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M. Shiham Adam and
A. Riyaz Jauharee

MARINE RESEARCH CENTRE
Ministry of Fisheries and Agriculture
Malé 20025, Republic of Maldives

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M. Shiham Adam¹, A. Riyaz Jauharee

*Marine Research Centre, Malé, 20025, Republic of Maldives
PO Box 2074, Malé, Republic of Maldives*

Summary

Yellowfin tuna is the second most important species caught in the Maldivian tuna fishery. Total catches are currently around 23,000 t annually representing roughly 15% of the reported national tuna catch. Although substantial amount of this catch continues to be of juveniles from pole-and-line fishery (< 60 cm FL) a significant amount of large yellowfin tuna (>100 cm FL) are caught from handline and longline fisheries. The handline catch is exclusively for export and fetched 30 million US\$ in 2008, representing more than 28% total marine exports from the Maldives.

In the past there was no targeted fishery for large yellowfin because there was no local demand. The restructuring of the fishery sector and access to overseas fresh fish markets of Far East and Europe made it possible to developing the handline fishery.

Information about the fishery has been lacking. The Marine Research Centre employed a field-officer to collect detailed information about the fishery and undertake size sampling. The work has been going on since September 2007. Additional data for this report was obtained from the Ministry of Fisheries and Agriculture.

The handline fishery is regulated whereby the vessels require a fishing license renewable on annual basis. Fishing is conducted from pole-and-line vessels. Locally fabricated FRP ice boxes and ice are supplied by the exporters on condition of sale of catch.

A variety of livebait are used to catch large yellowfin and most popular has been the trigger fish, *Odonus niger*, recently. Fishing trips last 3-15 days (average 8 days) on which more than 2 t are of large yellowfin are caught. The catch is gutted and gilled and stored on ice-boxes. More than 95% of the catch is sold to the exporters. Rejects are sold at the Malé Fish Market. Based on average catch per trip and the number of trips vessels make in a given month it is estimated the present catch of large yellowfin would be about 10,500 t per year. This is about 60% more than the reported catch by the fishermen. Data shows that catches have stagnated or are declining. This is also supported by declining catch rates.

¹ Email contact: msadam@mrc.gov.mv

1. Introduction

Yellowfin tuna (*Thunnus albacares*) is the second most important species caught in Maldivian tuna fishery. Recent catches of yellowfin tuna amounts to 23,000 t representing over 15% of the reported tuna landings. Traditionally yellowfin tuna are caught from livebait pole-and-line fishery. These represent juveniles (30-60 cm FL) caught along with skipjack in mixed surface schools (Adam and Anderson 1996).

A large proportion of yellowfin tuna catch continues to be caught from pole-and-line fishery a significant amount is now also caught from the handline and longline fishery. These are the large yellowfin tuna which has formed an important component for the fishery exports. In the recent years about 6,500 t are exported earning close to US\$ 25 million which is nearly 30% of all marine export revenue in the Maldives.

In the past there was no targeted handline fishery for large yellowfin tuna and longlining has always been a foreign activity undertaken beyond 75 miles offshore. Although Maldivian fishermen have known presence of large yellowfin tuna in coastal waters, they have never bothered to exploit them or developing a fishery. Skipjack tuna have always been caught in large quantities and constituted the primary food fish and the bulk of exports products. There was no demand for large yellowfin in the past and so there was no need developing a fishery.

Yellowfin tuna became a highly commercially important species following the Government's restructuring of fisheries sector in late 1990s. Export restrictions of fresh tuna were removed and private parties quickly established export markets facilitating the development of the large yellowfin handline fishery.

Developments of large yellowfin tuna fishery have been mentioned in earlier reports². However, a complete description of the fishery has not been provided. As part of the regional tuna sampling programme the Marine Research Centre employed a fishermen-field officer in North Ari Atoll who was assigned the task of recording information about the fishing trip and sampling of the catch. The main data analysis in this paper is of the 86 fishing trips which were recorded from September 2007 through September 2009.

2. Data

The Ministry of Fisheries and Agriculture (MoFA) has been collecting fishery statistics since late 1960s and has a long time series of tuna catch and effort data from 1970 (Anderson, 1986). Traditionally and still in practice, data are collected through fishermen voluntarily reporting catch and effort data to the island offices. Enumerated catch by species is reported to the Ministry of Fisheries and Agriculture as monthly summaries where conversion factors have been used to report the weights (Anderson and Hafiz, 1996). Because Maldivian tuna fishermen essentially undertake daily fishing trips effort is recorded as number of fishing days. Although there appears to be serious under-reporting and misreporting³ this method of collection are compilation continues to be practiced.

² Papers presented at the 2008 WPTT and 2007 WPTT.

³ Hussein Sinan, Ministry of Fisheries and Agriculture, pers. Comm., 2009

The progress of fishery development has meant that fishery activity diversified other means of data collection were also introduced. The fresh fish collection data is maintained by the state-owned MIFCO and all major fresh fish collectors across the country. Similarly data collection forms have been introduced in large yellowfin tuna fishery (Anderson et al 2003). Reporting of the data is mandatory. Unfortunately due to lack of oversight and follow-up nearly all fishery reporting are unsatisfactory. To make the matters worse, MoFA does not effectively use fresh fish collection data to check for validity of the catches reported by fishermen. Thus national catch statistics are based on fishermen reported catches only.

The handline large yellowfin tuna fishing vessels requires separate license from MoFA. They also require 'health certificate' because packing of gill-and-gutted fish for export used to takes place on these vessels. This requirement maintained and now reinforced with the coming up of IUU regulation. A major requirement of the fishery license is report the catch and effort data to MoFA.

An important source fisheries statistics is the export data collected by Malé Customs. These are particularly valuable because there is only one point through which all imports and exports pass (Malé) so it is relatively easy to ensure good data collection. Export data collated and maintained by MoFA. The breakdowns of various categories of export data are published by the Ministry's Basic Fisheries Statistics.

The Marine Research Centre employed a fishermen-field-officer from a large yellowfin fishing vessel operating from the island of Maabaidhoo in North Ari Atoll. The field officer has been employed since 2007 to collect data on catch and effort and other related information on the fishery. Data on 86 trips were recorded and was made available to MRC. One of us (ARJ) took part on several large yellowfin tuna fishing trips and has firsthand experience of this fishery.

3. Description of the Fishery

Handline fishing is traditional and relatively a common method of fishing in the Maldives. Except on a single island in the south, Gn. Fuva Mulaku, the method is not generally used for catching large yellowfin tuna (Anderson et al. 1993). But that was until about 1998 when the method was widely introduced for developing an export-oriented large yellowfin fishery.

Large yellowfin handline fishing is done on regular pole-and-line vessels without any modification except the use of handline gear. However, these vessels carry locally fabricated FRP ice-boxes with capacities of 5 or 10 t. These boxes are placed at the rear of the vessel on the fishing platform (Figure 1). It is not uncommon for large vessels to carry 6 of these boxes with total storage capacity of 60 t. Many boats have made informal arrangements with the yellowfin exporters on supply of ice. Often ice is provided free of charge on condition that catches is sold to the exporter.



Figure 1: Pole-and-line vessels converted to handline vessel, Malé Harbour – October 2009.

Fishing is carried out using livebait caught from atoll lagoons and around the coral reefs. Large yellowfin schools are sighted by presence dolphins and livebait is thrown to attract and maintain the school within reach of the boat. More than 90% of the schools are reported to be sighted by dolphins. The extent of this association of dolphins and large yellowfin tuna has been given in Anderson and Shaan (1998). Although there is a ban on any form of fishing other than pole-and-line around the FADs large yellowfin tuna fishermen also fish around FADs.

Handline line fishing is done using J-hooks or Japanese tuna hook. Livebait is hooked through their abdomen and the line is paid out while the vessel steams slowly forward. Livebait are thrown regularly to keep the tuna schools close to boat.

At any given time maximum of 5-8 lines are used. Hooked fish are pulled in with care and may take between 20 – 50 mins, rarely lasting an hour, to bring to the boat. Once brought close boat they are gaffed and taken on board. The fish is immediately killed, gilled and gutted and preserved in the ice box.

If fishing and the weather is good fishermen spend the night on the sea with engine turned off and letting the boat drift. Fishing trips last on 8 days (min = 2; max = 19 days) during which livebait fishing takes place more than once. Four to five bait fishing events not uncommon on a single fishing trip. The fishing trips would start either from home-port or from Malé and return to sell their catch to location of the packing facilities around Malé area.

Alternative fishing method used in the north is pole-and-line assisted with pulleys. A line going through a pulley rigged on the mast is attached to the end of the fishing pole. When the yellowfin hooked the angler is helped by another person at the pulley. Although man-power requirement is high it is considered to be more effective method of pulling in large yellowfin.



Figure 2: A fishing boat in Haa Alifu Atoll (North) with pulley system for large yellowfin tuna fishing (September 2004)

4. Livebait

Fishermen commonly use four varieties of bait; fusiliers (*Caesio sp*), bigeye (*Selar crumenophthalmus*) and round scad (*Decapterus macarellus*) and trigger fishes (*Odonus niger*) (Figure 3). Scads are often caught from pole-and-line and other varieties using lift nets. Fishermen often use scrapped fish as bait to lure them over the net. Scads, bigeye scads in particular, are caught at night with lights for attracting them. In this case lifts are also used.



Figure 3: Livebait used for large yellowfin handline fishery. Top clockwise: Fusiliers (Fam: Caesionidae), round scad (*Decapterus macarellus*), trigger fishes (*Odnous niger*) and bigeye scad (*Selar crumenophthalmus*).

Use of the trigger fish as a livebait is a recent introduction. Starting from around mid 2007 population of *O. niger* increased dramatically in Maldives. Thousands of trigger fishes (of which *O. niger* were > 90%) died and were washed on beach during this period. These mass die-offs have been associated with a bacterial infection (MRC, 2008). The die-offs lasted until early 2008. *O.niger* population, however, remained high until today (Riyaz pers Obs.) During this period fishermen started using *O. niger* as a livebait for large yellowfin and proved to be very efficient. Fishermen have since then used trigger fishes as livebait for catching large yellowfin tuna.

The behaviour of this species is considered to be good for large yellowfin fishing as they swim deeper and away from vessel helping to draw-up the yellowfin tuna school. Thus regular of chumming of trigger fishes makes the large yellowfin tuna follow the boat. Despite their qualities been ideal for the fishery many fishermen however, complain that trigger fishes make the school disperse as it is believed that thick skin and spines on the trigger fishes makes make their stomach to irritate.

The frequency of bait use (as observed by bait fishing events) on the 86 trip are shown in Figure 4. The relative importance of trigger fishes is clearly seen. But bigey scad and fusiliers are also a common livebait preferred by the large yellowfin fishermen.

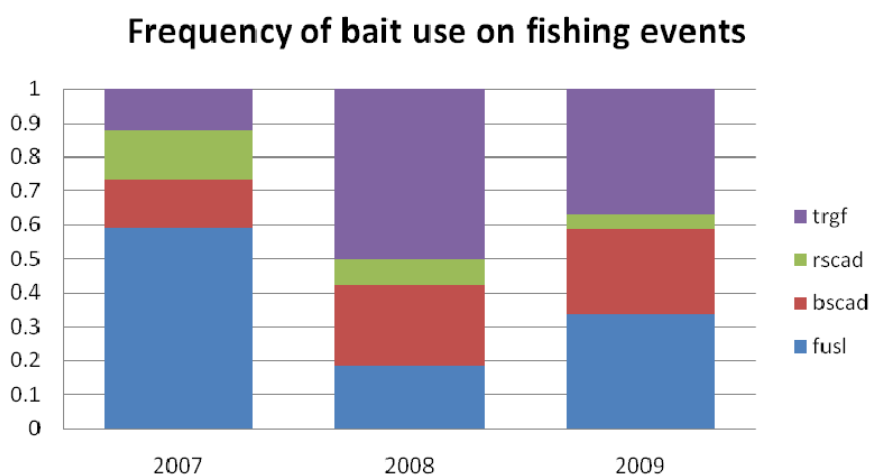


Figure 4: Relative frequency of type of livebait use in handline large yellowfin fishing for the study period.

5. Seasonality

Information on the seasonality comes from the collection data⁴ and from the total catches reported by the fishermen (Figure 5 and Figure 6). Peak season of large yellowfin in Maldives is August to November and January to March. Catches are lower during end of May to July and in December.

⁴ Large from collection data from Kanduoiy Giri (belonging to state owned MIFCO).

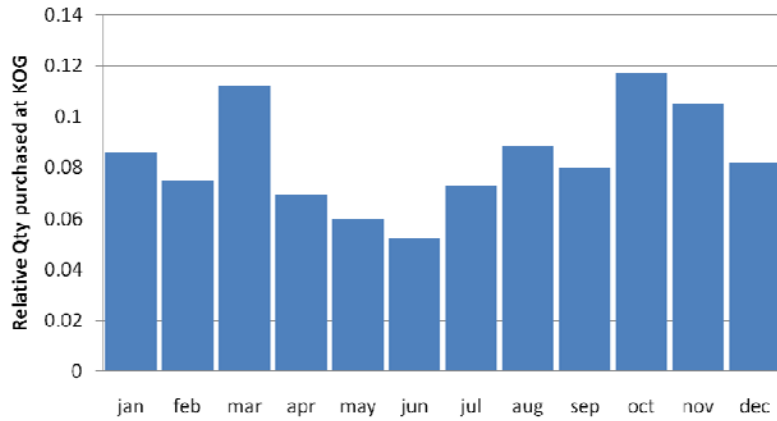


Figure 5: Monthly average collection of large yellowfin tuna at Kanduoiy Giri packing facility owned by the state-owned company MIFCO (2004-2007).

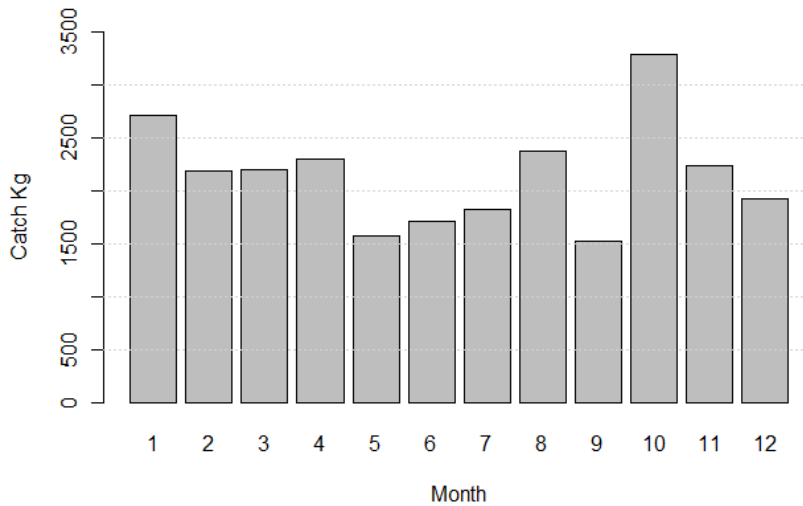


Figure 6: Monthly average of catch of large yellowfin catch (Mahibadhoo – Sept 07-Sep 09).

This pattern of seasonality is seen in the catch data reported by the field officer. On average they fishermen catch 2 t per tip and highest catches were recorded in October and during earlier parts of the year (Figure 6).

Adam and Anderson (1996) notes there components of the large yellowfin fishery;

1. Haa Alifu in January to April,
2. Central areas (Malé areas) during March to September
3. Fuvah Mulaku Island during April and November.

Except Malé area fishery the observation are consistent with patterns observed in the present-day large yellowfin tuna fishery. Figure 7 shows relative size of catch, its location and season. High catches appear to occur on the western side of the Maldives. In the past large catches of juvenile yellowing tuna are taken off Raa and

Baa Atoll during June-September (Adam and Anderson 2006). More data is required to confirm these observations.

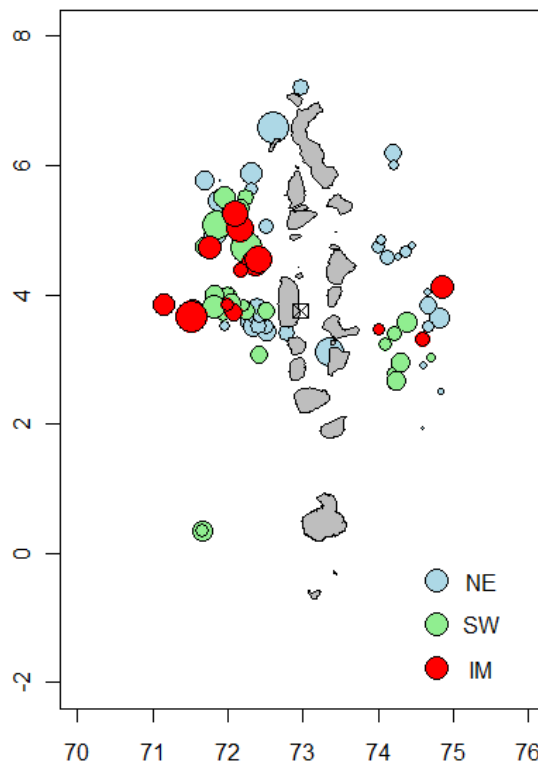


Figure 7: Fishing locations and relative catch by season for single vessels operating from Alifu Mahibadhoo September 2007- September 2009.

6. Size Composition

Over 3,800 fish were measured by the field officer during the September 2007 to September 2009. The size distribution of the sample is given in Figure 8. In general the large yellowfin caught in handline fishery is over 100 cm FL which is about 3.5 years old. The mean size of the yellowfin tuna in the fishery is about 145 cm FL. This size range is clearly distinct from the sizes caught in pole-and-line fishery (Figure 8)

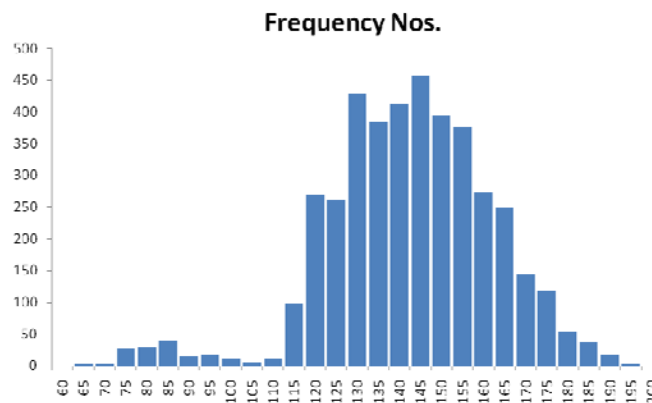


Figure 8: Size distribution of large yellowfin tuna caught on handline fishery, Mahibadhoo field officer data, September 2007 – September 2009.

The data reported data by field officer also allowed calculating the average weights of fish (Figure 9). Largest sized fish are caught from January to May while the sizes in the fishery are smaller during June to September. More information on seasonal patterns of movement and distribution is required to better understand the size distribution around the Maldives.

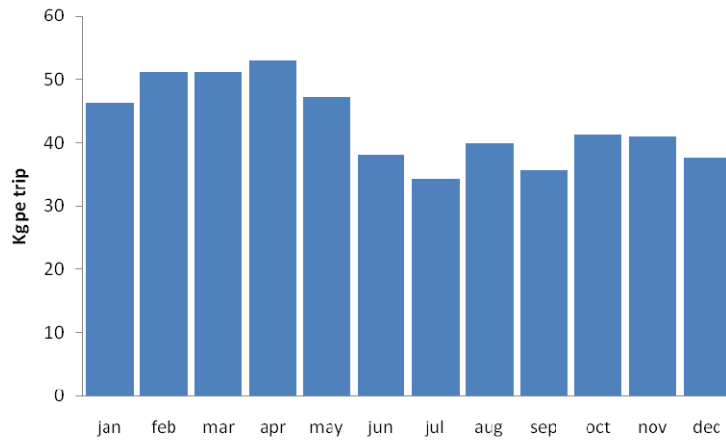


Figure 9: Monthly average weight of fish as reported by the field officer (Sept 07 - Sep 09).

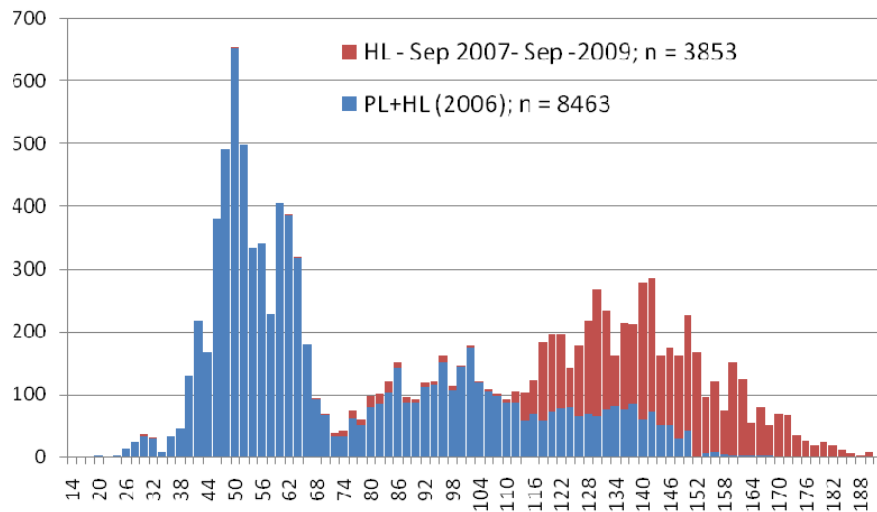


Figure 10: Size distribution of the large yellowfin along with the pole-and-line caught yellowfin tuna.

7. Catch and catch-per-unit of effort

It is difficult to estimate the catch of large yellowfin in the handline fishery. MoFA compiled total catch by gear type is given in Table 1 and Figure 11. Fishermen reported catch of 4,500 t per year does not match with the export data. For instance, reported handline catch in 2008 was 4,123 t whereas the (processed weight of) exports were 6,600 t.

An estimate large yellowfin tuna catch in the Maldives may be made from ancillary information. MoFA keeps records of fishery licenses issued for large yellowfin tuna vessels. The data is available from 2005 – September 2009. Total number of licenses issued from 2004 – 2009 is given in Table 2. Prior to January 2009 license were to be renewed on a quarterly basis and so the recorded number of licenses were cumulative number for the year and not necessary represent the number of ‘active’ vessels in the year . The licensing regulation was reviewed in January 2009 with requirement to renew the licenses on an annual basis. Up to September 2009 there were 117 vessels registered. Given the improvements updating the database this figure is considered to be a reliable estimate of the number of large yellowfin tuna vessels in the Maldives.

Table 1: Catches of yellowfin tuna by gear and quantity of fresh yellowfin tuna exports. Source: MoFA

Year	PL	HL	LL	Total	Fresh “YFT” exports (t)
1998	14,169	..	2,944	17,163	2,344
1999	14,268	..	811	15,079	584
2000	12,184	..	3,521	15,705	4,013
2001	13,897	682	2,213	16,792	1,254
2002	19,029	2,700	3,139	24,868	3,100
2003	17,822	2,114	3,165	23,101	4,709
2004	18,068	4,516	2,564	25,130	6,688
2005	18,368	3,192	3,011	24,571	7,484
2006	15,462	4,305	3,177	22,944	8,048
2007	15,739	5,619	3,048	24,406	7,666
2008	18,508	4,132	1,081	23,711	6,629

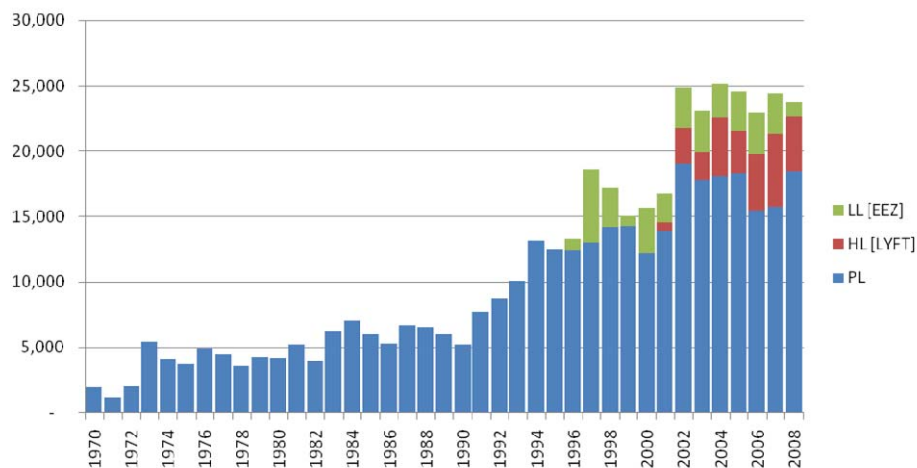


Figure 11: Time series of catches of yellowfin tuna by gear (1970-2008). Source: MoFA.

The field officer data gives an average of 3.5 trips month and with average of 2,165 kg per trip. With these the estimated handline large yellowfin tuna catch in the Maldives would be 10,630 t. This estimate appears to be reasonable. It is know that roughly 75% of the exports are loins/fillets and the remaining fraction is essentially

head-and-gutted (HNG) whole fish⁵. It is also known that a yield of roughly 50% is obtained for fillets/loins and 85% for head-and-gutted products. Assuming those proportions 10,630 t would represent about 6,300 t which is roughly the same value reported in export data.

Table 2: Number of licenses issued for handline large yellowfin tuna fishery. Source: MoFA

Year	Licenses issued
2004	--
2005	57
2006	138
2007	209
2008	269
2009*	117

Estimation of catch per unit effort is difficult as fishing effort is not adequately reported. In most cases numbers of fishing trips are reported. For the pole-and-line fishery this is one day and so the 'number of days of fishing' has been conventionally used as the unit of fishing effort. The problems in using number of days fishing is complicated due bait fishing activity and the search time. At present however, this is the only effort data available data.

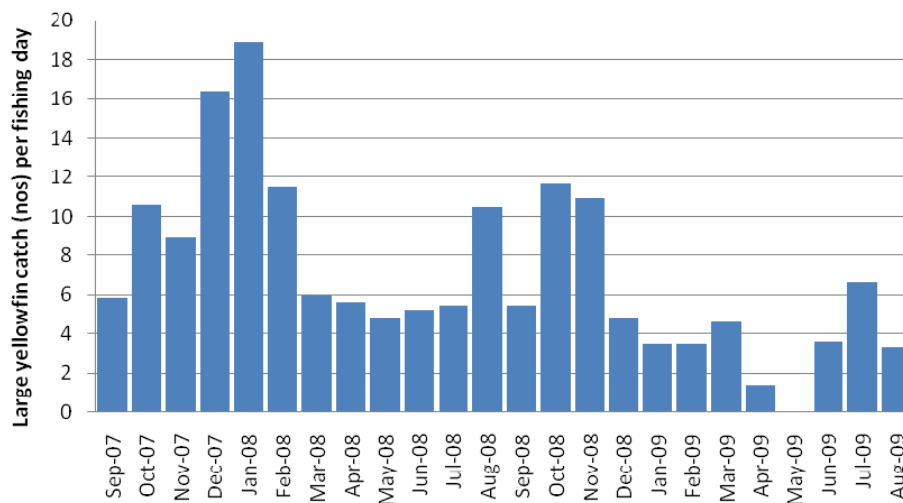


Figure 12: CPUE as indicated by numbers of large yellowfin tuna catch per day per month, Mahibadhoo field officer data, Sept 2007 – September 2009.

In the handline fishery the fishing trips last between 2-19 days and number days spend on the sea is related to catch. For this exercise the catch per fishing trip is used. The effects on variation due to differences in bait catching and searching may even out for large number of vessels. However, the data set is for a single vessel and for very short duration. The plot of average monthly catch per fishing day from September 2007 to August 2009 is given in Figure 12. A linear fit shows the slope is significantly different from 0 with a downward slope. This suggests that catch rates of large

⁵ Personal Communication: Mr. Waseem of Ensis Maldives and Mr. Husein Nizar of Aqualife Investment Maldives.

yellowfin tuna in the handline fishery is decreasing. Certainly the exporters have raised their concern on the decrease in supply of large yellowfin tuna and the effects it is having on their business.

8. Export Data

Malé Customs maintains detail records all exports. For marine products detailed data is regularly supplied to MoFA. Customs export data allows distinguishing various products of fresh yellowfin. It is likely that a small proportion of fresh yellowfin tuna exports include yellowfin tuna caught in the longline fisheries. But it is believed that this would be a small fraction as large proportion of longline catch is bigeye tuna.

Exports peaked in 2006 and have been declining although revenue has maintained at USD 30 million a year (Figure 13). These results are consistent with the catch and catch rate data showing the fishery is declining.

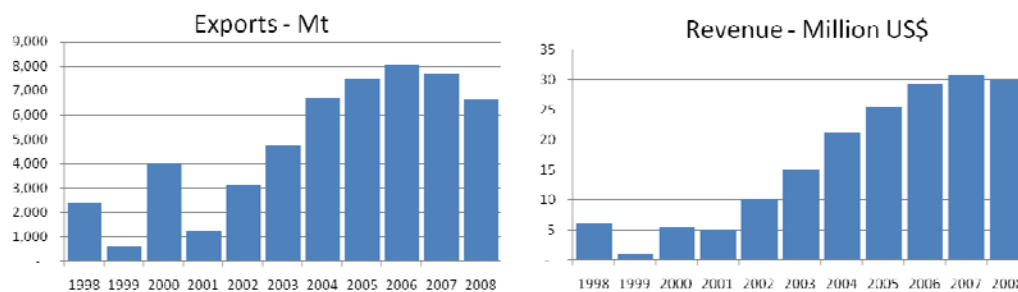


Figure 13: Export of large yellowfin from Maldives: 1998-2008. Data: Customs, compile by MoFA.

9. Acknowledgements

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