Recent Developments in the Maldives Pole and Line Tuna Fishery - Fleet Trends, Catch and Effort and Spatial Patterns

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Abstract

Maldives pole and line fishery primarily targets skipjack and small yellowfin tuna, both from free-swimming and Anchored Fish Aggregating Devices (AFADs). The fishery spans hundreds of years and constituted the main fishery in the Indian Ocean prior to the arrival of the distant water purse seiners and still remains a key fishery in terms of catch volume. Recent years have seen notable developments in the fishery in terms of fleet size, catch and effort and its spatial distribution. The *mechanized masdhoni* (mechanized fishing vessel) fleet, comprising of pole and line and handline vessels, have grown in number from almost 400 in 2010 to 769 in 2021, with the 22.5 – 27.5 m length category observing the most prominent growth. Catch and effort data on the other hand, indicates a 75% decline in pole and line effort in the 2009 – 2014 period and appears to have stabilized more recently. While the fishery operates entirely within the exclusive economic zone (EEZ) of the Maldives, recent data indicates uneven distribution of fishing effort where it is currently more concentrated in the southern and eastern regions than the northern and western areas. In terms of catch composition, skipjack and yellowfin tuna are the most important species with about 80 and 20% being contributed respectively. Frigate, kawakawa and bigeye tuna contributed less than 3% on average. Observer data from 181 trips provided additional insights on the operational aspects of the fishery. This paper presents the recent developments and operational information from the fishery which can contribute to better understanding of the skipjack and yellowfin tuna stocks of the Indian Ocean.

Contents

1. Introduction

Fish has been the main source of protein and livelihood for the Maldivians for centuries (Lister 2016). The most common method of fishing continues to be pole-and-line and handline although trolling was popular before the advent of mechanization in the mid-1970s (Anderson, 1987). Pole and line fishery targets skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), frigate (*Auxis thazard*) and kawakawa (*Euthynnus affinis*). From 2018-2022 the fishery contributed about 83% of the tuna catch in the Maldives. At present the Maldives is the third largest producer of tuna by pole and line in the world behind Indonesia and Japan (Gillette, 2015).

From around the mid-1970s, the Maldives tuna fishery rapidly evolved as a result of socio-economic and other developments that occurred in the sector. Mechanization of the fishing fleet, installation of Anchored Fish Aggregating Devices (AFADs), opening of the government cannery and fish purchasing, export of yellowfin tuna products to the fresh fish markets and development of the vessel designs are some of the drivers of change in the fishery. The fishery continues to adapt to the changing socio-economic and other related conditions on the sector.

This paper intends to describe to some extent the causes of such change and present a description of the most recent statistics from the pole and line tuna fishery.

2. Data sources

2.1. Fisheries Catch and Effort Data: 2004-2022

Owing to the importance of the tuna fishery for the country, Maldives began fishery data collection from the tuna fishery in 1959 (Anderson, 1986). Over the years, the data collection system evolved and developed to include additional species/groups and vessels details. This has produced an excellent data set that has proven to be crucial to the management of the Indian ocean skipjack tuna resource. The island office-based reporting system existed from the 1970 until it's termination in 2017, replaced by the logbook

system. The Ministry compiles the annual catch and effort data primarily from the logbook data provided by the fishers. Prior its termination, data from the island office-based fishery data collection system was also used to complement the missing logbook data.

2.2 Fishing License Data

The Ministry of Fisheries, Marine Resources and Agriculture (MoFMRA) issues fishery licenses to fish within the Maldivian waters. The annual license is mandatory to sell the catch to the processors and companies that export tuna and tuna products from the Maldives. MoFMRA maintains a database of the fishing licenses issued for the tuna and other fisheries.

2.3 Logbook Data; 2016-2022

Tuna fishery logbooks were first introduced in 2010, which was later revised based on the experience of the initial few years. Fishery logbooks were introduced to address the reporting requirements and obligations as well as to address other challenges in the data reporting system at the time. Over the years, logbook coverage has improved, most notably due to the requirement that fishers can only unload the catch at the commercial facilities upon provision of the log sheet for the fishing trip.

2.4 Scientific Observer Data

The National Observer Program was established in 2015 by the Fisheries Management Section of the MoFMRA. Several issues hindered the effective implementation of the program which resulted in suspension of the program within a few years. To comply with the IOTC requirements, Maldives is working towards establishing an Electronic Monitoring Systems based program. The Maldives Marine Research Institute and International Pole and Line Foundation began observing tuna fishing trips in 2014, data from which is reported to IOTC. Except for 2017-2018, trips covering throughout the year were conducted with a total of 181 being observed. Observation was conducted from 54 unique vessels on an opportunistic basis (Table 1). However, since tuna fishing is concentrated in the south most observations were done on vessels operated in the south,

with vessel lengths ranging between 8m and 36m LoA. The vessel however, operated throughout the Maldives and therefore sampling was well represented (Figure 1).

Table 1. Number of trips conducted under the fishery observer program (2014-2022)

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
2014	0	0	0	0	0	0	0	0	4	9	0	8	21
2015	6	5	8	16	10	3	0	14	0	15	8	0	85
2016	0	0	0	0	1	0	0	0	0	0	0	0	1
2019	0	3	8	6	9	11	5	4	4	3	6	0	59
2020	0	5	0	0	0	0	0	0	0	0	0	0	5
2021	0	0	0	0	0	0	0	0	0	0	3	0	3
2022	0	0	0	0	0	0	0	3	0	0	4	0	7
Total	6	13	16	22	20	14	5	21	8	27	21	8	181

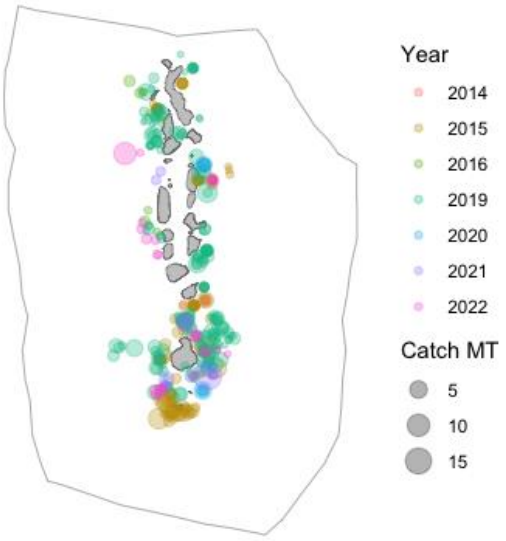

Figure 1. Locations of observer sampling - 2014- 2022 under the fishery observer program.

3. Discussion and results

3.1. Fleet Trends

The mechanized *masdhoni* (mechanized fishing vessel) fleet targeting tunas, consist of pole and line and handline vessels that have been officially registered as fishing vessels and obtain a fishing license to fish for tunas. The licensing system does not distinguish between pole and line and handline gears. The fleet has grown in number from almost 400 in 2010 to 769 vessels in 2021.

In terms of vessel sizes, vessels between 12.5 – 32.5 are most dominant in the fishery representing roughly 90% of the vessels, with the 22.5 – 27.5 vessel class being most common (Figure 2). This vessel class also observed the most prominent growth (136%) in number during the period (Figure 3).

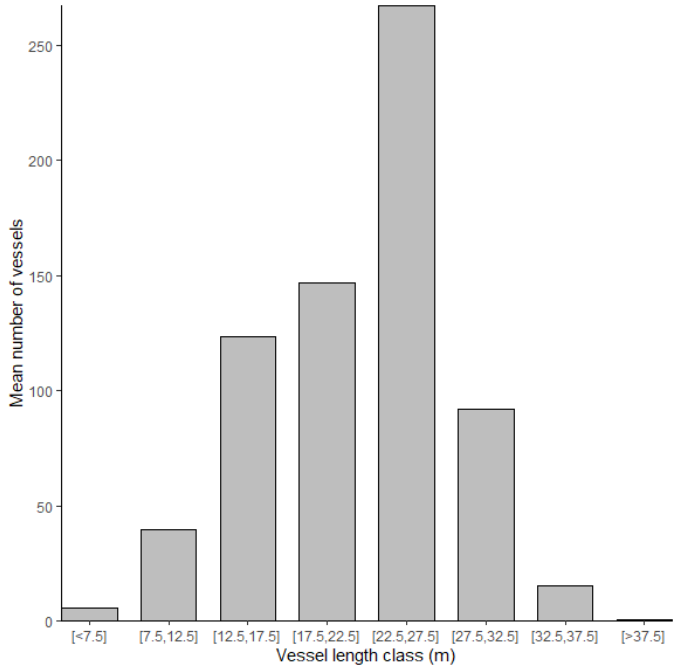

Figure 2. Distribution of vessel sizes in the tuna fishing fleet.

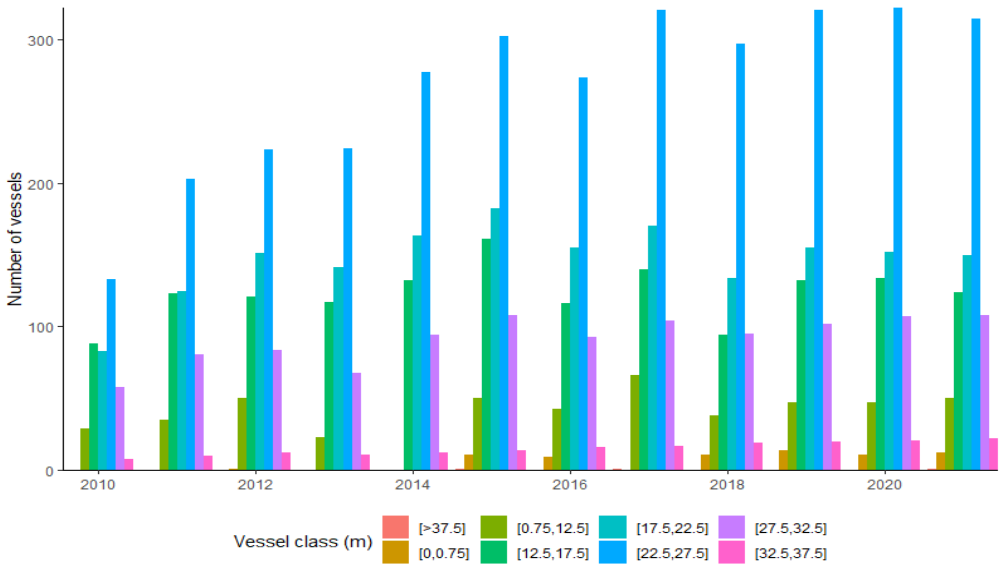

Figure 3. Vessel size class distribution by year, 2010-2021, in the tuna fishing fleet

3.2 Catch and Effort Trends

Maldives tuna fishery quantifies effort in the number of days fished. This was the most evident as historically, fishing trips only lasted single days as vessels were much smaller and did not have berthing and other facilities required for multi-day fishing. Fishers left the islands at night or early in the morning and fished for livebait. At the end of the day or trip, vessels returned to home port or the nearest island to unload the catch, sometimes to anchor for the night. Over the subsequent years, vessel designs improved allowing multi-day fishing and long-distance traveling. As larger vessels with better berthing and other facilities entered the fishery, the smaller vessels were consequently abandoned. The newer vessels could accommodate more fishers and be at sea for longer durations.

Catch and effort data indicates a substantial decline in nominal pole and line effort from more than 147,000 to about 27,000 days in the 2004 – 2021 period (Figure 4). Effort has since stabilized in the 2009 – 2014 period an average of almost 30,000 days. The decline in pole and line effort is believed to be partly caused by the shift from pole and line to

handline fishery that has been observed in the central and northern regions in the recent times.

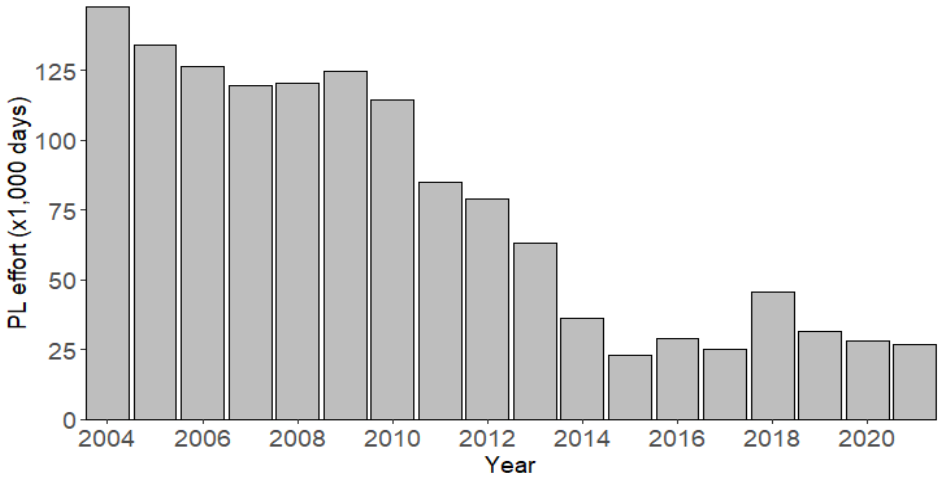

Figure 4. Trend in pole and line nominal effort, 2004-2021

The Maldives tuna fishery is mostly export oriented, hence access to landing sites is a crucial element of the fishery. This has been demonstrated in the past as fisheries developed in and around the landing sites and airports. The main landing sites for pole and line catch are Felivaru (in the north, eastern side), Male', in the central region, where the majority of the population resides; Maandhoo and Kooddoo in the southern atolls. Spatially correlated effort data shows pole and line effort to be mostly distributed around these landing sites (Figure 5). It is noteworthy that fishers from some key pole and line fishery islands in the north and central atolls are now predominantly using handline gear targeting large yellowfin tuna or mostly employed in other sectors. Transitioning from pole and line to handline tuna fishery is rather simple as the vessels do not require major modification or expensive gear. Handline fishery is also said to be more lucrative than pole and line, which may also have contributed to the shift.

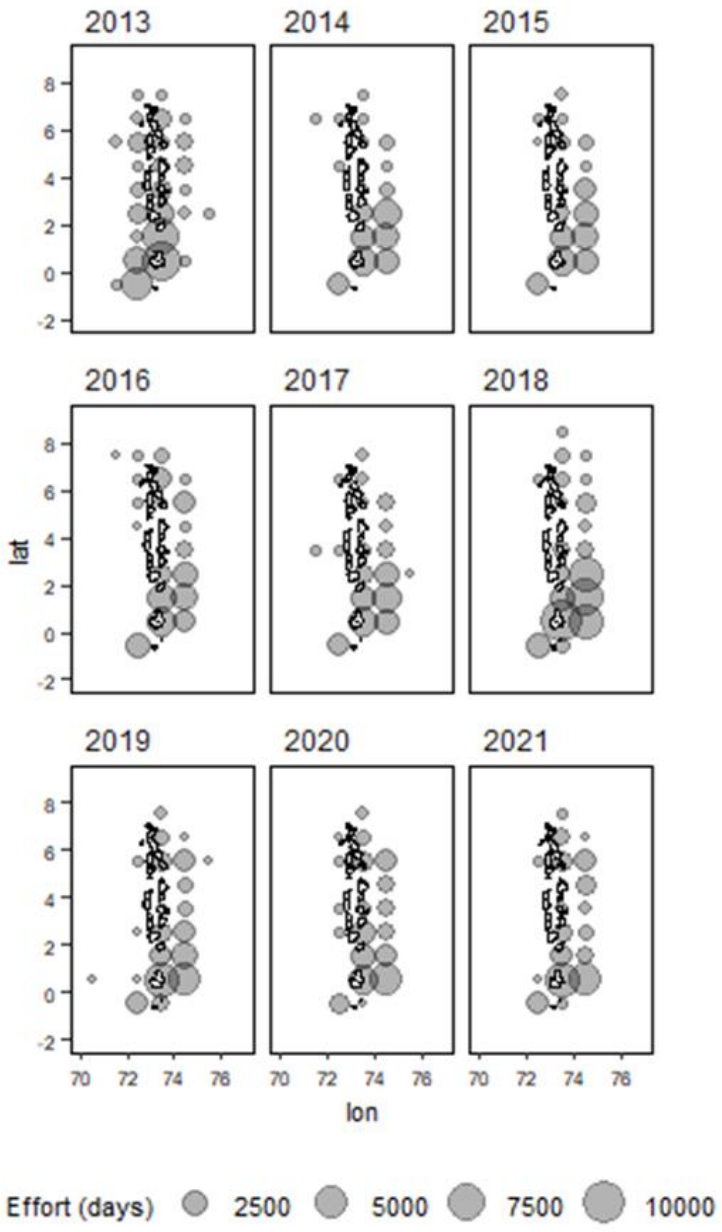

Figure 5. Spatial distribution of pole and line effort, 2013 - 2021

Logbook data for the pole and line fishery from 2016 to 2022 suggests about 90% of the trips to be less than 3 days in length, with 1- or 2-day trips being the most common (Figure 6). Historically, the trips only lasted a single day as the vessels were small and unfit for multi-day fishing. Livebait would have been the main limiting factor on the trip length as the gear requires ample amounts of livebait to attract the tuna to the vessel and reach of the

pole and line gear. Capacity to store the catch in ice, fuel and other factors would also be influential. Modern vessels without these limiting factors, would still be required to replenish the livebait supply and therefore be required to return to the inshore waters, where the bait is available. Thus, bait remains the main factor determining the trip duration in the Maldives pole and line fishery.

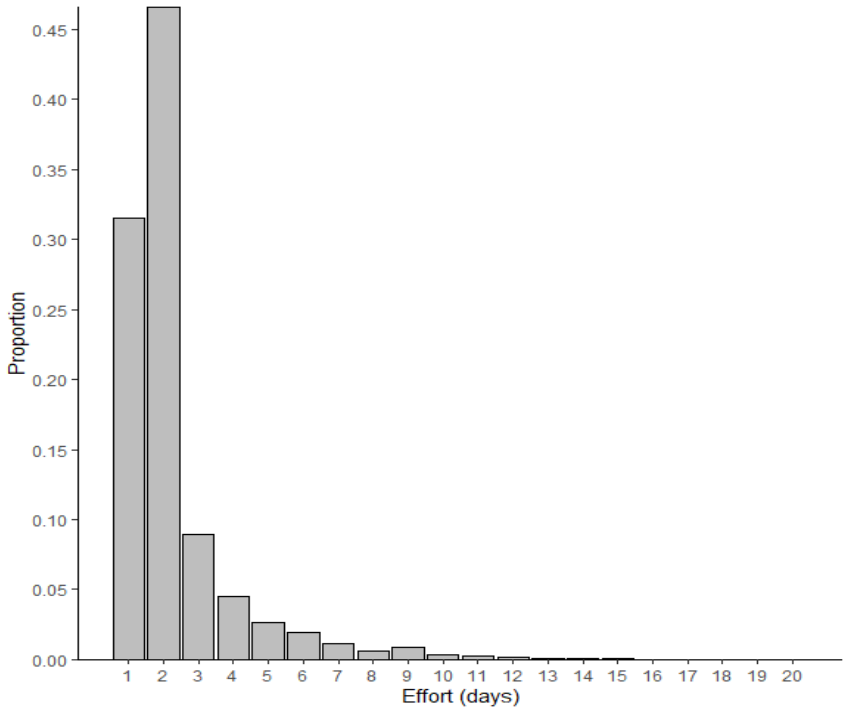

Figure 6. Distribution of trip length (days) reported in the logbook data

All three tropical tunas, skipjack, yellowfin and bigeye tuna are caught in the PL fishery along with neritic tunas, frigate tuna and kawakawa. Neritic tunas are being caught in small amounts from mixed schools, mostly from the AFAD fishery. Tropical tuna (skipjack, yellowfin and bigeye tuna) catch from the fishery peaked in 2006, amounting to 158,225 t, and subsequently declined until 2010 to 71,618 t, a 54% reduction. Catch has since been in an upward trajectory amounting to 143,455 t in 2021. Skipjack tuna comprise the bulk of the PL catch with about 86% contribution on average in the recent five years (2017- 2021). Meanwhile, yellowfin tuna contributed on average, 13% of PL caught tunas. In the recent five years, an average of about 99,000 t of skipjack tuna was caught using pole and line

gear. This comprises 99% of all skipjack tuna landed by the four tuna fishing gears: pole and line, handline, trolling and longline fisheries, highlighting the importance of the gear for skipjack tunas in the Maldives. Pole and line caught skipjack tuna observed a 31% increase in catch in the recent five years, while yellowfin tuna showed a 41% decline in the same period (Figure 7).

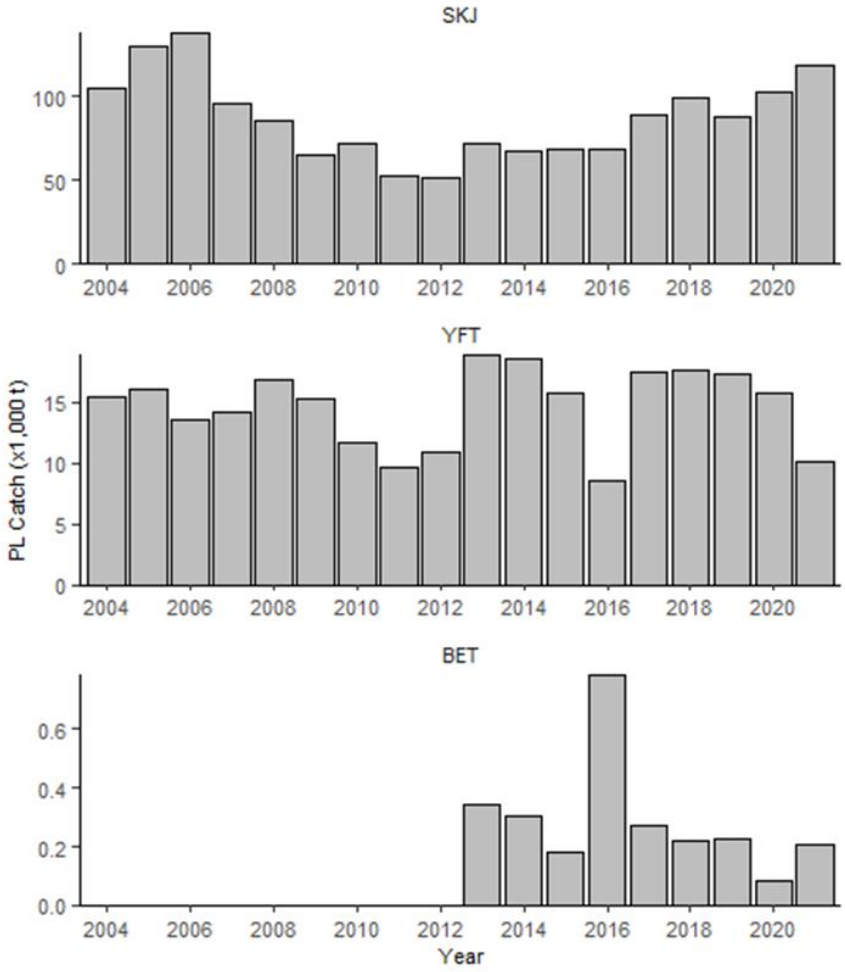

Figure 7. Catch trends of pole and line caught tropical tunas, 2004 - 2021

3.5 Operational Tends

The scientific observer data provides some emerging trends in the operation of the pole and line fishery. In general, larger vessels dominate the current pole and line fleet, especially in the south where tuna fishing is higher. With these larger vessels, efficiency is also increasing due to developments in several aspects such as harvesting and holding livebait, detecting fish schools, number of gear operational etc. Several vessels are now equipped with technology to locate fish schools and refrigerated seawater systems (RSW), improving quality of the catch. For example, of the vessels' on which observer trips were conducted on, 23% of the vessels had bird radars, and the number of vessel installing bird radars is increasing. Although 14% of the vessel had on board RSW to ensure the catches maintained at good quality for longer duration, the length of trips are still around one day. The mean duration of the trips is 23.2 hours (median 19.7 hours, range 1-5 days).

Figure 8 shows the school sighting method and school association. Except for seamount (SMT) and AFAD schools, all others may be considered as unassociated fish schools. Thus, it can be deduced that close to 50% of the school targeted were free swimming schools suggesting targeting free swimming schools is preferred, at least in the southern most atolls.

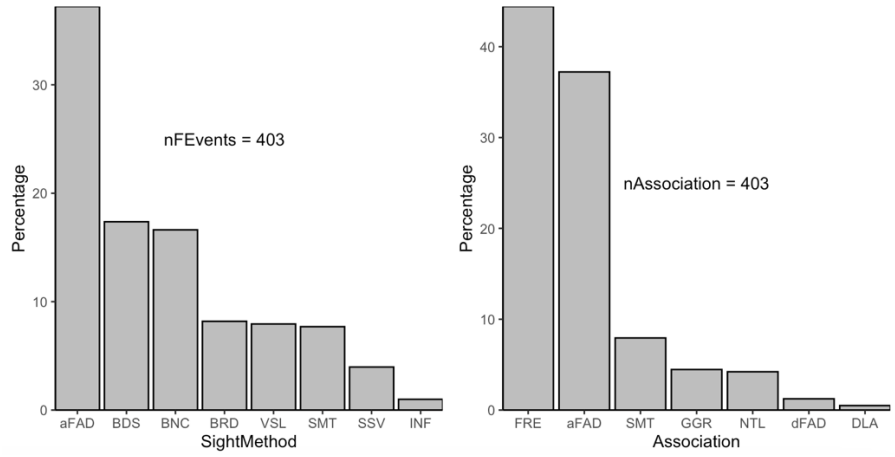

Figure 8. Frequency of school association and sighting method from scientific observer data. **Association**: FRE - Free swimming schools, AFAD - anchored FAD, SMT - Seamount, GGR - Ghost Gear, NT - Natural Log, dFAD - drifting FAD, DLA - Dolphin associated. **Sighting**

Methods: BDS - by birds, BNC - Binoculars, BRD - Brid Radars, VSL - by other vessels, SMT - by Seamount, SSV - Sea surface visuals, INF - by radio from another vessels.

During the observer trip, a random sample was set aside from most of the fishing events (fishing activities separated by 10 mins apart) which were later measured. The data shows the distinct "large skipjack" mode of around 65+ cm FL in the catches from free schools (Figure 9). In YFT it is not clear, but the sizes in seamount, AFAD, Log School (NTR + dFAD) overlap showing the distinct signature of the sizes classes in associated and non-associated schools.

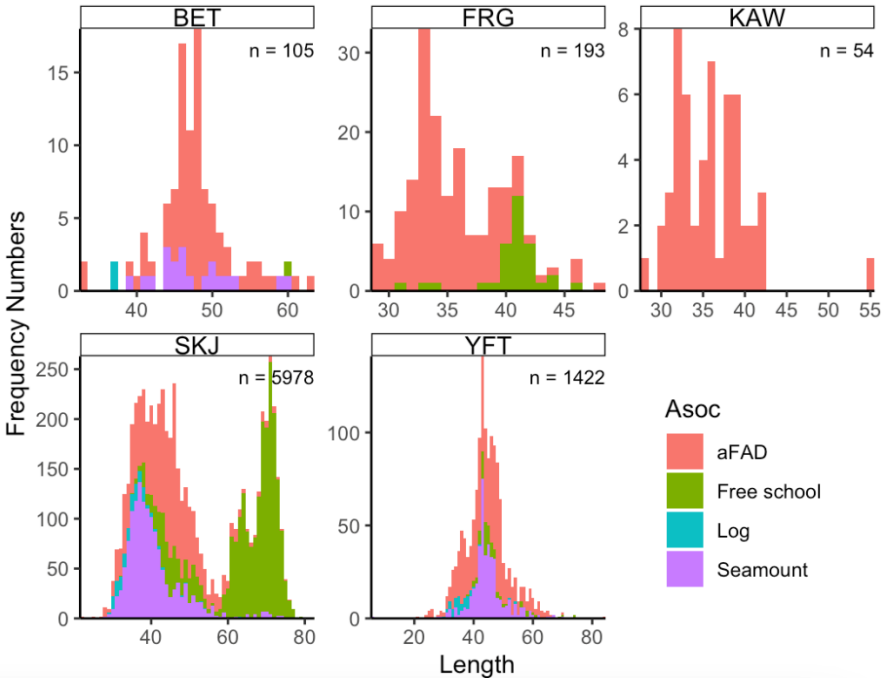

Figure 9. Size distribution of species by association

The size samples from fishing events allow us to estimate species composition by association. It is clear the Free schools are almost entirely monospecific and therefore the catch does not contain associated species (Figure 10). Proportion of yellowfin tuna in associated schools remain around 20%. The difference in target school type may suggest that yellowfin composition in reported catches from pole-and-line has dropped from around 17% to 7% in 2021 and 2022. Several factors also motivate fishers to target free schools, i.e., larger skipjack tuna. These include getting a higher price for larger fish, obtaining a

high tuna to bait ratio (being able to get a higher catch with less bait) and catching a high volume of fish within short time. Hence the overall efficiency of the fishing operation is improved when targeting free school skipjack tuna.

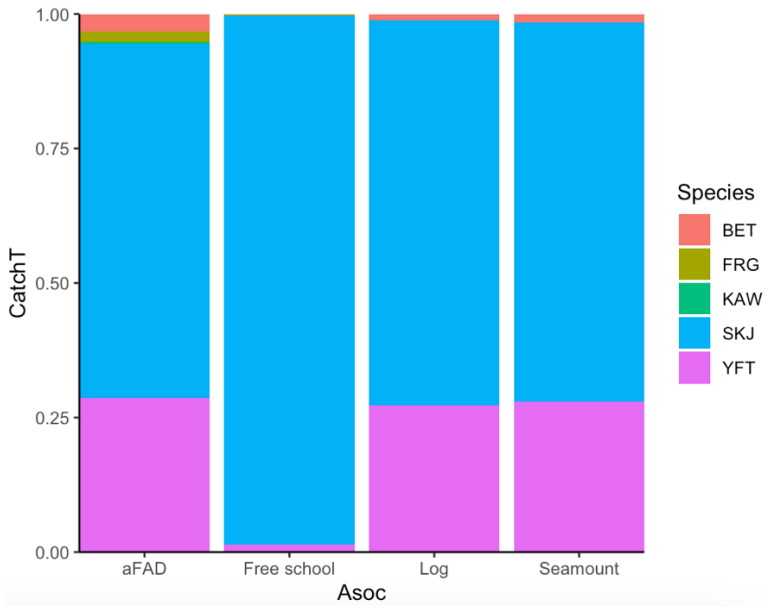

Figure 10. Proportion of species composition (in weight) by Association in the scientific observer data.

4. References

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