

# CURRENT STATUS OF THE REEF FISHERIES OF MALDIVES AND RECOMMENDATIONS FOR MANAGEMENT



# **Current status of the reef fisheries of Maldives and recommendations for management**

**Shahaama A. Sattar, Elizabeth Wood, Fahmeeda Islam and Ahmed Najeeb**

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## 1 Executive summary

The tourism industry of Maldives places a high value on the reef resources of Maldives, both as a tourist attraction and a source of food for the tourists. Demand for the resource as food is on the increase with the expanding tourism industry. Furthermore reef fish is also gaining more importance in the diet of locals, with reef fish being consumed on a weekly basis, much more than it was consumed 10 years ago.

This review of the reef fishery of Maldives aims to assess the current status, both qualitatively and quantitatively, to ensure that any management which is brought about is based on the current status of the fishery. Data for the assessment was obtained from various sources: commercial fishery catch and size data from fishermen and buyers (resorts), recreational fishery data from tourist resorts, export statistics for reef fish from reported statistics, data on consumption of reef fish by locals and qualitative assessment of the status of the fishery through fishermen interviews.

The most commonly caught species were seen to be *Elagatis bipinnulata* (Rainbow runner), *Aprion virescens* (Green jobfish), *Lutjanus gibbus* (Humpback snapper), *Lutjanus bohar* (Red snapper) and various species of the trevallies. Resorts were not observed to have a preferential species or a dislike for any of the species.

The total estimated annual catch of reef fish from Maldives is seen to be within the ranges of 10,400 MT to 29,145 MT and varies with different methodology used for the calculations. The higher values are just a few metric tonnes short of the estimated Maximum Sustainable Yield for reef fish (30,000 MT, Anderson et. al. 2006). The estimated annual catch for the whole of Maldives is higher now than in 2006 hence showing the impact of increasing demand for the resource.

Size distribution of most species have remained the same over the two survey periods, though for commonly exploited species such as *Lutjanus bohar* (Red snapper) and *Lutjanus gibbus* (Humpback snapper) there was a significant decrease in mean length of individuals caught. Furthermore, there was some variation in size distributions of individuals caught from different areas, with catch from Haa Alifu atoll generally being larger in size while individuals reported from Meemu Atoll and AA. Rasdhoo are seen to be generally smaller in size. This could be a possible result of the fishing pressures being felt by the stocks within these atolls.

Extrapolation of resort purchase data to estimate the total quantity of reef fish purchased in 2012 gives the value at approximately 5,300 MT, which is lower than what was estimated for 2007. However, this is affected by the occupancy rates of the 2 years. While the total annual purchase was seen to be less than the previous survey, value paid for the resource was seen to be higher, indicating the increasing value being placed on reef fish.

Not all resorts were observed to offer recreational fishing trips. While these trips are popular amongst guests, the catch of large amount of small sized individuals and the consumption of the

majority of the catch makes the fishery a very unsustainable one. On a positive note, the trend towards eco-friendly tourism and environmental awareness is leading to more resorts discontinuing the practice of these recreational fishing trips.

Reef fish exports form a very small part of all marine exports from the Maldives, both in terms of quantity and value. Contribution towards the income from marine exports in 2012, shows that income from reef fish exports only accounted for 0.24% of income from all marine exports.

Consultations with the major stakeholders of the fishery, i.e. the fishermen showed that the majority felt that the fishery had declined over the past years and hence they were in support of management of the fishery, if properly implemented. The majority of fishermen felt that protection of key spawning grounds and implementation of size limits for key species were the best approaches towards management of the fishery.

Hence with the resource gaining more importance both for the tourism market and local consumption, it is necessary that the fishery be carried out under certain management measures or guidelines. With this being the case, we therefore recommend the following:

- Registration/licensing of all reef fishing vessels specifically for the fishery
- Registration of all reef fishing processing facilities/purchasers (resorts, exporters, local traders)
- Mandatory reporting of catch data by fishermen
- Mandatory reporting of reef fish purchase data by all purchasers: tourist resorts, exporters, salting/drying facilities, local buyers
- Stakeholder consultations: fishermen, exporters, local sellers, fish processors (salting/drying), resorts
- Phased reduction/ban of reef fish exports
- Implement size limits for catch
- Identify key reef fish spawning aggregation sites and look into option of year round protection of top sites
- Encourage resorts to discontinue the practice of recreational fishing trips
- Recreational fishing trips (both by locals and resorts) if carried out should be undertaken with best practice guidelines
- National information and awareness / outreach programme

## 2 Introduction

The reef fishery of the Maldives (food fishery) has been previously assessed over a number of years and through various research programmes (Van Der Knaap et al. 1991; Anderson et al. 1992, Sattar 2008, Sattar 2010). Previous studies have shown that the reef fisheries for food are mainly targeted towards the tourism industry of the Maldives and the last extrapolated figure (in 2008) shows that approximately 7000 MT of reef fish are consumed by the tourist resorts on an annual basis (Sattar 2008). However, this figure was expected to rise with the expanding tourism industry. In comparison with the tourism market, a minor component of the reef fish caught are exported in various processed forms to neighbouring countries and South East Asia. A separate fishery which targets solely groupers (separately referred to as the grouper fishery) targets mainly the export industry and shipments of both live and fresh/chilled groupers are exported on a regular basis by a few key players. This report looks at the more generic reef fishery which targets a wide range of species and families of reef and reef-associated fish, most of which as earlier mentioned are sold to the tourist resorts.

Previous studies quite clearly detail the history of the fishery and various methods and gears used in the fishery. These reports also detail the species compositions of the catch and provide site specific catch and size composition data for various families of reef fish (Van Der Knaap et al. 1991; Anderson et al. 1992, Sattar 2008, Sattar 2010).

Work on the current review of the reef fishery was initiated in 2012 through the Darwin Reef Fish Project (DRFP), which is a four year collaborative project between the Marine Research Centre of Maldives and Marine Conservation Society of UK, funded by the Darwin Initiative. The main aim of the project is to study and analyse the coral reef fisheries of the Maldives (grouper, aquarium and food fisheries) so as to assess their status and formulate management plans for the different fisheries, which will aid to ensure their sustainability. In this respect, a management plan has already been finalized and launched, for the grouper fisheries of Maldives (Darwin Reef Fish Project 2011).

The aim of the review is to collect and analyse reef fishery data, which will help to formulate a management plan for the fishery, so as to ensure that the fishery is conducted in a sustainable manner. The review mainly focuses on obtaining information on the catch and size composition of catch from the commercial reef fishery of Maldives. The review also includes a preliminary investigation of the recreational fishery undertaken by both locals and tourists. In addition to fishery data, household reef fish consumption surveys were also conducted to obtain an idea of local demand and consumption of reef fish and how this weighs against the consumption by the tourist market. The status of the fishery was also assessed qualitatively through consultations with fishermen, who are the one of the key stakeholders of the fishery.

### 3 Methodology and data collection

In order to get a full understanding of the fishery and catch, data was collected from various sources which are listed below.

#### 3.1 Commercial reef fishery

For the purpose of obtaining data from the commercial reef fishery, two sources were used: field officers from fishing communities and tourist resort purchase of reef fish.

##### 3.1.1 Data from Field officers

Field officers were hired through the DRFP from 12 islands in 10 atolls, details of which are shown in Table 1.

**Table 1. List of islands from which field officers were hired**

Atoll	Island
K	Guraidhoo
K	Gaafaru
V	Fulidhoo
GA	Dhaandhoo
L	Hithadhoo
AA	Ukulhas
AA	Rasdhoo
ADh	Mahibadhoo
HA	Maarandhoo
M	Kolhufushi
B	Kudarikilu
F	Feeali

Field officers, who are reef fishermen themselves and carry out the fishery as an income earning activity, were hired for a period of 7 months (June to December 2012) on a contract basis. As a part of their contract, they had to collect data for our research purpose, twice weekly, so as to fulfill 8 fishing trips per month. Fishermen were asked to fill in a survey form provided (refer Appendix 1) which collected information about the fishing trip and catch. Data collected about the fishing trip includes:

- fishing vessel and crew details,
- time spent on the trip and time spent for each activity (i.e. bait collection and fishing),
- locations of bait haul and fishing activities,
- gear and bait used,
- information regarding sale of catch (i.e. who it was sold to and rate as well as total income earned for the day),

- catch composition and site specific size composition of catch (to be reported at a species level)

Data collected from the field officers was compiled and analysed on an individual level and also combined to provide average figures across all the sampled atolls. Site specific size measurements were used to compare size compositions for species from different sites (atolls) and to analyse whether there was a significant difference in size of individuals at different sites.

### **3.1.2 Reef fish purchase data from resorts (Resort landings data)**

Maldives is well known for its tourism with a total of 104 resorts as of March 2013, with 100 of these in operation. All resorts were contacted through the Ministry of Tourism, Arts and Culture, regarding our survey programme and a request was made to all resorts for participation in the programme. Resorts were asked to report their reef fish purchase data on two levels:

- Collection of fish/lobster purchase data: Resorts were requested to report numbers and weight of reef fish purchased by few key species and main family groups (Jobfish spp., Snappers, Trevallies/Jacks, Emperors, Rainbow runner, Groupers) specified on our survey form (Appendix 2). Fishing locations were also to be recorded as reported by fishermen. The survey also collected information on total price paid per consignment. This information was to be reported for every consignment of reef fish/lobsters purchased by the resorts and or caught by the resort for catering purposes. This reporting was normally undertaken by the staff at the Store.
- Collection of size sampling data of reef fish/lobsters: this was obtained for 1 consignment per week for reef fish purchased/caught by the resort for catering purposes and every consignment of lobsters purchased by the resort. This was undertaken by the resident marine biologists at the resorts. Data collection form used is shown in Appendix 3.

In order to enable easier identification of fish to family/species level, detailed fish identification guides showing the most commonly caught species in the commercial fishery were provided to the resorts. Resorts were also provided with map guides for easier marking of fishing locations.

While all resorts were informed about the research programme, it has to be noted that only 8 resorts participated in the programme and sent in data on a regular basis. This can be attributed to the fact that this programme was conducted on a voluntary participation approach rather than a mandatory approach. Sampling from tourist resorts was undertaken for the same period as that for sampling from field officers (i.e. for a period of 7 months from June to December 2012).

## **3.2 Recreational fishery**

While the initial aim was to obtain data on the recreational fishery of both locals and tourists, catch sampling data was only obtained from the night fishing trips conducted at the resorts. Resorts were requested to collect data on catch and size composition of individuals caught on their night fishing trips which are organized as an activity for their guests. As with reporting of reef fish purchase data, all resorts were asked for this information, though only 6 resorts participated and sent in data on a

regular basis. All resorts were again contacted to obtain information on whether the resorts conduct night fishing trips as a guest activity and if so, their frequency and number of guests per trip.

Recreational fishing trips by locals are a regular activity undertaken by the various island communities and residents of Male', especially during the full moon or new moon periods. However, we were not able to obtain any fishery information for the trips, due to the ad hoc nature of such trips, whereby locals can set out at any time and on any vessel which would take them out for a few hours of fun and relaxed fishing. Locals are also known to go out on their privately owned vessels for fun fishing trips. The fishery is unregulated and open to all. Hence to obtain an idea of number of recreational fishing trips undertaken from Male' on a weekly basis, vessels who normally undertake such trips and are docked at Male' harbour areas, were surveyed through a questionnaire. However, this proved quite unsuccessful as well, mainly due to absence of personnel on board these vessels (who were able to answer the questions) while docked in Male'.

### **3.3 Reef fish exports**

While tourism is the main market for the commercial reef fishery of Maldives, a portion of the catch is also exported by a few key exporters. Reef fish export data was obtained from the Basic Fisheries Statistics data of Ministry of Fisheries and Agriculture and analysed to obtain trends in exports over the past 18 years. Exports of groupers caught in the targeted grouper fisheries of Maldives also falls within the export of reef fish, especially export of live reef fish, though this is analysed separately due to the separate fishery, which solely targets the export industry and not the tourism market.

### **3.4 Household reef fish consumption surveys**

Prior studies have always focussed on the consumption of reef fish by the main market, i.e. the tourism industry. No surveys have been carried out to assess the amount of reef fish consumed by locals as part of their daily diet. Traditionally, Maldivians mainly ate tuna, though there is now an increasing trend in consumption of reef fish on a household level and other events such as barbecues. Hence as part of the current review, a household reef fish consumption survey was carried out on all islands with the aid of NGOs and students, using a standard survey form shown in Appendix 4. Household surveys were conducted as follows:

- Survey forms were sent to all Atoll Education Centres, to distribute to all the secondary schools in inhabited islands of the atoll. The aim was to get the assistance of the students in secondary school level, to survey 20% of all households of all inhabited islands. While the aim was to get 20% of households, forms were sent equivalent to 50% of households, in order to achieve the 20% mark
- Similarly survey forms were also sent to a few of the Secondary Schools in Male', with the aim of surveying 10% of all households of Male' to obtain an idea of frequency/quantity of reef fish consumed by the households. We were unable to do 20% of households in Male' due to the time limitations.

Data collected from these surveys were compiled and analysed as a combined set of data to assess the quantity of reef fish consumed by locals as part of their diet.

### 3.5 Consultations with fishermen

Reef fishermen from 16 islands in 10 atolls were consulted regarding their opinion on the status of the existing reef fishery of the Maldives and management of the fishery through a series of proposed measures. Islands for consultation visits were chosen based on the number of fishing vessels which undertake reef fishing as an income earning activity, irrespective of the target market (i.e. tourism, exports, island community). Fishermen were asked generic questions regarding their involvement in the fishery, as well as specific questions regarding their income from the fishery. They were then asked the following questions and asked to choose one answer from the given options, so as to get a quantitative idea of fishermen opinions.

- *How important do you think it is to have a management plan for the reef fishery which aims to ensure that it will continue to be productive and bring benefits to fishers?*
  - A) *Very important*
  - B) *Important*
  - C) *Not particularly important*
  - D) *Unimportant*
  - E) *Not sure*
  
- *There are various measures that are being considered to make sure that the reef fishery is sustainable in the long-term. What are your thoughts about these possible options? Please answer A, B, C etc for each*
  - A) *Very good idea – very much agree*
  - B) *Good idea - agree*
  - C) *Don't mind one way or the other*
  - D) *Bad idea - disagree*
  - E) *Not sure*

*Option 1. Maintain the commercial fishery at its current size by licensing the boats so that existing fishermen can continue but new boats are not allowed to join until research shows it is safe for them to do so*

*Option 2. Limit the total amount of reef fish that can be caught each year by commercial fishermen*

*Option 3. Have a 'bag-limit' for recreational fishers*

*Option 4. Have a policy to leave immature fish in the sea so that they can breed one or more times before being caught*

*Option 4. Provide complete all-year-round protection for a selection of the most important spawning sites for reef fish*

*Option 5. Prohibit fishing of spawning aggregations at all times by commercial and recreational fishers*

*Option 6. Create some additional no-take zones in addition to the Marine Protected Areas, in order to ensure that there are enough areas for reef fish to breed, grow and maintain productivity*

Fishermen answers to the above questions were analysed quantitatively and results are shown in Section 4.5.

## 4 Results

### 4.1 Commercial reef fishery

#### 4.1.1 Results of data collected from Field officers

Table 2 below shows a general overview of the reef fishing trips conducted by the different field officers hired during the survey period. This gives an idea of the intensity of effort spent on the fishery, in various atolls.

**Table 2. Overview of reef fishing trips conducted by the field officers hired for the survey period**

Atoll/ Island	No. of survey trips	Ave. trip time (hrs)	Fishing gear	Type of bait used	Market	Selling rate (MRF)	Average income (MRF)*
HA. Maarandhoo	32	~11	HL/DL	Live bait / fish pieces	Not specified	26 - 33	2200
B. Kudarikilu	30	~16	HL/DL	Live bait	Resorts	25 - 35	7900
K. Gaafaru	48	16.5	HL/DL/PL	Live bait	Resorts	20 - 37	4800
K. Guraidhoo	56	~8	DL/TR/PL	Live bait	Resorts Island Centre for people with special needs	20 – 30 20	3200
AA. Rasdhoo	16		HL/DL/TR	Live bait	Resorts	20	11300
AA. Ukulhas	24	~12	HL/DL	Live bait and fish pieces	Ukulhas Fish processors Resorts	22 – 65 25 35	7900
ADh. Mahibadhoo	24	~14.5	HL/DL	Live bait	Resorts	20 - 30	4700
V. Fulidhoo	48	~16	HL	Live bait	Resorts	23	5000
M. Kolhufushi	8	~12	HL/DL	Live bait	Not specified	15 - 20	3400
F. Feeali	32	~13.5	HL/DL/TR	Live bait	Feeali Island Male'	10 40	1100
GA. Dhaandhoo	16	~3.5	HL/DL/TR	Lure/ Fish waste	Resort	25	900
L. Hithadhoo	42	~7	HL/DL/TR/PL	Lure/ Fish waste	Hithadhoo Island Resorts	15 – 20 35	650

HL – Handline, DL – Dropline, PL – Pole and line, TR – Trolling

\*Average income shows average income by the vessel over the survey period of 6 months. Note: 1 US Dollar – MRF 15.42

The number of survey trips is seen to vary because the different field officers were hired at different points in time over the whole survey period. Furthermore, some field officers were noted to have



discontinued sending their data, for various reasons. As evident from the table, the time spent on fishing trips is seen to vary amongst the different survey areas. However, in terms of method of fishing and bait used, both are consistent across the atolls, with hand lines and drop lines being the most common method of fishing, while live bait is utilized by the majority of the survey group. The main market is seen to be the tourist market, while some fishermen also sell to the island and other buyers on the island. The rate of purchase is seen to vary widely amongst buyers, with resorts on the whole paying a better rate for the catch than other buyers.

Figure 1 shows the average catch reported by each field officer for the duration of the survey period. The average catch has been shown so as to get a picture of the actual fishing intensity within the atoll, since the number of trips undertaken by the field officers vary from atoll to atoll and would add bias to the total catch for the survey period. The average catch per trip is not observed to follow a similar trend as that of total catch hence showing the differences in fishing intensities (efforts) and possibly availabilities within the atoll.

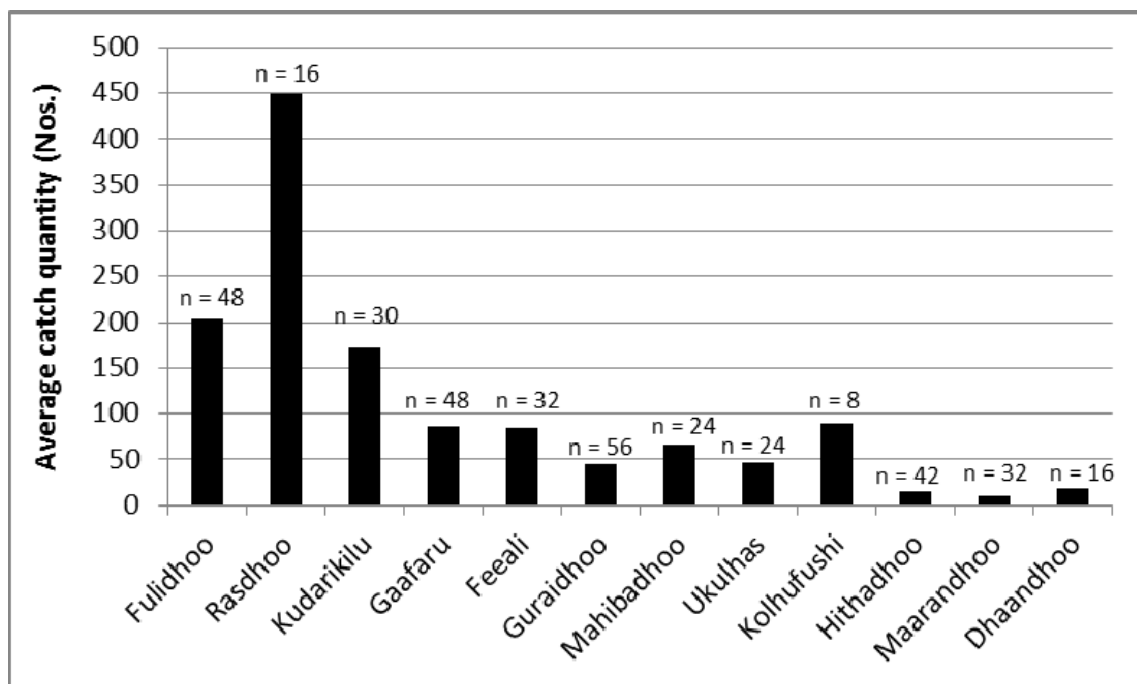
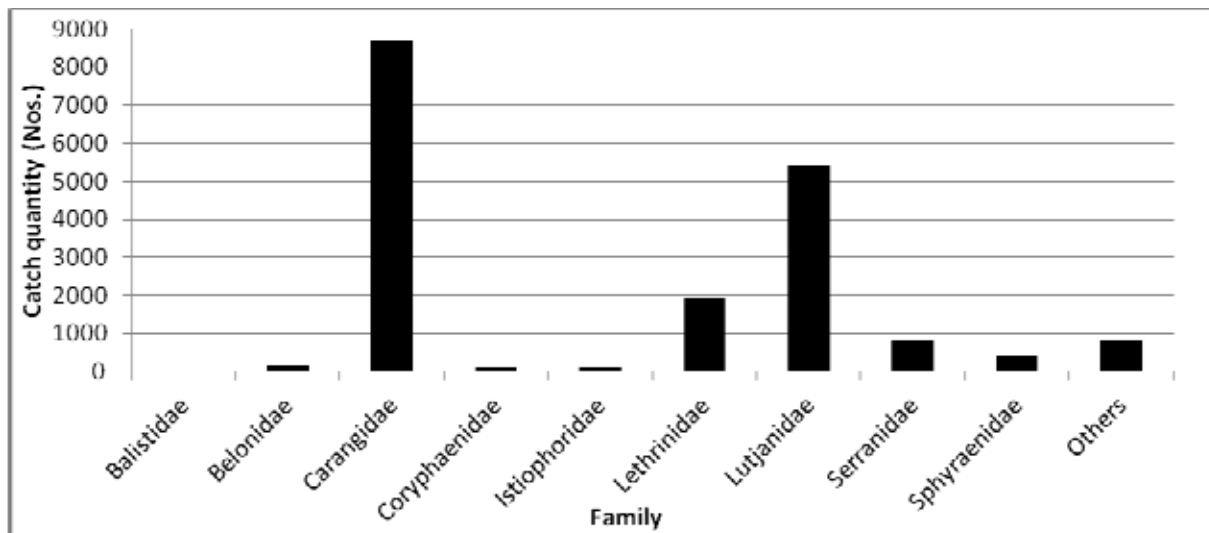


Figure 1. Average catch per trip as reported by field officers from the different survey atolls (n indicates number of survey trips)

#### 4.1.1.1 Catch composition

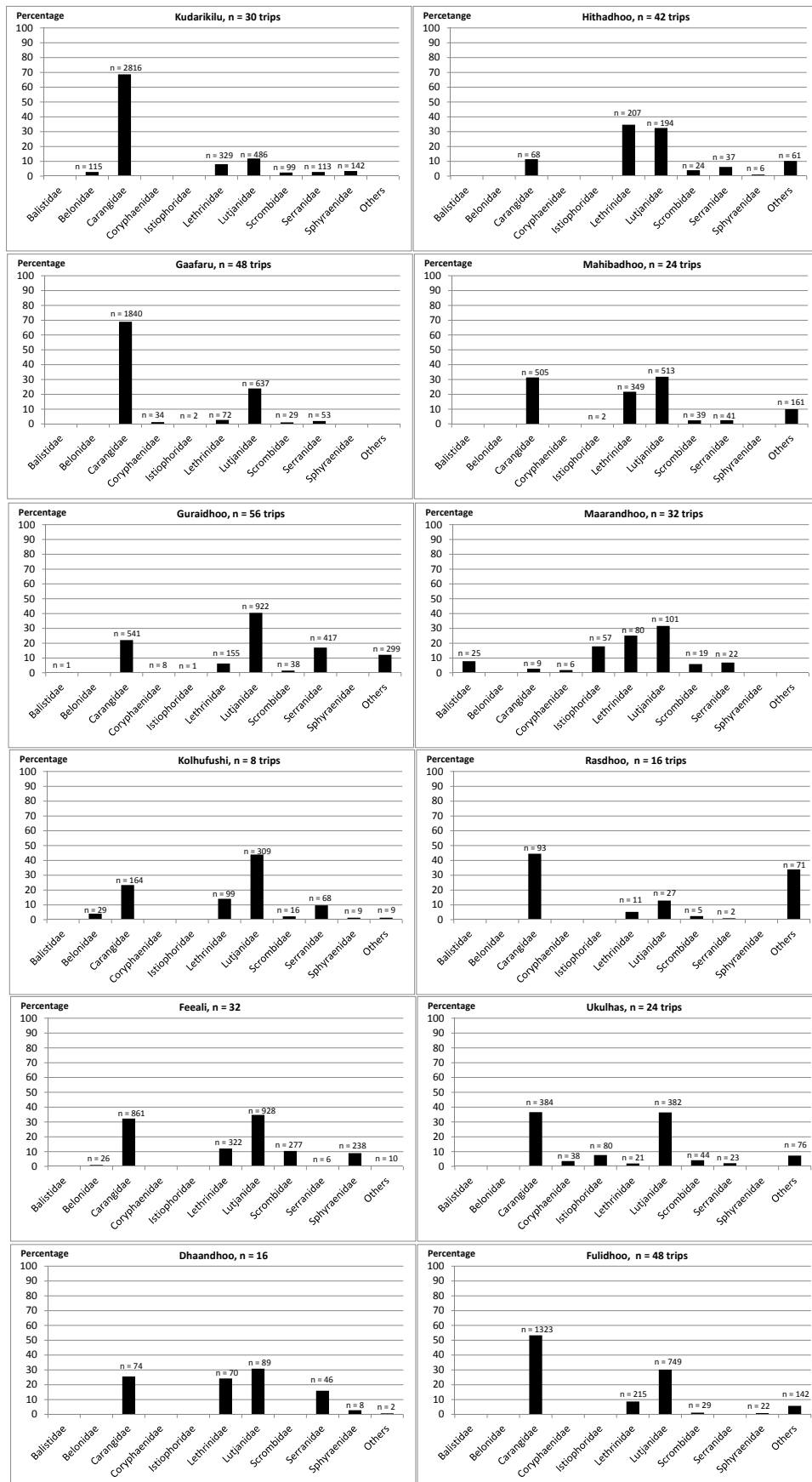
Although all field officers were requested to report their catch data on a species level, the reporting was not consistent amongst all field officers. While a few reported their data on a species level, others were seen to report their catch on a family level. Hence analysis of total catch has been conducted based on family level data. Figure 2 shows the total reported catch (based on size sampling data), by all field officers for the whole survey period. As evident from the figure, Carangids form the major part of the catch, followed by Lutjanids and Lethrinids. A look into the reported species, shows that carangids are dominated by individuals of *Elagatis bipinnulata*, followed by

species such as *Caranx melampygus*, and *C. sexfasciatus*. The lutjanids are seen to be dominated by individuals of *Aprion virescens*, *Lutjanus bohar* and *L. gibbus*.

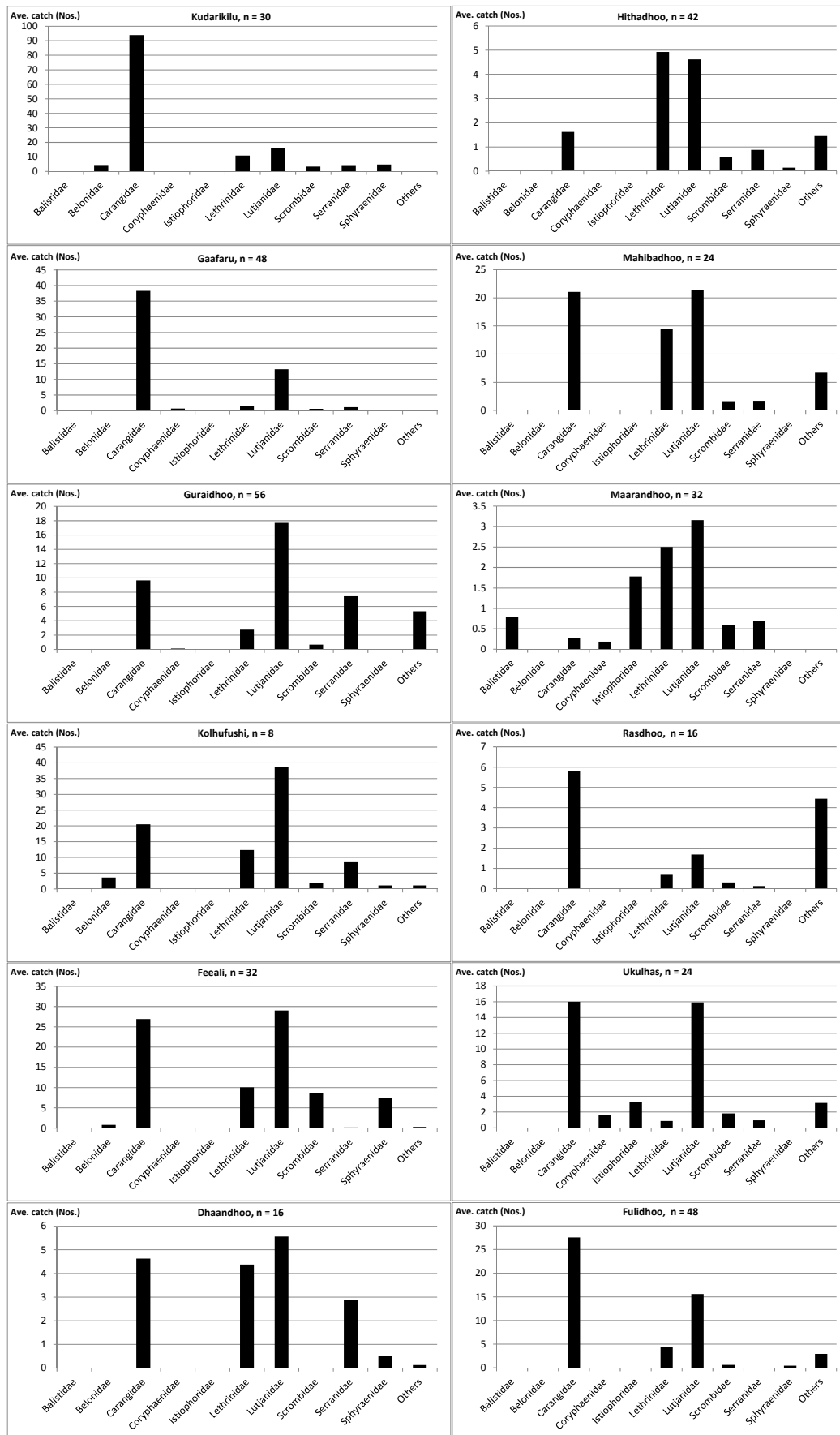


**Figure 2. Catch composition of total catch reported by all field officers**

Similar trends in catch composition is seen for the island-wise catch composition data which is shown in Figure 3, whereby the catch of the majority of surveyed islands is seen to be composed mainly of Carangids, Lutjanids and Lethrinids. The total reported catch for the whole survey period is however biased due to the varying number of survey trips made by the different field officers. Hence, in an effort to understand the actual catch numbers and to standardize the data, average catch has also been derived for each atoll and is shown in Figure 4.



**Figure 3. Total reported catch of each family group for the individual islands (n – number of survey trips and number of individual fish from each family)**



**Figure 4. Average catch per trip for each family group for the individual survey islands (n – number of survey trips)**

A detailed look into species data, for those islands which reported at this level, shows that a total of 15,086 individuals of 63 species were reported, though some were a bit ambiguous and questionable. From these 63 species, 7 species (Table 3) were seen to be caught in numbers greater than 500 individuals, which is the approximate cutoff point for contributing 2.5% towards the catch. As evident from Table 3, the 7 species caught the most are the same as the most commonly caught species reported in earlier reviews of the fishery (Sattar, 2008).

**Table 3. Species which were reported in numbers greater than 500 individuals**

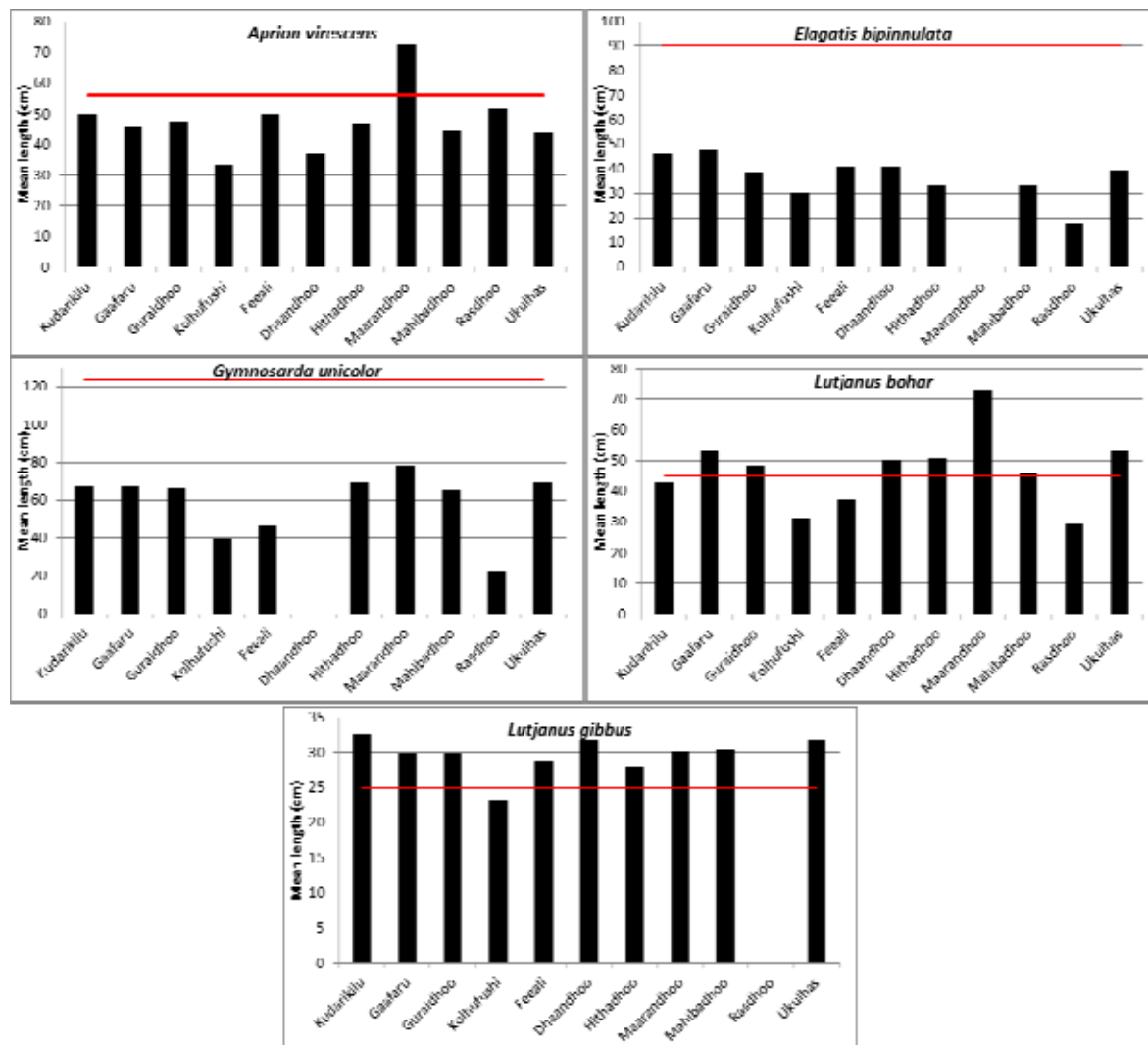
Species	Count
<i>Elagatis bipinnulata</i>	4199
<i>Aprion virescens</i>	2339
<i>Lutjanus bohar</i>	1381
<i>Lutjanus gibbus</i>	1350
<i>Caranx melampygus</i>	1250
<i>Caranx sexfasciatus</i>	880
<i>Gymnosarda unicolor</i>	581

#### **4.1.1.2 Size composition of catch**

For the most commonly reported species as shown in Table 3 above, mean size of individuals from different areas (atolls) of fishing have been calculated for the 5 species which were reported from almost all islands. While site specific catch data was also reported by fishermen, quantities reported from each site were too low to get an accurate picture of variation in mean size between the various locations of fishing in each atoll. Mean size of catch from the different islands are shown in Figure 5, which also shows the theoretical maturity length for the species, which has been deduced as half the maximum length of the species (Shakeel 1996). It is important to note that the maximum lengths have been taken as reported in literature (Fishbase, website accessed June 2012), and may not be on the whole, applicable to the stocks of Maldives. However, the values calculated are useful in giving an idea of size at maturity for the species in the absence of more accurate and applicable data.

The mean sizes of the five species are seen to vary from one area of fishing to another. The most noticeable trends in the plots for the five species is that on the whole, mean sizes for the various species are always greater for the catch reported from HA. Maarandhoo, than for other areas of fishing, while that reported from M. Kolhufushi and AA. Rasdhoo are low for every species, in comparison to values deduced for other areas of fishing. This variation in mean size can almost certainly be attributed to high fishing pressure reported in the area over the past years, as high levels of exploitation are known to have the potential to bring about changes in size distribution of the targeted stock (Jennings et. al. 2001). As the reef fishery in the Maldives develops together with the tourism industry, fishing pressure on reef fish species is mostly felt in areas where tourism has been established over the years. The tourism industry in the northern atolls of Maldives such as Haa Alifu atoll is quite young and on a small scale compared to the central atolls of Maldives. Hence this could be a reason for lower levels of exploitation in the area, which in turn could explain the relatively larger size of fish currently being caught. Fishing pressure could also account for the smaller sizes of fish reported from AA. Rasdhoo, where fishing was mainly carried out in the small

atoll of Rasdhoo and inside Ari Atoll (which is widely developed as a tourism centred atoll), and may also explain the smaller sizes of individuals reported from Meemu atoll, which is also an atoll where tourism is established on a small scale.



**Figure 5. Mean lengths of 5 commonly reported species (black bars) and the theoretical maturity length for the species (red line) (T<sub>m</sub> based on half max. size as reported in Fishbase)**

Similar to mean sizes of the main species reported on a species level, size frequency plots have also been taken for the atoll as a whole, rather than for individual locations of fishing. Size frequencies for those species which were reported on a species level by almost all field officers are shown in Figures 6 – 10.

Figure 6 shows the size frequency of *A. virescens*, for the catch reported from the different atolls. While most graphs do not show a clear trend, some due to the few numbers reported, catch from ADh. Mahibadhoo seems to show a binomial distribution in frequency, while catch reported from M. Kolhufushi and GA. Dhaandhoo is seen to be mainly composed of individuals belonging to the smaller size classes, while that from HA. Maarandhoo is composed of individuals belonging to the

larger size classes. The catch from K. Guraidhoo, V. Fulidhoo and F. Feeali shows certain size classes which are more frequent than the rest.

Figure 7 shows the size frequency plots for *C. melampygus* from the 6 islands which reported the carangids on a species level. Other islands were seen to report Carangids as a whole on the family level. No discernable trends are evident, though once again the size composition of catch from M. Kolhufushi and GA. Dhaandhoo is on the smaller size scale.

Figure 8 shows the size frequency plots for *E. bipinnulata*. The size distribution of catch from B. Kudarikilu is seen to follow a normal distribution, while once again the size composition of catch from M. Kolhufushi is seen to be of smaller individuals. Same is true for catch composition from AA. Rasdhoo. Another noticeable point is the large number of individuals of this species of length 71 to 72 cm which have been reported from V. Fulidhoo, while individuals of these larger lengths were reported in relatively small numbers from other islands.

Size frequency plots of *L. bohar* (Figure 9) shows that size composition of catch reported from B. Kudarikilu, K. Guraidhoo and AA. Ukulhas are spread over a large number of size classes, while catch reported from V. Fulidhoo again shows large number of individuals belonging to specific size classes. Individuals reported from M. Kolhufushi are again seen to belong to the smaller size classes.

Size frequency plots of *L. gibbus* (Figure 10) do not show any discernable trends, though for those islands which reported this species in greater numbers, the majority was seen to belong to length class of 30 cm, with slight variation between the islands. Data from M. Kolhufushi again showed individuals belonging to smaller size classes.

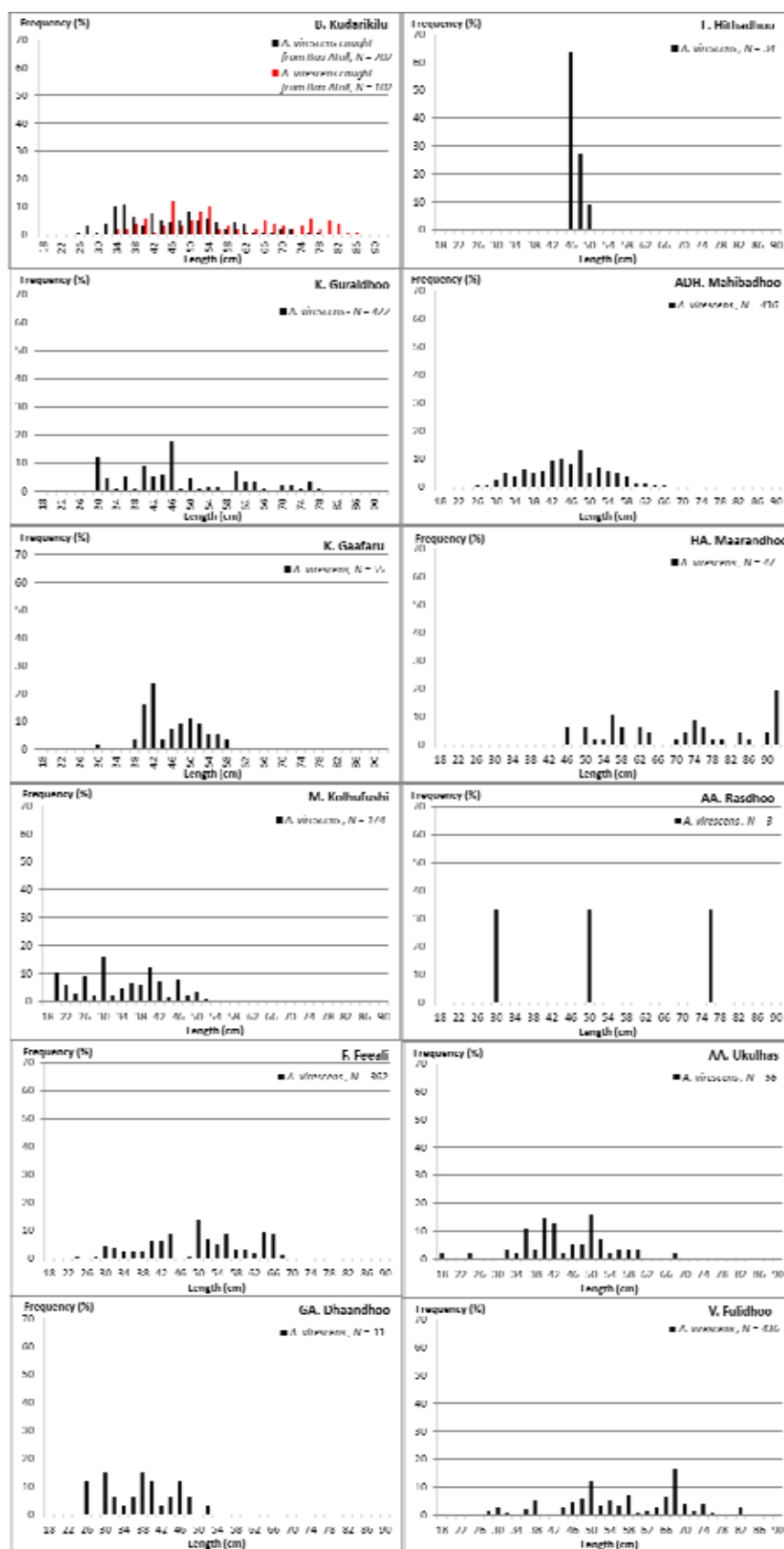


Figure 6. Size frequency plots for *Aprion virescens* as reported from the different atolls/islands (fishing was carried out within the local atoll for all except Kudarikilu, which covered both Baa Atoll and Raa Atoll)



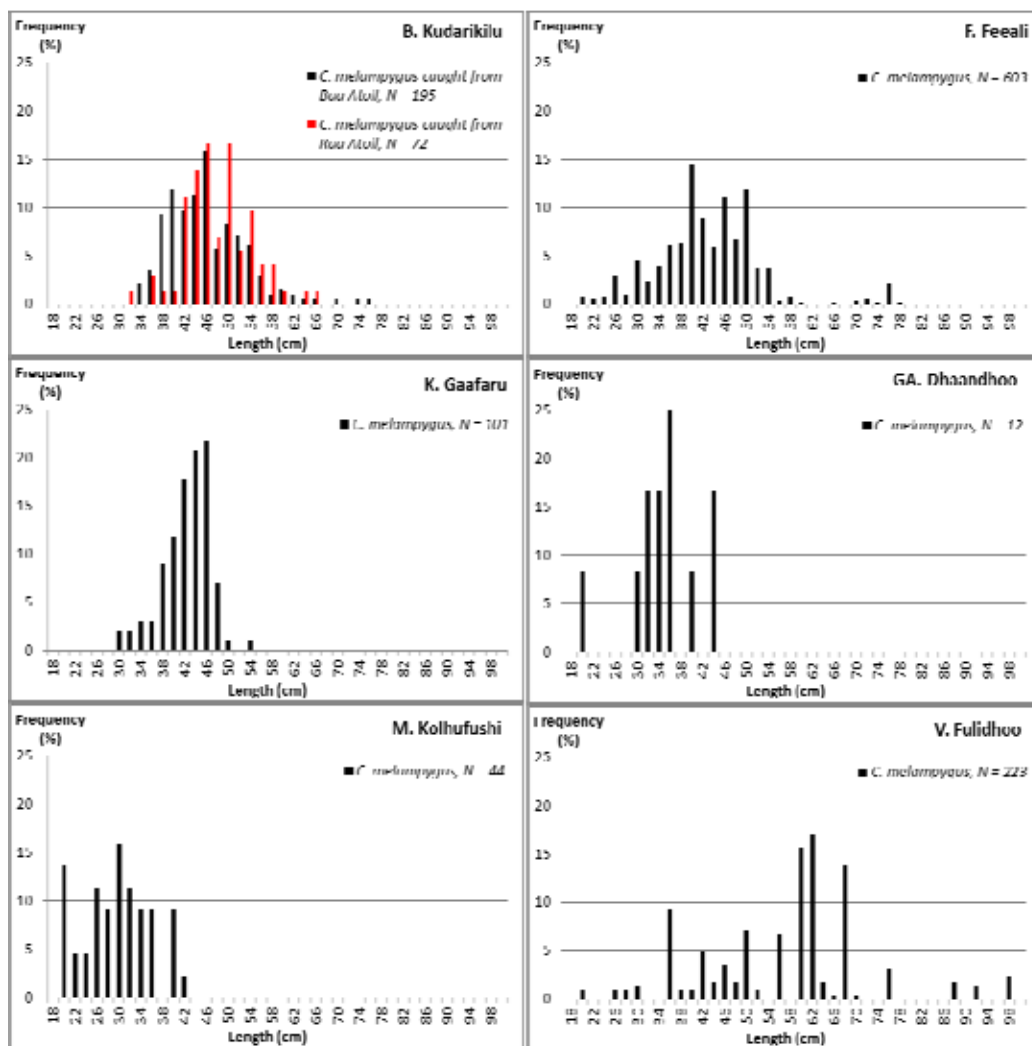


Figure 7. Size frequency plots for *Caranx melampygus* as reported from the different atolls/islands (fishing was carried out within the local atoll for all except Kudarikilu, which covered both Baa Atoll and Raa Atoll)

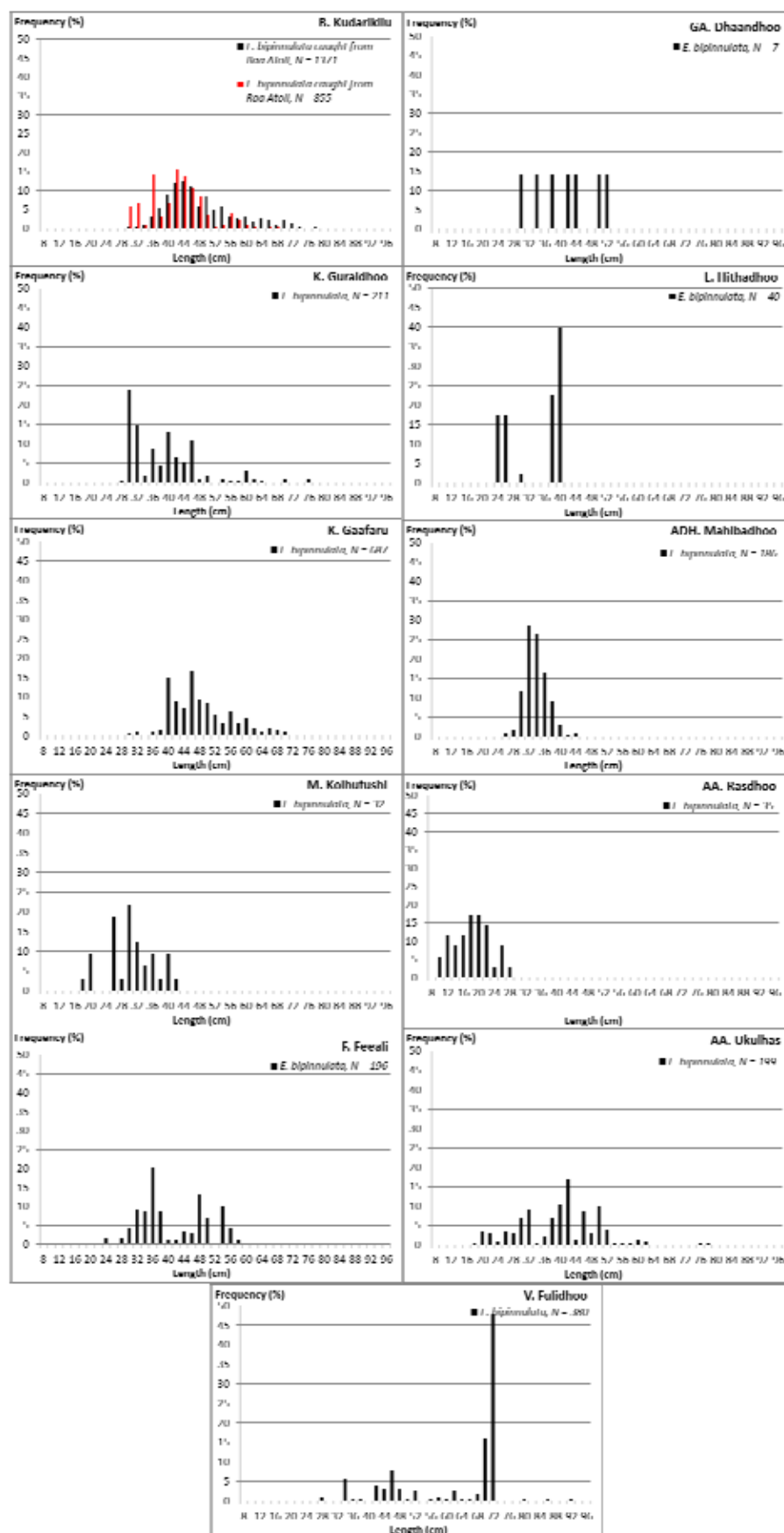


Figure 8. Size frequency plots for *Elagatis bipinnulata* as reported from the different atolls/islands (fishing was carried out within the local atoll for all except Kudarikilu, which covered both Baa Atoll and Raa Atoll)

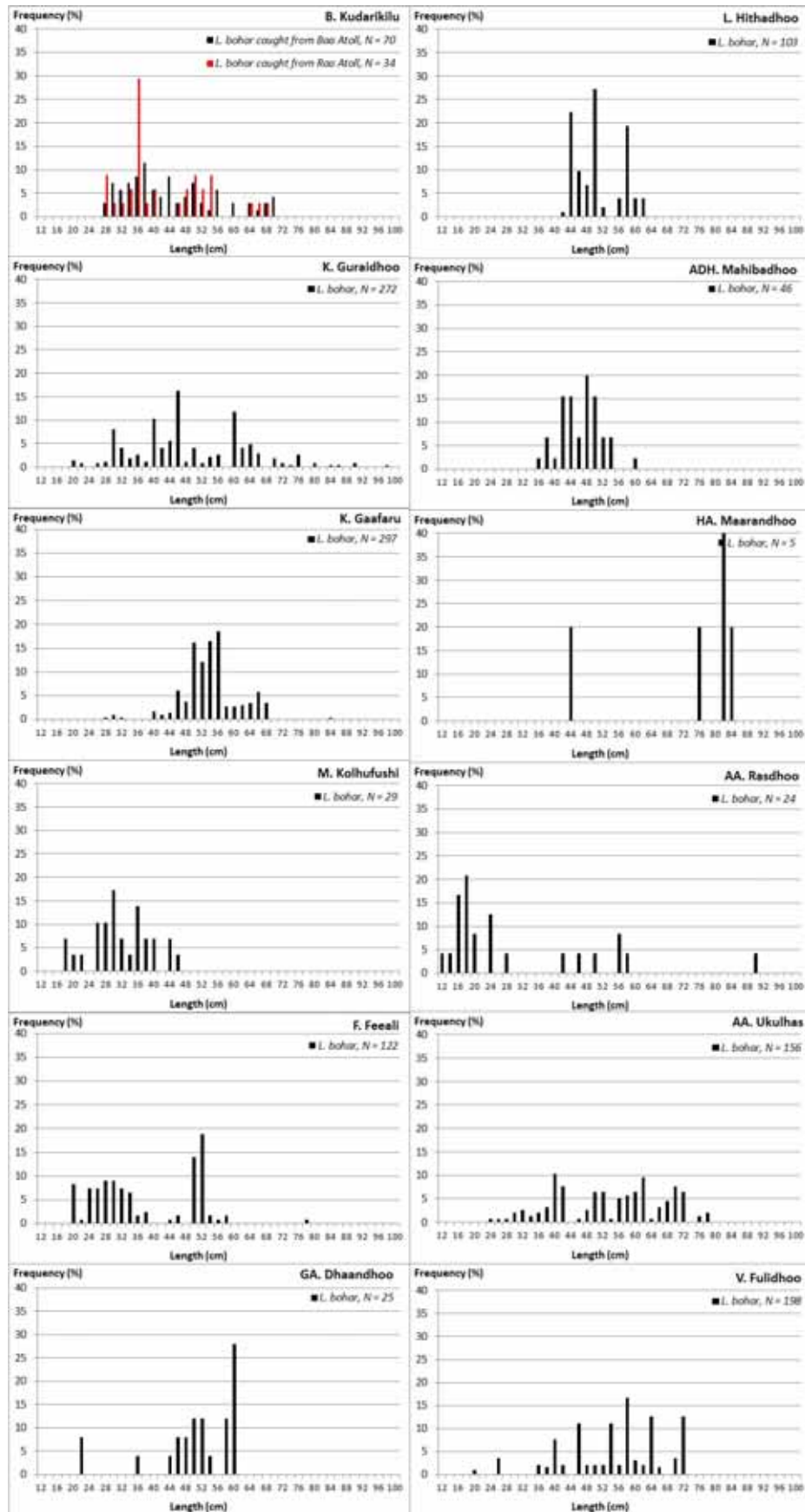


Figure 9. Size frequency plots for *Lutjanus bohar* as reported from the different atolls/islands (fishing was carried out within the local atoll for all except Kudarikilu, which covered both Baa Atoll and Raa Atoll)

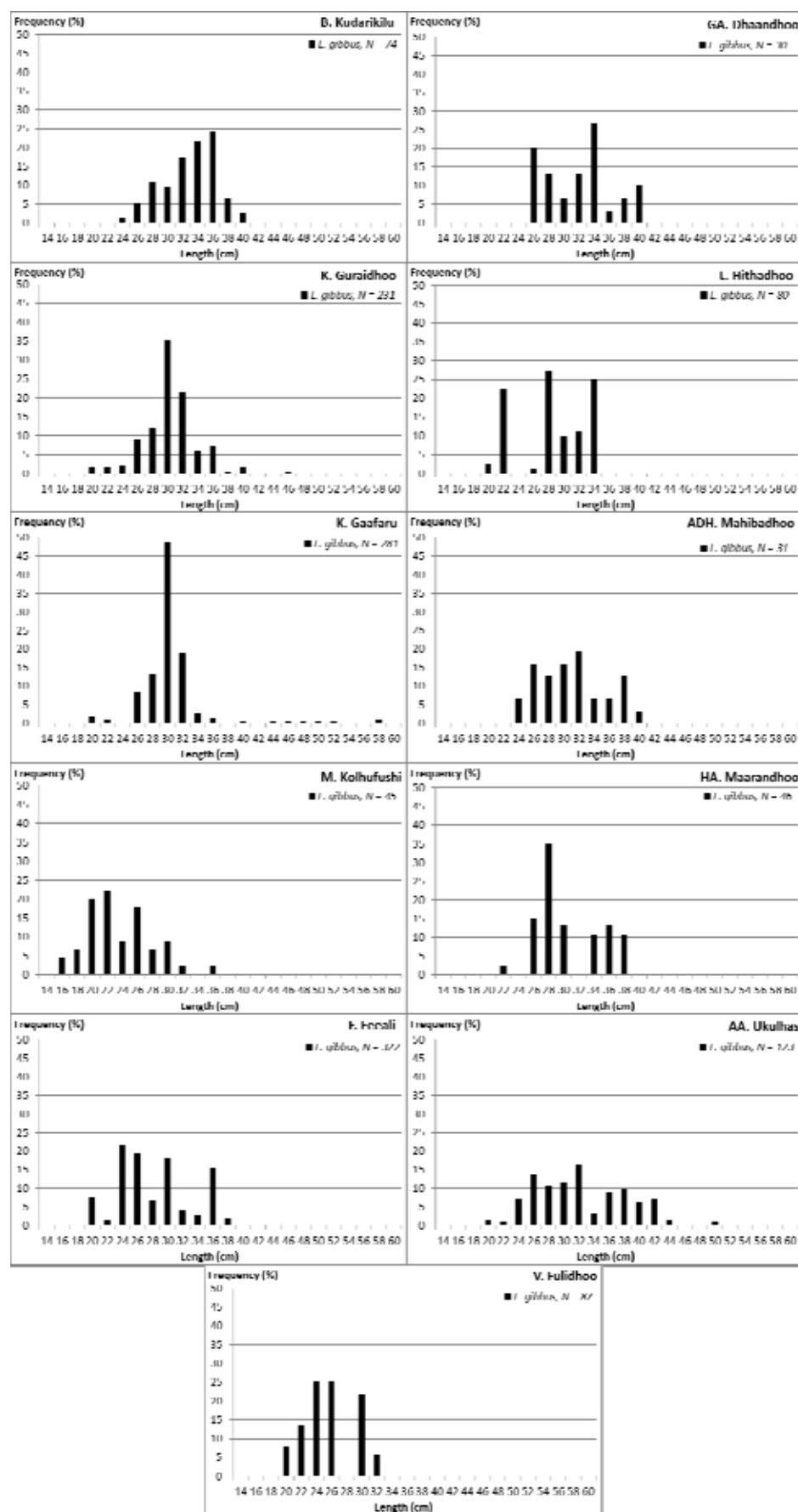


Figure 10. Size frequency plots for *Lutjanus gibbus* as reported from the different atolls/islands (fishing was carried out within the local atoll for all except Kudarikilu, which covered both Baa Atoll and Raa Atoll)

#### 4.1.1.3 Site Specific data

Site specific catch data reported by the fishermen have been analysed to assess the most popular and productive fishing sites within the atolls. Figure 11 shows the catch reported from each site (both total catch and average catch per trip) as well as the number of trips made to each site. As evident from the figure, there are certain sites which are popular and visited more frequently than others, which also provides a good catch. The graph shows clear in-atoll variation, with specific sites being more productive than others. Similar analyses have been done for all survey atolls and show similar trends.

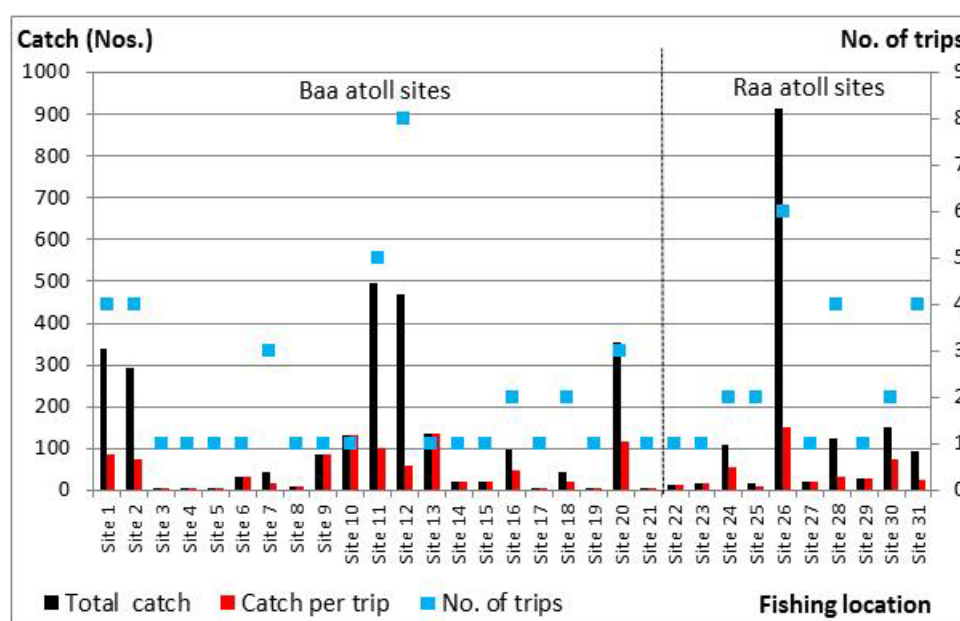


Figure 11. Total and average catch in numbers from each fishing site reported by field officer from Baa Atoll, during the survey period and number of trips made to each site (*Note: site names and locations have been kept confidential as it is seen to be ill advised to advertise these sites*)

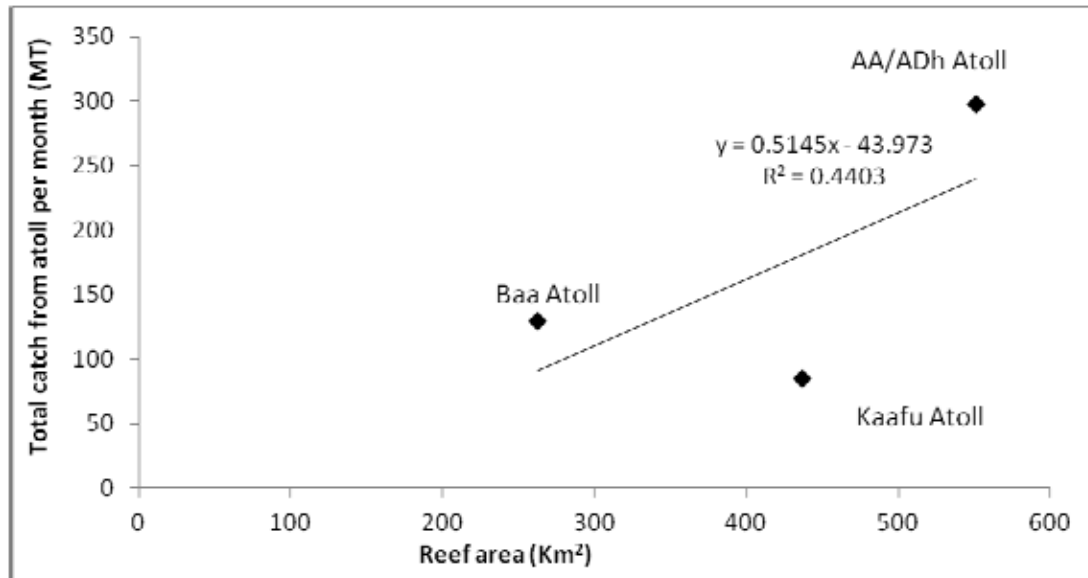
#### 4.1.1.4 Estimation of catch per atoll

In an effort to repeat the earlier process of calculating the total catch from Maldives, an estimation of catch per atoll was made for the 3 atolls from which we have the most data, which are Baa Atoll, North and South Ari Atoll and North Male' Atoll. Fishermen made an average of 462, 1029 and 504 fishing trips per month from these three atolls respectively. Using the average weight of catch per fishing trip for each atoll, an assumption of 252 fishing days per year and the reef area of each atoll, we inferred the total annual catch at 1554, 3575, and 1011 tonnes of fish for Baa, Alifu (North and South) and North Male' Atolls respectively. Using reef areas published in Naseer and Hatcher (2004), this equates to a yearly catch rate of 5.91, 6.48 and 2.32 tonnes per km<sup>2</sup> of reef for the three atolls respectively.

The estimated annual yield from North Male' atoll (2.32 tonnes per km<sup>2</sup>) is approximately one-third of that from Baa and Alifu atolls, (5.91 and 6.48 tonnes per km<sup>2</sup> respectively) highlighting that generalizing results from one atoll to the next need to be made cautiously, due to either naturally different stocks or different fishing pressure. While all 3 atolls are well known for the high number of resorts within the atoll, the yield from North Male' Atoll could be affected by many factors such

as the few number of fishermen active within the atoll and/or lower stock levels leading to lower average catch per trip.

A plot of catch/month from the three atolls against the reef area of these atolls as cited by Naseer and Hatcher (2004) is shown in Figure 12.



**Figure 12. Total catch from Baa, Alifu Alifu /Alifu Dhaalu and North Male' atolls for each month versus the total reef area of these atolls**

The equation of linear regression can then be used to obtain the total catch per year from the Maldives, which comes to an approximate value of 27,217 MT or an average of 6.1 tonnes/km<sup>2</sup> of reef area. This is 14,110 MT more than if the same was calculated for the earlier survey (Sattar, 2008) and is 90% of the Maximum Sustainable Yield of 30,000 MT (Anderson et al. 1992). Hence, evidently with the increase in demand for reef fish, the supply is also on the increase and is fast reaching the MSY. It is also necessary to carry out an exercise to recalculate the MSY of the fishery, as the status of the fishery would have undergone many changes over the past 20 years.

While the regression analysis gives an average value for estimated catch from the whole of Maldives, a similar estimate based on reef areas of the three individual atolls used for the analysis shows a total annual catch from Maldives within the range of 10,400 tonnes and 29,145 tonnes. Estimate of catch based on number of fishing vessels and average catch from a 'typical' fishing vessel, one from each atoll used for the other analyses, gave as results within the range of 18,000 tonnes to 23,400 tonnes.

#### 4.1.2 Results of analysis of Reef fish purchase data from resorts

A total of 574 reef fish purchase consignments were reported by the 8 participating resorts and details are shown in Table 4 below.

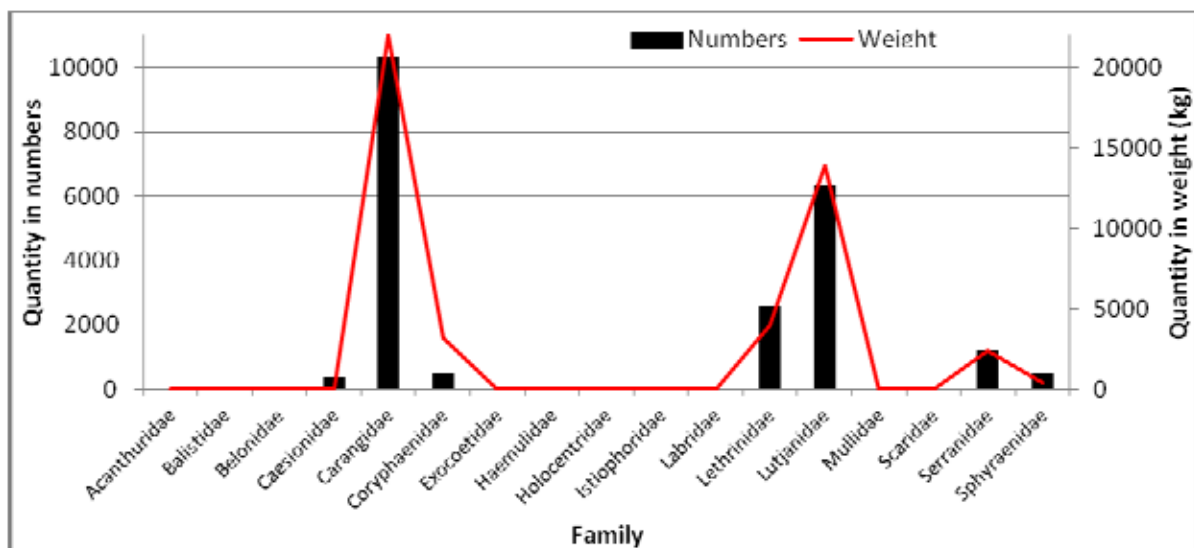
**Table 4. Number of shipments purchased by the resorts which reported fish purchase data (Resort names not revealed to ensure anonymity)**

Resort	No. of shipments reported
Resort 1	5
Resort 2*	79
Resort 3	171
Resort 4	14
Resort 5	36
Resort 6	238
Resort 7	11
Resort 8	19

\* Resort 2 reported 79 shipments of fish over the period of data collection but details of species numbers and weights were only recorded for 45 days. The analysis below is therefore based on these 45 days.

##### 4.1.2.1 Analysis of shipments purchased by family (based on catch composition data)

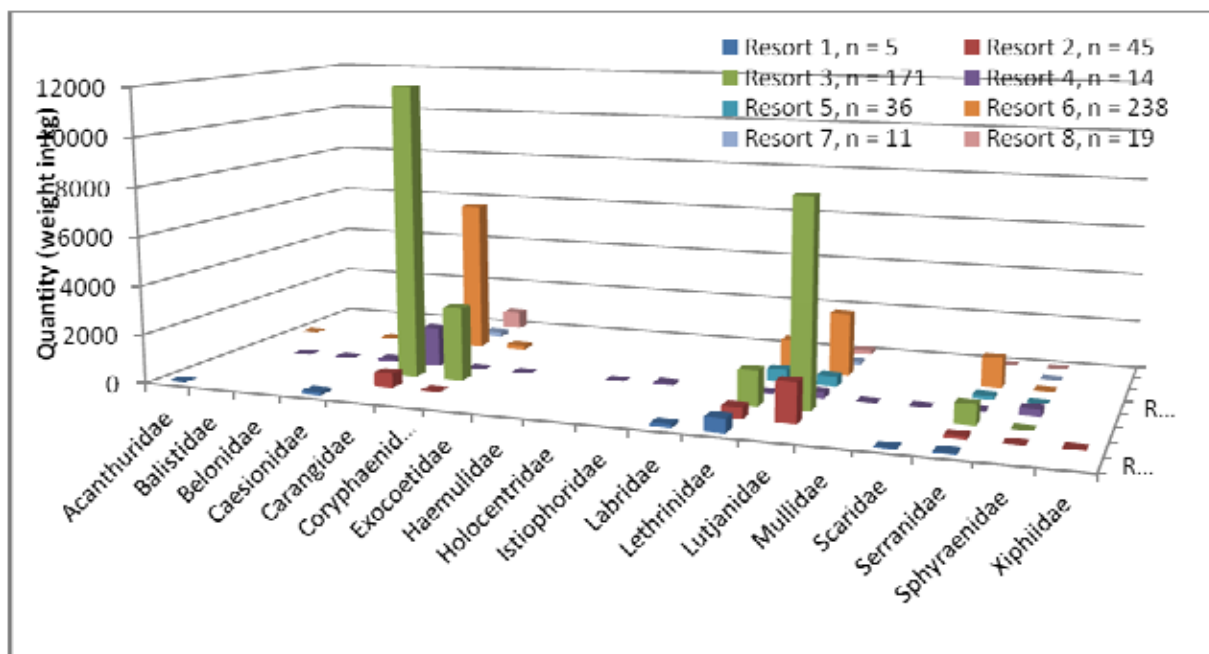
Figure 13 shows the total quantities of reef fish, in numbers and weight, purchased by the resorts divided into family groups. Carangids are seen to dominate, followed by Lutjanids.



**Figure 13. Total quantities of reef fish purchased by resorts divided into family groups (Black bars = quantity in numbers, red line = quantity in weight). Note: Weight by family was not recorded for all shipments. Results shown in this figure are based on analysis of 505 out of the total of 574 shipments (88% of the shipments).**

Carangids were seen to be mainly composed of species such as *Elagatis bipinnulata* (Rainbow runner), *Caranx melampygus* (Bluefin trevally), *Caranx sexfasciatus* (Bigeye trevally) and *Carangoides*

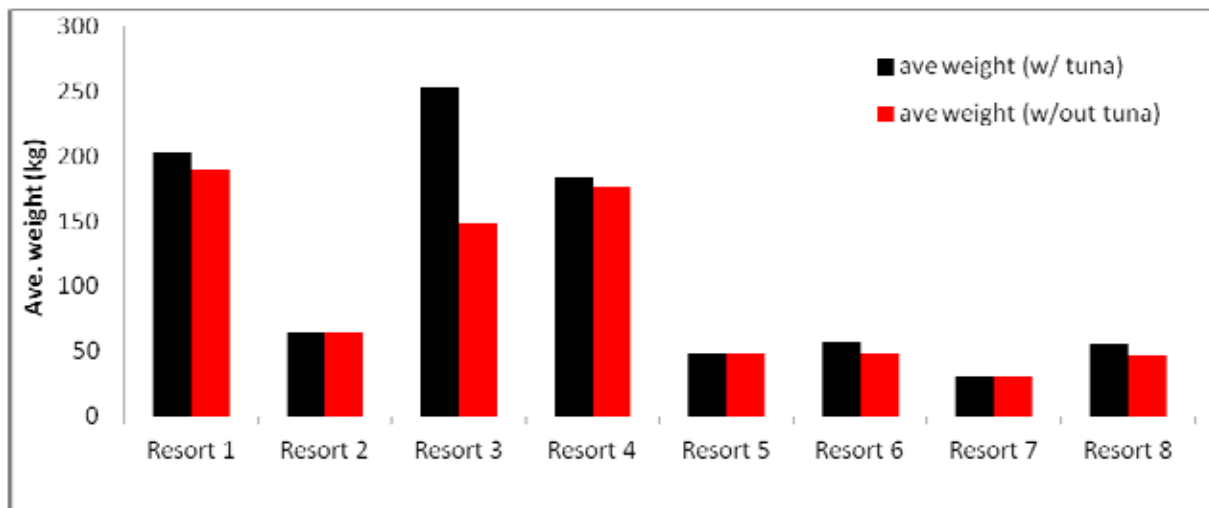
*fulvoguttatus* (Yellowspotted trevally). Lutjanids were mainly composed of *Aprion virescens* (Green jobfish) and *Lutjanus bohar* (Red snapper). The species and family composition of the shipments is not generally selected by the resorts. They may request a certain balance of species but what they receive depends to a large extent on what the fishermen have been able to catch. However, it has been previously noted that some resorts have a preference or dislike for certain family groups, depending on the shelf life of the species. However, they would at most times purchase what the fishermen bring, even if at a lower price. Other family groups recorded as purchased by the resorts include Lethrinids, Serranids, Coryphaenids and Sphyraenids. Some resorts have also occasionally reported scombrids within their reef fish purchase data, although not shown on the figure. Figure 14 shows the purchase quantities for individual resorts.



**Figure 14. Quantities of reef fish purchased by individual resorts divided into family groups (Numbers indicate number of days reported).**

For both Resort 3 and Resort 6 which had the highest number of days of fish purchase during the survey period, most commonly purchased species of fish belonged to Carangids, followed by Lutjanids, as indicated by the trend shown in Figure 13. Resort 2 which had the 3<sup>rd</sup> highest number of purchase days reported, show that Lutjanids were the most commonly purchased family group. Data for Resort 5 also shows purchase of large quantities of *Coryphaena hippurus* which is not seen from other resorts. This could be attributed to this particular species being selected for purchase, as this resorts reports their fish to be purchased from Male' fish market, which gives them the option of selecting the species they want for a particular day. Whereas if purchasing from a fishermen, resorts while they are able to specify the species they prefer, at most times purchase whatever the fishermen catch for the day.





**Figure 15. Average weight per shipment of fish purchased by individual resorts**

As seen in Figure 15, there seems to be a large variation in average weight per shipment of fish purchased amongst the resorts, which was seen to more or less correlate with the bed capacity of the resorts. Hence resorts with high bed capacity purchased greater quantities of reef fish in comparison to those with low bed capacity. However, the resort with the highest bed capacity was also seen to purchase almost the same quantity of reef fish as another resort which had almost the half the bed capacity of that resort. Level of occupancy is unknown and this would also influence the amount of fish purchased. Resort 3 has the highest average weight per shipment of fish purchased, but this can be attributed to the purchase of large numbers of *Thunnus albacares*, which is purchased for both guest and staff consumption. All other resorts do not show a great variation between average weight per shipment (including and excluding tuna) indicating that a small amount of tuna is purchased. It could also indicate that these resorts might not have reported their tuna consignments, as some resorts purchase their tuna and reef fish from different sellers.

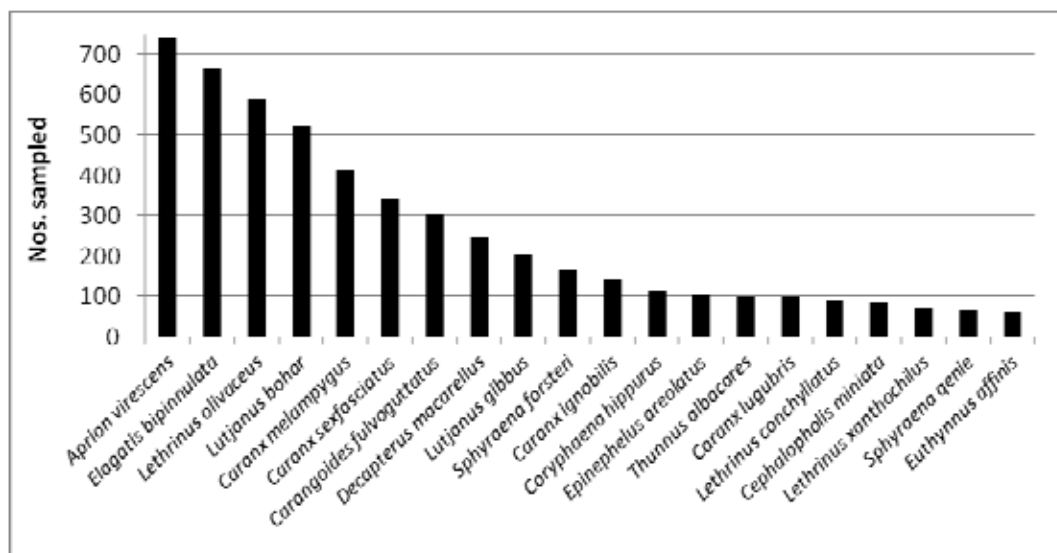
While Resort 6 had the highest number of shipments purchased (238), their average weight per shipment is considerably lower (approximately 50 kg) in comparison to average weight per shipment purchased by Resort 3 (approximately 150 kg) which had the second highest number of shipments purchased (171). Resort 4 which reported only 14 shipments purchased during the whole survey period shows an average weight per shipment of approximately 175 kg.

#### 4.1.2.2 Analysis based on size sampling data

Size sampling was reported for a total of 114 species, over a total of 97 days by 6 resorts. Details of participating resorts are shown in Table 5. Size sampling was conducted for representative numbers of each species of fish contained in the shipment which was to be sampled.

**Table 5. Number of size sampling days by individual resorts (Resort numbers correspond to numbers given above)**

Resort	No. of sampling days
Resort 2	8
Resort 3	29
Resort 4	14
Resort 5	27
Resort 6	16
Resort 7	3



**Figure 16. Twenty most commonly purchased species of reef fish as indicated by size sampling data**

The most commonly purchased species is *A. virescens*, followed by *E. bipinnulata*, *L. olivaceus*, *L. bohar* and *C. melampygus*, as indicated by size sampling data seen in Figure 16. *A. virescens* belongs to the family Lutjanidae, which overall was observed to be the second most commonly purchased family of reef fish (refer Figure 13). Although *D. macarellus* is shown as being quite commonly purchased, the data in fact comes from a single large shipment of this species purchased by one of the participating resorts. Overall, it is not a commonly purchased species. Appendix 5 shows a list of the majority of species caught in the fishery and importance of the species to the fishery.

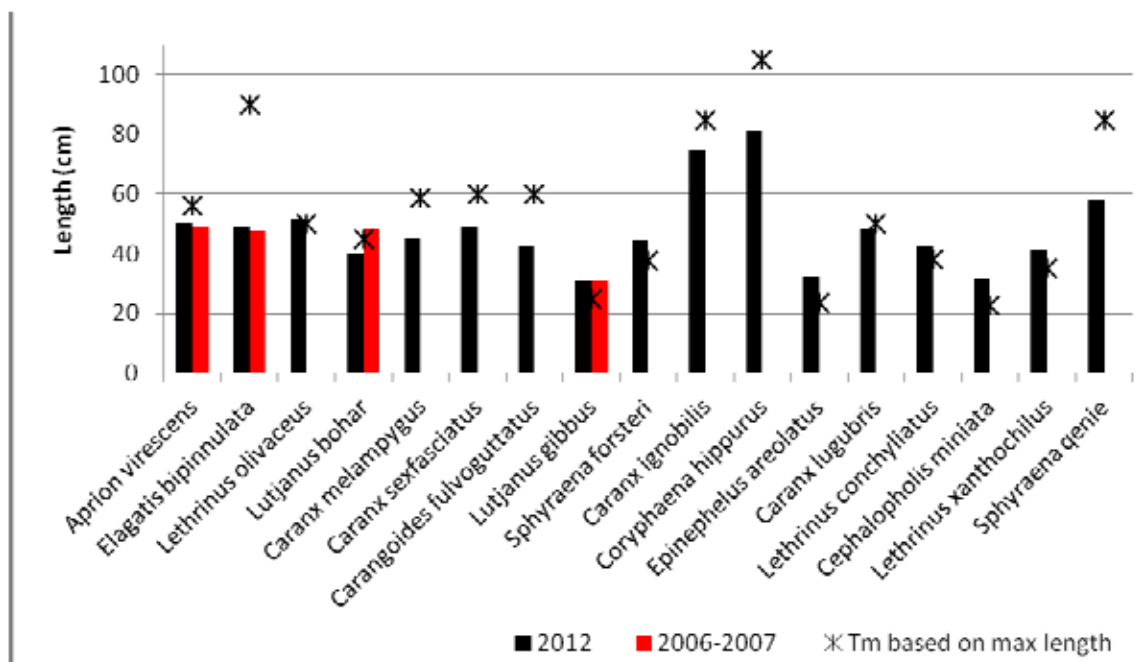


Figure 17. Mean length of top 20 species purchased (excluding *D. macarellus*, *T. albacares* and *E. affinis*); Black bars: mean length of size sampling survey from resorts in 2012, Red bars: mean length of size sampling of catch, conducted during reef fishery survey in 2006-2007, Tm based on max length; theoretical maturity lengths for the species based on Maximum length as reported in fishbase, where Tm is set at 50% of maximum length

Figure 17 shows mean length of all individuals for the given species which were sampled. Mean lengths for the majority of species are seen to be smaller than the theoretical maturity lengths which have been estimated based on maximum length reported in Fishbase. *D. macarellus*, *T. albacares* and *E. affinis* have been excluded from the figure, as these are not commonly purchased as reef fish shipments, but have been reported by some resorts on an occasional basis.

Comparison of mean length of samples for the current survey and those sampled in the reef fishery survey in 2006-2007, were only possible for 4 species (shown by red bars in Figure 17). We are unable to compare the mean lengths for the 2 survey periods for the other species, as species-wise lengths were not taken during the previous survey for these species. Lengths were recorded under family names.

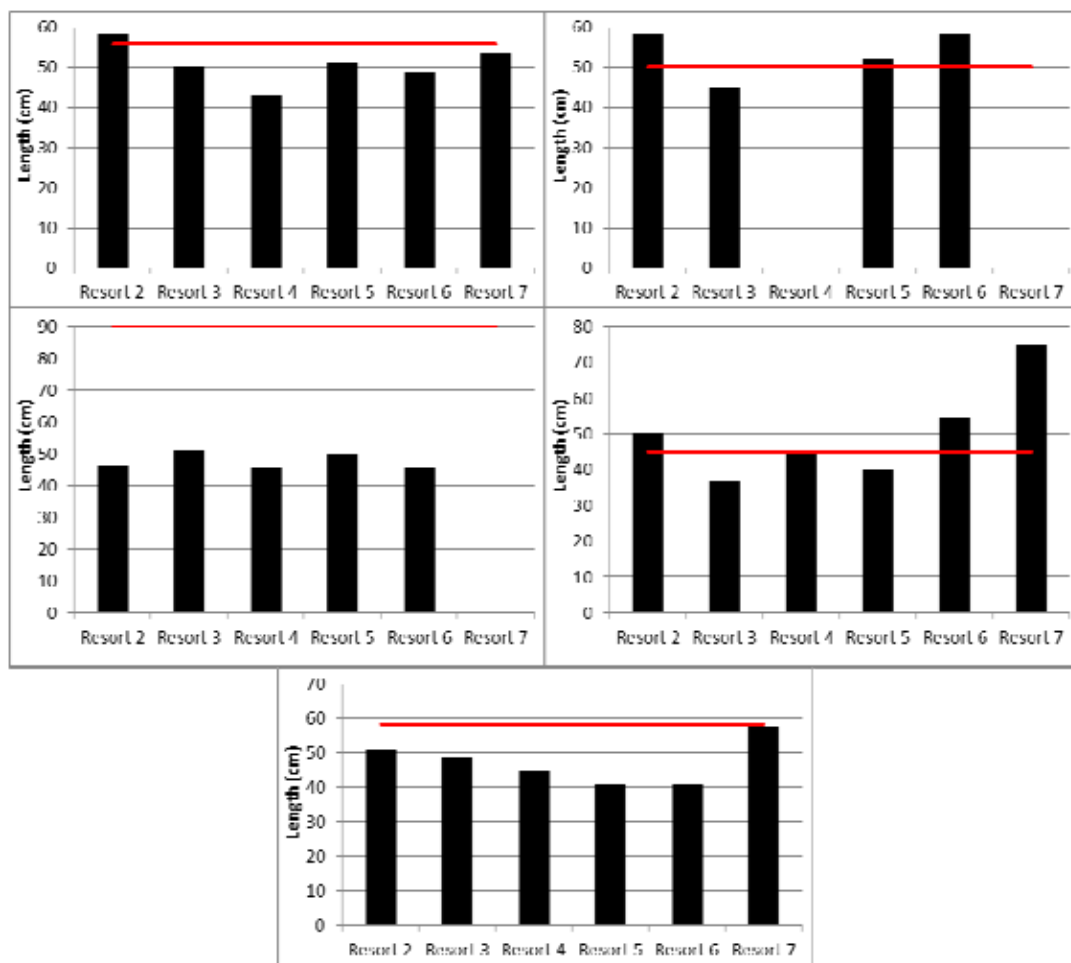
A t-test for significance in difference of mean lengths was carried out with the null hypothesis that there was no significant difference between mean lengths from two survey periods. Results of t-test for significance showed that mean lengths for *L. bohar* and *L. gibbus* were significantly different, while the difference in mean lengths of *A. virescens* and *E. bipinnulata* were not significant (

Table 6).

**Table 6. Results of t-test to test for significance in difference between mean lengths of two survey periods**

Species	t	df	t0.05(2)	Conclusion
<i>A. virescens</i>	3.07	1972	1.962	Accept null hypothesis – no significant difference in mean lengths for 2 survey periods
<i>E. bipinnulata</i>	4.51	3042	1.962	Accept null hypothesis – no significant difference in mean lengths for 2 survey periods
<i>L. bohar</i>	-10.5	950	1.963	Reject null hypothesis – there is a significant difference in mean lengths for 2 survey periods
<i>L. gibbus</i>	0.67	328	1.968	Reject null hypothesis – there is a significant difference in mean lengths for 2 survey periods

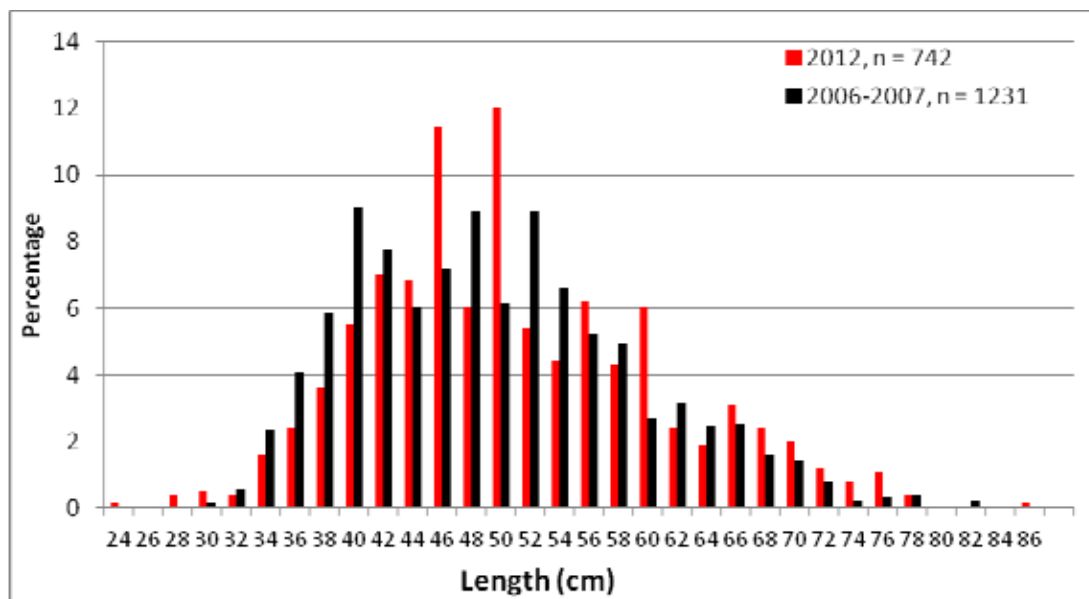
Mean lengths for the key species were calculated for the individual resorts and results for the top 5 species are shown in Figure 18. Results show that for species such as *L. bohar*, which was seen to have a significantly lower mean length during the current survey, in comparison to the survey in 2006-2007, there is also a big difference (a difference of 38 cm) between the mean lengths of individuals reported from the different resorts. While the difference in mean length was not particularly evident for the other 4 species, it has to be noted that there was still a noticeable difference in mean lengths of samples reported from the different resorts, with this difference being the smallest for *E. bipinnulata*.



**Figure 18. Mean lengths (black bars) for the top 5 species for the 6 resorts which reported size sampling data. Red line depicts the theoretical length of maturity for each species**

Figures 19 to 22 show size distribution graphs for some of the key species purchased by the resorts. Comparisons have also been done for those species where length data is available (for *A. virescens*, *L. bohar*, *L. gibbus* and *E. bipinnulata*) from the early survey period of 2006-2007 (Figures 19 to 22). As evident from these four figures, there is a similarity in size distribution of individuals of all species except *L. bohar* caught in the fishery then and now, indicating that there has not been a significant change in size of individuals of these species caught in the fishery. However, the size distribution plot for *L. bohar* for 2012 peaks to the left of the plot for previous survey, indicating that smaller sizes of this species are now taken in greater quantities than during earlier years. However, it should be noted that the plot also then follows similar trends as that observed in 2006-2007 indicating that the larger sizes are also caught in the current fishery.

The theoretical maturity length for *L. bohar* was estimated to be at about 45 cm, and the majority of catch in 2006-2007 is observed to fall into lengths around this value. However, with the shift in the peak to the left, this indicates that a large number of individuals of this species are currently being taken prior to reaching maturity.



**Figure 19. Size distribution graphs for *A. virescens* (total sample for current survey and reef fishery survey in 2006-2007)**

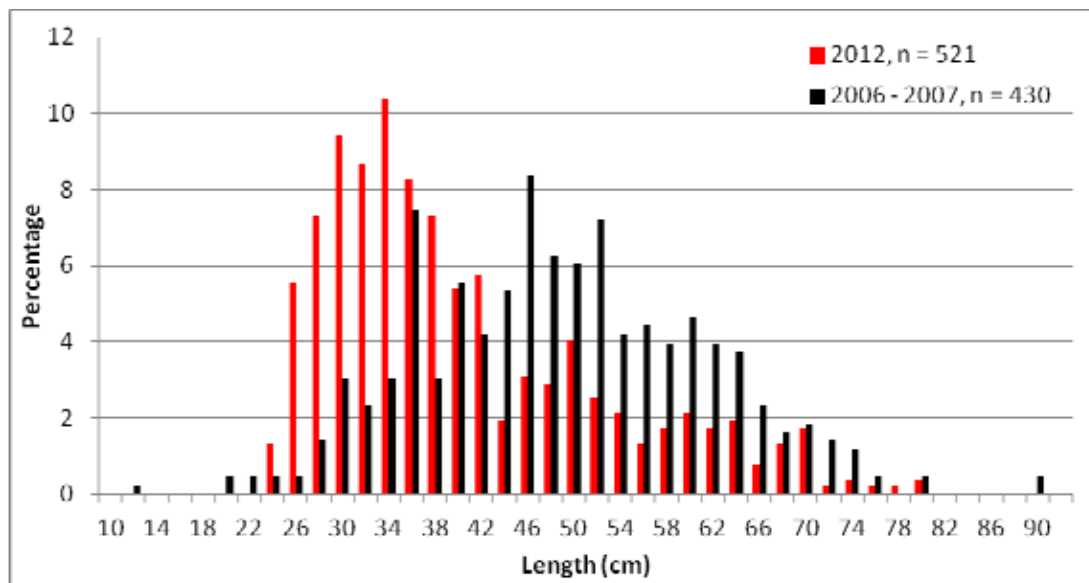


Figure 20. Size distribution graphs for *L. bohar* (total sample for current survey and reef fishery survey in 2006-2007)

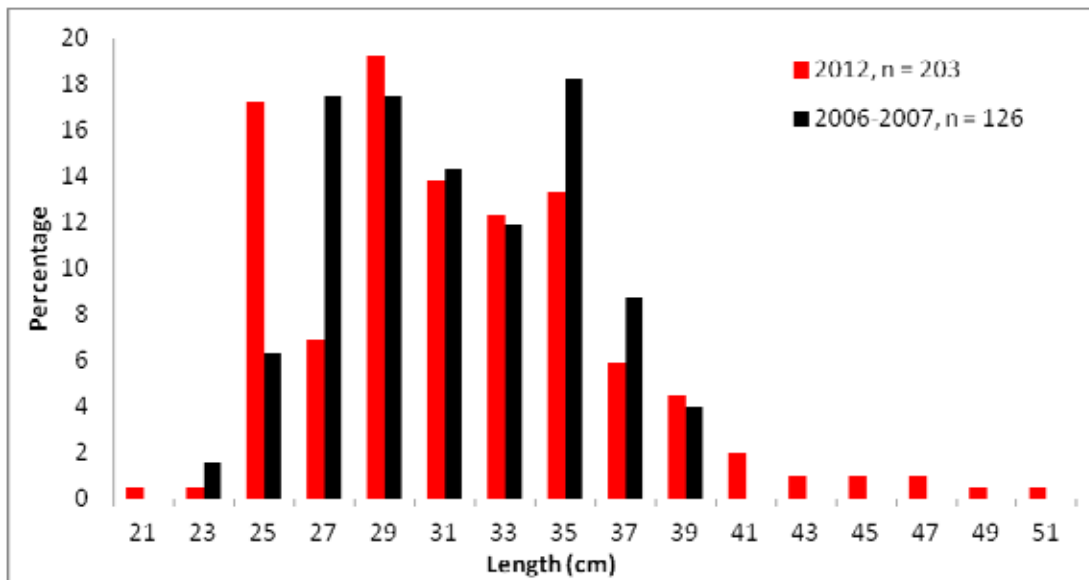


Figure 21. Size distribution graphs for *L. gibbus* (total sample for current survey and reef fishery survey in 2006-2007)

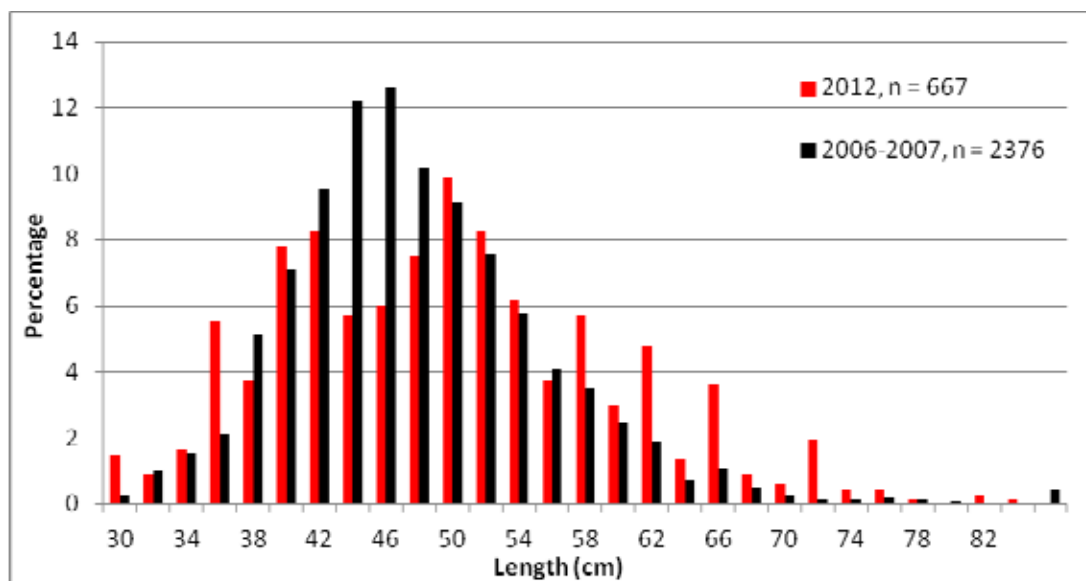


Figure 22. Size distribution graphs for *E. bipinnulata* (total sample for current survey and reef fishery survey in 2006-2007)

Size distribution plots for the commonly caught Carangid species, *C. melampygus* and *C. sexfasciatus* are shown in Figures 23 and 24. While the size distribution plot for *C. melampygus* does not show a distinctive peak, the plot for *C. sexfasciatus* shows two peaks, 1 major and 1 minor, with the major peak occurring at lengths around 46 cm and the minor peak occurring at lengths around 66 cm. The absence of a peak for *C. melampygus* indicates that a wide range of sizes are caught in similar quantities, while the presence of two peaks for *C. sexfasciatus* indicates that two dominant size classes are caught in the fishery. Given that the theoretical maturity length for *C. sexfasciatus* is approximately 60 cm, the dominant peak at 46 cm indicates that these individuals are caught prior to reaching maturity.

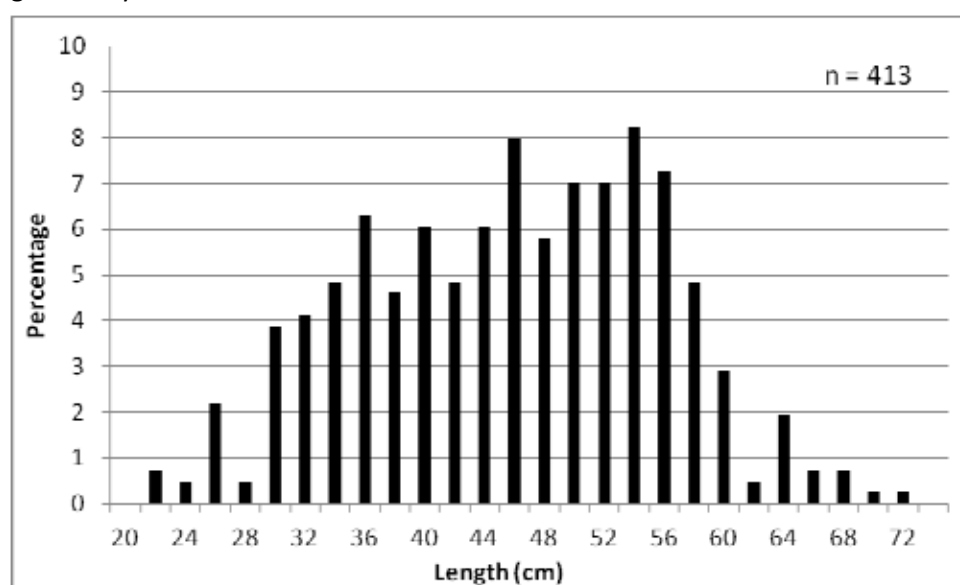


Figure 23. Size distribution graph for *C. melampygus*

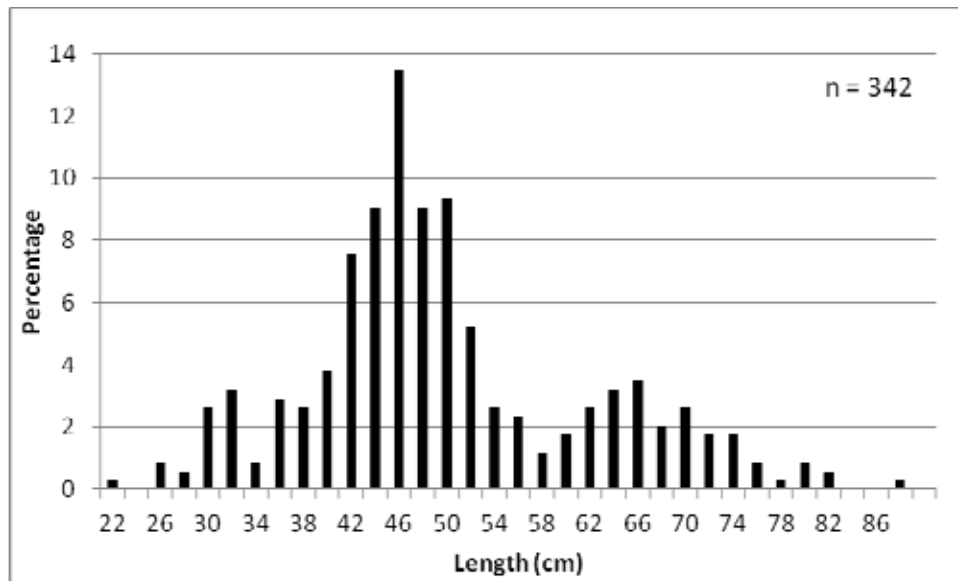


Figure 24. Size distribution graph for *C. sexfasciatus*

Figure 25 shows the size frequency distribution of all reported individuals of *L. olivaceus*, which again does not show a distinctive peak, though individuals between 40 to 50 cm were seen to be caught in greater numbers than those of other size classes.

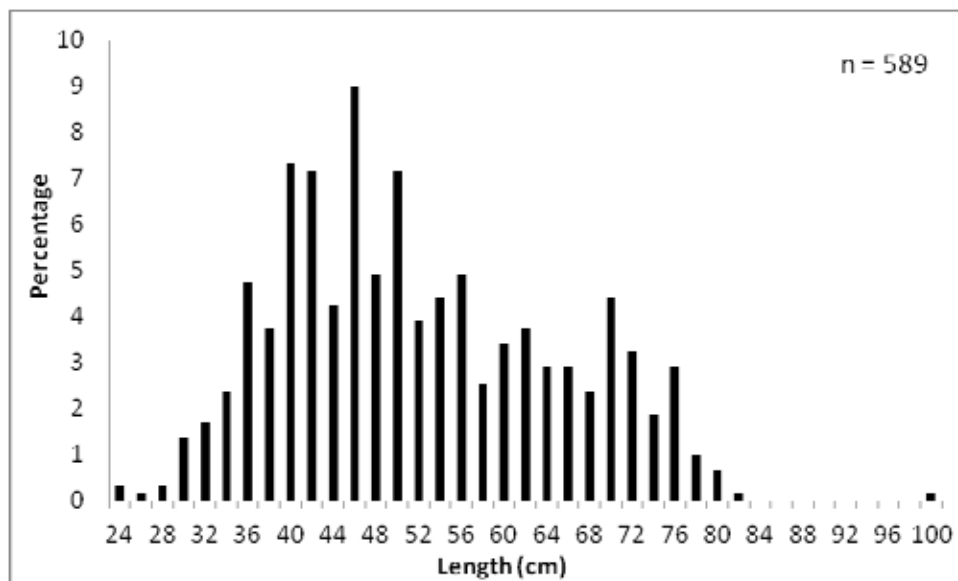


Figure 25. Size distribution graph for *L. olivaceus*

While size distribution plots for the key species have been done for the combined data from all resorts, figures depicting size distribution of data reported by individual resorts have also been generated for *A. virescens*, *L. bohar*, *C. melampyrgus* and *C. sexfasciatus*, which were reported by the majority of participating resorts (Figure 26).



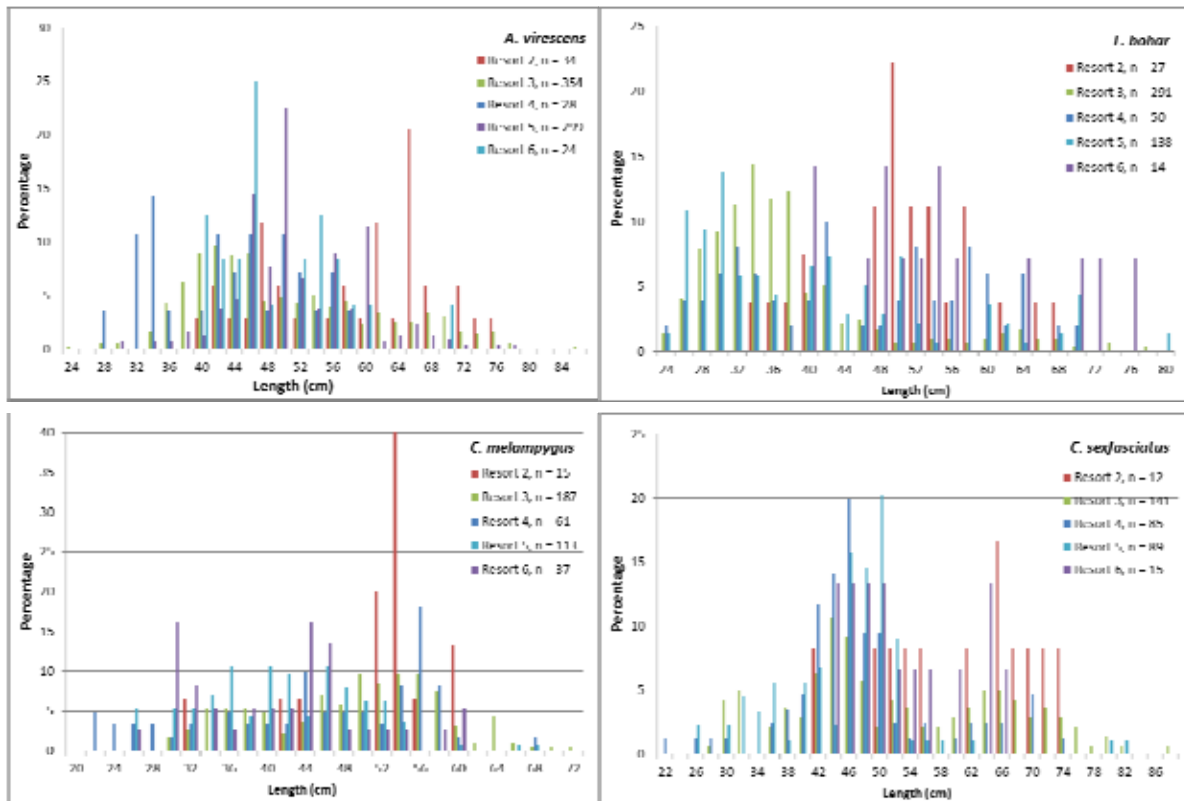


Figure 26. Size distribution graph for *A. virescens*, *L. bohar*, *C. melampygus* and *C. sexfasciatus* segregated into individual resorts' data

The figures showing length frequency plots for individual resorts do not show clearly discernable trends for any of the species, and a very varied catch in terms of size is observed for almost all 4 species and resorts.

#### 4.1.2.3 Annual reef fish purchase by resorts in 2012

All resorts were contacted to obtain data on their reef fish purchase and occupancy rates for the year 2012, in an effort to establish the annual purchase and consumption of reef fish by the tourism sector. However, we only received this data from one resort which also contributed towards the data collection on reef fish landings and size frequency sampling. Extrapolation based on this resort's reef fish purchase in 2012, its occupancy rate for 2012 and the number of beds, indicates that for each tourist night, 0.84 kg of fish was purchased by the resort. This extrapolation is based on 45 days sampling data and the reef fish purchase by the resort which was used for this exercise, is typical of what is observed in the fishery and sales (reef fish is bought to the resort either every day or every other day, from fishermen who go out fishing on daily trips and sell to the resort). The total number of registered beds in all resorts and hotels in Maldives for the year 2012 was 23,483 (MoTAC 2013) and the average occupancy rate for the year was 73.8% (MoTAC 2013). Therefore for a total 6,317,206 tourist nights, the quantity of reef fish purchased by all resorts in 2012 is estimated to be approximately 5,300 metric tonnes. While this figure is less than what was estimated for the year 2006 (~7000 MT, Sattar, 2008), it should be noted that the average occupancy for last year was lower by 8% than in 2006. Additionally, these results are based on data from a single resort and should be treated with caution. A more accurate comparison would be obtained if the above extrapolation had been based on data from the same resort as that which was used for this purpose

in 2006, or if the above analyses could be based on data from a number of resorts with varying quantities of fish purchase. However, we were unable to obtain the required fish purchase data and occupancy rates from more than one resort.

Another striking point is that there is a large anomaly between the estimated catch, based on fish catch data and the estimated purchase data by resorts. Given that tourist resorts are the main market for the reef fish industry, it is expected that the major portion of catch would be sold to this market. However, results do not show this and could again be attributed to the data from a single source. These results are indicative of the need for more research in the area.

Purchase prices of reef fish by the resorts varied between 15 to 60 MRf per kilo of reef fish with an average of about MRF 35 per kilo of reef fish (in comparison to the average rate of MRF 10 observed in 2006). This indicates that for the year 2012, an approximate total of MRf 185 million was spent on the purchase of reef fish. While the estimated quantity of reef fish purchased for 2012 is lower than that for 2006, the value has more than doubled. Given that the species which were being reported are the same as that observed in the earlier study this is hence indicative of the increasing value being placed on reef fish. It is a normal practice in such demand/supply chains, for the buyers to pay increasing prices for a supply which is in high demand and maybe decreasing in availability over time.

## 4.2 Results of recreational fishery survey

Seven resorts contributed data towards the data collection on recreational fisheries done by the resorts (i.e. night fishing trips organised as a guest activity). General information regarding the trips undertaken by the seven resorts is shown in Table 7.

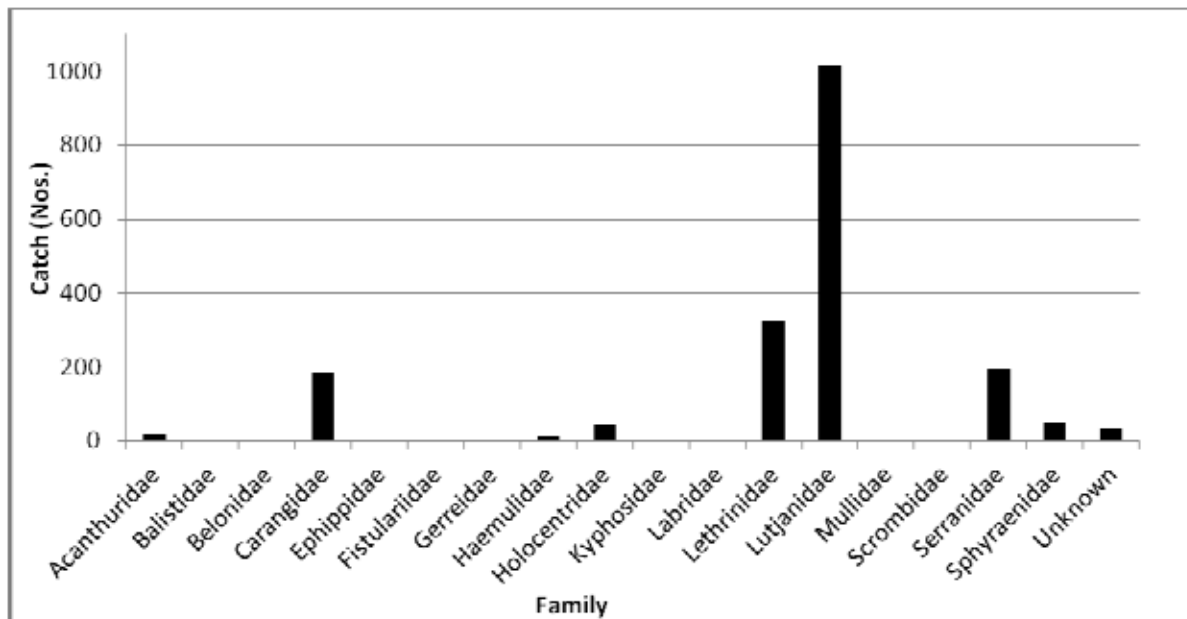
**Table 7. General overview of recreational fishing trips undertaken at the participating resorts**

	Total No. of fishing trips reported to date	Ave. group size	Ave. trip duration (hours)	Ave. catch /trip (Nos.)
Resort 1	32	12	1.5	7
Resort 2	79	8	1.5	6
Resort 3	22	11	2.5	5
Resort 4	14	7	3.25	16
Resort 5	52	12	1.25	3
Resort 6	16	11	1.5	6
Resort 7	14	8	1	12

As evident from the above table, these recreational fishing trips are very short and taken individually are of minor significance in terms of quantities of fish caught.

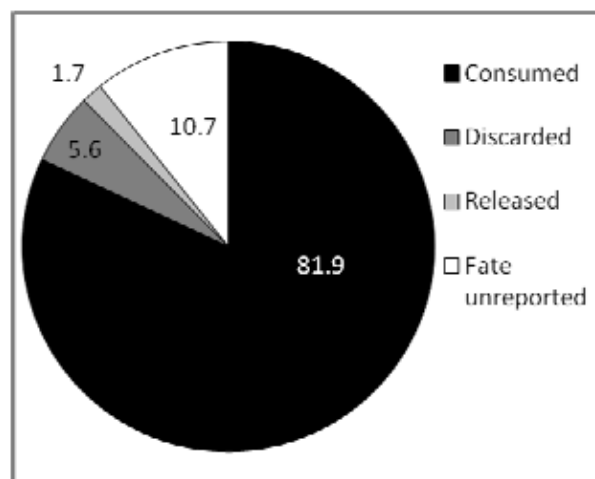
When looking at the catch composition of fish species caught on these trips, approximately 80 species were reported by the seven participating resorts, with the most common species being *Lutjanus gibbus* (Humpback red snapper, 23.2%), *Aprion virescens* (Green jobfish, 9.4%) and *Lutjanus*

*bohar* (Red snapper, 8.1%). Catch composition divided into family groups is shown in Figure 27, which shows that Lutjanids dominate the catch composition of this fishery, which is not surprising, given the fact that the most caught 3 species are Lutjanids.



**Figure 27. Composition of the catch from recreational fishing trips undertaken at the resorts, divided into families**

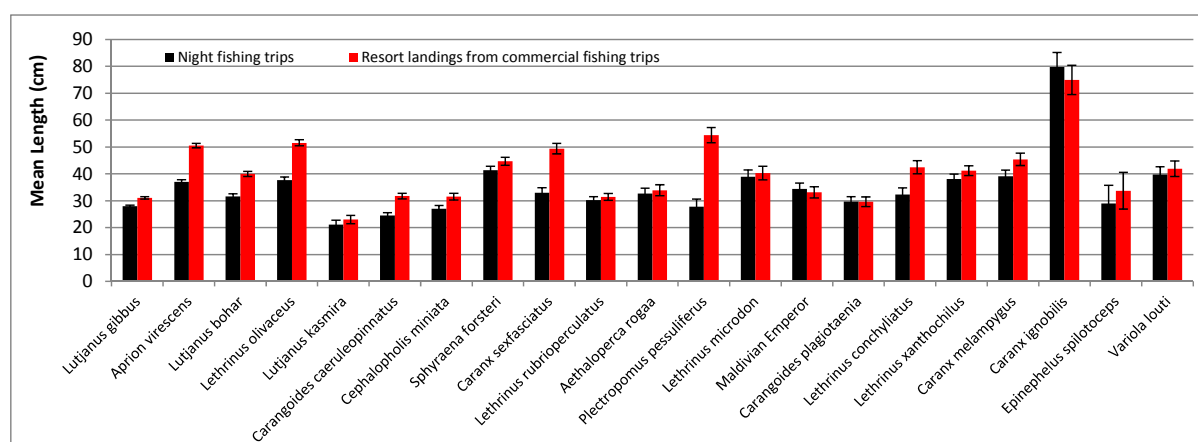
Resorts were also asked to measure every individual caught on the trips and also report the fate of the catch, as to whether they were consumed, discarded or released alive. Analysis of this data showed that major part of the catch was taken back to the resort for consumption (81.9%) (Figure 28).



**Figure 28. Fate of individuals caught on the recreational fishing trips (shown in percentages)**

Size sampling data was reported for almost 100% of the catch by all resorts. Mean lengths were calculated for each species and Figure 29 shows the mean lengths of the commercially important species of which 10 or more individuals were reported by the resorts as being caught on the night fishing trips. Mean lengths of individuals caught on the night fishing trips were also compared with

the mean lengths of these species as reported in the commercial fishery (based on landings at the resort). Mean lengths of the majority of the species are seen to be smaller for the catch from the night fishing trips than for the commercial fishery (Figure 29).



**Figure 29. Comparison of mean lengths of the commercially important species caught in the recreational fishing trips (species for which  $\geq 10$  individuals were reported) (Error bars show standard error)**

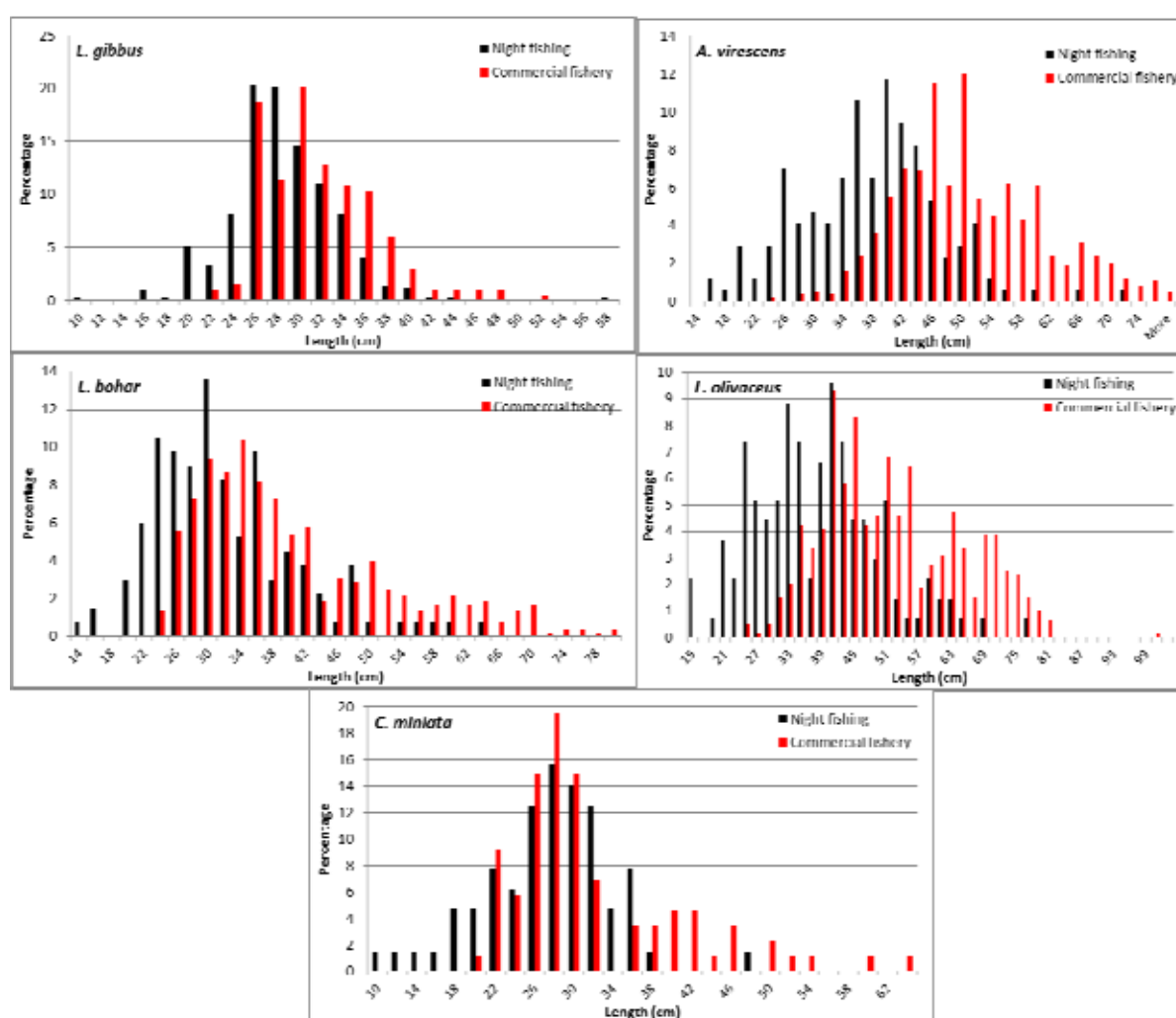
A t-test was undertaken to test for significance in the difference in mean between the two sets of data. Results of the t-test showed that while the difference in mean was significant for some species, it was not significant for others (details in Table 8).

**Table 8. Results of the t-test for significance, to assess whether difference in mean lengths of two samples is significant**

Species	Difference in mean length SIGNIFICANT	Difference in mean length NOT SIGNIFICANT
<i>Lutjanus gibbus</i>		✓
<i>Aprion virescens</i>		✓
<i>Lutjanus bohar</i>		✓
<i>Lethrinus olivaceus</i>		✓
<i>Lutjanus kasmira</i>	✓	
<i>Carangoides caeruleopinnatus</i>		✓
<i>Cephalopholis miniata</i>		✓
<i>Sphyræna forsteri</i>		✓
<i>Caranx sexfasciatus</i>		✓
<i>Lethrinus rubrioperculatus</i>	✓	
<i>Aethaloperca rogaa</i>	✓	
<i>Plectropomus pessuliferus</i>		✓
<i>Lethrinus microdon</i>	✓	
<i>Maldivian Emperor</i>	✓	
<i>Carangoides plagiotaenia</i>	✓	
<i>Lethrinus conchyliaetus</i>		✓
<i>Lethrinus xanthochilus</i>	✓	

<i>Caranx melampygus</i>		✓
<i>Caranx ignobilis</i>	✓	
<i>Epinephelus spilotoceps</i>	✓	
<i>Variola louti</i>	✓	

Size frequency plots were made for the five species most commonly reported in the night fishing data and which are also of commercial importance (Figure 30). The size frequency plots were also compared against the size frequency plots for the same species for data reported in the commercial fishery. As seen from these plots, the individuals caught in the recreational fishery were mainly of smaller size classes than those caught in the commercial fishery.



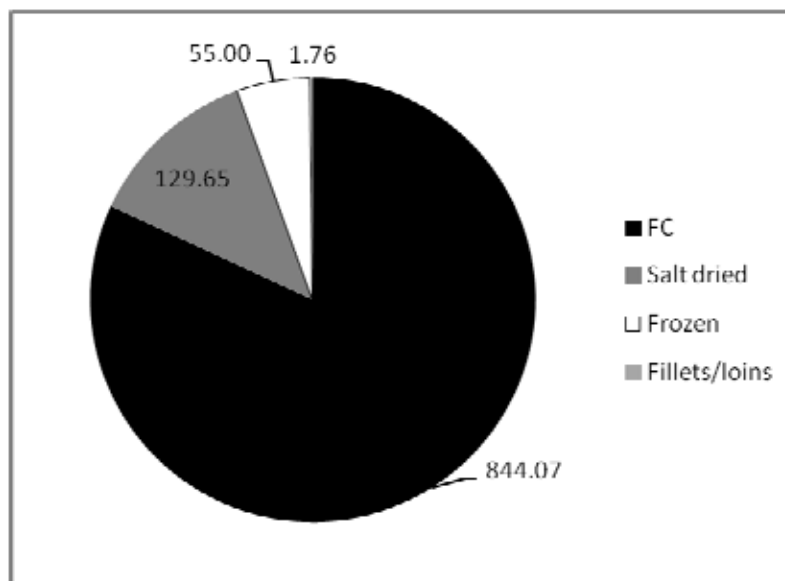
**Figure 30.** Size frequency plots for the five most reported species in the recreational fishery and which are also of commercial importance

In addition to the above sources of information, an effort was also made to get information on the number of resorts which conduct night fishing trips and details of these fishing trips. 18 resorts replied to this enquiry and from these 18 resorts, 12 resorts conduct night fishing trips with an average of 3 trips per week and maximum 20 guests per trip. Five resorts did not conduct night

fishing trips, while 1 reported organising trips upon request by the guests. Using the above figures and extrapolating these figures to the total number of resorts in operation in the Maldives, it is estimated that a total of 68,000 individuals are caught annually in the recreational fishery of Maldives. However, it should be noted that this is a very rough extrapolation and we need to get the exact number of resorts who conduct these trips to get an accurate figure, especially as with more resorts becoming environmental friendly resorts, some which used to conduct these trips have discontinued this practice.

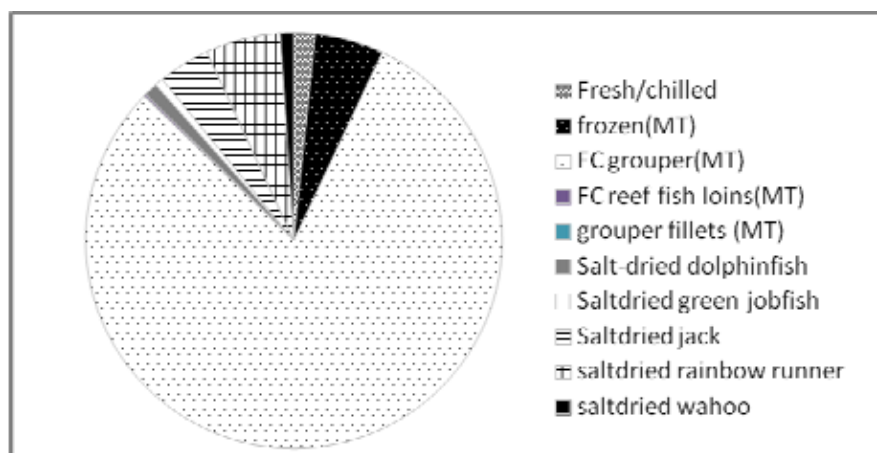
### 4.3 Reef fish Export data

Reef fish exports are seen to be composed of various forms of processed reef fish which are shown in Figure 31 and Figure 32.



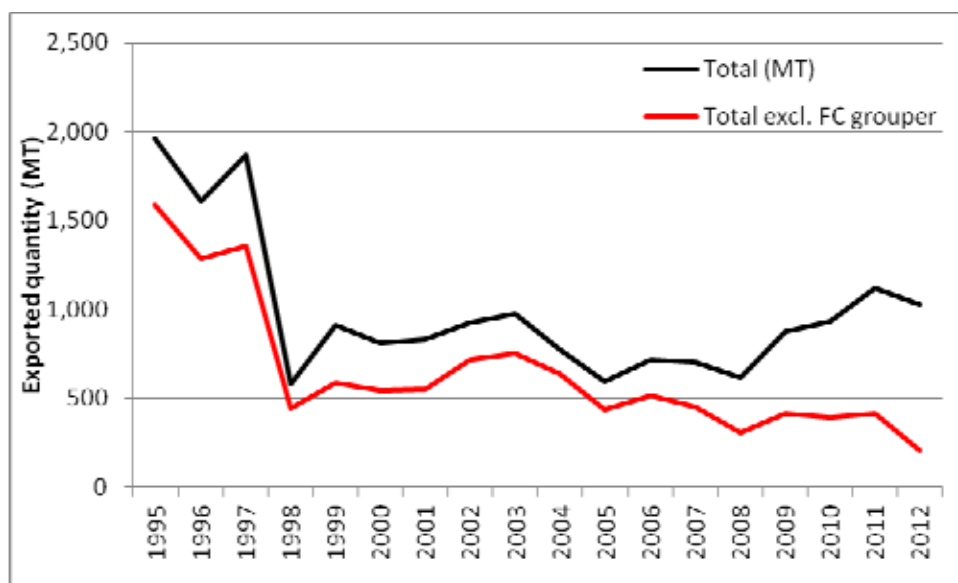
**Figure 31. Total quantities (in Metric Tonnes) of various forms of reef fish exports for 2012 (excluding live, which is reported in numbers). Source: MOFA, Basic Fisheries Statistics**

As seen in Figure 31, reef fish exports are dominated by fresh/chilled forms of reef fish, followed by salt/dried forms. A breakdown of these is shown in Figure 32.



**Figure 32. Breakdown of various forms of reef fish exports (Metric tonnes) excluding live exports (for 2012). Source: MOFA, Basic Fisheries Statistics**

Figure 32 shows a breakdown of the different forms in which reef fish are exported from the Maldives, and their respective quantities for 2012. As seen in Figure 32, 80% of exports of reef fish for 2012 were composed of fresh/chilled groupers which are exported as part of the separate grouper fishery which is solely targeted towards the export market. 6% of exports of reef fish was composed of salt/dried rainbow runner, which is commonly caught in the reef fishery, as well as in the pole and line fishery (hence this could be exports by tuna exporters as well). These figures show the exports of processed reef fish. The live exports are almost 100% composed of export of live groupers, which is caught in a separate fishery and has been discussed in detail in a separate review (Sattar et. al. 2011).



**Figure 33. Export of all forms of processed reef fish from 1995 to 2012 (black line) and export of processed forms of reef fish excluding fresh/chilled groupers (red line) Source: MOFA, Basic Fisheries Statistics**

Figure 33 shows exports of all forms of processed reef fish (excluding live groupers), with and without fresh/chilled groupers which are exported by grouper exporters as part of the grouper fishery, which is different from the generic reef fishery carried out in the Maldives. Fresh/chilled groupers are seen to form a big part of the processed forms of reef fish exports and the increase in exports for the past 3 years can also be attributed to the export of fresh/chilled groupers. This is indicated by the difference in export trends for recent years, once the fresh/chilled grouper exports are removed from the total exports (red line). Figure 34 shows the export of live reef fish, which was seen to be almost 100% composed of live groupers (which are exported in the grouper fishery). This is on an alarming decreasing trend and is now being addressed through a grouper fisheries management plan (DRFP 2011).

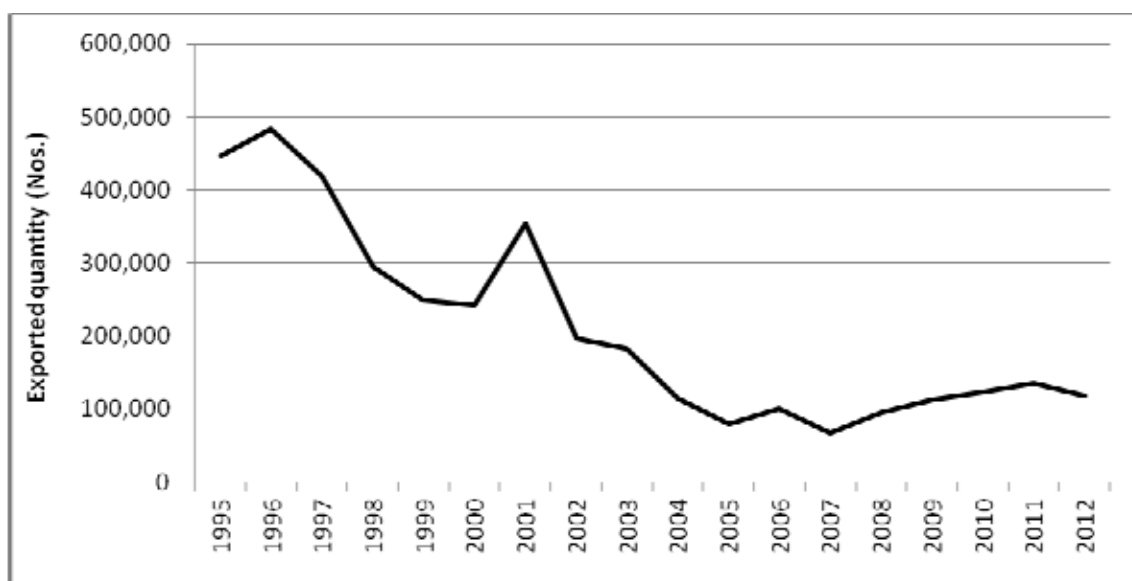


Figure 34. Export of live reef fish (mainly groupers). Source: MOFA, Basic Fisheries Statistics

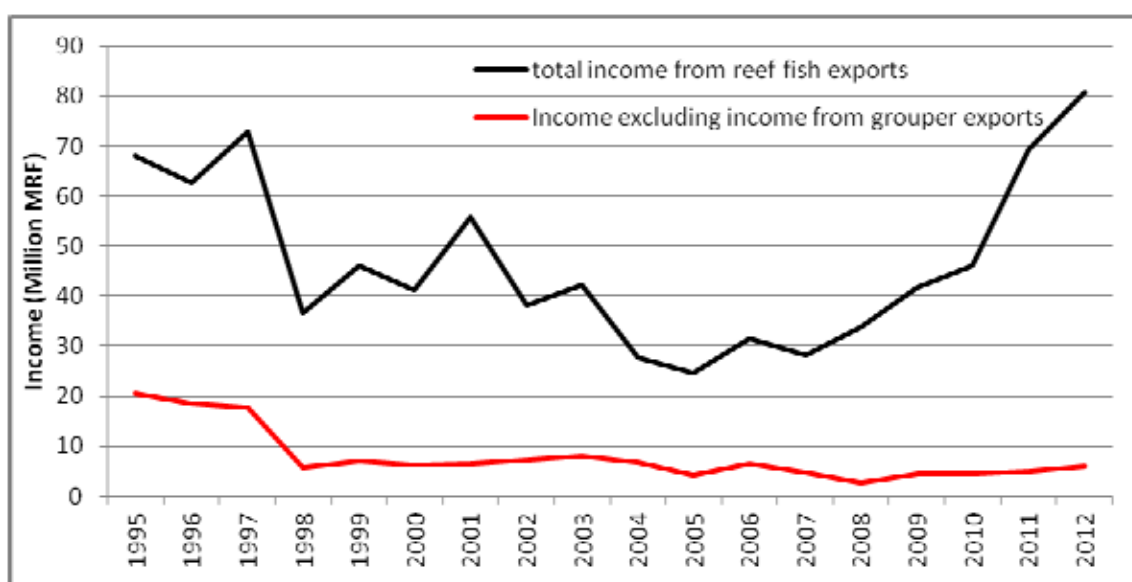
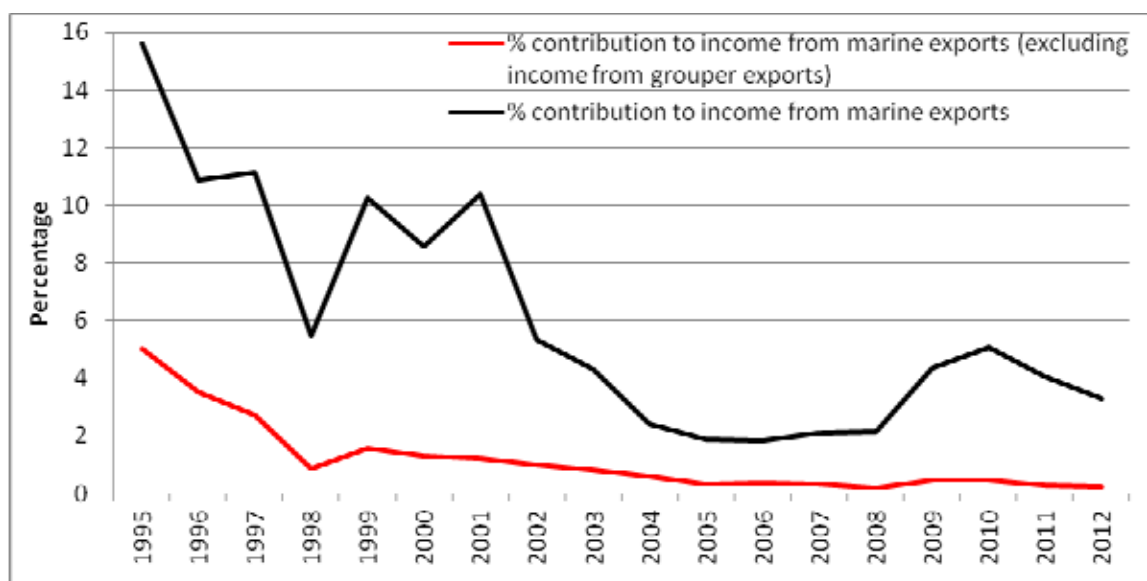


Figure 35. Income from reef fish exports (total income from reef fish exports (black line) and total income excluding the income from grouper exports (red line)). Source: MOFA, Basic Fisheries Statistics

Figure 35 shows the trend in income from reef fish exports over the past years from 1995 to 2012. As seen from the figure, total income (inclusive of income from grouper exports) follows a fluctuating trend which is similar to that seen in income from grouper exports (Sattar et. al. 2011). However, once income from grouper exports is removed, the income from exports of other forms of reef fish is seen to be much less than the total income (which is inclusive of grouper exports). This again indicates that grouper exports have the greatest value of all reef fish exports.





**Figure 36. Percent contribution to income from marine exports by income from reef fish exports (including and excluding income from grouper exports (black and red lines respectively)).** *Source: MOFA, Basic Fisheries Statistics*

Figure 36 shows the percent contribution by income from reef fish exports to income from all marine exports. As clearly seen in the figure, the contribution is on a decreasing trend, having gone down to almost a quarter of the contribution in 1995. Once again, when contribution from income earned through grouper exports is removed, the contribution by reef fish exports towards the total income earned from marine exports is almost insignificant (ranging from 0.17% to 5%).

#### 4.4 Results of Household survey

A total of 16,061 forms were sent to 193 islands of Maldives (excluding Male'). From these, only 1,030 forms (6.4%) were filled and returned from 18 islands, details of which are shown in Table 9). While our target was to survey 20% of households from each inhabited island, which comes to a total of approximately 6,387 households, the received number of forms account for 16% of households. However, since forms were received from 50% of households from those islands which participated in the survey, on the whole this is not completely representative of the total population.

**Table 9. Number of forms received from the 18 islands which participated in the household survey**

Atoll	Island	Forms sent	Forms received	%
HA	Thuraakunu	33	33	100
HA	Mulhadhoo	24	24	100
Sh	Noomaraa	42	42	100
Sh	Lhaimagu	51	40	79.2
N	Landhoo	60	50	83.3
B	Dhonfanu	33	33	100
Lh	Naifarua*	303	179	59.2
K	Dhiffushi	60	54	90

K	Huraa	59	53	90.6
K	Maafushi	90	88	97.8
M	Dhiggaru	77	77	100
Th	Vilufushi	95	95	100
Th	Dhiyamigili	48	23	47.9
Th	Kinbidhoo	68	5	7.4
L	Mundoo	25	23	93.9
L	Kunahandhoo	49	47	95.9
GA	Dhaandhoo	97	97	100
GA	Dhevvadhoo	67	67	100

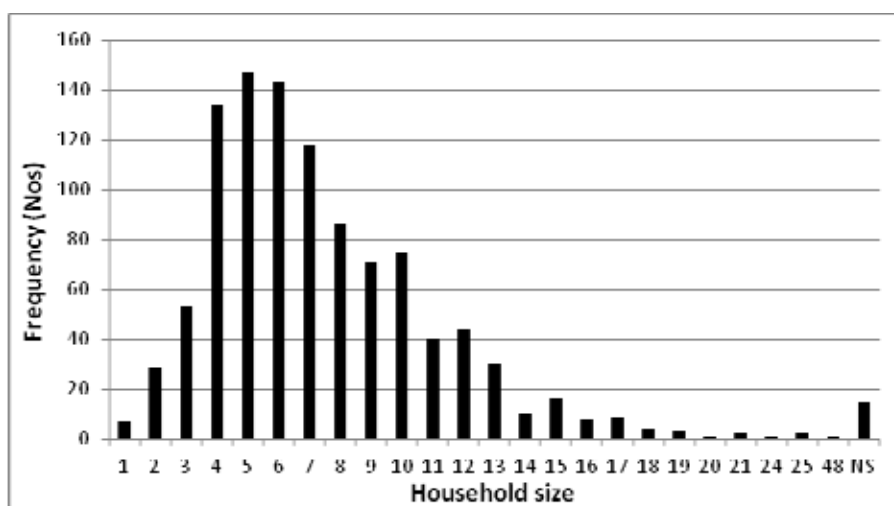
A total of 1500 forms were sent to four schools of Male', in order to achieve the 10% of households from Male'. Details of forms sent and received are shown in Table 10. Only 19 forms were received and from only one school, mainly due to the difficulties in getting students to fill in the forms. Furthermore, survey period coincided with exams and holidays so some schools found it difficult to distribute the forms

**Table 10. Number of forms received from the participating schools in Male'**

School	Forms Sent	Forms Received	%
Majeediyya School	400	-	-
Imaadudhdheen School	400	-	-
Dharumavantha School	300	-	-
Hiriya School	400	19	4.75

While the number of respondents are seen to be very low and not on a whole representative of the whole survey population, since participants are from a few islands of Maldives, some analyses have been carried out to get an idea of reef fish consumption at the household level. Survey results from Male' have been amalgamated into the total survey results as the number of responses are too few to be analysed separately.

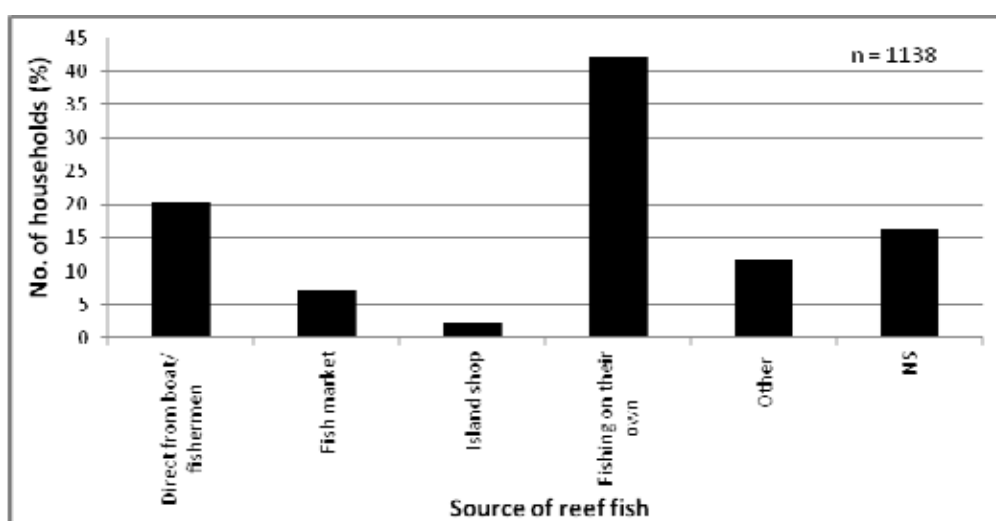
Figure 37 shows that the majority of households surveyed had a household size of 4 to 6 people, while households size of about 10 people were also not uncommon. A few households were also reported to have 15 to 25 people living and eating together. This is not an uncommon practice in some of the islands, where extended families live in the same house. While household sizes in Male' are generally smaller, with individual families living separately in small spaces within one plot of land, one household from Male' was reported to have 48 residents. This is a rare occurrence for Male', especially if all residents cook and eat together.



**Figure 37. Distribution of household size of all survey respondents (NS – Not stated)**

Respondents were also asked about the number of fishermen in their households, who went for either tuna, reef fish or grouper fishing. In total 681 households reported to having a total of 1147 fishermen. A total of 499 households reported a total of 691 tuna fishermen, while 361 reef fishermen were reported from 237 households and 96 grouper fishermen were reported from 76 households.

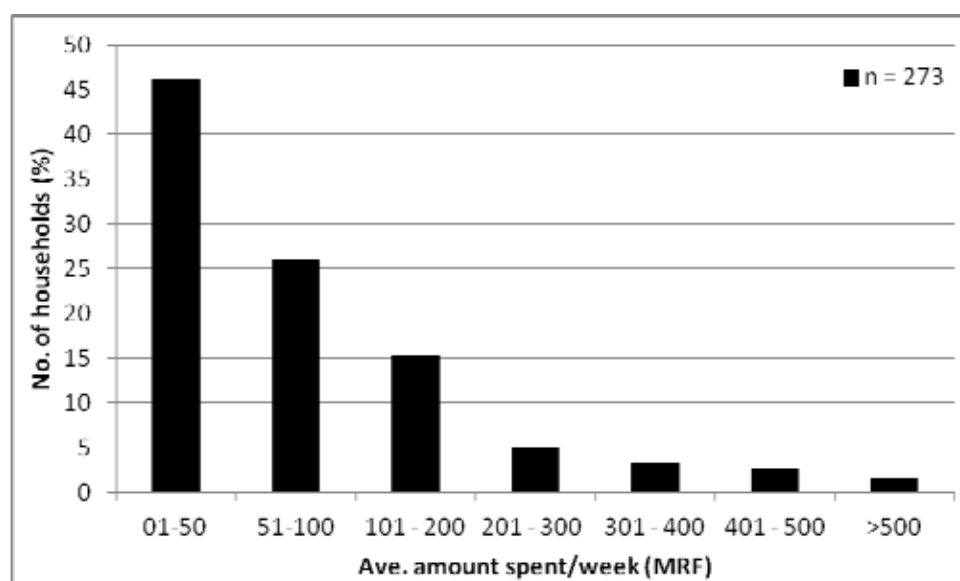
In response to where the households obtain the reef fish they use for consumption, the majority (42%) reported that they catch it on their own, by going out for fishing (Figure 38), while 20% reported to getting it direct from either the fishing boat or the fishermen. When inquired about recreational fishing trips, 561 respondents reported that members of their households go for recreational fishing trips every week at an average of 3 days per week.



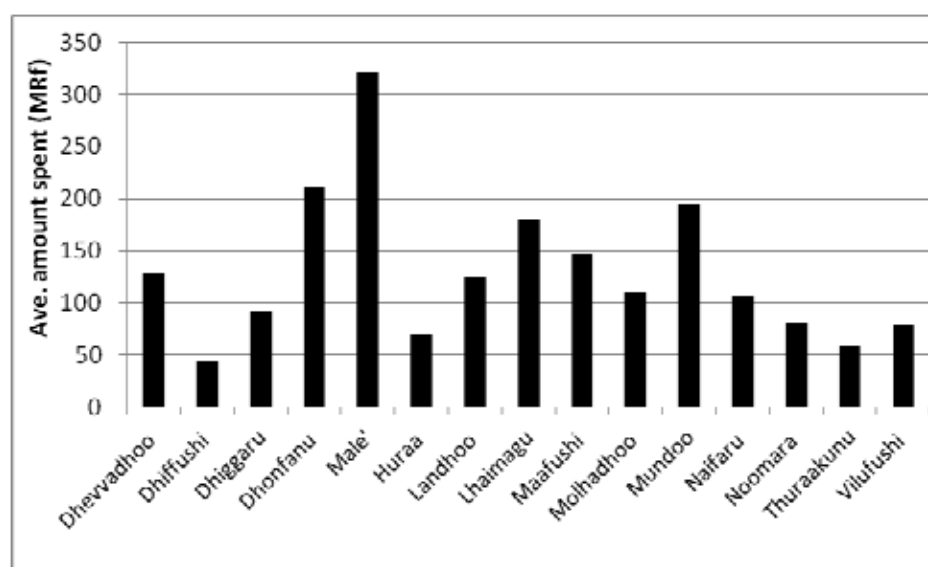
**Figure 38. Source of reef fish consumed by households (NS – Not stated)**

Households were found to spend an average of about MRF 110 per week on purchase of reef fish, though this value varied greatly from household to household and island to island as seen in Figures 39 and 40. Figure 39 shows the frequency distribution of amount spent on reef fish purchase per

week, while Figure 40 shows the average amount spent from household on reef fish purchase, for the different islands surveyed. It should be noted that only 26% of households responded to this question.



**Figure 39. Frequency distribution of amount spent on reef fish purchase**

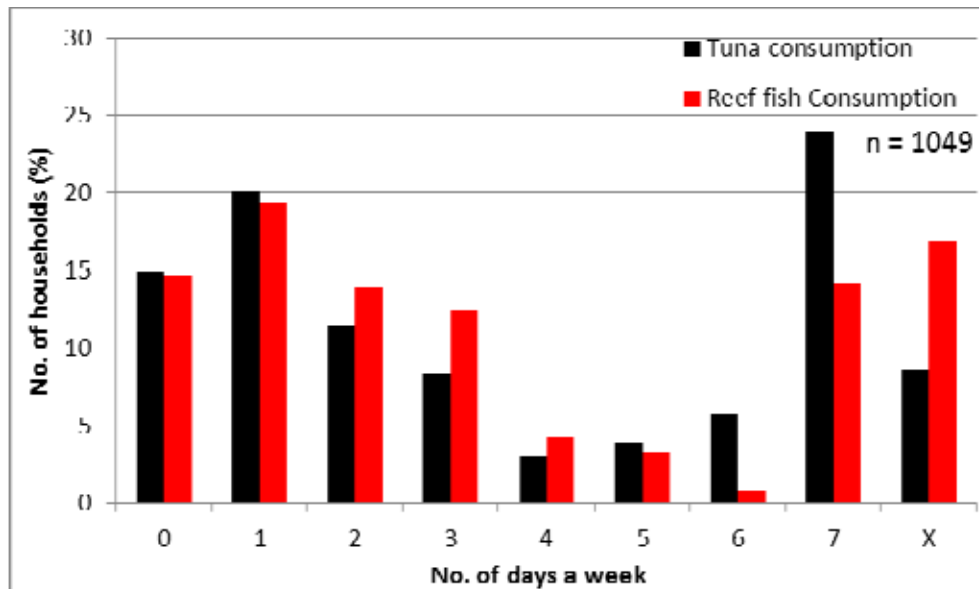


**Figure 40. Average amount spent by households on reef fish purchase, for the different islands surveyed**

As seen from Figure 39, the majority of households spend an amount between MRF 1 to 50 per week on reef fish purchase, while a few also report to spending amounts greater than MRF 200 per week on reef fish purchase. A detailed look into the most reported purchase price range (MRF 1 to 50) showed that the majority paid an average of MRF 25 per week on reef fish purchase.

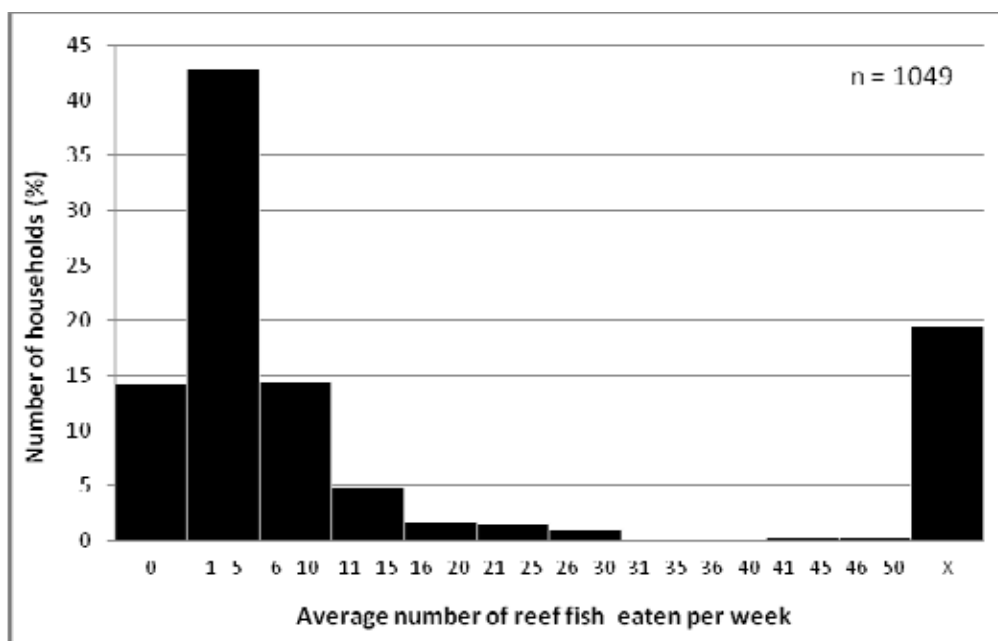
A comparison of the number of days a week, households consume fresh reef fish and fresh tuna shows that consumption of tuna is more prevalent with the majority of households reporting they consume tuna 7 days a week, while the majority of households which reported the consumption of

reef fish, reported consuming reef fish once a week (Figure 41). Maldivians have had a diet which consisted mainly of tuna, since the very early days, given the history of pole and line fishery in the country since the time of our ancestors. A look into same comparison for each island showed a similar trend with tuna being consumed more frequently than reef fish.



**Figure 41. Frequency distribution for number of days of tuna and reef fish consumption by households (X – unreported/misreported data)**

For those who reported to consuming reef fish at least once a week, they were then asked about the average number of reef fish consumed per week, which was found to be 5 on average, which as shown in Figure 42 is the number of reef fish consumed per week by the majority of households that participated in the survey.



**Figure 42. Frequency distribution of average number of reef fish consumed by households per week (X – unreported/misreported data)**

Interviewees were then asked about the quantity of reef fish/tuna consumed by the households in comparison to 10 years back. This comparison shows that households report consuming greater quantities of reef fish now than 10 years ago, while consumption of tuna has decreased over the last 10 years (Figure 43).

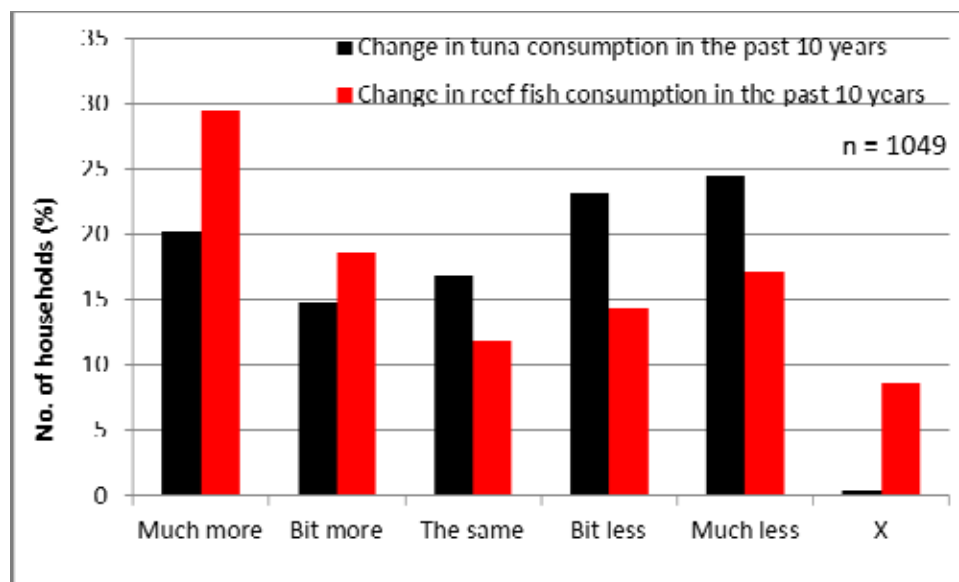


Figure 43. Frequency distribution of change in tuna/reef fish consumption over the past 10 years (X - unreported/misreported data)

Approximately 48% of households who participated in the survey reported consuming more reef fish now than 10 years ago, while only about 34.9% reported the same for tuna consumption. On the other hand, 47.6% reported consuming less tuna than 10 years back. A detailed look into the same analysis for each islands, showed that islands were divided on this question, some reporting more consumption of reef fish, while others reported more consumption of tuna. Hence, this is evidence that reef fish is also gaining greater importance in the diets of locals, in addition to the important role it plays in the tourism market.

#### 4.5 Consultations with reef fishermen

A total of 102 fishermen were consulted from 16 islands of 10 Atolls (Table 11).

Table 11. Details of stakeholders (fishermen) consulted in terms of numbers and localities

Atoll	Island	No. of fishermen consulted
HA	Maarandhoo	11
B	Kudarikilu	9
K	Gulhi	6
	Guraidhoo	4
	Gaafaru	5
	Himmafushi	7

AA	Ukulhas	8
	Rasdhoo	6
ADh	Dhangethi	9
	Mahibadhoo	5
V	Fulidhoo	3
F	Bilehdhoo	4
	Feeali	4
L	Maamendhoo	9
GDh	Gahdhoo	4
<b>Total</b>		102

Experience of fishermen (in terms of number of years being involved in the fishery) interviewed ranged from 2 months to 46 years, with average being approximately 17 years of experience in reef fishing.

When asked about reasons for choosing the reef fishery, the majority (approx. 80%) stated that they chose the fishery for its good income, while some also specified that the fishery was a means of earning a good income while being close to the island (approx. 7%), in comparison to tuna and grouper fisheries where they are away from their islands for long periods at a stretch.

Average income was found to be about MRF 1900 per person per week (excluding one persons reported income of MRF 13000 per week). The majority of interviewees (approx. 27% of those who reported an income) were seen to earn an income between MRF 1001 and MRF 1500 per week (Figure 44). 47% of interviewees reported to earn an income from other avenues such as other fisheries, construction work etc., while 53% reported reef fishing as their sole income earning activity.

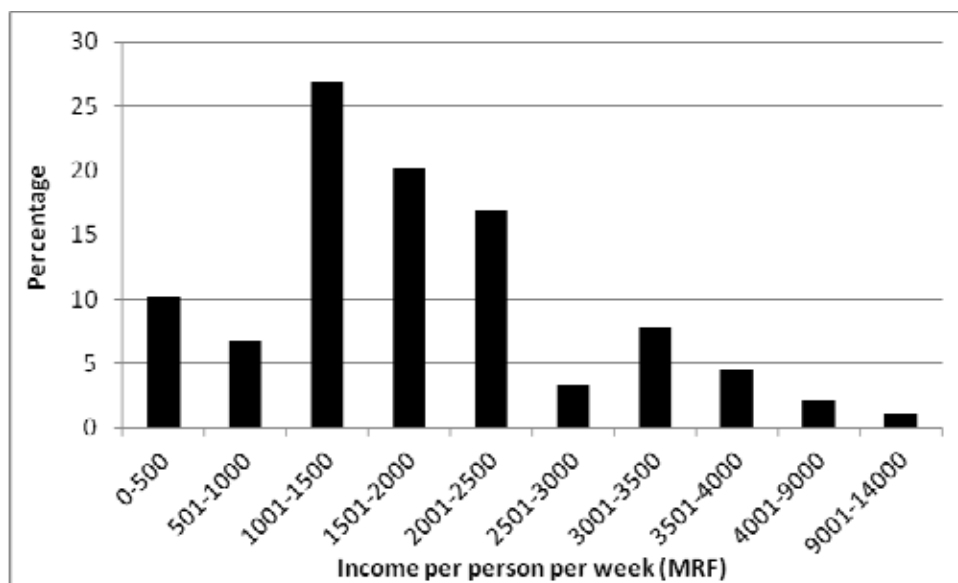
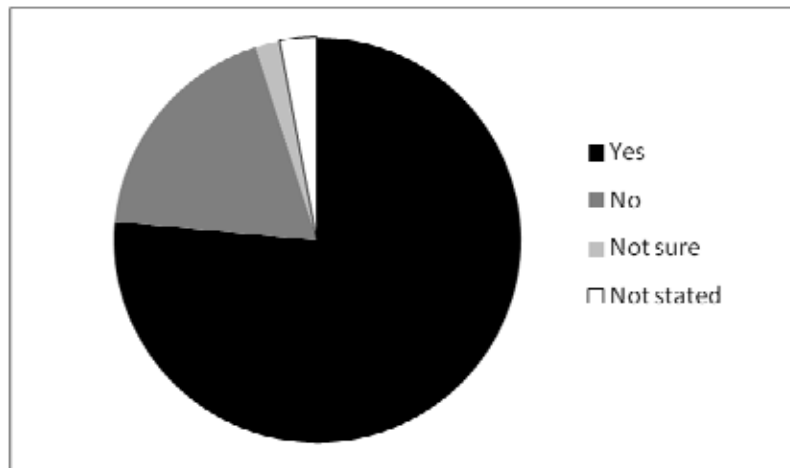


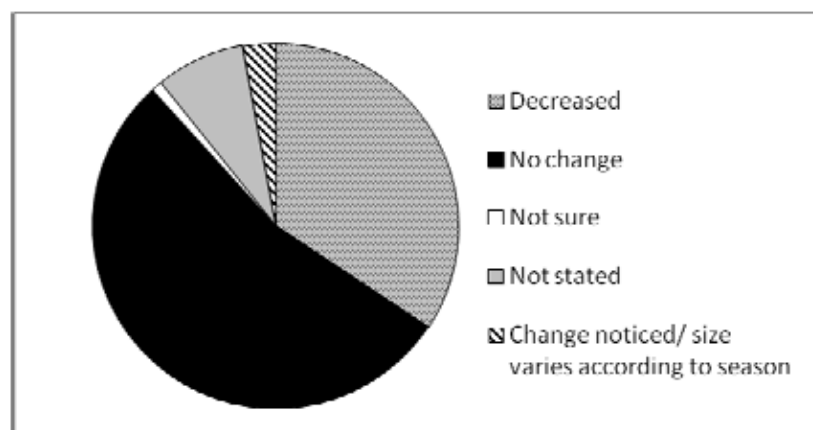
Figure 44. Income earned per person per week

When asked whether they had noticed a change to the fishery, 76% said the fishery had undergone a change, while 19% said that the fishery was the same as earlier. 2% were not sure of a change in the fishery and the remaining 3% did not answer the question (Figure 45).



**Figure 45. Fishermen perception on whether the fishery has undergone a change over the years**

Interviewees were then questioned about whether they noticed a change in size of individuals caught, to which the majority replied that sizes have not undergone any change and they are still able to catch the same sized individuals as during earlier days of the fishery. However, 34% of interviewees reported a decrease in size of individuals caught (Figure 46).

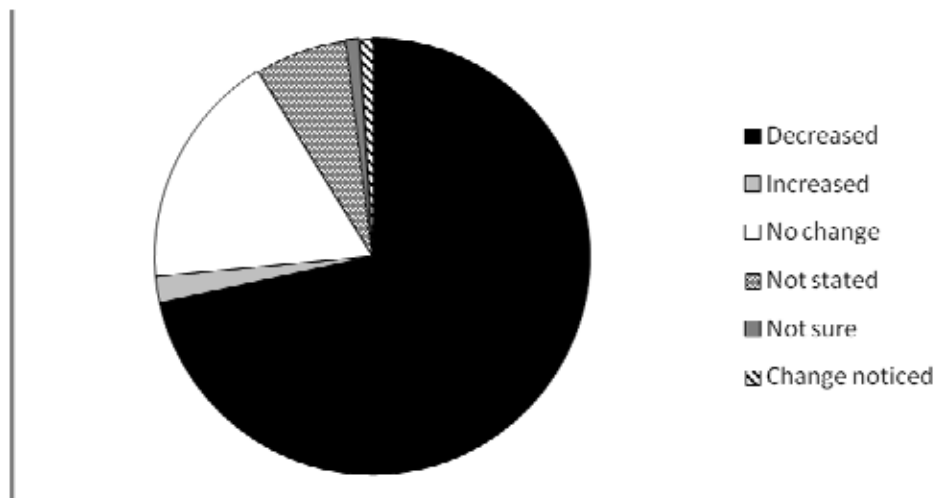


**Figure 46. Fishermen perception on changes which have occurred to the size of individuals caught in the fishery**

Fishermen perceptions on whether the quantities caught in the fishery have undergone any changes shows that the majority (approximately 72%) believe the quantities caught have decreased, while 17% believe that the fishery has not undergone any change (Figure 47). Only 2% believe that quantities caught in the fishery have increased over the years. While 72% reported a decline in catch quantities, 7% of these individuals stated that although catch is declining, they are getting a better income from the fishery now than earlier. This is mainly due to better market prices (better rates paid by tourist resorts). 2% stated that they believed the fishery to be in decline due to increased number of people involved in the fishery, while 9% reported a decrease in species diversity of catch,

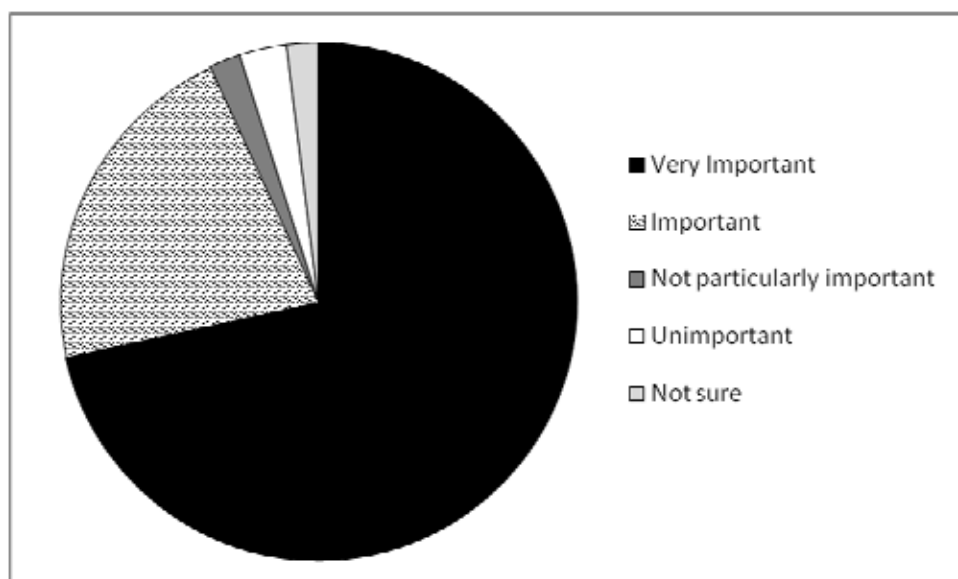


especially declines in numbers of important species such as Red snapper, Emperors, Groupers and Jacks.



**Figure 47. Fishermen perception on changes which have occurred to the quantity of individuals caught in the fishery**

Fishermen were then asked about the importance of managing the fishery to ensure its sustainability, to which the majority (93%) responded that it was important to manage the fishery, while 71% of this 93% thought it was very important to manage the fishery (Figure 48).



**Figure 48. Fishermen perception on importance of managing the reef fishery**

Analysis of the responses of fishermen towards the various options given to manage the fishery, showed that the majority of the fishermen felt that year round protection of selected spawning sites (Figure 49e) of reef fish was the best option out of the 6 given, followed by the establishment of size limits on catch (Figure 49d).

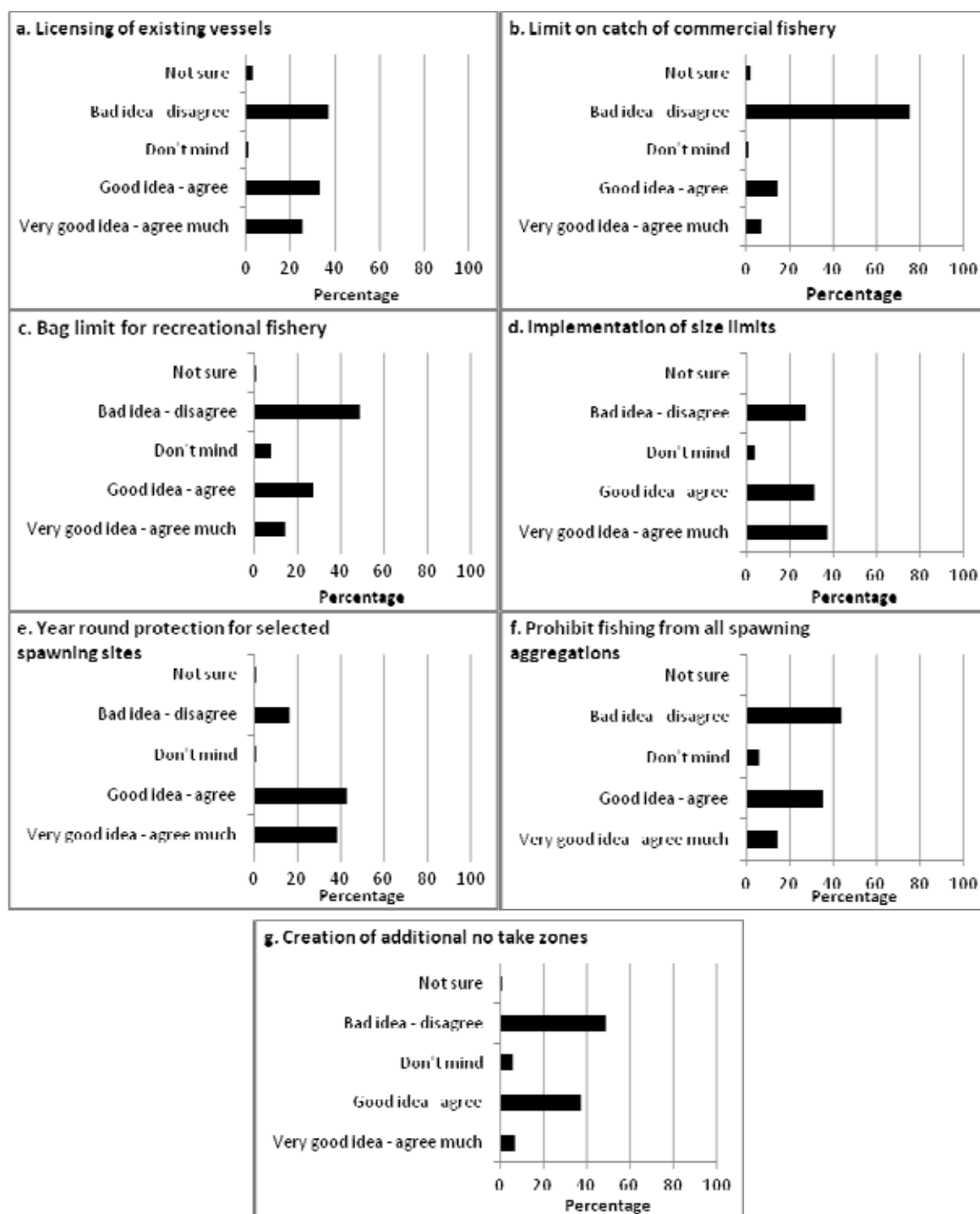


Figure 49. Fishermen perception towards the various options available to manage the fishery

## 5 Conclusions

### 5.1 Commercial fishery

The main market for the commercial reef fishery for all survey areas is seen to be the tourism market, which correlates with the fact that the reef fishery is mainly targeted towards the tourism industry. However, a smaller market is also seen to exist mainly for the purpose of export of reef fish in various processed forms. The method of fishing has remained the same since the last survey, with baited handlines and droplines being the main gear used in the fishery. The fishery is supplemented by a live bait fishery.

The fishery catch data shows that the method and areas of fishing does not limit the catch solely to those species which inhabit the reefs. The fishery also catches a large number of individuals of species which are reef-associated, such as the *Elagatis bipinnulata* and jacks. These species are in fact observed to form the major part of the catch. This was what was observed in the earlier review of the fishery as well. Other species commonly caught in the fishery are *Aprion virescens*, *Lutjanus gibbus* and *Lutjanus bohar*. These trends in catch composition were observed for all islands surveyed, hence showing that fishermen of different areas do not have a species which is preferred over others and hence targeted, but their catch possibly relates to availability and gear specificity.

Size comparisons do not show a large variation in size between the catch from different atolls, though the catch reported from HA. Maarandhoo is generally composed of bigger individuals for most species, while that from M. Kolhufushi and AA. Rasdhoo is generally composed of smaller individuals. This is especially evident when comparing the mean sizes of individuals caught from various atolls. This variation in mean size can almost certainly be attributed to high fishing pressure reported in the area over the past years, as high levels of exploitation are known to have the potential to bring about changes in size distribution of the targeted stock (Jennings et. al. 2001). As the reef fishery in the Maldives develops together with the tourism industry, fishing pressure on reef fish species is mostly felt in areas where tourism has been established over the years. The tourism industry in the northern atolls of Maldives such as Haa Alifu atoll is quite young and on a small scale compared to the central atolls of Maldives. Hence this could be a reason for lower levels of exploitation in the area, which in turn could explain the relatively larger size of fish currently being caught. Fishing pressure could also account for the smaller sizes of fish reported from AA. Rasdhoo, where fishing was mainly carried out in the small atoll of Rasdhoo and inside Ari Atoll (which is widely developed as a tourism centred atoll), and may also explain the smaller sizes of individuals reported from Meemu atoll, which is also an atoll where tourism is established on a small scale.

Estimation of catch per atoll, based on data from 3 atolls which had the most data, showed variation between the atolls with Kaafu Atoll (North and South) having a yield approximately one third of the yield from Baa Atoll and North and South Ari Atoll. A quick analysis of effort in terms of time spent fishing and average crew sizes showed that these factors were almost consistent amongst all three atolls. Hence this variation could be attributed to decreased availability from within Kaafu Atoll, which is quite possible given that reef fishing has been carried out within the atoll for a longer period (since this was the first atoll for the introduction and development of the tourism industry in the

Maldives). Additionally an increasing amount of recreational fishing is also being undertaken within the atoll especially by locals nowadays.

Catch rates in terms of tonnes per km<sup>2</sup> for all three atolls, are in the mid ranges of published yields from coral reefs which normally range between 1 and 10 tonnes per km<sup>2</sup> (Dalzell *et al.*, 1996; Newton *et al.*, 2007; Bell *et al.*, 2009).

Anderson *et al.* (1992) calculated the Maximum Sustainable Yield for the Maldivian reef fishery to be at 30,000 MT  $\pm$  13,000 MT. This MSY was based on the status of the fishery 20 years ago and it is clear that the fishery has undergone vast development over the last 20 years with the increasing demand for the resource. The current annual catch is seen to have increased since the last review in 2006/2007. Hence, it can be confidently assumed that this catch will increase over the future years, with the increasing demand which will be placed on this valuable resource due to the further expansion of the main market, i.e. the tourism industry. Therefore, it is prudent that certain steps be taken to carry out the fishery in a managed way so as to ensure that the fishery is sustainable and extraction does not exceed the MSY of the resource. It is also important to manage the reef fishery with respect to the value reef fish have live on the reef for the dive tourism industry and for the role they play in maintaining a healthy reef ecosystem.

Resort purchase data of reef fish shows that purchase amounts vary amongst resorts, mainly based on bed capacity of the resort. Species composition of individuals purchased show the same patterns as that reported by fishermen, with lutjanids and carangids being purchased in large quantities.

Mean lengths of individuals reported by the different resorts showed some variation, though not significant. Mean lengths of individuals reported for *L. bohar* and *L. gibbus* were also seen to be significantly smaller for the current survey in comparison to the individuals caught during the survey carried out in 2006. Size distribution plots do not show a major change in sizes for commonly caught species, though the size composition of *L. bohar* is seen to have shifted to the left indicating that individuals of this species caught in the fishery have become smaller in size. As discussed earlier, this is a commonly seen effect of high fishing pressure. *L. bohar* is an aggregating species, which is targeted during the full moon season by fishermen as well as recreational fisheries and large numbers of this species can be caught each full moon.

Extrapolation of catch data based on the occupancy rate of a single resort was used to obtain an estimate of the total reef fish purchase by all resorts in 2012. This value was found to be approximately 5,300 MT, which is lower than the estimated value of 7,100 MT obtained in the earlier survey. However, it should be noted that the occupancy rate was 8% less than for 2012 than in 2006. With an average of MRF 35 being paid per kilo of reef fish, this indicates that MRF 185 million (approximately USD 12 million) was spent on reef fish purchase by resorts in 2012. This value is more than double of what was paid in 2006 indicating that the value of reef fish is increasing. Given that the species which were being reported are the same as that observed in the earlier study this is hence indicative of the increasing value being placed on reef fish. It is a normal practice in such demand/supply chains, for the buyers to pay increasing prices for a supply which is in high demand and maybe decreasing in availability overtime.

## 5.2 Recreational fishery

Both locals and tourists contribute towards the recreational fishery carried out in the Maldives. It is a common practice amongst many locals to head out for fun filled fishing trips for a night, especially during the full moon period of the lunar month, as they are then guaranteed a good catch of species such as the Red snapper (*L. bohar*). As mentioned in Section 3.2 efforts were made to assess the status of the recreational fishery undertaken by locals, especially from Male', through interviews with vessels which normally undertake such trips. However, this proved quite unsuccessful mainly due to absence of personnel on board these vessels (who were able to answer the questions) while docked in Male'. Since the fishery is unregulated and open to all, it was not possible to get an idea of number of vessels which carry out these fishing trips.

Recreational fishery or night fishing trips are also a regular activity offered by a number of resorts throughout the Maldives. Based on data obtained from the participating resorts, and extrapolation from these data it was found that 67% of resorts conduct these night fishing trips and an estimated 68,000 individuals are caught in the fishery on an annual basis. It should be noted that with eco-friendly tourism becoming more established, quite a number of resorts are now opting to discontinue the practice of organising such fishing trips. This is to the advantage of the health of the fish stocks, as it was found that the mean lengths of main species being caught was smaller than that of the same species being caught in the commercial fishery. Furthermore, while it is good that what was caught was being consumed (especially if they were dead when hauled on to the boat), current night fishing activities mean that large numbers of smaller sized individuals which have the potential to grow and breed are being taken out from the sea.

## 5.3 Export of reef fish

Reef fish exports form a minor part of marine exports and contribute a minor percentage to the total income from all marine exports (~0.24% contribution in 2012). Hence this again shows that the majority of the catch from the fishery is targeted towards the tourism industry. The value of the reef fish exports is increased with the addition of income from the export of groupers. However, groupers in the Maldives are caught in a targeted fishery which is separate from the reef fishery and the declining trend in exports of this valuable resource is currently being addressed through the Grouper Fisheries Management Plan and the implementation of the Regulation on fishing and export of groupers (which will commence on the 26<sup>th</sup> of November 2013).

While it has been earlier recommended to restrict or bring about a ban on the export of reef fish species (other than groupers), the industry still continues. However, based on export data and purchase data from resorts, it would be appropriate to implement a phased reduction in export, leading to a ban. There is a strong argument for this because the resource is currently being heavily used for the local/tourism market and given the trends in the fishery, it is likely that the fishery could reach a stage where the supply might not be sufficient to meet the demand (if it continues unmanaged). The Maldives might then reach a stage where it might have to import the resource to meet the local demand. It clearly both important and justifiable to restrict the usage of this resource to prevent such a scenario and to do so in a way where it would least affect the stakeholders. Since exporters of reef fish do not solely get their income from this avenue, but through other avenues

such as grouper/tuna exports, it is worthwhile investigating the option of restricting exports of reef fish. However, it is recommended to carry out a thorough stakeholder consultation with all exporters/local sellers prior to bringing about such a restriction.

## **5.4 Household surveys and local consumption**

Maldivians have always obtained their main source of proteins from fish, especially tuna. The pole and line tuna fishery carried out in the Maldives since the time of our ancestors has ensured that we always had a good supply of fish. Reef fish was not traditionally consumed at the local level, especially not as commonly as tuna. However, results of the household survey show that local consumption of reef fish has increased over the years with most households consuming between 1 to 5 reef fish per week.

The total amount of tuna and reef fish consumed at household level has also changed over the past 10 years with more households now consuming a greater amount of reef fish than they used to 10 years ago. Conversely, they are currently consuming a lesser amount of tuna than 10 years ago. This changing trend could be due to the greater number of people who are currently involved in the reef fishery and the greater number of locals who now go on recreational fishing trips, often on a weekly basis.

The above is evidence of the fact that reef fish are gaining more importance in the diet of locals and it is therefore prudent that we conserve this resource for sustainable use by Maldivians in the future.

## **5.5 Consultations with fishermen**

While the review aimed to have a consultative process with all stakeholders in the fishery (fishermen, exporters, local sellers, purchasers) due to shortage of resources and time and difficulty in obtaining lists of exporters/sellers we were only able to consult with the reef fishermen. A total of 102 reef fishermen were consulted from throughout the Maldives and asked about the status of the fishery and their opinions on the management of the fishery.

The majority of those consulted reported decreased quantities though they did not feel that the size of individuals caught have decreased. However about 1/3<sup>rd</sup> of those interviewed did report a decrease in size of individuals. With these status assessments, the great majority (71%) of fishermen felt that it was very important to manage the fishery and carry it out in a sustainable manner so that they are able to reap its benefits in the longer term.

While fishermen were not aware of spawning aggregations of reef fish, they were able to identify areas where fishing was always good. The majority of fishermen were in support of year round protection of selected spawning sites so as to allow the reef fish to breed and populate. Implementation of size limits for key species was also a key measure to which most fishermen were in agreement.

Reef fish are relatively sedentary and site-attached, inhabiting discrete reef areas for the most of their life. They also have slow growth rates and long lives, which further make them susceptible to over exploitation. Intense fishing pressure on any single area for a continued period of time is inevitably going to affect the population health of reef fish stocks in the area.

While all the above results show that the reef fishery of Maldives is still below the estimated MSY for the country, we should take all results with precaution, especially since the MSY was calculated at a time when the status of the fishery of much lower importance than it is now. It is worthwhile to calculate a new MSY for the resource so as to assess the current status of the resource. Furthermore, the current yield is slowly approaching the limit of MSY and it is important that we implement management measures before that happens.

## 6 Recommendations

**Table 12. List of recommendations and implementing agencies**

Recommendation	Importance	How to achieve	Implementing Agency
Registration/licensing of all reef fishing vessels specifically for the fishery	Important when identifying the effort which goes into a fishery Critical for future management of the fishery	Mandatory licensing through the Fisheries Management Agency (FMA), Ministry of Fisheries and Agriculture (MOFA)  Renewal on an annual basis	FMA (MOFA)
Registration of all reef fishing processing facilities/purchasers (resorts, exporters, local traders)	Important for management purposes to identify and monitor all stakeholders within the fishery and the roles they play	Mandatory registration of processing facilities at FMA/MOFA  Mandatory registration of all processors and local buyers/sellers at MED (trade dept.) as reef fish traders	FMA, Ministry of Economic Development (Trade Dept) / MoTAC
Mandatory reporting of catch data by fishermen	Establishing accurate daily records of catch in a fishery is essential for proper monitoring and assessment of the fishery. This will ensure that appropriate management measures can be taken for particular species/fishery areas	Include in list of criteria for licensing a vessel for the fishery and renew license annually based on record submissions  Implementation of log books	FMA (MOFA), MRC
Mandatory reporting of reef fish purchase data by all purchasers: tourist resorts, exporters, salting/drying facilities, local buyers	Means of verification of catch data Will provide accurate information on value of reef fish for different consumer sectors and trends in value and volume	Log books	MRC, FMA (MOFA), Ministry of Tourism, Arts and Culture
Stakeholder consultation: fishermen, exporters, local sellers, fish processors (salting/drying), resorts	Crucial to consult all stakeholders and get their opinions on status of fishery, management, measures to implement etc.	Workshop  Small group consultations	FMA, MRC
Phased reduction/ban	With the increasing	Step 1: Notify all	Ministry of Economic



of reef fish exports	demand for this resource within the Maldives, both for the local market and the tourism market, a means of conserving the resource for the future is needed.	export companies of phasing-out programme. Step 2: Set quotas on exports based initially on current levels, then year-by-year reduction. Step 3: Ban exports  Grace period of 3 years	Development (Trade) with MOFA (FMA)
Implement size limits for catch (the report provides recommended size limits in Appendix 6)	Ensure survival of immature fish to an age/size at which they can breed and add to population growth	Establish size limits for key species  Ban catch and purchase of species below established size limits  Implement spot check programme at landing sites, markets & other retail outlets	MRC,FMA  Purchasers
Identify key reef fish spawning aggregation sites and look into option of year round protection of top sites	Protect breeding population from being fished, especially during spawning periods – ensure population growth and regeneration	Interviews with fishermen  In-water verification of sites which have been identified as good fishing spots (potential spawning spots)  Spawning site report scheme for Dive Centres  Fishwatch surveys to monitor distribution and abundance of key species	MRC, Dive schools Resorts
Encourage resorts to discontinue the practice of recreational fishing trips	Minimise catch of smaller sized, immature individuals - ensure population growth and regeneration	Awareness campaigns  Voluntary phasing out of recreational fishing trips by resorts	FMA (MOFA), Ministry of Tourism, Arts and Culture
Recreational fishing trips (both by locals and resorts) if carried out should be undertaken with best	Minimise catch of smaller sized, immature individuals – ensure population growth and	Establish guidelines which can be followed by all resorts/ recreational fishers	MRC, FMA (MOFA), Ministry of Tourism, Arts and Culture

practice guidelines (refer to Appendix 7 for best practice guidelines)	regeneration  Minimise discards	Awareness raising campaigns to increase awareness amongst tourists and general public about best practice in fisheries	
National information and awareness / outreach programme	General public/ fishermen and all concerned stakeholders are well informed about the value of reef fish for fisheries, tourism and biodiversity and the need for management	TV documentaries Posters Bulletins TV spots Youtube spots News letters/fliers	MRC/FMA / MOFA/ LGA/ Ministry of Tourism, Arts and Culture

**Table 13. Proposed timetable for list of recommendations**

Activity	Tasks to be done	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Registration/licensing of all reef fishing vessels for the fishery	Identify personnel at FMA/MOFA to do the work												
	Construct database with information on all existing reef fishing vessels/addition of new info. as it comes												
	Preparation of application form for license/modification of existing form to specify fishery												
	Revision of current regulation to include clause(s) on licensing for the reef fishery												
	Gazetting of revised regulation												
	Public announcement re. new procedures of licensing												
	Assist fishermen with form filling through Councils etc.												
Registration/licensing of all reef fish processing facilities/local buyers	Identify personnel at FMA/MOFA and Trade Department to do the work												
	Construct database with information on all existing reef fish processing facilities/local buyers/ addition of new info. as it comes												
	Preparation of application form for license/modification of existing form												
	Public announcement re. new procedures of licensing												
Mandatory reporting of catch data by fishermen	Identify personnel at MOFA/MRC to carry out the work												
	Preparation/revision (if necessary) of data collection form												
	Preparation of a database for data entry (enables easier monitoring of reporting)												
	Distribution to all fishermen through FMA/Island councils												
	Monthly monitoring of data reporting by all licensed vessels - follow up if necessary												
Mandatory reporting of reef fish purchase data by all purchasers: tourist resorts, exporters, salting/drying facilities, local buyers	Identify personnel at MOFA/MoTAC/ Dept. of Trade to carry out the work (and liase when necessary)												
	Preparation of data collection form												
	Preparation of a database for data entry (enables easier monitoring of reporting)												
	Distribution to all purchasers through FMA/MoTAC/Trade Dept./Island councils												
	Monthly monitoring of data reporting by all purchasers - follow up if necessary												

[illegible]

[illegible]

	Indicates periods during which immediate action needs to be taken
	Indicates ongoing activities



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## Appendix 1. Survey form used by fishermen

Side 1.

<b>Marine Research Centre</b> Ministry of Fisheries and Agriculture Male' 20025, Maldives Tel: 332 2242, Fax 332 2509 Email: reeffish-maldives@gmail.com	Reference Number: ..... /..... (Trip No./year)
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### Reef fishery daily log form

1. Date:..... 2. Atoll/Island:..... 3. Dhoni registration No.:.....

4. Name/address of recorder:..... 5. No. of fishermen:

6. Trip information: 6.1 Time of departure  am/pm 6.2 Time of arrival back at the island  am/pm

7. Bait fishery information

7.1. Did you haul bait for the trip: Y/N 7.2. Start time  7.3. End time

7.4. Bait species used: Muguraan ☐ Nilamehi ☐ Mushimas ☐ Rimmas ☐ Latti ☐ Rehi ☐ Vadhu ☐ Others.....

8. Fishery information

8.1. Fishing start time  End time  No. of fish caught  Total weight of fish caught  kg

8.5. Fishing gear used: Net ☐ Handline ☐ Drop line ☐ Pole and line ☐ Trolling ☐ Others.....

9. Sale of fish

9.1 Resort sold to:..... Selling rate (MRF):  Total earned (MRF):

10. Catch composition

Species	Code	Nos.	Total weight (kg)
Emperors	SBR		
<i>L. gibbus</i>	HSN		
<i>A. virescens</i>	JBF1		
<i>A. rutilans</i>	JBF2		
<i>A. furca</i>	JBF3		
<i>L. bohar</i>	RSN		
<i>E. bipinnulata</i>	RNB		
Snappers	SLF		
<i>C. hippurus</i>	RNB		
Tholhi	THL		
Groupers	GRP		
Jacks	JCK		
<i>G. unicolor</i>	DOG		
Others			

**Additional information**

Note: This is a translated version. The original of this form is in Dhivehi for ease of fishermen

Side 2.

## Appendix 2: Survey form used by resorts to record reef fish purchase/size

<b>Marine Research Centre</b> Male', Maldives Tel: (960) 332 2242, Fax: (960) 332 2509 Email: reefish.maldives@gmail.com	Resort code-form no.-year Ref. no. : .....-.....-.....
---	---

### Reef fish/Lobster purchase data collection form for Resorts

Date: ..... (DD/MM/YYYY)

Resort: .....

Information collected by (Name/Designation): .....

Origin of fishermen (Atoll/Island): .....

Name of dhoni / Registration & Contact number: .....

Location of fishing (Name, Atoll and Grid Ref): .....

#### Fish purchase details

Total weight of purchased fish:  kg      Catch quantity (in numbers)

Buying rate/kg: MRF       Total price paid: MRF

#### Catch composition

	Qty*	Wt*	Others (List Species)	Qty*	Wt*
Jobfish species ( <i>Giulhu/Rankarumas</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>
Snappers ( <i>Raiymas/Ginimas</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>
Trevallies/Jacks ( <i>Handhi</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>
Emperors ( <i>Filolhu</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>
Rainbow Runner ( <i>Maaniyamas</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>
Groupers ( <i>Faana</i> )	<input type="text"/>	<input type="text"/>	.....	<input type="text"/>	<input type="text"/>

\*Qty - Total quantity in numbers Wt - Total weight in Kg

Lobster purchase details	Lobster Species	Qty	Buying Rate	(Please specify if per kg or per individual)
Total number of lobsters purchased <input type="text"/>	<i>Panulirus femoristriga</i> (PF)	<input type="text"/>	<input type="text"/>	
Total price paid: MRF <input type="text"/>	<i>Panulirus penicillatus</i> (PPen)	<input type="text"/>	<input type="text"/>	
	<i>Panulirus versicolor</i> (PV)	<input type="text"/>	<input type="text"/>	
	<i>Panulirus omatus</i> (PO)	<input type="text"/>	<input type="text"/>	
	<i>Panulirus polyphagus</i> (PPol)	<input type="text"/>	<input type="text"/>	
	.....	<input type="text"/>	<input type="text"/>	
	.....	<input type="text"/>	<input type="text"/>	


  

**Darwin Reef Fish Project**  
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## Appendix 4: Survey form used to carry out survey on household consumption of reef fish

**Marine Research Centre**  
**Ministry of Fisheries and Agriculture**  
**Tel: 332 2242, Fax: 332 2509**



**HOUSEHOLD FISH CONSUMPTION SURVEY**

Date:..... Atoll/Island:..... Surveyor:.....

**Interviewee Information**

House name:..... Gender: M / F Age: < 18 ☐ 18-24 ☐ 25-35 ☐ 35-45 ☐ >45 ☐

**Household fish consumption information**

1. No. of people in the household ☐

2. Age/Gender structure in household (please put numbers for relevant groups)

0-15 years: M ☐ F ☐ 15-30 years: M ☐ F ☐ 30-45 years: M ☐ F ☐ >45 years: M ☐ F ☐

3. Employment of household members (list numbers)

Fisheries	Tuna	Reef	Grouper
No. in household employed in fisheries			
Ave. no. of days/person/week spent on fishing trips			

Fish processing ☐ Farming ☐ Construction/Carpentry ☐ Resort work ☐ Others (specify).....

**Tuna consumption**

4. How many days a week does your household eat fresh tuna?

5. In comparison with 10 years ago, does your family eat more or less tuna?

Much more ☐ Bit more ☐ The same ☐ A bit less ☐ Much less ☐

**Reef fish consumption**

6. How many days a week does your household eat fresh reef fish? ☐ On ave. how many reef fish are eaten per week? ☐

7. Please list species/type in order of importance

a)..... b)..... c)..... d)..... e).....

8. Where do you get your fresh reef fish from: Direct from boat ☐ Fish market ☐ Island shop ☐ Others(specify).....

9. If you buy reef fish how much do you pay per kg ☐ OR per individual? ☐ (List species wise prices on other side of form if able to answer)

10. Approximately how much does your household spend on reef fish per week ☐ MRF OR per month? ☐ MRF

11. In comparison with 10 years ago, does your family eat more or less reef fish?

Much more ☐ Bit more ☐ The same ☐ A bit less ☐ Much less ☐

**Recreational/subsistence fishing**

12. How often do members of your household go for recreational/subsistence fishing per week? ☐ days

13. What's the total OR average catch per fishing trip in numbers? ☐

14. Do you target any particular species?.....

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## Appendix 5: List of species normally caught in the fishery and their importance

Scientific name	English name	Dhivehi name	Importance
<b>Snapper (Lutjanidae)</b>			
<i>Aprion virescens</i>	Green jobfish	Giulhu	A
<i>Aphareus rutilans</i>	Rusty jobfish	Rankarumas	B
<i>Aphareus furca</i>	Small toothed jobfish	Keyolhu rovvi	B
<i>Lutjanus gibbus</i>	Humpback red snapper	Ginimas	A
<i>Lutjanus bohar</i>	Red snapper	Raiymas	A
<i>Lutjanus monostigma</i>	One spot snapper	Filolhu (Dhon)	B
<i>Lutjanus fulvus</i>	Blacktail snapper	Dhon mas	D
<i>Lutjanus kasmira</i>	Blue striped snapper	Dhon reendhoo mas	D
<i>Lutjanus madras</i>	Madras snapper	Madharaasee mas	D
<i>Macolor macularis</i>	Midnight snapper	Kalhu fonyamas	B
<b>Jack (Carangidae)</b>			
<i>Carangoides caeruleopinnatus</i>	Coastal trevally	Vabboa handhi	B
<i>Carangoides ferdau</i>	Blue trevally	Dhabaru handhi	B
<i>Carangoides fulvoguttatus</i>	Yellow-spotted trevally	Dhon thiki handhi	A
<i>Carangoides gymnotethus</i>	Bludger trevally	Mushimas handhi	B
<i>Caranx ignobilis</i>	Giant trevally	Muda handhi	A
<i>Caranx lugubris</i>	Black trevally	Kalha handhi	B
<i>Caranx melampygus</i>	Blue fin trevally	Fani handhi	A
<i>Carangoides orthogrammus</i>	Island trevally	Thumba handhi	B
<i>Carangoides plagiotaenia</i>	Barcheek trevally	Thimara handhi	B
<i>Caranx sexfasciatus</i>	Big eye trevally	Haluvimas	A
<i>Elagatis bipinnulata</i>	Rainbow runner	Maaniyamas	A
<i>Scomberoides lysan</i>	Doublespotted queenfish	Kashi Vaali	B
<i>Seriola rivoliana</i>	Almaco jack	Andhun handhi	B
<i>Trachinotus bailloni</i>	Small spotted dart	Goru vaali	B
Unidentified jack		Theyo handhi	B
Unidentified jack		Thora handhi	B
<b>Emperors (Lethrinidae)</b>			
<i>Gymnocranius griseus</i>	Grey large eye bream	Kandu uniya	C
<i>Lethrinus conchylia</i>	Red axil emperor	Thun raiy filolhu	B
<i>Lethrinus erythrocanthus</i>	Orange fin emperor	Bolike	B
<i>Lethrinus microdon</i>	Small tooth emperor	Thun dhigu filolhu	B
<i>Lethrinus nebulosus</i>	Spangled emperor	Filolhu	B
<i>Lethrinus olivaceus</i>	Longnose emperor	Filolhu (kashithun)	A
<i>Lethrinus rubrioperculatus</i>	Spotcheek emperor	Kalhihi	B
<i>Lethrinus xanthurus</i>	Yellowlip emperor	Reendhoo thun filolhu	B

	Maldivian emperor	Laaboa Kalhihi	C
<b>Grouper (Serranidae)</b>			
<i>Aethaloperca rogaa</i>	Redmouth grouper	Ginimas faana	A
<i>Cephalopholis argus</i>	Peacock hind	Mas faana	A
<i>Cephalopholis aurantia</i>	Golden hind	Ran faana	B
<i>Cephalopholis miniata</i>	Coral hind	Koveli faana	A
<i>Cephalopholis sexmaculata</i>	Sixblotch hind	Landaa faana	A
<i>Cephalopholis sonnerati</i>	Sonnerati	Veli faana	A
<i>Cephalopholis spiloparaea</i>	Strawberry hind	Naaringu faana	B
<i>Epinephelus areolatus</i>	Areolate grouper	Thijjehi faana	A
<i>Epinephelus flavocaeruleus</i>	Blue and Yellow grouper	Dhon Noo faana	A
<i>Epinephelus fuscoguttatus</i>	Marble grouper	Kas faana	A
<i>Epinephelus macrospilos</i>	Snubnose grouper	Fijjehi faana	A
<i>Epinephelus miliaris</i>	Honeyfin grouper	Kurehi faana	B
<i>Epinephelus multinotatus</i>	White blotched grouper	Baafothi faana	B
<i>Epinephelus polyphekadion</i>	Camouflage grouper	Kula faana	A
<i>Plectropomus areolatus</i>	Squaretail grouper	Olhu faana	A
<i>Plectropomus pessuliferus</i>	Roving coral grouper	Dhon olhu faana	A
<i>Plectropomus laevis</i>	Black-saddled coral grouper	Kula olhu faana	A
<i>Variola albimarginata</i>	White edged lyretail	Kandu Raiy haa	A
<i>Variola louti</i>	Moontail seabass	Kanduhaa	A
<b>Tuna (Scombridae and Xiphiidae)</b>			
<i>Euthynnus affinis</i>	Kawakawa	Latti	C
<i>Gymnosarda unicolor</i>	Dogtooth tuna	Voshimas	C
<i>Tylosurus crocodilus</i>	Crocodile needlefish	Tholhi	C
<i>Platybelone argulus</i>	Schooling needlefish	Tholhi	C
<b>Barracuda (Sphyraenidae)</b>			
<i>Sphyreana forsteri</i>	Bigeye barracuda	Faru tholhi	A
<i>Sphyreana barracuda</i>	Great barracuda	Maa tholhi	B
<b>Others</b>			
<i>Coryphaena hippurus</i>	Dolphinfish	Fiyala	B
<i>Sargocentron spiniferum</i>	Sabre squirrelfish	Raiverimas	D
Family: Mullidae	Goatfish	Kalhuoh	D
Family: Balistidae	Triggerfish	Rondu	D

Key:

A – Very important (in top 10 of the most commonly caught/reported species list)

B – Important

C – Quite important

D – Not so important



*Note: while groupers are not major player in the reef fishery, they are caught in a separate targeted fishery for export, and hence are of high economic value.*

## Appendix 6: Recommended minimum size limits for key reef fish species

Table 1 shows proposed size limits for key reef fish species other than groupers. These are draft guidelines and have not been implemented under any regulation. However, it is recommended that all individuals smaller than specified size guidelines are released, if alive.

Table 1. Proposed size guidelines for minimum size of harvest

Species	Proposed size guideline for min. size (cm)
<i>Aphareus rutilans</i>	50.0
<i>Aprion virescens</i>	50.0
<i>Carangoides fulvoguttatus</i>	45.0
<i>Caranx ignobilis</i>	70.0
<i>Caranx lugubris</i>	30.0
<i>Caranx melampygus</i>	45.0
<i>Caranx sexfasciatus</i>	45.0
<i>Coryphaena hippurus</i>	70.0
<i>Elagatis bipinnulata</i>	45.0
<i>Lethrinus conchylatus</i>	35.0
<i>Lethrinus erythracanthus</i>	30.0
<i>Lethrinus olivaceus</i>	40.0
<i>Lethrinus rubrioperculatus</i>	25.0
<i>Lethrinus xanthochilus</i>	35.0
<i>Lutjanus bohar</i>	45.0
<i>Lutjanus gibbus</i>	25.0
<i>Lutjanus monostigma</i>	30.0
<i>Macolor macularis</i>	30.0
<i>Macolor niger</i>	30.0
<i>Seriola rivoliana</i>	40.0
<i>Sphyraena forsteri</i>	40.0

Table 2 shows size limits which have been set for key grouper species. These size limits will be implemented under the **Grouper Fisheries and Export regulation** which is set to come into effect on **March 15th 2014. It will be illegal to harvest any individuals which are smaller than specified size limits from this date onwards.**

Table 2. Size limits for minimum size of harvest of grouper species which will be implemented under regulation from March 15<sup>th</sup> 2014.

<b>Species</b>	<b>Length (cm)</b>
<i>Aethaloperca rogae</i>	27.0
<i>Anyperodon leucogrammicus</i>	31.0
<i>Cephalopholis argus</i>	26.0
<i>Cephalopholis miniata</i>	26.0
<i>Cephalopholis leopardus</i>	20.0
<i>Cephalopholis sexmaculata</i>	20.0
<i>Cephalopholis sonnerati</i>	20.0
<i>Cephalopholis urodeta</i>	20.0
<i>Epinephelus areolatus</i>	30.0
<i>Epinephelus caeruleopunctatus</i>	32.0
<i>Epinephelus fasciatus</i>	25.0
<i>Epinephelus flavocaeruleus</i>	30.0
<i>Epinephelus fuscoguttatus</i>	<31 and between >45 to <63
<i>Epinephelus macrospilos</i>	32.0
<i>Epinephelus ongus</i>	28.0
<i>Epinephelus polyphekadion</i>	31.0
<i>Epinephelus spilotoceps</i>	28.0
<i>Plectropomus areolatus</i>	35.0
<i>Plectropomus laevis</i>	35.0
<i>Plectropomus pessuliferus</i>	35.0
<i>Variola albimarginata</i>	25.0
<i>Variola louti</i>	31.0

## **Appendix 7: Best practice guidelines for reef fishing and recreational fishery**

1. Know your fish species; including those which are protected and must not be caught and those which have a size limit:

The following groups and species of marine life are protected by law in the Maldives:

- Whales and dolphins
- All shark species
- Turtles
- Lobsters smaller than 25 cm or berried lobsters
- Giant clams
- Black coral
- Napoleon wrasse
- Whale sharks
- Triton shell

It is prohibited to catch/extract/kill any individuals of these groups or species from within the Maldivian waters. List/Posters of protected marine life of the Maldives can be obtained from the Marine Research Centre of Ministry of Fisheries and Agriculture

2. Know the legal size limits for those species which have statutory size limits. Currently there are limits for certain species of grouper and for all lobsters. ALL small sized individuals covered by the regulations MUST be released:

A grouper fishery management plan was launched in December 2012 and lists size limits for certain species of groupers. The regulation for implementation of these size limits will be implemented from March 15<sup>th</sup>, 2014. Awareness posters showing species and size limits can be obtained from the Marine Research Centre and it is recommended that all fishers/purchasers use these size limits as guidelines for smallest sizes of groupers which should be caught.

Lobsters smaller than 25cm must not be taken.

3. Know the size guidelines for other species; release ALL small sized individuals

This report includes size guidelines for key reef fish species. While not implemented under regulation, it is recommended that all individuals smaller than specified size guidelines are released, if alive. This would promote sustainability by allowing for population regeneration and growth.

4. Never fish from a protected area:

These areas have been protected to ensure conservation of biodiversity and promote sustainable use of resources. It is also recommended that fishers refrain from fishing from known fish aggregations and from areas which have been listed as sensitive areas of the website of the Environmental Protection Agency (see link below).

5. Only use legally permitted fishing equipment:

The following fishing gears and methods have been banned for use in the Maldives:

- Use of dynamite or explosives
- Use of spear guns
- Use of chemicals to collect/catch fish
- Use of scuba gear to collect sea cucumber
- Use of nets to catch whole schools of scads
- Beach seining (Rodhulun)

A list of banned fishing gears can also be obtained from the Marine Research Centre

6. Practice and encourage others to catch and release, so ensuring the ongoing survival and supply of fish into the future. Various methods exist to allow better survival of released fish:

- Fishing techniques and bait which allow for proper hooking locations. Fish hooked in critical locations such as gills, stomach, oesophagus have higher mortality (Bartholomew and Bohnsack, 2005)
- Use of Circle hooks instead of J hooks: Circle hooks reduce deep hooking in comparison to J hooks (Bartholomew and Bohnsack, 2005)
- Use of barbless hooks
- Use of artificial lure vs. natural bait; fish tend to ingest natural bait whereas artificial lure is rejected
- If a fish is deeply hooked, cut the line as close as possible to the hook instead of trying to remove the hooks. Studies have shown that fish tend to get rid of the hook on their own (Bartholomew and Bohnsack, 2005)
- Restricting capture depth: capturing and hauling in fish from deeper waters can result in internal injuries due to swim bladder expansion and protrusion. Releasing the trapped gases with a hypodermic needle can increase survival of such fish (Bartholomew and Bohnsack, 2005)
- Decreased handling time of fish, while out of water
- Always handle fish with wet hands; never with a cloth or other material which could rub off the mucus layer on the fish
- If a fish has to be lifted out of the water for any reason, support its weight horizontally; NEVER lift the fish by its jaw as this could result in injury to the area and affect the its feeding capability
- Revive fish which are exhausted by passing water over its gills (moving the fish forward in the water with its mouth open)
- Gently release a fish head first into the water
- Never gaff a fish which is below the size limits or which cannot be harvested; or a fish which you will release afterwards
- Use a dehooker: these come in a variety of shapes and sizes

The above are some of the measures fishers can use to minimise mortality of released fish. There is diverse literature available online for anyone interested in implementing such measures. Some references have been included in our reference list in the report such as the publications by Florida Sea Grant and other websites. Please refer to list for details.

7. Only catch sufficient fish for your immediate needs:  
While recreational fishing trips, especially during full moon periods are a great source of entertainment, catching large number of individuals from specific points, means that we are targeting aggregations of these species. From a sustainability viewpoint, this is not an advisable practice and it is recommended that only limited numbers of fish are caught from such areas. Any small sized individuals caught should be released. It is also recommended that those not released (or are in too poor a condition to survive after being released, even if small sized) should be used for consumption and not discarded.
8. Avoid practising new destructive methods of fishing such as the relatively new method of jigging using stones and pieces of corals. This method (described as “gaa kooththuvun”) had been reported by fishermen during consultations and would have negative impacts on the seabed over time and ultimately could affect fish populations.
9. Avoid wastage of live bait: Take only as much as you need
10. Report catch regularly to MRC through forms which will be available from MRC
11. Report incidents of destructive fishing practices/methods which are banned, to the Fisheries Management Agency or Island/Atoll Councils