figure 6, for the islands which have data from 2006 and 2007. Similar to Figure 4, Figure 6 also shows that in 2006, *E. bipinnulata* was the most commonly caught species from all islands except in V. Felidhoo (for reasons detailed above). Furthermore, similar to Figure 4, *E. bipinnulata* played a less dominant role in the catch from individual islands in the year 2007. Species composition for V. Felidhoo for 2007 also shows the presence of other reef fish species besides groupers, which is the data obtained from the single vessel presently carrying out reef fishery. This vessel had been beached for maintenance when the team visited the island in 2006.



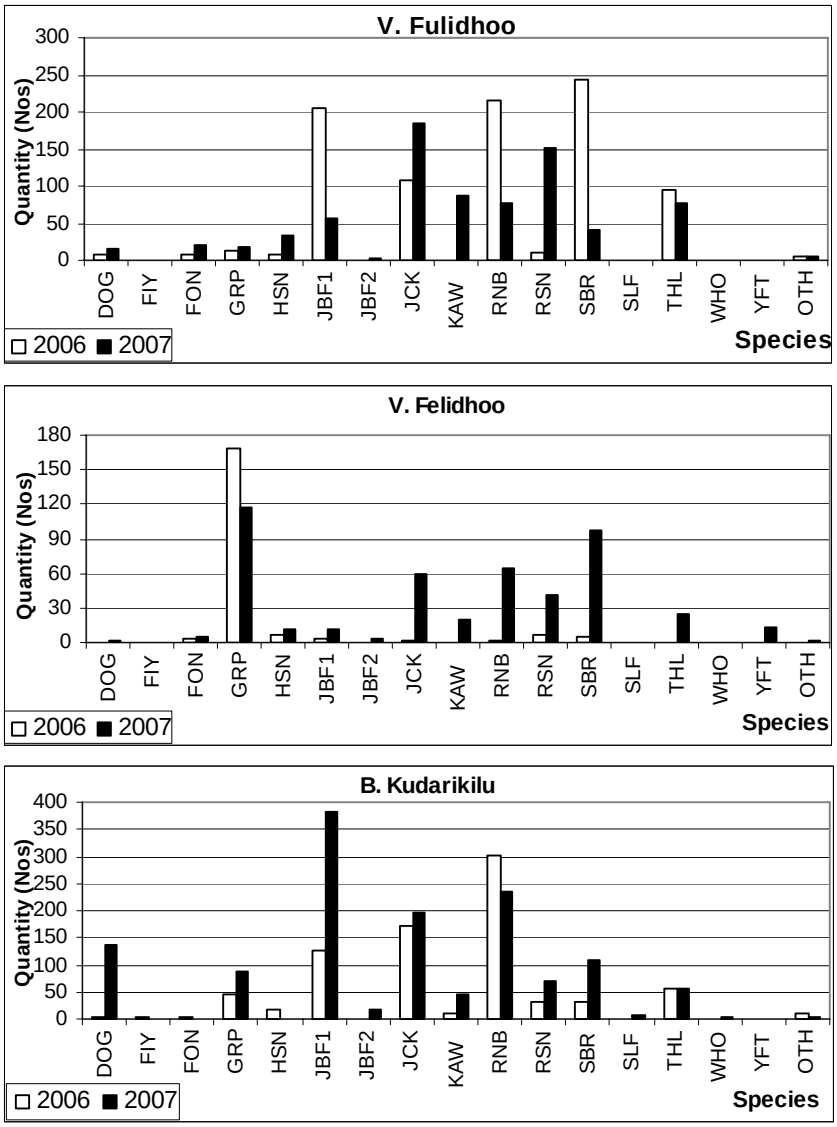


Figure 6. Species composition of catch from individual islands shown separately for 2006 and 2007

Size composition of catch:

Figure 7 below shows the average weight and length of five of the species caught in the fishery for which length samples were taken on a species level in both years; *L. gibbus* (HSN), *E. bipinnulata* (RNB), *E. affinis* (KAW), *A. virescens* (JBF1) and *L. bohar* (RSN). Standard deviation from the mean show that size composition deviates greatly from the mean especially for the weight of the individuals. The large variation in weights could be attributed to technical error; length-weight data was taken on board the vessel on the way to the resort at the end of the days' fishing. This would mean that the vessel would

be in motion and weight taken would be affected due to the movement and waves.

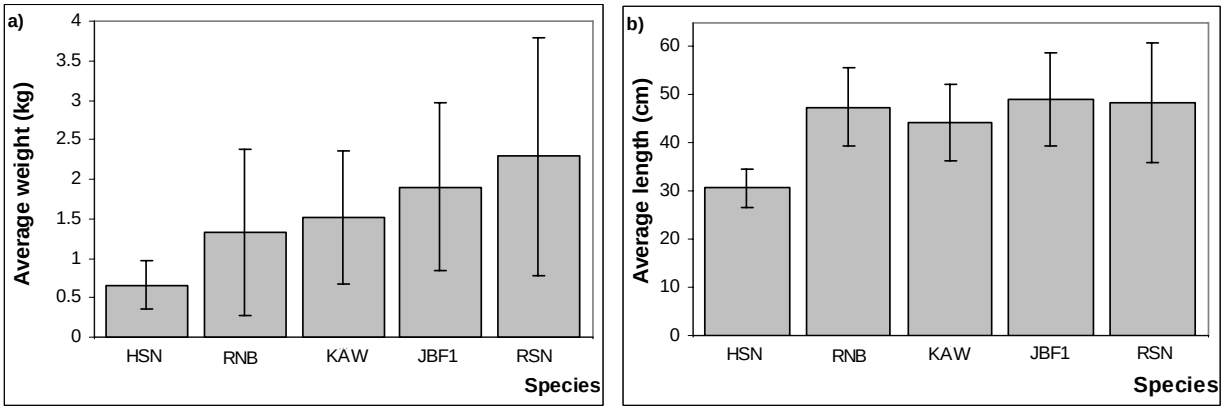


Figure 7. Average weight (a) and length (b) of the main species caught in the fishery

A comparison of the average weight of current catch with data obtained in the reef resources survey carried out in 1988/1989 (Anderson, Waheed et al. 1992) shows a decrease in average weight for *A. virescens*, *L. bohar* and *E. affinis* (Figure 8).

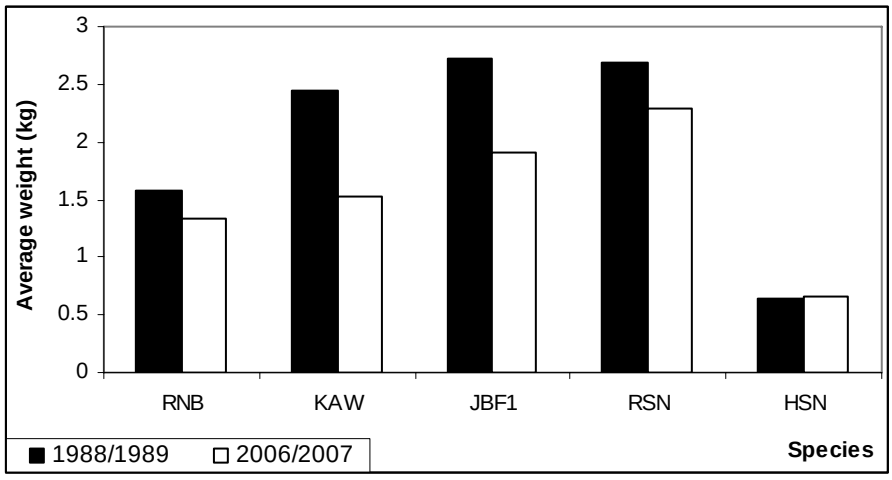


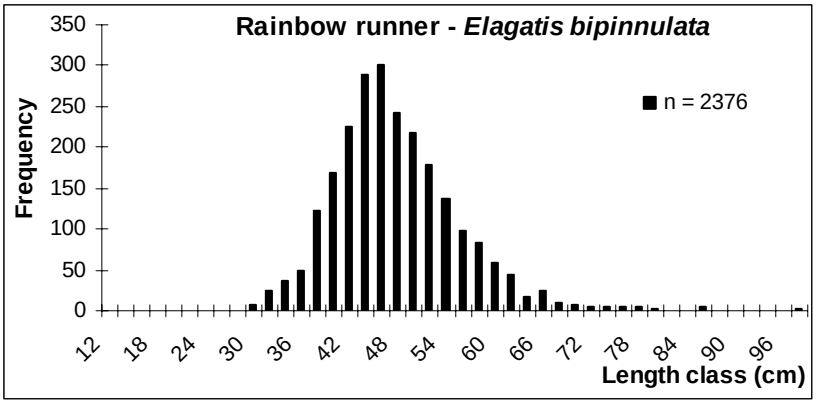
Figure 8. Comparison of average weight of main species caught in the current fishery with that observed on the 1988/1989 survey

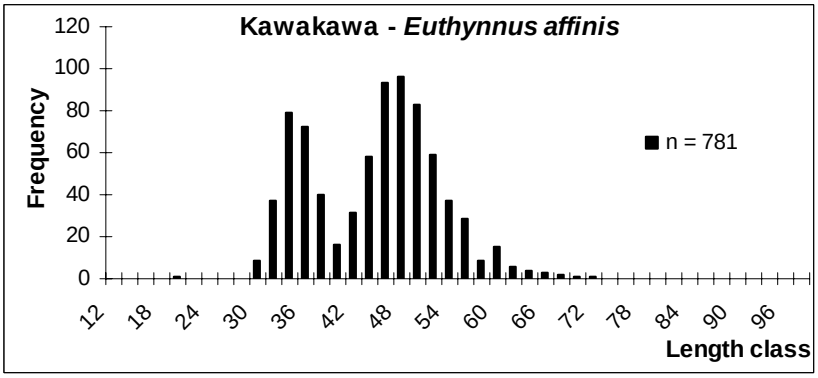
Although emperors, groupers and jacks were also commonly caught in the fishery, length data was not taken on a species specific basis. Therefore it is not possible to obtain mean length and weight for a separate species in these families.

Length frequency distributions of *L. gibbus*, *E. bipinnulata*, *E. affinis*, *A. virescens* and *L. bohar* are shown in Figure 9. Comparison of size distributions for *A. virescens, L. bohar*

and *L. gibbus* with those obtained in the reef resources survey carried out in 1991 show a similar trend with respect to mean sizes. However the frequencies are noticeably different with the current survey in general having decreased numbers especially for the humpback red snapper.

E. bipinnulata shows a normal distribution around the mean, with individuals belonging to the larger size group being caught in few numbers. *A. virescens* and *L. bohar* show a similar trend, although for these 2 species, there are distinct peaks at few lengths around the mean. In the case for *A. virescens* where the mean length is 49 cm, these peaks are observed at 40, 48 and 52 cm. Similarly for *L. bohar* with a mean length of 48.42 cm; peaks are observed at 36, 46 and 52 cm. Even more interesting is the length frequency distribution for *E. affinis* which shows a binomial distribution indicating the catch of a large number of younger individuals as well as the mature individuals.





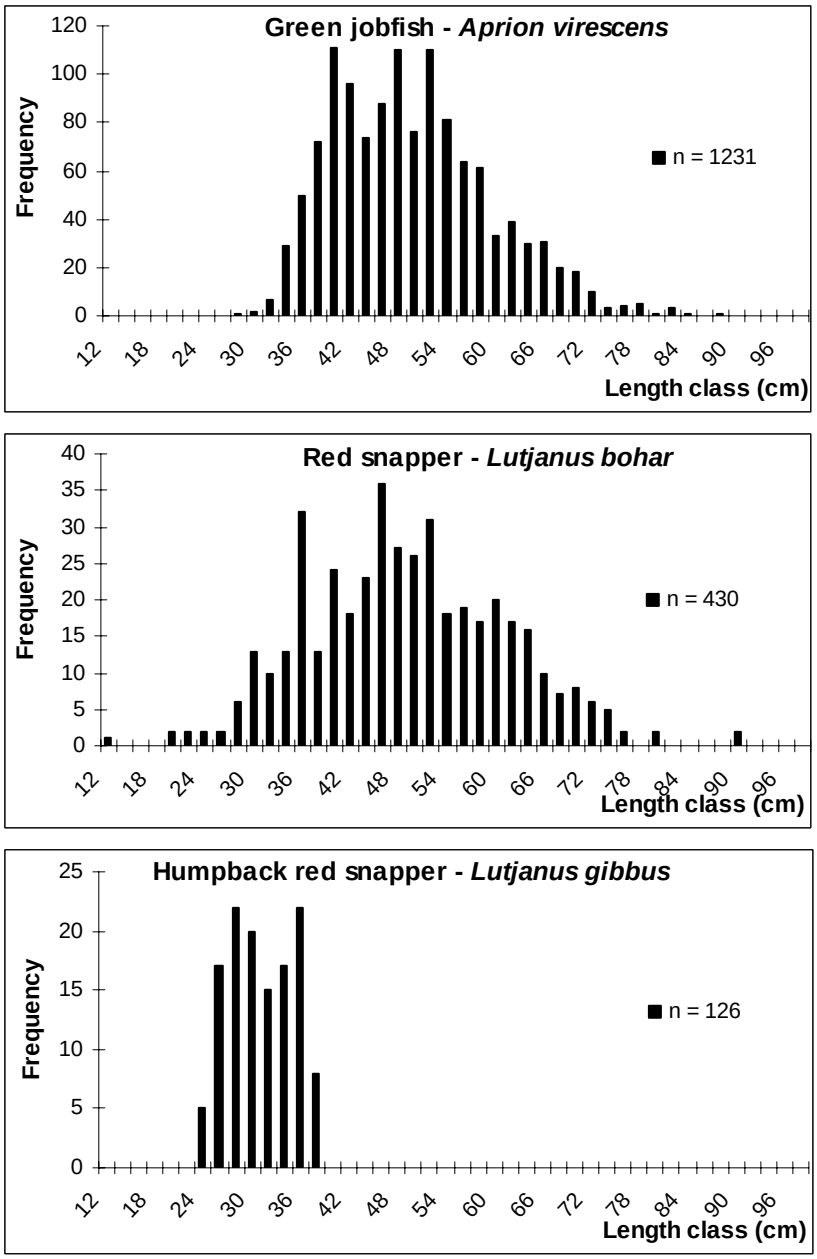


Figure 9. Size compositions of the main species caught in the fishery

Figure 10 gives length frequency distributions for the main family groups taken in the fishery. All groups show more than one peak, indicating that these groups are composed of more than one species. However the peaks are more distinct in the figure for cornetfish/barracudas, for obvious reasons which will be detailed below. Jacks and groupers show peaks at lengths between 40 and 60 cm, whereas groupers show peak lengths in the smaller size classes, i.e. between 25 and 40 cm. This could be due to the catch of large number of individuals belonging to those genera which do not grow to

large sizes (e.g. Cephalopholis). However, in the grouper fishery in Vaavu atoll, fishermen were targeting individuals belonging to Plectropomus genus which have the capability to grow to large sizes (e.g. 80 to 100 cm). The few individuals of this length are seen in the figure for groupers towards the tail of the plot. The large number of smaller individuals could be indicative of the fact that even those species which had the capability to grow large were being caught at smaller sizes. However, fishermen do stress that they try to leave such individuals as their worth is more at larger sizes.

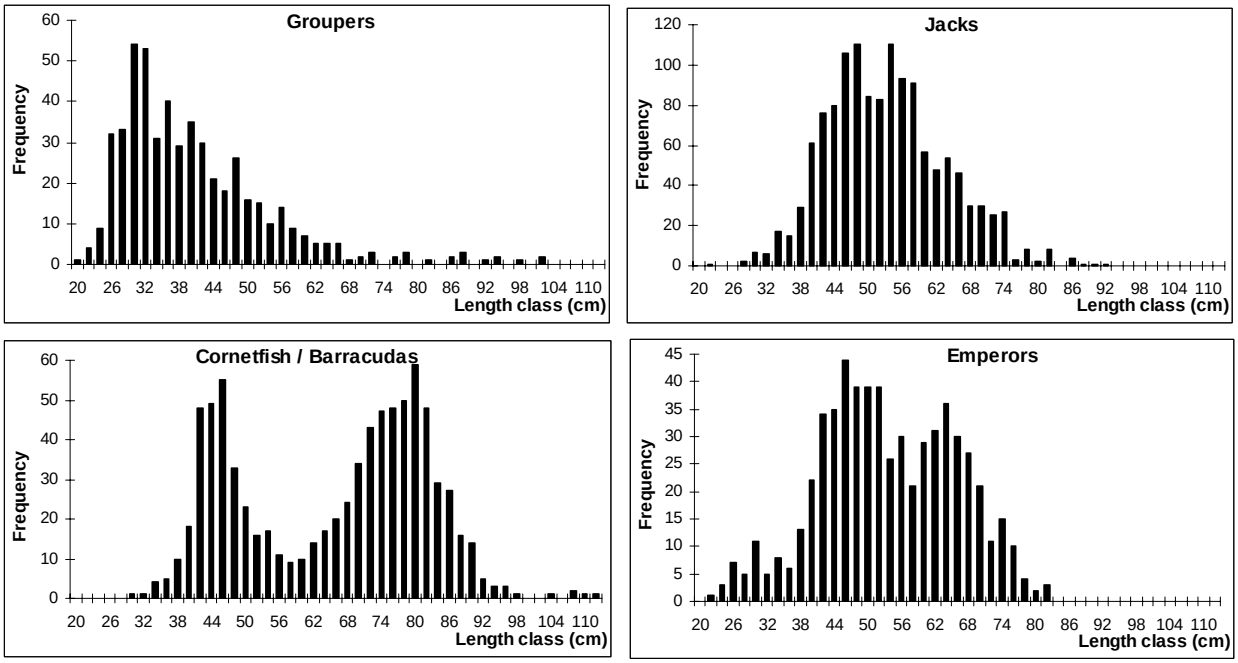


Figure 10. Size compositions of species assemblages obtained in the fishery

The graph for cornetfish/baraccuda shows data for two separate families, data for both of which were entered under the general code of THL. This is an error which was made at the beginning of the survey, and as explained previously was rectified in the 2nd part of the survey, in 2007. Although data collection in 2007 was made more species specific, due to the previous data having been classed under the general group of THL, this data was also entered the same. The best we can do from this data is to identify the two peaks as belonging to the two families. Cornetfish are long and weigh little, whereas species belonging to the barracuda family are shorter (except for *S. baraccuda* of which only a few individuals were caught on the survey trips). Hence we could state that the peak at the smaller size class belongs to the baraccuda family and that at the larger size class belongs to the cornetfish family.

Bait composition:

Species composition of bait used shows that various fusilier species (*muguraan*) are most commonly used especially in instances when fishermen use live bait (Figure 11). They were seen to be used as the main type of bait on approximately 70% of the trips carried out. Different bait species were used depending on whether gear being used was a drop-line or hand-line. According to fishermen, certain species of fusiliers are better in instances when a drop-line is used.

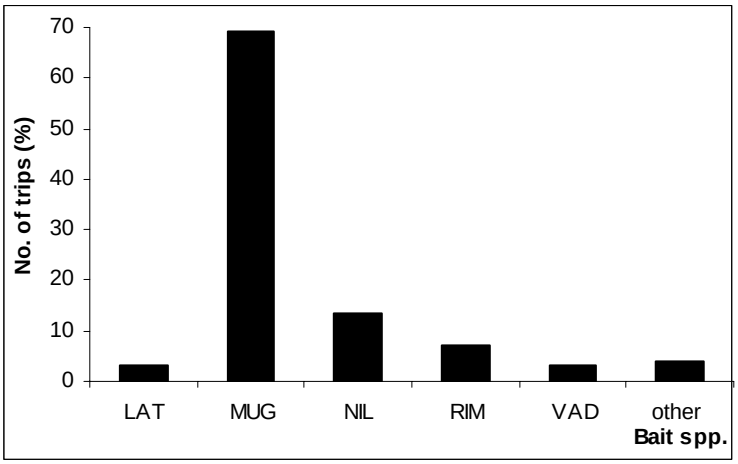


Figure 11. Species composition of bait used
LAT (latti/kawakawa), MUG (muguraan/fusiliers), NIL (nilamehi/damselfish), RIM (rimmas/mackerel scad) VAD (vadhu/artificial lure)

Other live bait types used include members of the wrasse (*hikaa*) and damselfish (*nilamehi*) families. Cut pieces of mackerel scad (*rimmas*), kawakawa (*latti*) and frigate tuna (*raagondi*) were also used on occasion, mostly when fishermen were trolling for wahoo and sailfish. Fishermen also used artificial lures (*vadhu*) on some occasions especially when targeting sailfish.

Gear types:

Hand-lining was observed as the most common method of fishing (Figure 12) and was mainly used to catch those species in the upper layers of the water. Drop-lines which were the 2nd most popular gear in the reef fishery are used to catch those at the bottom.

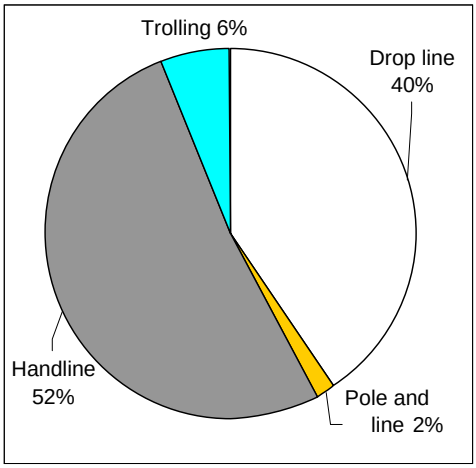


Figure 12. Gear types used in the fishery

Hence gear type used depends on the target species. Another method which is fast gaining popularity is the use of drop-lines with the aid of snorkeling gear. In these cases, fishermen enter the water in search of fish with the aid of snorkeling gear. Once the individuals are spotted baited lines are dropped in the area and the individual is captured. This method of fishing was previously reported to be preferred by grouper fishermen (Sattar and Adam 2005). This method has the advantage that the fish are seen before being caught, which means that if the individual is small the fishermen have the choice of leaving them in the water. This could be a useful management tool, in the case where minimum size limits are implemented.

3.1.6 Estimation of catch per area

Following exploratory surveys in 1988/1989 and 1990/1991, Anderson et al (1992) calculated a MSY of 30,000 $\pm$ 13,000 tonnes/year. However it is believed that reef fish is being exploited at levels below this MSY. To verify this assumption, an attempt has been made to calculate or estimate the total catch of reef fish from the whole of Maldives on an annual basis.

Based on how the fishery is carried out and the number of vessels (who go reef fishing on a regular basis and sell their catch to either processing facilities or resorts), I estimated the fishermen of Alifu Alifu/Alifu Dhaalu, Baa and Vaavu atolls to make approximately 525, 357 and 210 fishing trips per month respectively. These atolls were

chosen due to the greater availability of data from these atolls. Table 4 shows the number of fishing vessels in each island of these 3 atolls and an estimation of the total number of fishing trips made by these vessels per month. To estimate this value we assumed that on average each vessel goes fishing 21 days of the month, i.e. after accounting for Fridays, public holidays and days with bad weather.

Table 4. Number of fishing vessels and estimate of number of trips made by these vessels on a monthly basis

Atoll: Baa	No. of vessels	Atoll: Alifu Alifu /Alifu Dhaalu	No. of vessels	Atoll: Vaavu	No. of vessels
Kudarikilu	4	Rasdhoo	2	Fulidhoo	2
Dharavandhoo	1	Ukulhas	4	Felidhoo	4
Dhonfanu	3	Bodufulhudhoo	9	Keyodhoo	4
Kihaadhoo	2	Mahibadhoo	3		
Thulhaadhoo	3	Mandhoo	1		
Eydhafushi	4	Kunburudhoo	3		
		Dhigurah	2		
		Dhihdhoo	1		
Total	17		25		10
Estimated no. of fishing trips/month	357		525		210

Results from our survey trips were used to calculate average weight of catch per fishing trip for each atoll. These average weights enable us to calculate the total catch per month for the above 3 atolls (Table 5). These were plotted against surface area of these atolls (Table 5), taken from Naseer and Hatcher (2004). The results of this exercise are shown in Figure 13.

Table 5. Total estimated catch per month for the 3 atolls and their total surface area

Atoll	Total surface area (km^2)	Total catch per month (MT)
Baa	1239.56	65
Alifu Alifu/Alifu Dhaalu	2338.34	121
Vaavu	1137.69	34

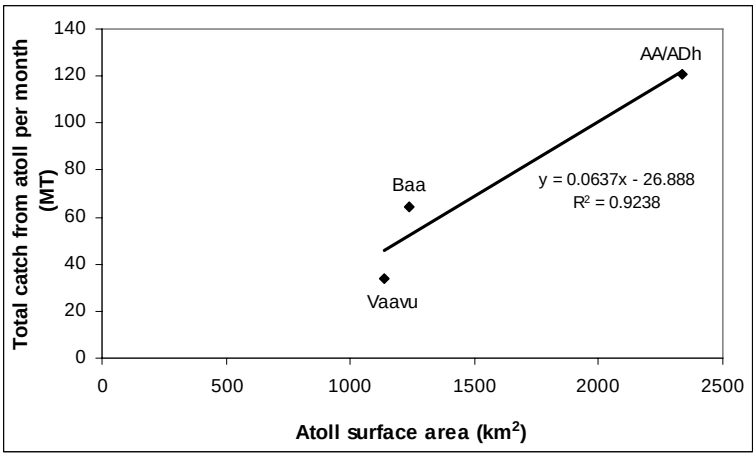


Figure 13. Total catch from Baa, Alifu Alifu /Alifu Dhaalu and Vaavu atolls for each month versus the total surface area of these atolls

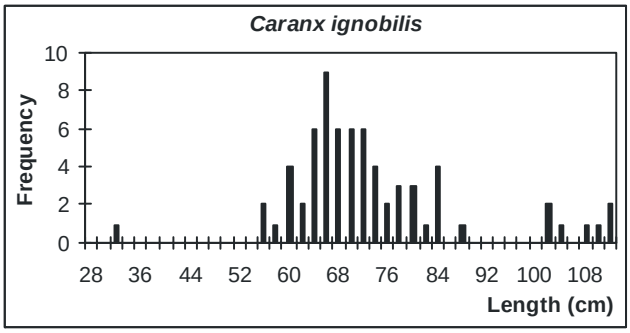
Using the equation for the linear regression and the total surface area of Maldives i.e. 21,372.72 km^2 (Naseer and Hatcher 2004) we can estimate the total catch per year from the whole of Maldives. This approximates to 16,000 metric tonnes per year which is slightly more than 50% of the estimated 30,000 tonnes MSY. However, we should bear in mind that our estimated catch is an underestimate of the total as it does not account for the catch made by fishermen who fish on an opportunistic basis and sell their catch to the islands. It also does not account for the grouper fishermen from Baa atoll do not get their catch solely from within the atolls, but make fishing trips throughout the Maldives, which could last for a month at the least. Therefore as mentioned by Anderson (2006), although the reef resources are currently being exploited at levels below their MSY, this is no reason for us to leave the fishery to continue at its current rate of exploitation. The demand for reef fish is due to increase with the expansion and increase in tourism over the coming years and soon these resources will be exploited from areas which are currently untouched. However, reef fish unlike tuna have slow growth and late maturity and many species are hermaphrodites. All these characteristics make them more vulnerable to intense exploitation and therefore it is vital that we carry out the fishery under a precautionary approach.

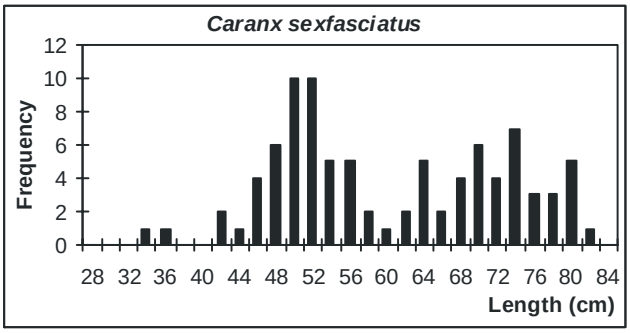
3.1.7 Male' Market length frequency data

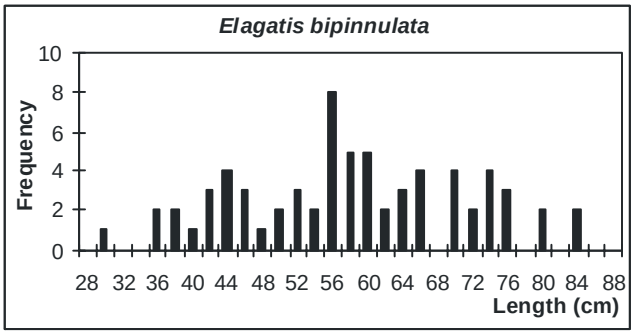
Length frequency sampling was carried out in the Male' Market in 2007, and data obtained from this sampling is shown in Figure 14 for the most common species found at the market. Most reef fish are brought to the market if there is no demand from the

resorts or as by-catch from the trips when fishermen go for yellowfin tuna. Most commonly represented families at the market were, Carangids, Lethrinids, Lutjanids, Coryphaenids, Sphyraenids and Serranids. Length was measured on a species specific basis and that for the most commonly seen species in the above mentioned families is shown in Figure 14 below.

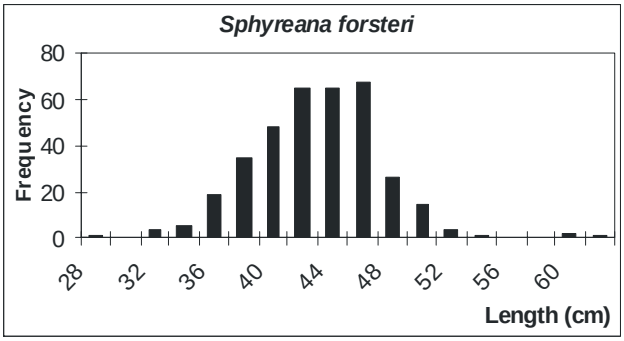
Family: Carangidae



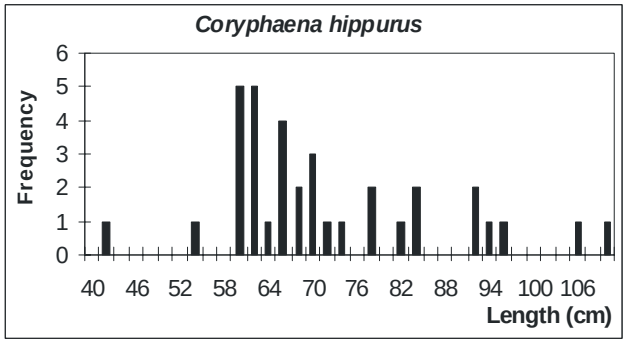




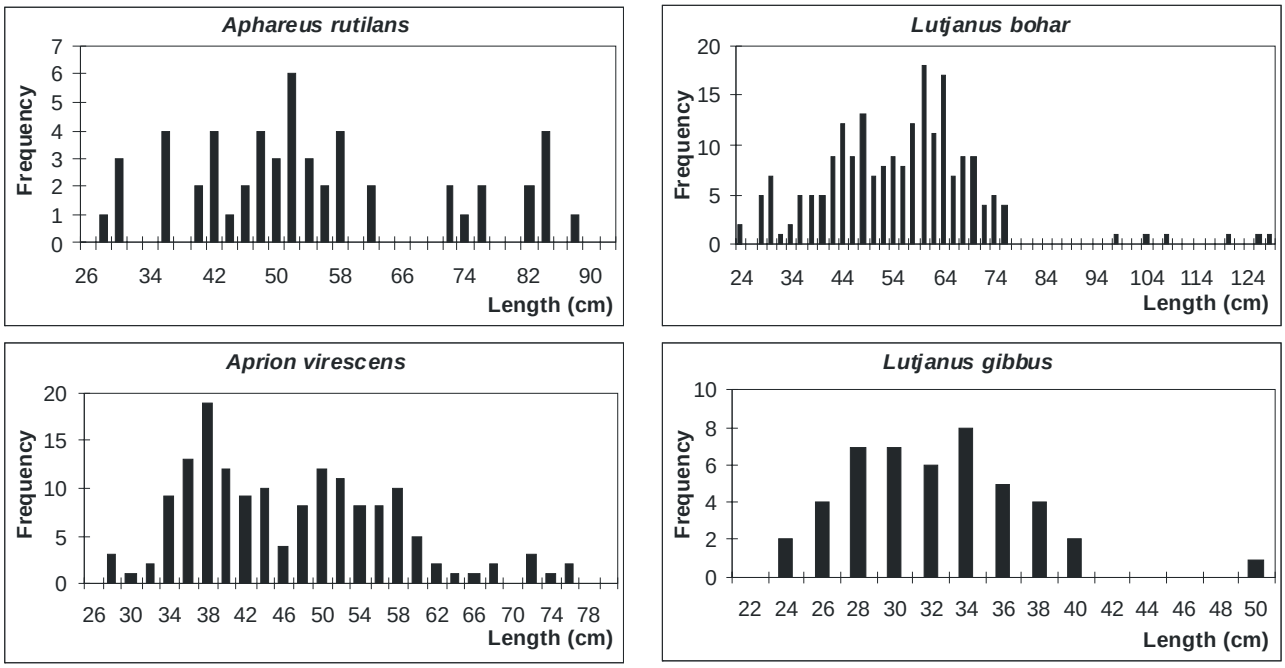
Family: Sphyraenidae



Family: Coryphaenidae



Family: Lutjanidae



Family: Lethrinidae

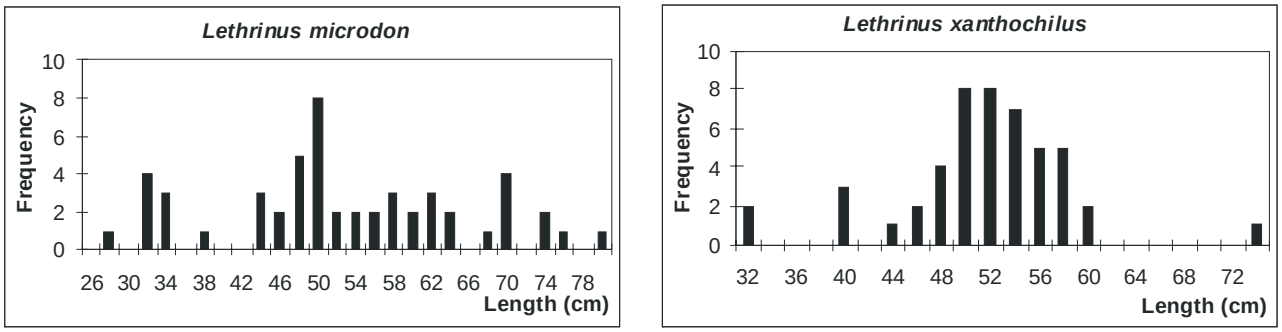


Figure 14. Length frequencies of the most commonly observed species in the Male' market, divided into their families

Comparison of the above figure with Figure 9 (size composition of the main species which were caught in the observation trips made by MRC), shows some differences with respect to the size classes caught on these trips and those of the individuals sold at the Male' fish market. As such, for *E. bipinnulata*, those individuals which were measured at the Male' market were generally larger and had a modal length at 56 cm whereas those observed on the fishing trips had a modal length at 46 cm. In contrast to this for *A. virescens*, peak length was observed at a shorter length (38cm) for those sold at the Male' market. However the size classes commonly observed in the fishery and those seen at the market were similar. Similarly *L. bohar* and *L. gibbus* also showed similar

size classes in both observations, although in the case of *L. bohar* there were a few larger individuals (i.e. 100+ cm) at the Male' market. This could be those individuals caught during the *L. bohar* spawning seasons. Having visited the market on a frequent basis, we had better opportunities to sample during this period every month. However on the observation trips with the fishermen this period could only be sampled if our trips coincided with the spawning times (i.e. 13^{th} – 15^{th} of the Hijri or Islamic calendar months).

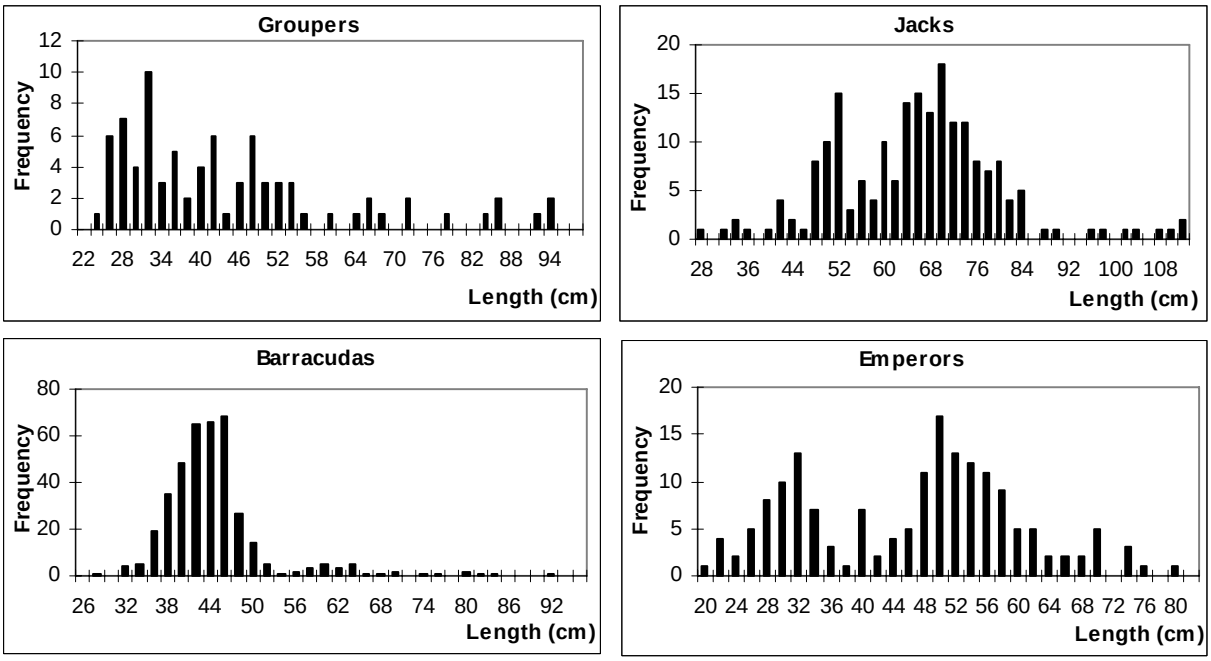


Figure 15. Length frequencies of the family groups observed at the Male' market

Groupers, emperors and jacks observed on the MRC observation trips (Figure 10) and those seen at the market (Figure 15) show similar size classes. However emperors measured at the market show a clear bimodality in their length indicating the catch of smaller individuals or a larger catch of the smaller sized species. The barracudas show a peak length at approximately 40 cm and this could further verify our assumption for Figure 10 that the first peak in the chart for barracudas/cornetfish in that figure indicates the length classes of barracudas observed on the MRC observation trips with the fishermen.

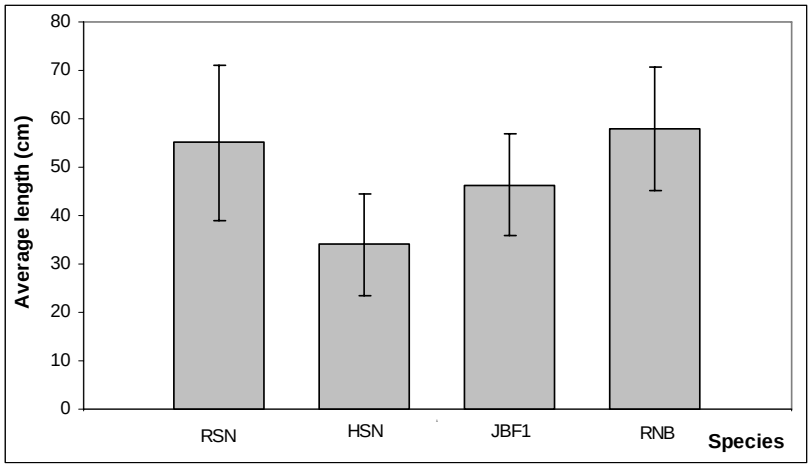


Figure 16. Average lengths of the market samples for those species which were most commonly observed on the MRC survey trips

Comparison of the average lengths of the most commonly observed species on the survey trips (figure 7b) and the average length of individuals of these species seen at the market (Figure 16) shows that *L. bohar, L. gibbus* and *E. bipinnulata* seen at the market are on average larger. This could be attributed to the different stocks which occur in the different areas.

3.2 Reef fish purchase and consumption by tourist resorts

From the 90 resorts in Maldives, only approximately 20% of the resorts replied to our survey questionnaire. As prior mentioned, data collected by the resorts are not in our required format. This was the biggest problem we faced in obtaining the data, as having to conform to our requirements also means that the resorts have to obtain more detailed data when purchasing. To make it easier for the resorts, we adjusted our survey to meet with their data collection methodology. However opposed to what we had hoped, this did not encourage more resorts to reply to the survey.

Extrapolation based on one resort's reef fish purchase in 2006, its occupancy rate for 2006 and the number of beds it has, indicates that for each tourist night, 1.29 kg of fish was purchased by the resort. The total number of registered beds in all resorts and hotels in Maldives for the year 2006 was 18,407 (MoTCA 2007) and the average occupancy rate was 81.8% (MoTCA 2007). Therefore for a total 5,495,778 tourist nights, the quantity of reef fish purchased by all resorts in 2006 would have been approximately 7108 metric tonnes. This is more than 3 times the amount (i.e. 2064 tonnes) that would

have been purchased by all resorts in 1988, which was when the last review of the reef fish fishery was done in the Maldives. The large increase in numbers purchased is owing to the wide expansion of tourism in the Maldives in the last 10 years.

Purchase prices of reef fish by the resorts varied between 5 to 18 MRf per kilo of reef fish. The average purchase price corresponds to what was observed on the field trips, i.e. MRf 10 per kilo of fish. This indicates that for the year 2006, an approximate total of MRf 71 million was spent on the purchase of reef fish. Prices paid for reef fish purchases by resorts, did not vary with the time of the year in comparison to what is observed in grouper cages where when fishing is low, exporters pay higher amounts than they would during periods of good fishing (Sattar and Adam 2005).

Resorts also pay different rates for different species of fish, i.e. all reef fish are purchased at higher rates than that paid for kawakawa or small skipjack tuna. However if only a small quantity of either is brought to the resort, together with the reef fish catch, then these species are also weighed at the same rate as that for the reef fish.

It was noted that in addition to paying the fishermen for their catch, some resorts also provide them with food items and diesel which could be used on board during their fishing trips. Although diesel given might not cover the whole month, this still allows the fishermen to save more than they would if they had to purchase the above items.

Furthermore resorts have different policies when purchasing reef fish from the fishermen. Some resorts require that the fishermen behead and gut the fish, while other resorts require only the gutting of fish. Most resorts purchase the fish as a whole and do not require the fishermen to do any of the above. From the resorts visited by us on the fishing trips, one resort was noted to have their own regulations with respect to fish purchase (refer photo plate 6), where they were not purchasing individuals smaller than a certain size or if they were immature. The same resort also does not purchase any fish from the fishermen if they have any sharks on board which might in some instances have been caught accidentally.

Survey also revealed one resort to be purchasing fish from the fish processing factory on a neighboring island.

3.3 Export of reef fish

Reef fish exports are noticeably dominated by the private sector, especially in the case of live exports to vessels visiting the holding cages. Exports are mainly in fresh/chilled, dried or salt-dried forms. Maldives Customs Services collects reef fish export data and as mentioned earlier, this data is annually published in Basic Fisheries Statistics booklet by MoFAMR.

Trends in the export quantities and prices are shown in figures below. Figure 17 shows the trend in total export of reef fish (except live exports) for the last 12 years. There was a sudden drop in exports in 1998 and although it has remained stable since then, exports are 50% lower in terms of quantity, than they were prior to 1998. Statistics show that on average the private sector contributes approximately 99% towards the export industry in terms of quantities exported.

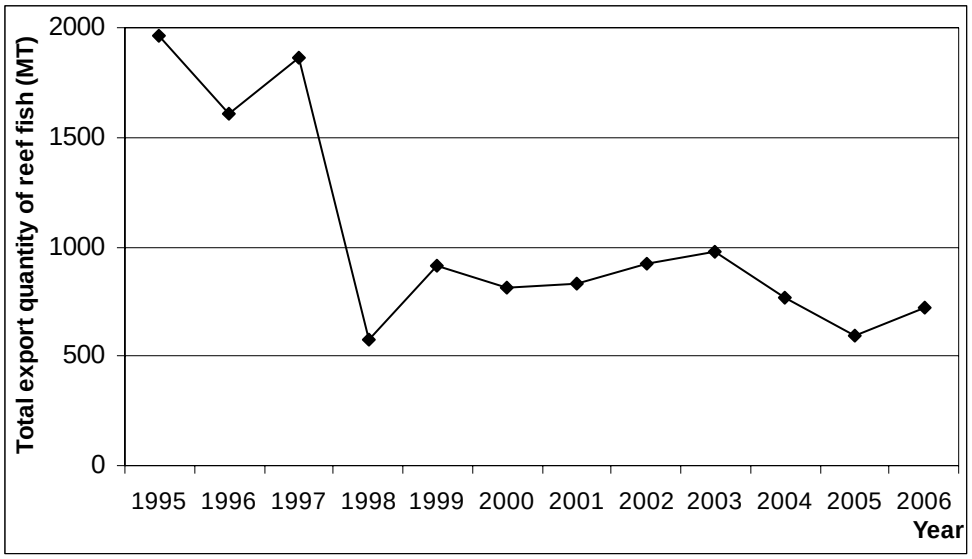


Figure 17. Total export quantity (MT) of reef fish (bar live exports) for the last 12 years

Source: MoFAMR Basic Fisheries Statistics (1995-2006)

Figure 18 shows the contribution of fresh/chilled and salt/dried forms of export towards all reef fish export (excluding live export). Figure 18a shows the two forms of exports to be reflections of each other, indicative of the fact that these two forms dominate the exports. Trends in exports for the two forms were seen to fluctuate between 1995 and 2002; i.e. a reverse in trends and vice versa. However from 2002, where almost equal

quantities of both forms were exported, the trends once again shifted back to what they were previously, i.e. products in the salt/dried form were exported more than fresh/chilled products. This however is not the case in reality, as more reef fish is exported in the fresh/chilled form than in the salt/dried form. This error occurs due to the exports of rainbow runner being included in the reef fish exports, as it plays a dominant role in the reef fishery in terms of species-based catch numbers.

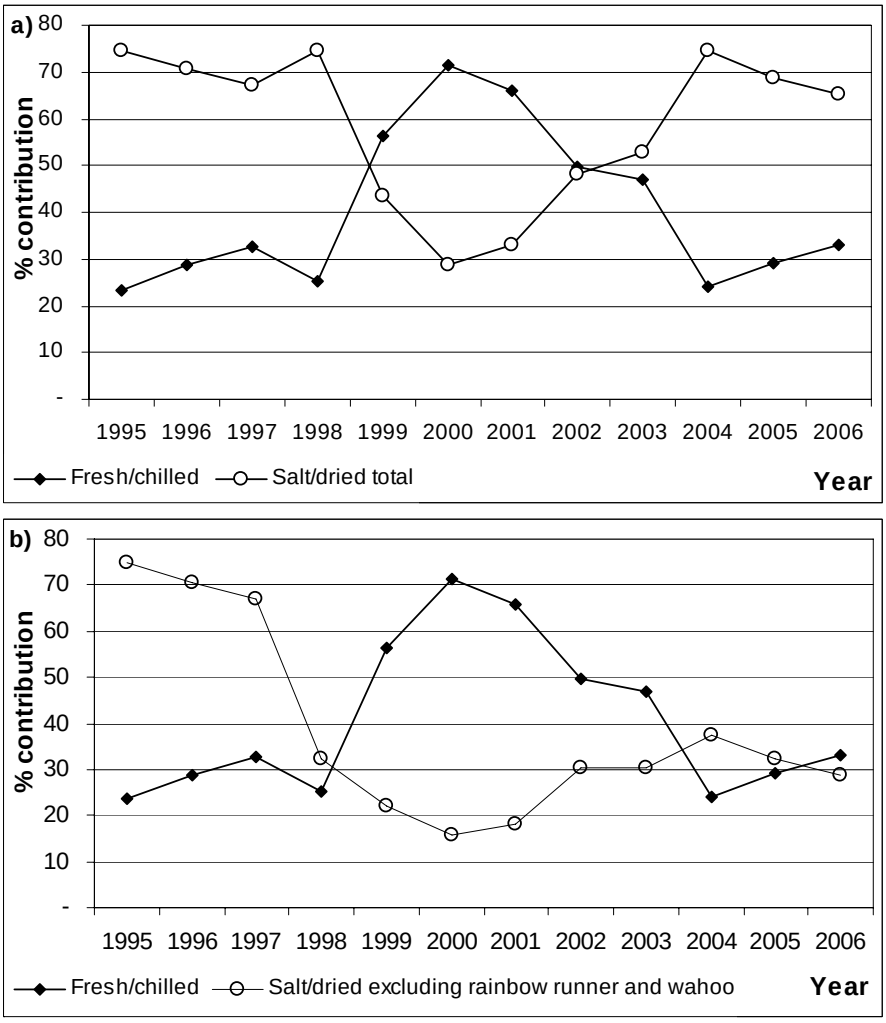


Figure 18. Contribution of fresh/chilled and salt/dried forms towards reef fish exports including (a) and excluding (b) rainbow runner and wahoo
Source: MoFAMR Basic Fisheries Statistics (1995-2006)

A plot of salt/dried reef fish exports excluding that for rainbow runner and wahoo depicts a truer picture (Figure 18b), where fresh/chilled forms of reef fish are exported in greater quantities in comparison to salt/dried forms. However in the years 2004 and 2005, salt/dried forms were still exported in greater quantities. Export data for fresh/chilled

forms shows a large decrease in the exports of fresh/chilled reef fish and fresh/chilled groupers, for the years 2004 and 2005. This could be owing to the large number of fishermen leaving the grouper and reef fishery and turning towards yellowfin fishery.

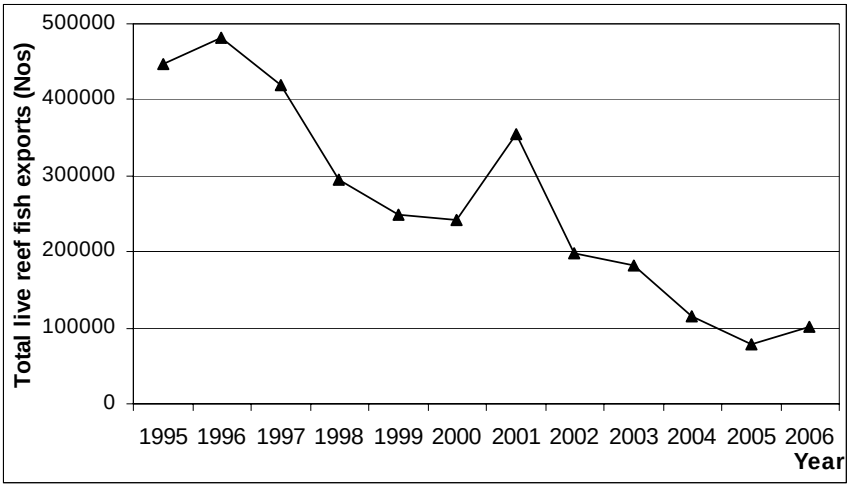


Figure 19. Total export quantities of live reef fish
Source: MoFAMR Basic Fisheries Statistics (1995-2006)

Figure 19 shows the trend in total export quantities of live reef fish (groupers inclusive), which is seen to be decreasing. This is similar to what was previously reported for the live grouper exports (Sattar and Adam 2005). As the live reef fish exports are dominated by grouper exports with a contribution between 91 – 100% in all years, the above trend is hardly surprising. As prior noted, export of live individuals is only carried out by the private sector.

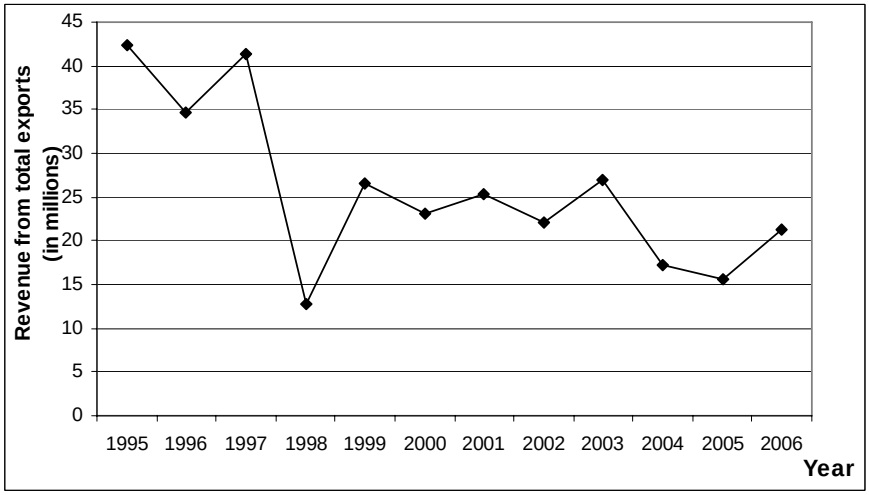


Figure 20. Revenue from the total export of fresh/chilled, dried and salt/dried forms of reef fish
Source: MoFAMR Basic Fisheries Statistics (1995-2006)

Figure 20 above shows the total income earned by export of fresh/chilled, salt dried and dried forms of reef fish. Similar to export quantities, statistics reveal that income earned by the private sector contributes, approximately 99% towards the total value earned indicating that this sector dominates the export industry of reef fish both in terms of quantity and income.

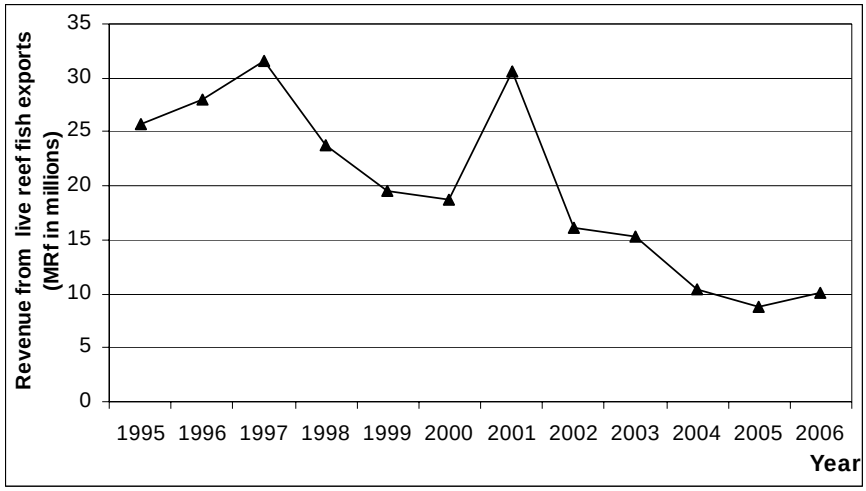


Figure 21. Revenue from total live reef fish exports
Source: MoFAMR Basic Fisheries Statistics (1995-2006)

Total income earned by live reef fish exports (Figure 21) closely follows the trend for the export quantities of live reef fish (Figure 19). In general, since 1997 the income earned due to live exports shows a decreasing trend to date, although from 2000 to 2001 there was a large increase in the earnings.

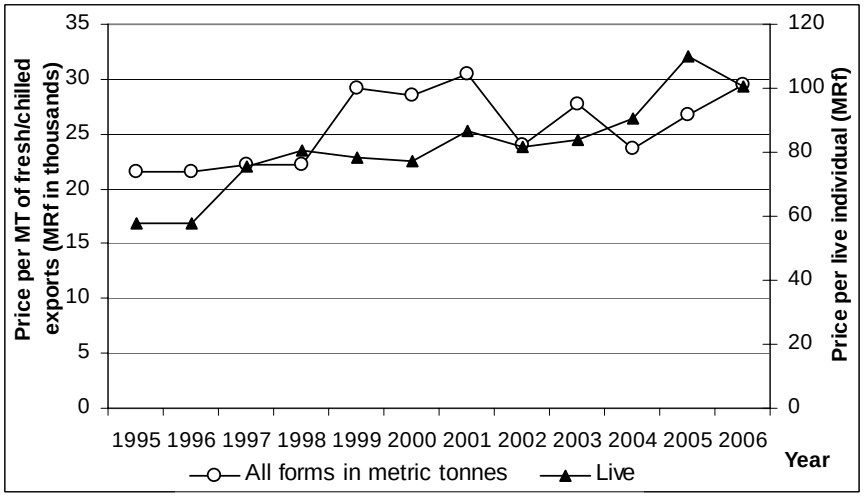


Figure 22. Average price per metric tonne for total reef fish exports (all forms bar live exports) and price per individual exported in the live reef fish export trade
Source: MOFAMR Basic Fisheries Statistics (1995-2006)

Figure 22 above shows the price paid per metric tonne and price per individual in the live reef fish export trade. Price paid per metric tonne represents that for all forms of export bar live exports (i.e. fresh/chilled, salt/dried, dried and frozen forms) by both the government and private sector. Price paid per metric tonne is seen to fluctuate from the year 1998 onwards. However in the last 2 years this is seen to be on the increasing trend. On the other hand price per individual for live exports show an increasing trend from the beginning, indicating that although export quantities of live reef fish are decreasing (Figure 19) the buyers are paying higher prices to obtain what resource is remaining. This in itself is an incentive for exporters and fishermen to stay in the business in times of declining fisheries.

Although both live and fresh/chilled reef fish exports in general show a decreasing trend and appear to be exported in much less quantities than a decade ago, these exports are more widespread than we are aware of and would like to believe. As mentioned previously, during lean periods in the Yellowfin handline fishery many are believed to purchase reef fish which are exported fresh-chilled.

4 Concluding Remarks

Demand for reef fish, from the tourism industry solely has more than tripled in the last 15 years and will continue with the future expansion and increase of tourism. The tourism industry of Maldives hopes to attract 1 million tourists per year by 2010. Additionally, a greater number of Maldivians as well as the 70,000+ expatriates working in the Maldives (*source: Ministry of Higher Education, Employment and Social Security,* website accessed April 2008) are starting to appreciate the value of reef fish. As a result there will be consistent increase in the demand for the reef fish for local consumption and export. As mentioned in the report, the reef fish export industry is far more wide-spread than we are aware. It is a common practice among yellowfin tuna exporters to turn towards reef fish during times of low yellowfin catches. While the aquarium fishery and bait fishery have certain management guidelines, there are no management regulations for reef food fish bar the declaration of the Napoleon wrasse (*Cheilinus undulates*) as a protected species and the export ban on all species of parrotfish.

Elagatis bipinnulata dominates the catch of reef fishermen which could be due to reasons mentioned in the report, i.e. this species forming large schools provide fishermen with an easy and fast catch. Although, this is the case, fishermen are discouraged from catching large quantities of this species at a time, as it has a very short shelf life and is easily damaged. Hence resorts also purchase this species in large numbers only at times when fishing is low. Apart from this species, *Aprion virescens* contributed the greatest numbers towards the catch on a species level.

Size changes were observed for commonly caught species such as *A. virescens* and *L. bohar*. Individuals belonging to these species and which are being caught now were on average smaller in size than those which were sampled in the study carried out in 1991. Although the difference in size was reasonably small, this should still be a warning enough, that if the fishery is continued at the rate it is now, we will begin to see substantial changes in the size compositions. Similar to groupers and sharks, many reef fish species have slow growth and late maturity and if their harvest is continued at high rates, could lead to changes in the demographic structure of the population such as changes in intrinsic rate of population growth and how the population responds to perturbations as a result (Anderson et al. 2008). Research shows that removal of the

larger individuals can have adverse effects than just decreased size. Larger individuals have higher fecundity. Thus the reproductive potential of a population is also adversely affected by the removal of the larger individuals (Birkeland and Dayton 2005). Recent research shows that exploited populations show that juvenescent populations have increasing unstable population dynamics because of changing demographic parameters such as intrinsic growth rates (Anderson et al. 2008). They conclude that this enhanced nonlinearity also explains a lot of the volatility seen in fish stocks today (Anderson et al. 2008). Reef fish species have much lower fecundity and longer population doubling time than species such as tuna. Therefore effects on the population reproductive potential as well as demographic structure would be felt more in these populations. Furthermore, it would take a very long time of discontinued exploitation before the population returns to its prior unexploited status.

Most species of reef fish are quite sedentary, have a very small home range and do not migrate large distances. Therefore exploitation of one area on a continuous basis over a long period of time renders such species in the area to very easy over exploitation. There are also those species such as groupers that form large spawning aggregations at certain periods of the year. Targeting of these aggregations also renders these species to easy over exploitation. It is quite evident from fishing location data and interviews with fishermen, that they are aware of these aggregation sites. They also admit to targeting these sites simply due to the easy and quick catch from the area in large quantities.

The only assessment of the reef fish fishery being carried out in the Maldives was done 16 years ago. In the earlier surveys, the assessment identified various reef fish species and their abundance and exploitation levels as well as various gear efficiencies. However these surveys also have their shortcomings. Both were exploratory surveys which in itself did not account for how much was actually being exploited in the fishery. An MSY was calculated using the Kulbicki method, with the aid of the data collected over the survey period. However, due to the nature of the survey and available data, the estimate of MSY should be taken with caution (Anderson et al. 1992).

The status of the current reef fish resources in the Maldives is not well understood. As

mentioned above, a MSY of 30,000 tonnes was estimated in a study carried out in 1991(Anderson et al. 1992). However since this was calculated more than 16 years ago, it is important to undertake a more comprehensive survey of reef fish resources to obtain a more updated MSY. The present assessment suggests that reef fishery resources are being exploited at levels below their MSY. However, given the biology of reef fish and the rapid decline witnessed in the grouper fishery we now know how easy it is to overexploit a reef resource on an atoll-basis (Anderson 2006). It is therefore important that a precautionary approach be used in managing the reef fishery resources. As with all fisheries in the Maldives, management has always been considered once the fishery has been carried out for a number of years and starts to show a decreasing trend. Despite our conservative estimate being below the estimated MSY, we suggest precautionary harvest policies be put in place now before the fishery starts to show gross depletion in all the varieties. MRC suggests the following management recommendations or precautionary harvest rules, which were also put-forth in Anderson (2006):

- Improvement of the reef fishery statistics being taken by MoFAMR
- Continuation of the reef fish survey carried out by MRC
- Restricting or ban on the exports of reef fish
- Establishing minimum size limits for the more commonly taken species
- Establishment of seasonal or area closures of important spawning grounds
- Use of Vessel Monitoring Systems to manage the reef fishery

More research is required to further understand fishing effort levels in more complete manner.

5 Issues raised by fishermen

The following are issues which have been raised by fishermen on our various survey trips. Some of them although minor, are recurring complaints and might be important to be addressed from a management angle. Prior to finishing this report, a Memo has been sent to the Resource Management section in MOFAMR, highlighting these issues and it is our hope that at least some of these will be addressed by MOFAMR.

5.1 Conflict between divers and fishermen:

It is a very common occurrence that dive vessels drop off their passengers at a spot where fishermen are present even though the spot is not an identified dive spot and hence not a 'protected dive site'. This is a common complaint by the fishermen, as the fishermen do not fish from a spot while divers are present. There is no set rule or regulation that both parties cannot be present at the same spot at the same time. But it is a form of respect which exists between the fishermen and dive vessels and this should be respected by both parties. During one of our survey trips with the fishermen, we were also able observe such an incidence. Two dive boats from a safari moored nearby dropped off their passengers at the fishing spot while the fishing vessel we were on, was at the spot. It has to be noted that on this day, they were not fishing from a spot where fishing is banned (i.e., protected dive site). Hence they had every right to be present at the spot for their regular fishing activity. It is very unfair that the tourism industry can have such authority as to chase away the fishermen from a spot on the open ocean, from doing their work, just to satisfy the needs of a few tourists who come to dive. This was in Alifu Dhaalu Atoll and therefore there were many spots where diving is good and it is of much frustration for fishermen that the day they choose one spot to fish is the day the dive vessels also decide to unload their passengers at that spot. Given that at most times the fishermen respect this unwritten mutual agreement, the absence of the respect from most of the dive vessels, is very unfair on the fishermen and if this happens, there is not much they can do about such incidents. However, given the unfairness of such situations it would be in the best interest of the fishermen if concerned government bodies (i.e. MOFAMR) could lobby against this in order to provide some protection to the fishermen in such incidents. It is simply not enough to say that the tourism industry has the power and leave it at that. Complaints are made for a reason and given that this is a

common occurrence and a common complaint, maybe it is time someone decided to do something about this issue.

5.2 General treatment of fishermen by some resorts:

Fishermen are treated unacceptably low in some resorts. For example one resort which the fishermen sold their catch to during our survey trips, does not allow the fishermen to use the jetty to unload their catch. The fishermen have to dock a certain distance from the jetty and wade through the water, carrying the bags of fish (each weighing approximately 50kg) and then load them onto carts. This is to avoid the spillage of blood onto the resort jetty. Most resorts have a separate supply jetty where the fishermen are able to unload their catch. If this is not available, fishermen are allowed to load their catch from the main jetty and the resort provides supplies such as baskets or containers which will minimize the spillage of blood onto the jetty. It should also be noted that this resort also does not provide any food or diesel for the fishermen (which as noted below is done so by many resorts).

5.3 Low prices paid by tourist resorts for the catch:

Fishermen also complained about the low price being paid by resorts for their catch (on average, 10 MRf per kilo). This is lower than what is being paid per kilo of chilled fish at the market as well as that for fresh fish. Having said this, it should be noted that some resorts do provide the fishermen with diesel, water as well as food such as rice, flour for use on the vessel. However, with the booming tourism industry, it would not put that big a dent in their accounts to pay a slightly higher price per kilo, in light of the hard work, energy and time which is being spent by the fishermen to get this catch. Especially on days of low fishing, it takes a long time and lots of driving around to just get a suitable amount of bait. Furthermore, on such days fishermen have to drive around from spot to spot trying to find a spot where they can get a good catch. On such days they waste a large amount of diesel and time before they find a good spot (if they are lucky). There are days when they do not get a good catch at all and have to return to the resort with whatever little catch they get. Fishermen spend long hours at sea, away from their families and islands to get whatever catch they can for these tourist resorts and their effort definitely deserves more than MRF 10 per kilo of fish they bring to the resort.

5.4 Light bait fishing:

Light bait fishing affects the general reef fishery. The reef fish are attracted to the light which is used for bait fishing at night. This disturbs their natural rhythms and confuses the fish which then move to other areas during day time when reef fishermen come to these areas for fishing. This is a complaint which we hear often and although the fishermen do agree that this is a difficult issue to deal with, it appears to show some detrimental effects of light bait fishing, which should be noted. Additionally it was reported by fishermen of Vaavu atoll that fishermen from other atolls carry out night fishing using lights. This, according to the fishermen, is destructive to the reef fishery and fishermen are not able to get any catch from these areas during the day time.

5.5 Shark fishing using nets:

This issue was brought up by fishermen of Baa atoll. According to them, fishermen from other atolls use nets on the bottom reef (thila) to catch sharks in the area. These nets also capture a lot of bycatch in the form of reef fish (e.g., red snappers and emperors). This deters other reef fish species in the area and yields low catch. These incidents had been reported to authorities but according to these fishermen, no steps were taken against those responsible. In one incident it was the dive staff of a nearby resort that cut the net and released the sharks. Similar reports have been heard from divers, that there are some fishermen who carryout the same in a nearby dive spot. They have caught sharks from this area and decreased the numbers which can be seen.

5.6 Conflict with the sea cucumber fishermen:

This is another complaint which has been repeatedly heard from fishermen. Sea cucumber fishermen have been known to empty the waste water from having cooked the sea cucumbers into the ocean. This is toxic to the reef fish and bait species in the area. There have been many incidents where fishermen have reported spots from which bait used to be taken in abundance, but which has ceased yielding bait due harmful effects of the discharge.

5.7 Use of fish finders:

Some reef fishermen use fish finders to locate emperors and groupers in the deeper

habitats. These are species which at times come up to the bottom reef. However, according to fishermen, since some fishermen started fishing them from their deeper habitats, these species no longer come up to the bottom reef as they used to in the past. Hence the use of fish finders to locate fish from an area seems to be disrupting the natural pattern of fish species in that area which overtime could have detrimental effects for the population in the area. Additionally, it also prevents those who cannot afford fish finders from fishing from these areas.

5.8 Conflict with grouper exporters regarding payment

This is another complaint which is repeatedly heard from grouper fishermen and was brought up in the workshop held in April 2007, to formulate a Grouper Fishery Management Plan. Fishermen complained that they had difficulty in getting the payment for what they sell to the exporters. Payment is not made on the spot and most of the times; the fishermen have to sell their catch on credit. This, over a long time, becomes a problem as they are not able to cover their expenses. As mentioned above, this is not the first time this complaint has been heard. It might be worthwhile to make it mandatory for the grouper exporters to make the payment on a regular basis.

5.9 Complaints against foreign longliners:

Another common complaint by fishermen is that regarding foreign longliner vessels which carry out shark-finning in the Maldivian waters. Although this is something which is being monitored, it is still carried out and longlining vessels have been captured with large number of shark fins on board.

6 References

Ahmed, H., S. Mohamed and M. R. and Saleem (1997). Exploitation of reef resources – bêche-de-mer, reef sharks, giant clams, lobsters and others. . Maldives / FAO National Workshop on Integrated Reef Resources Management in the Maldives, Male', Maldives, Bay of Bengal Programme.

Anderson, C. N. K., C.-h. Hsieh, S. A. Sandin, R. Hewitt, A. Hollowed, J. Beddington, R. M. May and G. Sugihara (2008). "Why fishing magnifies fluctuations in fish abundance." Nature **452**(7189): 835-839.

Anderson, R. C. (2006). Maldives Fisheries Outlook study: baitfish and reef fish analysis and management. Unpublished report.

Anderson, R. C., Z. Waheed, M. Rasheed and A. Arif (1992). Reef Fish Resources Survey in the Maldives - Phase II Reef Fish Research and Resources Survey. B. o. B. Programme. Madras, Bay of Bengal Programme/ FAO**:** 54 pp.

Birkeland, C. and P. K. Dayton (2005). "The importance in fishery management of leaving the big ones." Trends in Ecology & Evolution **20**(7): 356-358.

Colin, P. L., Sadovy, Y. J. and Domeier, M. L. (2003). Manual for the study and conservation of reef fish spawning aggregations. S. f. t. C. o. R. F. A. S. P. N. V. 1.0)**:** pp. 1-98+iii.

Jonklass, R. (1961). A preliminary investigation of the spiny lobster resources of the Maldive Islands

MoTCA. (2007). "Khabaru - midhiya aharu nimunu iru Raahje ah 601,923 fathuruverin ziyaaraiy kohfai vey." 88-SR/NEWS/2007/01 Retrieved January 29, 2007.

Ministry of Higher Education, Employment and Social Security, website accessed April 2008:

http://www.employment.gov.mv/Resources/Statistics/2008/Indicators/Expatriate%20Employment%20Annual%20Growth%20Rate,%202003%20-%202007.pdf

Naseer, A. and B. G. Hatcher (2004). "Inventory of the Maldives' coral reefs using morphometrics generated rom Landsat ETM+ imagery." Coral Reefs **23**: 161 - 168.

Sattar, S. A. and M. S. Adam (2005). Review of Grouper fishery of the Maldives with

additional notes on Faafu Atoll fishery. Male', Marine Research Centre**:** 54 pp.

Shakeel, H. and H. Ahmed (1996). Exploitation of Reef Resources, grouper and other food fishes in the Maldives. *Workshop on Integrated Reef Resources in the Maldives* **BOBP/REP/76**: 312 pp.

Van Der Knaap, M., Z. Waheed, H. Shareef and M. Rasheed (1991). Reef fish resources survey in the Maldives. Reef fish Research and Resources Survey. B. O. B. Programme. Madras, Bay of Bengal Programme/ FAO**:** 60 pp. .

Wright, A. (1992). The Maldives fishery resources: assessment and requirements for development and management. Maldives Fishery Sector Strategy Study, Primex-GOPA-TPC. **:** 1-95.

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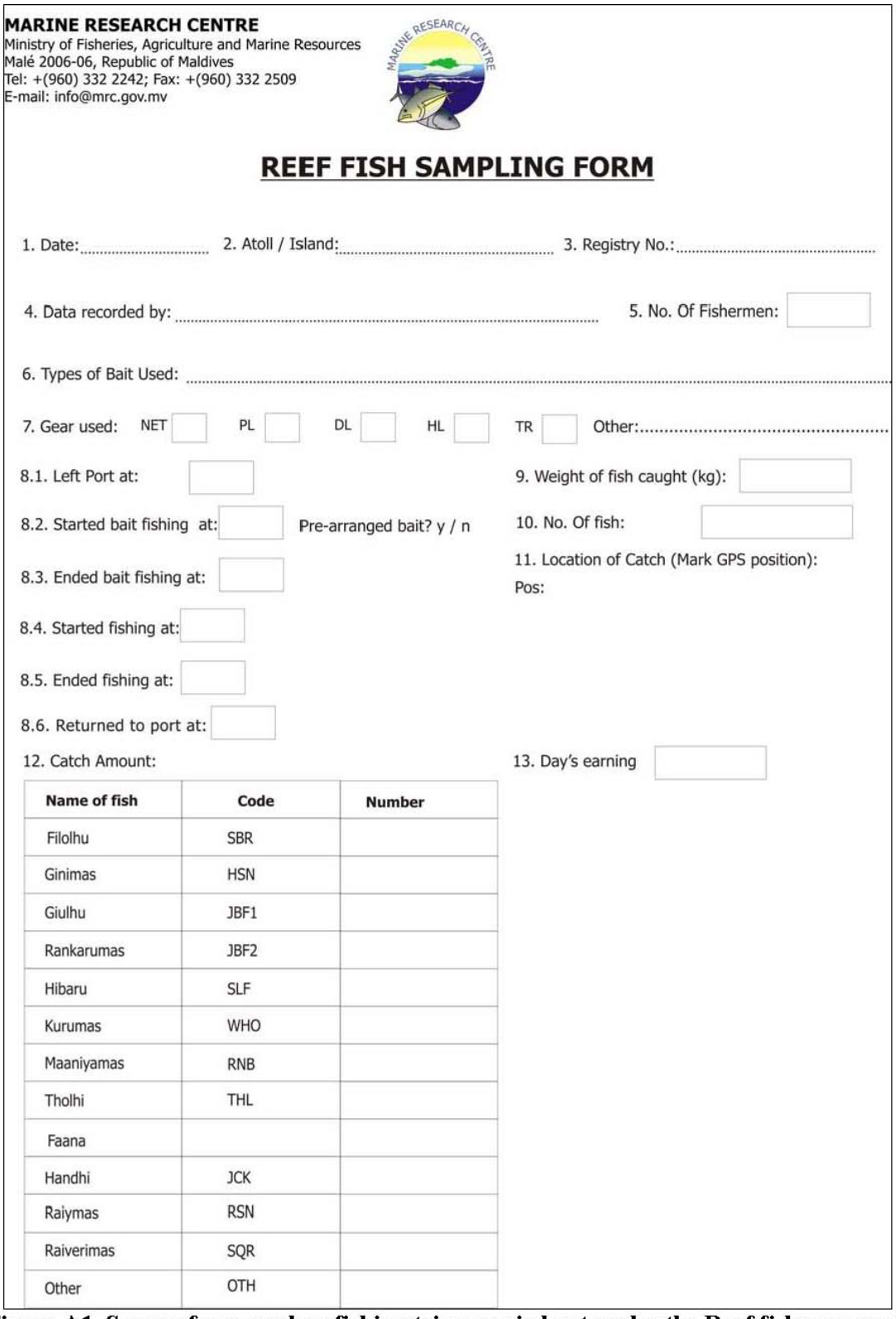
Secondly I would like to thank all the fishermen who took us out on their trips with them and made our fishing trips and data collection possible. Additionally I note the contribution by various tourist resorts towards this study, both in their data contribution as well assistance on our visits to the resort with the fishermen.

Thanks are also due to the staff of ERSS of the Ministry of Fisheries, Agriculture and Marine Resources, as well as all those at MRC and other government institutes and private companies who assisted me during the various stages of this survey. Last but not least I would like to thank all Atoll and Island offices, and island communities who assisted us on our various survey trips.

Appendix 1. Sample forms



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REEF FISH SAMPLING FORM

1. Date:..... 2. Atoll / Island:..... 3. Registry No.:.....

4. Data recorded by: ..... 5. No. Of Fishermen:

6. Types of Bait Used: .....

7. Gear used: NET PL DL HL TR Other:.....

8.1. Left Port at:

8.2. Started bait fishing at: Pre-arranged bait? y / n

8.3. Ended bait fishing at:

8.4. Started fishing at:

8.5. Ended fishing at:

8.6. Returned to port at:

9. Weight of fish caught (kg):

10. No. Of fish:

11. Location of Catch (Mark GPS position):
Pos:

12. Catch Amount:

13. Day's earning

Name of fish	Code	Number
Filolhu	SBR	
Ginimas	HSN	
Giulhu	JBF1	
Rankarumas	JBF2	
Hibaru	SLF	
Kurumas	WHO	
Maaniyamas	RNB	
Tholhi	THL	
Faana		
Handhi	JCK	
Raiymas	RSN	
Raiverimas	SQR	
Other	OTH	

Figure A1. Survey form used on fishing trips carried out under the Reef fishery survey

Appendix 2. Photo plates

Plate 1. Bait fishing

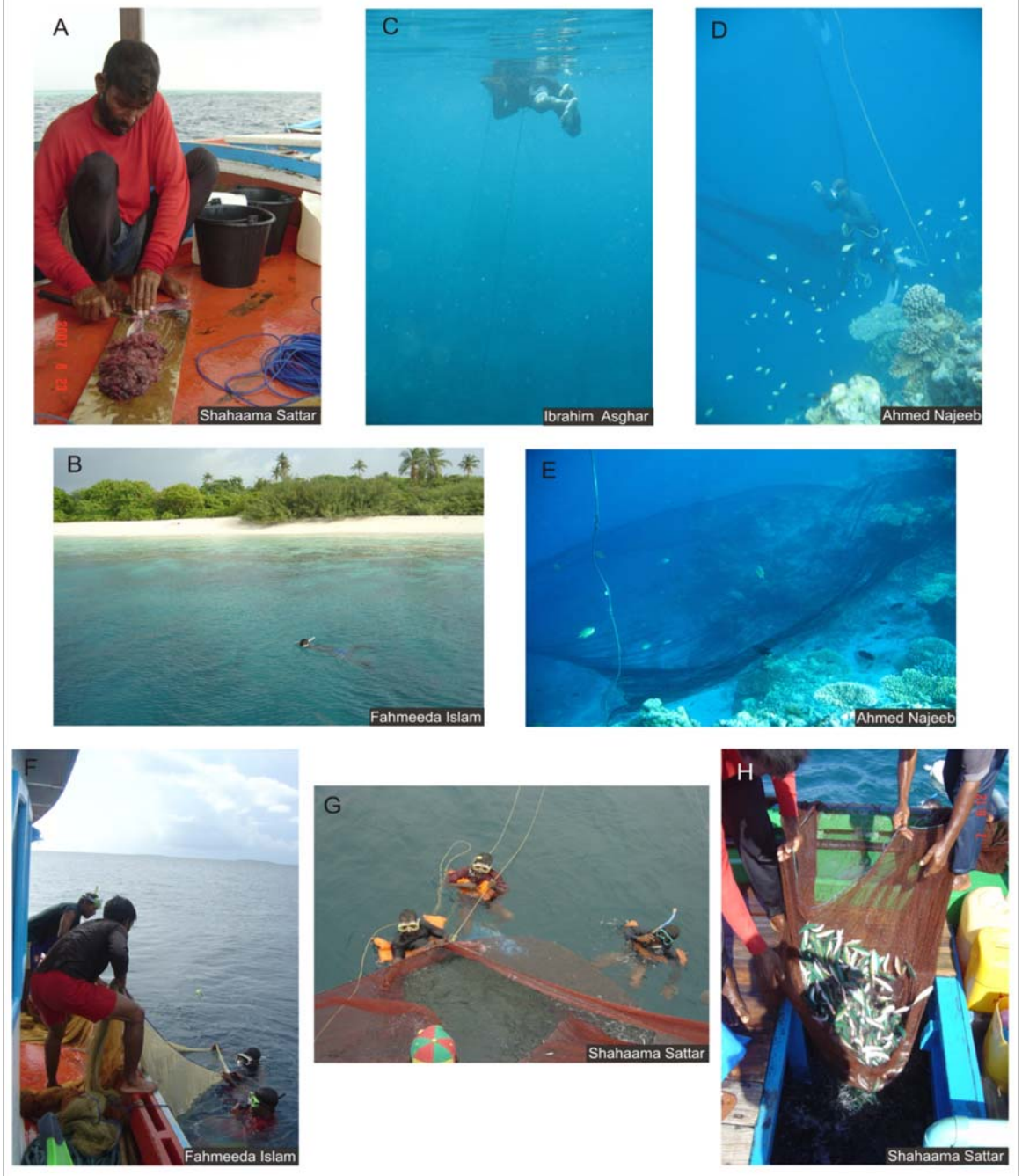

Photo titles:

A. '*Fili jehun*' or the preparation of fish scrapings which is used to attract bait
B. Looking for bait schools
C. Maneuvering the net from above and below (D)
E. Net being laid on coral reefs to capture bait
F. Captured bait
G. Captured bait being loaded on boat
H. Bait haul

Plate 2. Reef fishing

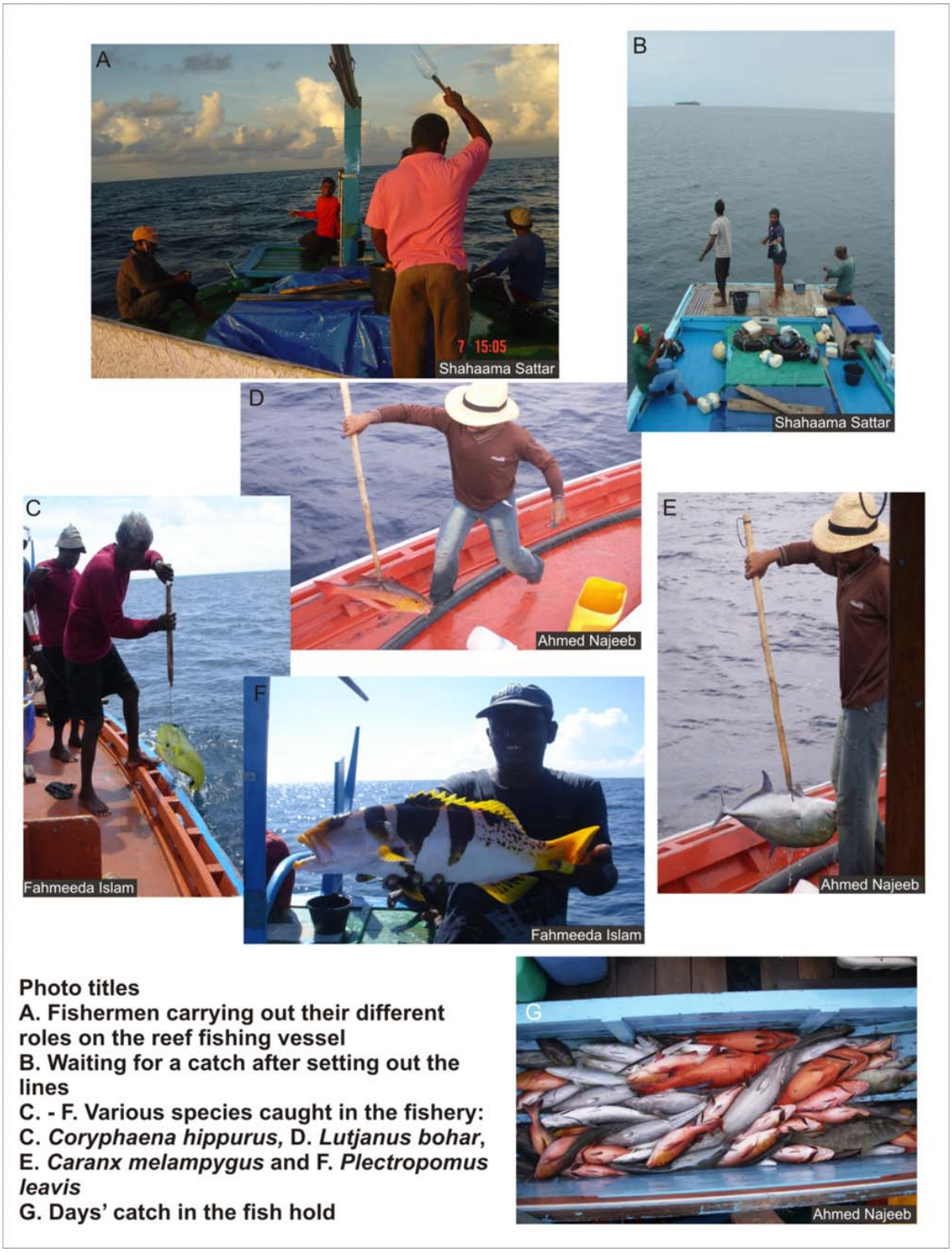

Photo titles
A. Fishermen carrying out their different roles on the reef fishing vessel
B. Waiting for a catch after setting out the lines
C. - F. Various species caught in the fishery: C. *Coryphaena hippurus*, D. *Lutjanus bohar*, E. *Caranx melampygus* and F. *Plectropomus leavis*
G. Days' catch in the fish hold

Plate 3. Grouper fishery

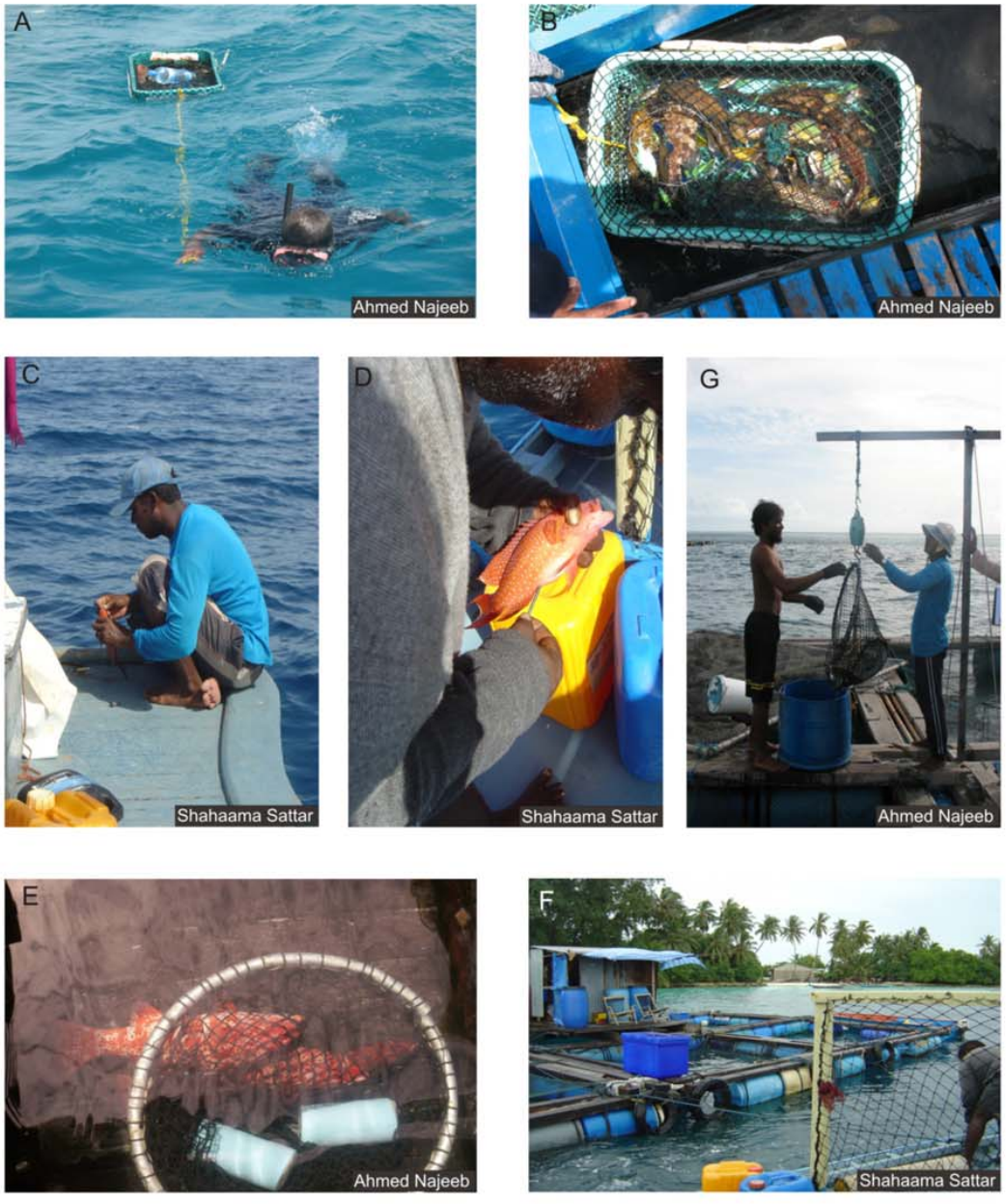

Photo titles
A. Grouper fishing using visually aided snorkelling gear
B. Grouper catch using VAS loaded on board
C Grouper fishing using handlines
D. Degassing the grouper caught using handlines
E. Grouper caught using handlines, left to stabilise in the boat hold
F. Grouper cage near V. Keyodhoo
G. Grouper catch being sold to the cage

Plate 4. Hibaru fishery

A. *Rehi* which is used to catch scads to be used as bait
B. Bait haul
C. Scads which is used as bait in the fishery
D. Baited lines with floaters at end which are released into the area
E and F. Hauling in the catch
G. Catch in the fish hold
H. 'Olhey vadhu' which is used as an artificial lure in the trolling apparatus set out from the side of the boat

Plate 5. Procedure for selling to resorts

Photo titles
A. Gutting of catch prior to selling to the resorts
B. Days catch ready to be weighed at the resort
C. and D. Days catch being taken to be weighed
E. and F. Weighing of catch
G. Stocking the catch

Plate 6. Seafood purchasing policy practiced by Four Seasons Resort Maldives at Landaagiraavaru

އެއް އަހަރުތެރޭގެ ތެރޭގައި ފަތުރުވެރިކަން ފުޅާވާންފަށައިގެން ބޮޑުވުމާ ފަރުމަސްވެރިކަންވެސް ފުޅާވެގެންގޮސްފައެވެ. ވީމާ، މިމަސްވެރިކަމަށް ކުރާނެ ނުރައްކާތެރިކަން ކުޑަކުރުމުގެ ގޮތުން ފަރުމަސް ބެލެހެއްޓުމާ މިންވަރު ކަމު ކުރުން ނޫނީ ބޭނުންކުރުމުގައި ވަކި މިންވަރުތަކެއްގެ ދަށުން ބޭނުންކުރުން ރަގަޅުވާނެ ކަމަށް ފެނެއެވެ.

4. އާއްމުގޮތެއްގައި ފަރުމަސްވެރިކަމުގައި ބޭނުން ފަރުމަހުގެ ބާވަތްތަކަށް ބޭނުން އެންމެ ކުޑަ ސައިޒެއް ކަނޑައެޅުން. މަސްވެރިކަމުގައި ބޭނުން އެންމެ ކުޑަ ސައިޒެއް ގާއިމު ކުރުމަކީ ވަރަށް ދިރުން ބާވަތުގެ މަސްވެރިކަން ދެމެހެއްޓެނިވި އުސޫލެއްގައި ކުރިއަށް ގެންދިޔުމަށް އެއް ޒަރޫރީ ކަމެކެވެ. މިގޮތުން ސައިޒު ކަނޑައަޅައިދޭ ބާވަތް އެންމެ ކުޑަ ސައިޒަކީ ވާންވާނީ އެބާވަތެއްގެ މަސް ބިސްދޫކުރާ އުމުރަށް އަރާއިރު ހުންނަ ސައިޒަށްވުރެ ބޮޑު ސައިޒަކަށެވެ.

5. ފަރުމަސް ބިސްދޫކުރަން ޖަމާވާ އެއް ދުވަސްވަރު އެސަރަހައްދުތަކުން މަސްބޭނުން މަނާކުރުން. މިހެން ވަކި ދުވަސްވަރު ވަކި ސަރަހައްދުތަކުން މަސްބޭނުން މަނާ ކުރުމުން އަބަދުވެސް އާބާދީގެ ކޮންމެވެސް ބައެއް ރައްކާތެރިވެދޭނެއެވެ. އަދި ބިސްދޫކުރަން ޖަމާވާ އެއް ސަރަހައްދުތަކުން އެދުވަސްވަރު މަސްވެރިކަން ކުރުމުން މަސްކުރުން ފަރުމަހުގެ އާބާދީއަށް ވަރަށް ބޮޑު ބަދަލުތަކެއް އަންނަން ކަމަށް ދެކެވެއެވެ. މިގޮތް ސަބަބުން އާބާދީ އިތުރުވެ، އަދި އާބާދީ އާލާވާ މިންވަރުވެސް އިތުރުވެގެންދާނެއެވެ.

6. މަސްވެރިކަން ކުރާ އެކިއުސޫލުތަކުގެ މޮނިޓަރކުރުން ފުޅާކުރުން. ދުނިޔޭގެ ވަރަށް ގިނަ ސަރަހައްދުތަކުގައި މަސްވެރިކަން ކުރާ އެކިއުސޫލުތަކުގެ ހަރަކާތްތައް މޮނިޓަރ ކުރަމުން ގެންދެއެވެ. މިގޮތުން މަސްވެރިކަންކުރާ އެކިއުސޫލުތަކުގައި ބޭނުން ކުރާ ނިޒާމު ހަރުކުރުމުން ކާނޑު ދުވަހުގެ އެކިއުސޫލުތަކުގެ ޖާގަ ސަރަހައްދުތައް އެނގި އަދި އެ އެކިއުސޫލުތަކުން އެދުވަހުގެ މަސްވެރިކަމުގެ ރިޕޯޓުތައް މިނިސްޓްރީއަށް ހުށަހެޅުމަށް މަޖުބޫރުވެއެވެ. ކޮއްޗެއްގެ ތެރެއިން ދުވަސް އަދި ބޭނުންވާ ސަރަހައްދުތަކުން ފެނިގެންދާ މަސްތަކުގެ މިގޮތުގެ ނިޒާމު ވަރަށް ބޭނުންތެރިވާނެއެވެ. މަސްވެރިކަން ބެލެހެއްޓުމުގައި މިހެންވެސް އަދިގިނަ ދުވަސްތަކަށް ދިރާސާ އެންމެ ބޭނުން އެއްޗެއް ކަމުގައިވާ ކުރާނެ މިފަދަ ނިޒާމުތައް ފާހަގަކުރެވެއެވެ. ނަމަވެސް މިދަނޑި ނިޒާމު ބަލަހައްޓާ މަސްވެރިކަން ކުރާ ހިންގުމަށް ވަރަށް ބޭނުންތެރި ކަމަށް ފެނެއެވެ.

އަދި މުޅިރާއްޖެއަށް ބަލާއިރު މިގޮތަށް ތަފާތުވާ އަދަދަކަށްވުރެ ދަށް މިންވަރަކަށް ފަރުމަސްބާނާ ކަމުގައިވިޔަސް، ފަރުމަހަކީ އާޔެ ޖާތީގައި ފަހަރަކު އަތޮޅުތަކުން އެއްބައިއެއްގައި ހުރި މިންވަރު ނުބަލާ ގިނަ އަދަދަކަށް ބާނަން ފެށުނަ ބާވަތްތަކެވެ. މިކަން އަލުގަނޑުވެރުންނަށް ރާއްޖޭގައި ކުރެވުމުން އަންނަ ފާނަ މަސްވެރިކަމުންވެސް ވަނީ ކަށަވަރުވެފައެވެ.

- ރާއްޖޭގައި ކުރެވުމުންދާ ފަރުމަސްވެރިކަމުގެ ހާލަތު އަދި ރާއްޖޭގައި އުޅޭ ފަރުމަހުގެ ބާވަތްތަކުގެ ސްޓޮކުތަކުގެ ހާލަތާއިމެދު އަލުގަނޑުވެރުންނަށް އެނގިފައި ވަރަށް ކުޑަ އެއްޗެކެވެ. ނަމަވެސް މިހާ ފުޅާދާއިރާއެއްގައި ކުރެވުމުންދާ، އަދި ކުރިއަށް އޮތްތަނުގައިވެސް އިތުރަށް ފުޅާވެގެން ދާނެ މިމަސްވެރިކަން ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުރުން އެއީ ވަރަށް މުހިއްމު ކަމެކެވެ. މިގޮތުން މަޖިލީގައި ބަޔާން ކުރެވުނު 'ދެމެހެއްޓެނިވި ގޮތެއްގައި ފަރުމަސް ނެގުން އެންމެ މަތީ މިންވަރު' މުޅި ރާއްޖެއަށް އަދި ވަކި ވަކި އަތޮޅުތަކަށް ހޯދުމަކީ ވަރަށް މުހިއްމު ކަމެކެވެ. އެންމެ ފަހުން މުޅިރާއްޖެއަށް މި މިންވަރު ހޯދައިފައިވަނީ 1991 ގައި ކުރެވުނު ދިރާސާގައެވެ. އަދި މިކަން ކުރެވުނުދުވަސް މިހާރުވެސް ކުރެވުމުންދާ ފަރުމަސްވެރިކަން ސަފާރީކަން ބަރައްޖެއްގައި ދުރާލާ ވިސްނައިގެން ކުރިއަށް ގެންދިއުން ނުވަތަ "ޕްރިކޯޝަނަރީ އެޕްރޯޗް" އެއްގެ ދަށުން ކުރުން މުހިއްމެވެ. މިގޮތަށް ދެމެހެއްޓެނިވި ގޮތެއްގައި މި މަސްވެރިކަން ކުރިއަށް ގެންދިއުމަށް މިކުރުން ދިރާސާގެ އަލީގައި ގުޅިގެން ރިސާރޗް ސްޓަޑީތަކުން ތިރީގައިވާ ކަންތަކަށް ތަފާ ދެވުނެވެ.

<u>ފަރުމަސްވެރިކަން ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުރިއަށް ގެންދިއުމަށް ކުރުމަށް ތަފާތުވުން ކަންތައްތައް</u>

1. މިނިސްޓްރީ އޮފް ފިޝަރީޒް، އެގްރިކަލްޗަރ އެންޑް މެރިން ރިސޯސަސްގެ ފަރާތުން ނަގާ ފަރުމަސްވެރިކަމުގެ ތަފާސް ހިސާބު މިހާރަށް ވުރެ ހަރުދަނާކުރުން. މިހާރު މިނިސްޓްރީ އިން ނަގާ ތަފާސް ހިސާބު ނަގަނީ ފަރުމަހުގެ ބާވަތްތައް އެބާވަތްތަކުގެ ސައިޒަށް ބަލާފައި 3 ގްރޫޕަކަށް (ބޮޑު، ކުދި، ކުޑަ) ބާހާލައިގެންނެވެ. މިގޮތުން ނަގާ މައުލޫމާތުގައި، ފުރިހަމަ ނުވުމުގެ އިތުރުން، ގިނަ މައްސަލަތައް އުފެދެއެވެ. މިގޮތުން ކޮންމެ ގްރޫޕެއްގައި ބާނާ ޖުމްލަ މިންވަރު އެނގެއިރު އެއީ ކޮން ބާވަތްތަކެއްކަން ބާނާ ބާވަތްތަކުން ބާނާ ހިއްސާއެއްކަން ސާފެއް ނުވެއެވެ.

2. ފެދުން ރިސާރޗް ސްޓޮކްއެސެސްމަންޓް ހިންގި ފަރުމަސްވެރިކަމުގެ ދިރާސާ ކުރިއަށް ގެންދިއުން. މަސްވެރިކަމުގެ ދިރާސާ ކުރެއިރު، އެމަސްވެރިކަމެއްގައި ބޭނުން ކުރާ ސަރަހައްދު މަޢުލޫމާތުތަކަށް ފިޔަވަ ކަންކަމަށް ދެނޑުނުކަން ކުރިއަށް ކަންކަމެވެ. ވީމާ މިއަހަރުން ފެށިގެން މަސްވެރިންނާއި ގުޅިގެން ފަރުމަހުގައި މިން އެއުޅޭ ބާވަތްތައް ފެށުން ކުރިއަށްވެއެވެ.

3. ފަރުމަސް ބާނުމުގެ މިންވަރު ހަދާ ކުރުން. ރާއްޖެއިން ފަރުމަސް ބާނުމުގެ މިންވަރު ވަކި ވަރަކަށް ބޭނުން ދަށަށް ގެނެވޭނެވެ. މިގޮތުން މިހާރު މަޢުލޫމާތު ދިރާސާގައި ދިރާސާކުރެވުނު ފިހާރަތަކުން ބާނުމުގެ ފަރުމަހުގެ ގޮތުގައި ބާނާނެ ފާހަގަވެއެވެ. ފާނަ މަސްވެރިކަމަށް އަދާކުރާ މަސްވެރިކަމާއި ގުޅުމުގައި ކުރާ މަސްވެރިކަމެވެ. މިގެ އިތުރުން ފަރުމަހުގެ ގޮތުގައި ބޭނުން މާނަކުރާ ނަމަކީ ވަރަށް ގިނަ އަދަދަކަށް ބާނުމެވެ. ކުރިއަށް

ދިރާސާއާއި ބޭނުންވާ މައުލޫމާތު އަދުގަނޑުވެސް ނަގާފައިވަނީ ފަރުމަސްވެރިންނާއެކު ހެދުނު މަސްވެރިދުވަސްތަކުގައި މިނިސްޓްރީގެ މުވައްޒަފުން ބައިވެރިވެގެންނެވެ. އަދި ރިސޯޓުތަކަށް ފަރުމަސްގަންނަ އަދަދު ހޯދިފައިވަނީ ރިސޯޓުތަކާއި ގުޅައިގެންނެވެ. މީގެ އިތުރުން ފަރުމަސް އެކްސްޕޯޓުކުރާ މިންވަރު އަދި މިކަމުން ލިބޭ އާމްދަނީގެ ތަފާސް ހިސާބުތައް މިނިސްޓްރީ އޮފް ފިޝަރީޒް، އެގްރިކަލްޗަރ އެންޑް މެރިން ރިސޯސަސް އިން ލިބިފައިވެއެވެ.

ކުރެވުނު ދިރާސާގެ ނަތީޖާތަކުން ބަލާލާއިރު ފާހަގަ ކުރެވޭ ކަންތައްތަކަކީ:

- ރާއްޖޭގައި މިހާރު ކުރެވެމުންދާ ފަރުމަސްވެރިކަމުގައި އެންމެ ގިނައިން ބޭނޭ ވައްތަރުގެ މަހަކީ ގިނިއާމަހެވެ. ފަރުމަސްވެރިކަމުގައި ގިނިއާމަސް ގިނަ އަދަދަކަށް ބޭނޭ އަޅިން ހަދައިގެން ފަރުބަދުތަކުގެ ބޯކުޅައިރުގައި އުޅޭ ބާވަތްތަކަށް ވުރެން، ގިނަ އަދަދަކަށް ކުޑަ ފަރުބަދުތަކާއި ގޮށިތަކުގައި ބޭނޭ ގޮތަށް ފާހަގަވެއެވެ. ނަމަވެސް، އޭގެ ޖުމްލަ މިންވަރަކީ ފަރުމަސްވެރިކަމުގެ ގޮތުގައި ނުބެލެވޭ، މިބާވަތް އުނި ކުރުމަކުން އެންމެ ގިނައިން ބޭނޭ ވައްތަރުގެ ފަރުމަހަކީ ދިއުލިކަން ފާހަގަ ކުރެވެއެވެ.
- ފަރުމަހުގެ ގޮތުގައި އެންމެ ގިނައިން ބޭނޭ ބާވަތްތަކާ ކަމުގައިވާ ގިއުލާ އަދި ރަތްމަހުގެ ސައިޒަށް (ބޮޑުމިން) ބަލާއިރު، 1990/1989 ގައި ކުރެވުނު ދިރާސާގައި ބޭނުން މިބާވަތްތަކުގެ ސައިޒަށް ވުރެ މިހާރު ބޭނޭ މަހުގެ ސައިޒް ކުޑަވެފައިވާކަން ފާހަގަ ކުރެވިއްޖެ. މިއީ އަދަދަށްވުރެން ކަންބޮޑުވާން ޖެހޭ ކަމެކެވެ. މީގެ ކުރިން ކުރިއަށްދާ ދިރާސާތަކުންވެސް ދައްކައިދޭ ގޮތުން މަސްވެރިކަމުގައި ބޭނޭ މަހުގެ ވަކި ސައިޒުކަން ނުވަތަ އުމުރުފުރާއަކުން އަޅުކުރެވިގެން ކުރާ މަސްވެރިކަމުގެ ސަބަބުން މަހުގެ އާބާދީގައި އޮހުރުވާ ގޮތްތަކީ ސައިޒުތަކުން ބޮޑު ނޭނގޭ ބަދަލުތަކެއް އައިސްފައިވެއެވެ.
- ފަރުމަސްވެރިކަން ކުރުމަށް އެންމެ އާއްމުގޮތެއްގައި ބޭނުންކުރެވެނީ އަތް ނަންނެވެ. މީގެ ދުވަސްކޮޅަށް ހިފުނެވެ. އެއީ ފައްކައިގެން، އަޖިގައި އެކި ވައްތަރުގެ ބާވަތްތަކަށް ހިފާ ބޭނުން ކުރާ ނަރާއި، ޢާއްމު ދުއްކަނޑުގެ މަތީ ފަރަތަތަކުގައި އެކި ފަރުމަހުގެ ބާވަތްތައް ހިފާ ބޭނުން ކުރާ ނަރެވެ. މިގޮތުން އެންމެ ގިނައިން ބޭނުންކުރާ ފަރަކަށްދާ ނިއްކުރާ ބޭނުންކުރާ އަތް ނަރެވެ. މިދިރާސާއިން ދެއްކި ގޮތުގައި ގިނަ އަދަދެއްގެ މިންވަރު ސައިޒުގެ ބޭނުން އެއީ މިކަމުގެ ސަބަބުން ދެއްކި ނަތީޖާއަކަށްވުން އެކަށީގެންވެއެވެ.
- ބޭނުންކުރުން ފަރުމަހުގެ އަދަދަށް ބަލާއިރު، ވީތުވުރި އައްޗިތަކުގެ ތެރޭގައިވެސް ބޭނުންކުރެވިފައިވާ އަދަދު ދަށްވެފައިވެއެވެ.
- ރާއްޖޭގެ ރިސޯޓުތަކަށް ޖުމްލަ ގޮތުގައި ބޭނޭ ފަރުމަހުގެ އަދަދު ވަނީ 1991 ގައި ކުރެވުނު ދިރާސާއާ އަޅާބަލާއިރު ވަރަށް އިތުރުވެފައެވެ. ރިސޯޓުތަކުން ލިބުނު މައުލޫމާތަށް ރިއާޢަތްކޮށް އަންދާޒާ ކުރެވުނު ގޮތުގައި 2006 ވަނަ އަހަރު ރާއްޖޭގެ ރިސޯޓުތަކަށް 7،000 ޓަނުގެ ފަރުމަސް ގަނެވުނެވެ. ނަމަވެސް ރިސޯޓުގައި ފަރުމަހުގެ ބޭނުންކުރާ ސަރުކާރު ރޭވުމެއް ނެތުމުން ފަރުމަހުގެ ތިއުރަތަކީ? އަދަދު ވަނީ އުޅަގަޑު ކުރެވުނު ދިރާސާގައި އަންދާޒާ ކުރެވުނު އަދަދަށް ވުރެ މަދުވެފައެވެ.
- ރާއްޖޭގައި ކުރެވެމުންދާ ފަރުމަސްވެރިކަން އަދި ކުރެވެމުން ދަނީ އެތަކެތީގެ 'ލައިވް ފުޑް ސަޕްލައި ޗެއިން' ނުވަތަ މިބާވަތުގެ ސްޓޮކް ދެމެހެއްޓުމަށް ޓަކައި ހަމަހަމަ އެންމެ ބޮޑު މިންވަރަށް ދަނޑިވަޅު މިންވަރުގައި ކަމަށް ވީނަމަ ކުރެވިފައެވެ. މިގޮތަށް ރަނގަޅަށް "ދުވަހުން ވީއްލި ޓަކައި ފަރުމަސް ހިތާހާ ބޮޑު މިންވަރު" ރަނގަޅަށް ގެނައުމުން ކަމަށް ފަހަރެއްގައިވެސް މިސްރާބުގެ ނަތީޖާއެއް އެކަށީގެންވާ ކަމެކެވެ. އެއީ

ދިވެހިރާއްޖޭގެ ކުރީގެ ފަރުމަސްވެރިކަމާ ބެހޭ ރިޕޯޓުގެ ޚުލާސާ

ރާއްޖޭގެ ކުރެވުނުތާ ފަރުމަސްވެރިކަމުގެ ދިރާސާއެއް މިދެ ކުރިން ކޮށްފައިވަނީ 16 އަހަރު ކުރިންނެވެ. މިގޮތުން ޖޫން ވޮތްވޭތީ އަހަރުތަކުގެ ތެރޭގައި މިމަސްވެރިކަމަށް އައިސްފައިވާ ބަދަލުތައް މި ރިޕޯޓުން ވަރަށް ސާފުކޮށް ފެންނަން އެބަހުރެވެ. ނަމަވެސް ދުވަހަކުގެ މަތިން ކުރެވުނު ދިރާސާތައް ކުރިއަށް ގެންދެވެފައިވާ މުދިން ތަފާތުތަކެއް ބޭނުންކުރެވުނު ފަދަ ކޮށްތަން މުހިއްމެވެ.

މިހާރު ފެށިގެންދާނެ ރާއްޖޭގައި ކުރެވުނު ފަރުމަސްވެރިކަން މައިގަނޑު ގޮތެއްގައި އަމާޒުކުރެވިފައިވަނީ ރާއްޖޭގެ ކުރީއަހަރުތަކު ފަތުރުވެރިކަމުގެ ދާއިރާއަށެވެ. މީގެ އިތުރުން މިމަސްވެރިކަމަށް އެކްސްޕޯޓް ދާއިރާވެސް ހިއްސާއެއް ކުރެއެވެ. ނަމަވެސް، ކުރިން ހަމައެކަނި ރަށްވެހިން ކެއުމަށް ކުރެވުނު އަދި މިފަރުމަސްވެރިކަން ފަތުރުވެރިންނަށް މައިގަނޑު ގޮތެއްގައި ފަތުރުވެރިކަމުގެ ދާއިރާތަކުގެ ދިއުމުގެ ސަބަބުންނެވެ. މިގޮތުން މިހާރު ރާއްޖޭގެ އެކި ސަރަހައްދުތަކުގައި އަލުން ރިސޯޓް ތަރައްގީކުރުމުގެ ސަބަބުން ކުރިއަށް އޮތް އަހަރުތަކުގެ ތެރޭގައިވެސް މި މަސްވެރިކަން އިތުރަށް ފަތުރުވެރިންގެ ދާއިރާގައި އާއްމުކުރާނެއެވެ. މީގެ އިތުރުން ބޭރު މާރުކެޓުގައި ފަރުމަހަށް ލިބޭ ބޮޑު އަގުވެސް މިކަމަށް އިތުރު ބާރެއް އަޅާނެއެވެ.

ފަރުމަހަކީ އާދޭ ޖެހިގެން ކަނޑުމަހާ ވަރަށް ބޮޑަށް އެކްސްޕޯޓުކުރެވޭ މަހެވެ. ދިރަ ބާވަތްތަކުގެ ފަރުމަހަކީ ގްރޫޕަރ ބޮޑުވާ، ނަޕޯލިއަން ގޮތުން ބެސްޓްކަރާ އަދި ރަތް ނުވަތަ ސަރީހަން ބޮޑުވާ ބާވަތްތަކެވެ. މީގެ އިތުރުން ބައެއް ބާވަތްތަކުގެ ފަރުމަހަކީ އެކްސްޕޯޓް ކުރެވޭ ބާވަތްތަކެއް ނޫނެވެ. ރިސޯޓްތައް ބޮޑަށް ބޭނުންވާ ބާވަތްތަކެވެ. ފަރުމަހުގެ ބާވަތްތައް ބެސްޓްކަރާ ދިވެސްމަހު ފަރުމަހުގެ ގޮތުގައި ހިސާބުކުރާ ބާވަތްތަކަށް ވަނީ ފާހަގަކުރެވޭ ފެނުމެވެ. މިގޮތުން ޖަމާވާ ތިރީ ދިވެސްމަހު އެސަރަހައްދު ތަކުން ބޮޑު ބަދަލުތަކެއް އައިސް ވާތީ، އެސަރަހައްދުތަކުގައި ރިޒޯޓް ތަރައްގީ ކުރުމުގެ ބޭނުމުގައި މަސްބޭނުންކުރުން ބޮޑުވެއެވެ. މިގޮތުން ދިރަ އެދަރުތަކުގެ ކަން ބޮޑުތަކުގެ ދާއިރާގައި ފަރުމަސް ބާނާ ފޯޓްޖެހިފަ ފަރުމަހުގެ ސްޓޮކްތަކުގެ ވަރަށް ނުރަކަ އަސަރު ކުރުމަށް އަސަރުކުރަނީ ކަމެވެ. މިގޮ މަސްވެރިކަން ތަފާތުގޮތްގޮތަށް ބަހާ ސްޓޮކްތަކުގެ ނިޒާމުގައިވެސް މަސްވެރިކަމުގެ ހާލަތު ދިރުމުގެ ކުރިން މަސްވެރިކަން ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުރުމަށް ފުރުޞަތުތައް އެބަހުރި ފާހަގަ ކަމެވެ.

މަސްވެރިކަން ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުރުމަށް އެކިއެކި ފިޔަވަޅުތައް ކަނޑައެޅުމުގެ ކުރިން، މިހިސާބު ރިޕޯޓު ސްޓޮކްއެސެސްމަންޓް ވަނީ 2006 އާއި 2007 އަހަރު ފަރުމަސްވެރިކަމުގެ ދިރާސާއެއްކޮށްފައެވެ. މިގޮތުން މިހާރު ރާއްޖޭގައި ފަރުމަސްވެރިކަން ކުރެވުނު އަނބަރަ ގޮތައި، ސަރަހައްދުތަކާއި، މަސްވެރިކަން ކުރާގޮތް ބޭނުންކުރާ އާލާތް، ބާނާ މަހުގެ ބާވަތް ،އަދަދު، ދިރާސާއި އަދި ބަދަލުތަކުން މިދިރާސާގައި ބެލުނެވެ. މީގެ އިތުރުން ބާނާ މަސް ރިޕޯޓަށް ވެއްޓުމުގައި ގެންގުޅޭ އުސޫލުތަކާއި އަދި ފަރުމަސް އެކްސްޕޯޓް ކުރާ ފަރާތް އަދި މުއްދަތު ބިޔާ މާލޭގެ އަންނަމަސް ބަލާލެވުނެވެ. މިދިރާސާގެ ނަތީޖާ މިރިޕޯޓުގައި ތަފްސީލުކުރެވިފައިވާނެއެވެ.

ދިވެހިރާއްޖޭގެ ގަނޑުދޮށުގެ ތަކުރުސްވެރިކަން ދިގާދަށް 2006 - 2007

2008 ވަނަ

ހިލާލްއަޙްމަދު ސައްތާރ

ސަމަކާ ބަދުރުސަމަދު

ވިދިކުރި ތަކެއްޗާ ގުޅުންހުރި
ދިވެހިރާއްޖެ ގަވާއިދާ ގުޅުންހުރި ގޮތުން ވިދިކުރި ތަކެއްޗާ ގުޅުންހުރި،
ހ. ފާހަގަކުރެވޭ ހިސާބު، ފާރު، ދިވެހިރާއްޖެ

ދިވެހިރާއްޖެގެ ތަކުރުވެރިކަމާ ގުޅުންހުރި ލިޔުންތައް:

Sattar, S. A. (2008) Review of the Reef Fishery of Maldives, Marine Research Centre. Malé, Maldives. 62pp

ކަވަރ ފޮޓޯ: ހަސަންދަ ނަޢީމް

ދިވެހިރާއްޖެގެ ކުރިއަށް ގެންދަނ ސަރުވޭ ރިޕޯޓް

ސަރުގަ ބަލާދިނ ސަރުވޭ

ދިވެހި ތިރުވަނ ސަރުވޭ ޓީމް
ގ.ދ، ދިވެހިރާއްޖެ

2008 ވަނ