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# Length Distribution of Yellowfin Tuna from the Maldives Pole-and-line and Handline Tuna Fisheries

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## Abstract

Maldives tuna fishery used to be predominantly comprised of pole-and-line and troll gear to exploit skipjack tuna (*Katsuwonus pelamis*) and similarly sized yellowfin tuna (*Thunnus albacares*) and neritic species of frigate (*Auxis thazard*) and kawakawa (*Euthynnus affinis*). With increased private sector access to overseas markets in the Far East and Europe and the demand it created, Maldives tuna fishermen began targeting adult sized yellowfin tuna using handline gear beginning the late 1990s. Prior to this, only small seasonal handline fisheries and a foreign licensed longline fleet operating within the EEZ exploited sub-adult and adult sized fish respectively. Expansion of the more lucrative handline fishery was possible due to the ease with which a traditional pole-and-line vessel could be modified to conduct handline yellowfin tuna fishing simply by the accommodation of onboard storage of fish in ice. Recent five years' catch data showed a 47% increase in catch of yellowfin tuna by all gears and 44% increase in catch from the handline yellowfin tuna fishery. Marine Research Centre conducts an ongoing size sampling program engaging observers, fishermen and port samplers to obtain data from the tuna fisheries. Data collected demonstrate that Maldives pole-and-line and handline fisheries exploit two distinct size groups of yellowfin tuna. Approximately 80% of the pol-and-line caught yellowfin tuna are between 38 and 62 cm FL. On the other hand, as much as 80% of the handline caught yellowfin tuna fall between 102 and 162 cm FL. Market preference for fish above 18kg (corresponding to about 105 cm FL) further encourages fishermen to target larger individuals. The separate size classes exploited by the PL and HL fisheries assist in traceability of catch from both the fisheries. With the expansion of the handline yellowfin tuna fishery, the large sized yellowfin tuna resource has become an important component of the country's tuna fishery.

## 1. Introduction

Maldives has been a tuna fishing nation since time immemorial. In the early days, the fishery exploited nearshore schools of skipjack tuna (*Katsuwonus pelamis*) which were often times mixed with yellowfin tuna (*Thunnus albacares*). Neritic species of frigate (*Auxis thazard*) and kawakawa (*Euthynnus affinis*) also formed part of the pole-and-line (PL) catches.

The predominant use of PL to exploit the tuna resources, resulted in yellowfin tuna caught being mostly of similar size (30 – 60 cm FL, Adam and Anderson, 1995). Larger fish were not exploited at high levels

due to an absence of a great demand as markets for these fish were not developed at the time. Despite this, subadults of more than 70 cm FL were caught by the seasonal handline and trolling fisheries that existed in the early 1990s (Adam and Anderson, 1995) and particularly in Fuvah Mulaku island in the south (Anderson and Waheed 1993). Adult sized fish were caught in the foreign-licensed longline fleet that operated within the Maldivian EEZ from late 1980s until 2010. Policy changes on licensing foreign vessels to fish within Maldivian waters led to suspension of foreign licensing and introduction of a local longline fleet beginning late 2011 (Adam et al., 2015). The fishery targets bigeye and yellowfin tuna that are exported to overseas markets. In short, yellowfin tuna was historically under-exploited in the Maldives tuna fisheries.

This situation changed when during late 1990s', a commercial handline (HL) fishery targeting large sized yellowfin tuna was introduced. This was a result of the demand created by increased private sector access to overseas markets, notably in the Far East and Europe. The simple gear (handline) and the ease with which the fishery could be conducted off a regular PL vessel by accommodation of onboard storage of fish in ice allowed expansion of the fishery over the years. Vessels built more recently are designed with insulated fish holds that can store the catch in ice, eliminating the use of fibre reinforced plastic storage boxes, which has been typical of HL vessels.

With the development of the HL yellowfin tuna fishery, the previously under-exploited adult yellowfin tuna resource became an important resource for fishermen's income and foreign exchange. This is evident from the increase in HL catch by 45% from 24,500 t in 2011 to almost 35,600 t in 2015. The same period showed the total catch of yellowfin tuna rise from 35,500 t to 52,500 t from all gears.

Along with increasing catch, contribution from the two primary gears has also conversed over time. Of the four gears that primarily land YFT, PL contributed on average 63% of the catch in the period 2004-2008, which dropped to 32% in the last five years (2011-2015). On the other hand, HL contribution increased from an average of 17% to 66% in the same time frames. Catches of yellowfin tuna by the trolling and longline fleet were insignificant, with a combined average catch of less than 2% being landed in the past 5 years.

## 2. Data and methods

Data used in this paper spans a time frame of ten years (2007 – 2016) which is a subset of the size data set available at MRC. The dataset comprise of yellowfin tuna caught using pole-and-line and handline gears and covers the whole country. Data were collected by various samplers which included MRC staff, fishermen and non-fishermen samplers and fisheries observers. Sampling was based at the three pole-and-line tuna landing ports, handline yellowfin tuna landing and processing facilities, fishing vessels and Male' fish market. In addition, fisheries observers and fishermen samplers gathered measured the daily catch on the vessels.

Fork length (FL) measurements from more than 94,300 PL caught yellowfin tunas and 20,000 handline caught fish are used. Data from each individual sampler was visually inspected to remove suspect data.

## 3. Tuna length data collection in the Maldives

The tuna length sampling program at Marine Research Centre (MRC) routinely collects size data since the 1980s. Sampling effort in the initial years focused on the PL catch due to the need for average weights required to convert catch reported in numbers to weights. The sampling program incorporated handline caught tunas in 2003 by contracting two fishermen as samplers. Their duty was to regularly obtain a representative sample of their own catch and submit the data to MRC. A description of the sampling program, up to 2011, is presented in Ahusan et al., 2011. Maldives tuna length sampling efforts have been funded by various overseas funding agencies in addition to the Government of Maldives (Table **1**).

Table 1. Tuna size sampling programs and their funding agencies.

| **Sampling Program** | **Funding Organization** | **Project duration** |
|---|---|---|
| Regional Tuna Length Frequency Sampling Program | World Bank / IDA | 1994-1996 |
| Maldives Length Frequency Sampling Program | Offshore Fisheries Cooperation / Japan | June 2003 – March 2005 |
| Maldives Pole-and-Line Tuna Port Sampling Project - 2014 | Worldwide Fund for Nature - Pakistan | 2014 – 2015 |
| Observer trips and site visits by fisheries observer | International Pole and Line Foundation | 2015 – current |

In the initial years, data collection was done by MRS staff at the Male' fish market on a regular basis. Male' fish market was a cost-effective and an ideal location for data collection as it was a central landing site for vessels in the central region. In 1987, the program expanded when samplers were hired in key fishing islands, tasked with sampling the catch landed at their respective islands. However, this was proven unsuccessful over time due to decreased landing at the islands and conflicts between the samplers and the Island Offices where the samplers were stationed.

From 1994 – 1996, the World Bank / International Development Association funded a Regional Tuna Length Frequency Sampling program in which active fishermen were hired to sample their catch daily. This was quite effective at the time as fishermen had ready access to their catch, which was now being landed to canneries and collection vessels. Subsequent to the project, Maldives government funded the sampling efforts for a number of years which eventually tapered due to lack of oversight.

MRC then received funding from the Overseas Fishery Cooperation Foundation (OFCF - Japan) to implement the Maldives Length Frequency Sampling Program (2003 – 2005). Following from the World Bank Project, active fishermen were contracted to sample their catch from the vessels they go fishing. Following the end of the project, samplers were maintained, supported by the local budget. However, due to lack of oversight and supervision, sampling intensity was sub-optimal.

After about 10 years, MRC implemented the Maldives Pole-and-Line tuna Port Sampling Project – 2014 with financial assistance from the World Wide Fund for Nature – Pakistan (WWF-Pakistan). Unlike in the previous project, non-fishermen samplers were based at three pole-and-line catch landing ports in the country. It was considered that sampling at the landing ports would have a better spatial coverage than fishermen providing data from their vessels.

At present, Government funded data collection continues at the 3 pole-and-line catch landing sites. In addition, 2 fishermen samplers collect data from their catch, while another samples catch landed at the Male' fish market. Furthermore, a fisheries observer contracted by the International Pole and Line Foundation (IPNLF) collects size data as part of the observation trips and also visits the handline catch processing facilities to supplement the data collection work. MRC further collaborates with HL YFT tuna exporters to implement data collection by their staff.

## 4. Results and discussions

Prominent use of pole-and-line to exploit tunas in the Maldives resulted in exploitation of surface swimming yellowfin tuna similar in size to skipjack. Prior to the introduction of the commercial HL YFT fishery in the late 1990s, only a small amount of adult sized fish (<70cm FL) was caught in the seasonal handline and the longline fishery.

Length data collected by MRC indicate a distinct difference in the sizes of yellowfin tuna caught in the PL and HL fishery (Figure 1). Catch from PL fishery comprise of smaller fish, with fish in the range 38 – 62 cm FL constituting 80% of the catch. The data indicates the presence of a clear and distinct mode between 42 and 48 cm. On the other hand, 80% of the catch from the handline fishery which targets large surface swimming adult fish comprise between 102 and 162 cm FL. Unlike those caught in the PL fishery, lengths of HL caught fish are more widely distributed and are devoid of clear modes. The results further suggest the two fisheries target totally different size classes. This clear distinction would also help in traceability of fish from two different fisheries.

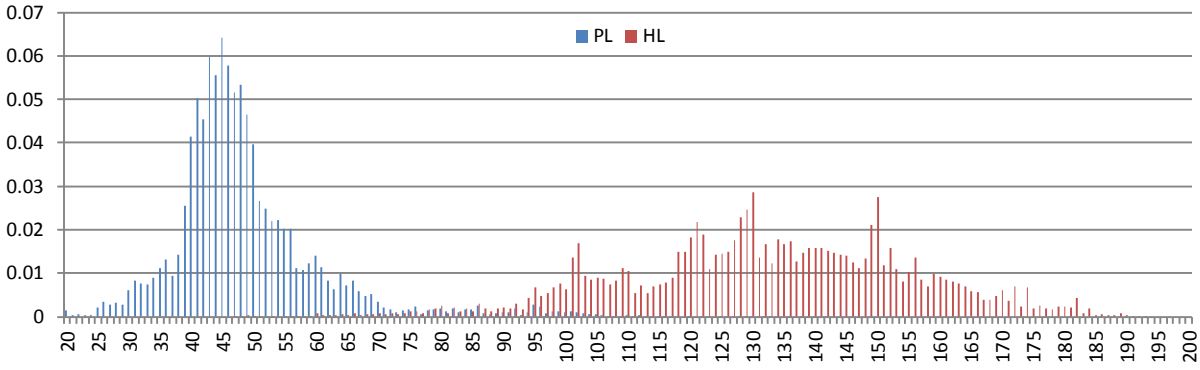


Figure 1. Length distribution of yellowfin tuna caught in the pole-and-line and handline fisheries.

A possible cause for the clear difference in size of fish caught in the two fisheries could be the inability of the PL gear to land large sized heavy fish. This shortcoming is sometimes compensated for by joining two poles wherein a team of four members are able to haul in larger fish. Another alternative is to use a line going through a pulley rigged on the mast and attached to the end of a fishing pole. The fish is then

hauled in with the assistance of the person at the pulley (Adam and Jauharee, 2009). Double poles and pulley assisted fishing is probably the reason for the presence of PL caught fish in the range 75 – 110 cm FL. Such methods to fish for large yellowfin tuna are only opportunistically used by PL fishermen and are uncommon among the dedicated HL YFT fishermen.

Closer scrutiny of the data suggest that most of the HL caught YFT by the pole-and-line fishermen who do not cater for the large yellowfin tuna export market are on average smaller, with 80% of the catch between 89 and 130 cm (compared to 102 and 162 cm FL for commercial HL fishermen). Absence of landing sites of large YFT exporters in the outer atolls and lack of a financial incentive deters PL fishermen from targeting larger individuals. The demand for fish above 18kg (about 105 cm) by the export market further encourages fishermen to target larger fish.

A more comprehensive data collection would be required to understand seasonal and regional differences in size distributions in these two different fisheries. The ongoing sampling effort would help to elucidate this.

## 5. Summary

Prior to the introduction of the commercial handline fishery during late 1990s, large yellowfin tuna were a relatively under-utilized by the tuna fishermen. The only fisheries that exploited adults and sub-adults of the species were the seasonal handline fishery and the longline fishery that existed at the time. No data is available on the length distribution of the fish caught in the two fisheries. However, literature suggests that the seasonal handline fisheries caught on average fish greater than 70 cm FL.

Length distribution of pole-and-line and handline caught yellowfin tuna showed a distinct difference in the sizes of fish caught in the fisheries. While PL caught fish were smaller than HL caught fish, there showed a difference in the size of fish caught using HL gear between commercial HL fishermen and PL fishermen who opportunistically employ HL gear. This difference is attributed to experience and non-targeting of larger fish sized fish by PL fishermen due to unavailability of market access. The separate size classes of fish exploited by both fisheries enable traceability of catch from the two fisheries.

The increasing catch and export trend of HL caught yellowfin tuna and its products since the fishery began and more significantly over the last five years, is evident of the growing importance of the fishery. Evidences show that the larger sized yellowfin tuna has become an important component of the Maldives tuna fishery.

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