Use of Anchored FADs in the Maldives – Notes for a Case Study for Assessing ALDFG

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Abstract

The Maldives has a coastal fishery targeting surface schooling tunas of mainly skipjack and yellowfin. An anchored array of fish aggregation devices (aFADs) deployed around the archipelago has been helping fishermen to locate tuna schools while improving efficiency of their pole- and-line fishing operations. The aFAD deployment program started in early 1980s, initially as a pilot, has grown and established to maintain a permanent array of about 50 aFADs, by re-deploying lost FADs at almost the same location. The aFAD program is managed exclusively by the government and so has maintained detail records of deployment; fabrication methods, marking, and of FAD attachments. More important are records of lost date and information about retrieval and reuse. We present here information for a case study of a well-managed aFAD program, which in general, follows FAO's Voluntary Guidelines of Marking of Fishing Gear, and the Best Practice Framework for Fishing Gear set out by the Global Ghost Gear Initiative. On average 19 aFADs are lost on an annual basis, which are replaced soon after they are reported lost. Fishermen are financially incentivized to retrieve and return the detached or lost buoys. Roughly 8-10 buoys are returned on an annual basis making annual loss rate at 9-11 buoys. Based on these we estimate that 0.1 aFAD would be lost per 1,000 MT of fish caught in the fishery making this as a fishery with lowest abandoned, lost or otherwise discarded fishing gear (ALDFG) footprint

Introduction

Abandoned, lost or otherwise discarded fishing gear (ALDFG) is a major concern for conservation and management efforts of marine stocks (Macfadeyn et al. 2009). Fishing gear loss contributes ghost fishing — entrapping and entangling of sharks and turtles and other large predators — and is unnecessary and wasteful (FAO, 2009). They contribute to marine litter, and often gets stranded on beaches of coastal states and islands chains requiring expensive clean ups (Baske et al. 2019). Several international instruments call for voluntary measures to mitigate the issue. Among them the FAO Code of Conduct of Responsible Fishing and the Voluntary Guidelines on the Marking of Fishing Gear - VGMFG (FAO, 2019). The MARPOL Convention Appendix V regulates discharge of plastic waste into the open ocean. The ALDFG issue has now become a much talked about topic among the eNGOs in the fishery world.

More recently the Global Ghost Gear Initiative has taken up to deal with the issue by formulating a Best Practice Framework for the Management of Fishing Gear which defines roles of various stakeholders from a life cycle perspective; from manufacturing of the gear to its use, reuse and disposal (GGGI, 2019)

In global tuna fisheries two main gear-types contribute to ALDGF, namely drifting gillnet and purse seine fishing. In the Indian Ocean gillnet fishing contributes 18% of tropical species (skipjack, yellowfin and bigeye) while purse seine fishing contributes 47% (IOTC, 2019).

In the drifting gillnet fishery, the context of the gear loss, abandonment and discarding is clear but the situation in the purse seine fishing is less so. While the purse seine net may hardly or never be lost, discarded on abandoned, it is the indirect gear[1], the fish aggregating devices (FADs) used in purse seine fishing that get lost and abandoned, or otherwise discarded.

FADs are purpose-built devices put into the ocean (drifting or tethered to an anchor) with the specific purpose attracting and aggregating pelagic fish, especially skipjack and yellowfin tuna. Essentially, they have a raft / float and attachment to extend their presence. In the case of anchored FADs (or aFADs) , the mooring and the anchor are important aspects of the FAD to extend to its longevity and useful lifespan.

Drifting FADs (or dFADs) are almost exclusively used in the purse seine fishery. Over 90 % of skipjack caught by the purse seine in the Indian Ocean is from dFAD set, or commonly referred to as log-schools sets (IOTC, 2018). Large number of dFADs (literary thousands) equipped with echosounder and satellite transmitter is released to the ocean, which can be monitored in (almost near) real time by the vessels. Decision are then made which dFAD to visit based on the distance and the amount of fish aggregated underneath them. The most contentious issue is so-called "deactivation", which often happens in situation where FADs drift into areas that become unfavorable to fish or infeasible to retrieve including cases where they drift into EEZ's of coastal states. Lack of responsibility to recover dFADs by the fishing companies has been a major issue in tackling ALDFG in dFAD fishery.

The Maldives pole-and-line fishery uses an array of anchored FADs (aFADs) to help their coastal fishery improve efficiency of their daily fishing trips. With FADs anchored at popular and known locations, fishermen can repeatedly arrive at the spot to fish without having to waste time in search of schools. The aFADs have been in use in the Maldives since 1981 - thanks to an FAO project which piloted its use proving its success immediately and gaining popularity among the fishermen. Anchored FADs are now essential and integral aspect of the Maldives pole-and-line fishery.

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[1] GGGI classifies FADs as a class of gear and examples of gear types are anchored and drifting fishing FADs – see the link, accessed Sept 2019.

Furthermore, the aFAD program in the Maldives is 100% funded and managed by the government, which in the South Pacific has been found to be essential for sustaining coastal tuna fisheries (Gillette, 2019).

Unfortunately, very little has been published about aFADs use in the Maldives tuna fishery. Naeem (1998) provided an account of development of the FAD program in the Maldives including their efforts in improving buoy design, mooring and anchor. Anderson (1991) provided information on catch rates from FAD-targeted fishing using data from a single atoll, while Anderson and Latheefa (1994) provide bio-socio economic account of the fishery. Govinden et al. (2011) provided information about movement and behavior, and more recently Shainee and Leira (2013) provided an account of premature loss of aFADs in the Maldives. Information about its attachments, recovery and reuse how it contributes ALDFG is not known.

This paper provides a preliminary account of the aFAD program of the Maldives for developing a case study of a well-managed aFAD fishery.

Data and Methods

The government have been keeping records of FAD deployment since the program began in 1981. These include, date of deployment, GPS location, reported lost date, and information about recovery and reuse.

The data have been maintained on a spread sheet starting from FAD number 1 which was deployed on 24 February 1981. It is not entirely sure if this was the very first FAD deployed during the pilot, but from this date the Ministry has been keeping records of all FADs that was deployed. At the time of this writing 520^{th} FAD was being installed.

For each deployed FAD, the date it was reported lost have been recorded. Currently 56 FADs are deployed around the entire archipelago in an equally spaced fashion to allow easy access to entire fishing community in the Maldives.

Information is also available on the fabrication methods, about the mooring and attachments. These data are used to provide descriptive account of the FAD use in the Maldives pole-and-line fishery.

Results

Unlike many coastal fisheries that uses aFADs, the Maldives case may be special in that the FAD program is entirely owned and managed by the government. Ownership and conflict is non-existent as fishermen have equal access to the FAD array. Fabrication and deployment costs are relatively high (currently US$ 15,000 per FAD) and so there is no incentive for any private party to deploy and maintain FADs. The issue has never risen in the Maldives.

Location of Deployment: Locations of FAD deployment are agreed following consultations with the fishers. As FADs grew in number, starting from the first FAD, new locations of deployment were suggested by the fishermen themselves. FADs were loosely named, or popularly known among the fishermen, associated with a well-known fishing island (Figure 1). Since the locations are areas where fishermen commonly fish, fishermen would visit the FADs almost daily. It is therefore easy for the fisherman to report when FADs are lost and demand from the Ministry to replace the lost FAD.

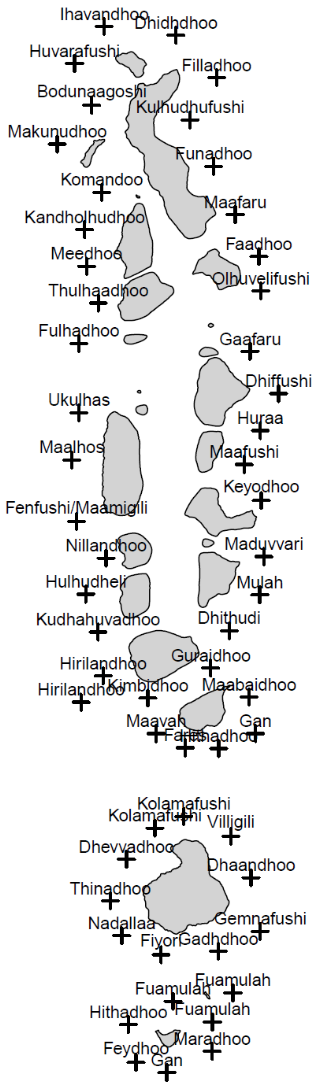

Figure 1: Location of the aFAD array of the Maldives and associated island names. FADs are deployed about 12 nautical miles from the atoll reef, equally spaced to allow easy access to entire fishing community of the outer islands.

Fabrication / Deployment: A dedicated FAD Unit was established within the Ministry soon after the FAD program was running following the initial trials in 1981. The FAD Unit was recently elevated to a Section within the Fishery Department. The Section's primary work is maintaining the FAD array by replacing lost FADs. Government allocates regular annual budget for the FAD program and emphasis has been placed for research and development including looking at ways of minimizing loss and type of material used.

FAD system is designed and fabricated entirely locally using imported material. The design of the buoy, the mooring system, anchor and the FAD-attachments have evolved over time and adapted to meet local conditions (Naeem, 1998).

Specially manufactured ropes with wire-core and stainless-steel link chains are regularly procured from overseas for the mooring. Anchors are series of steel-reinforced concrete blocks or each 130-

140 kg inter-locked together to make 2 x 1.5MT weights. The total dead-weights of the anchor in the current deployments have been 3 MT

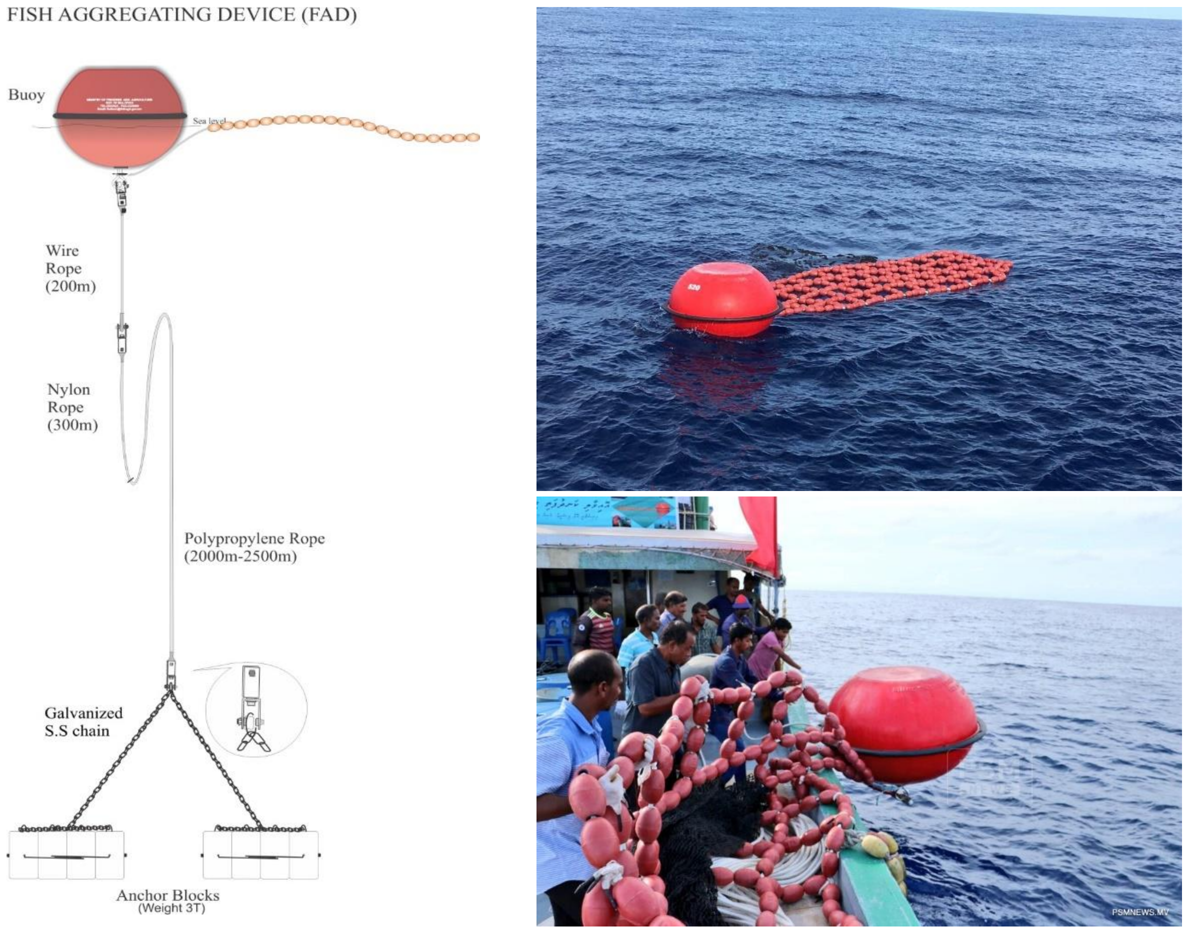

Figure 2: Current design of anchored FAD used in the Maldives. The only attachment to increase FAD's presence is the floating

Attachments: In the past, FAD attachments were section of old nets; initially nylon livebait nets followed by larger meshed nets, mostly nettings salvaged by fishermen from purse seine dFADs that drift into the Maldives. These attachments were about 10-15 m below the surface attached to the mooring. The current design which started in early 2004 does not have hanging nets. They are technically non-entangling FADs, where the attachment to increase the presence of the FAD is a set of floating buoys (350 of them threaded to form squared mesh with floats on each side) with netting fixed to lay horizontally underneath the floats. The net is not hanging and therefore highly unlikely to contribute entanglement. Its function is to create a shade underneath the floats to give some sense of "protection" to the attracted fish (see Figure 2).

All FADs are almost always anchored in about 2,000 m of water.

Marking: all FADs are marked "Ministry of Fisheries and Agriculture, Rep of Maldives" embossed on the buoy (Figure 3). This is done during fabrication of the discus shaped FRP[2] buoy. The unique number of the FAD is printed in white color at the time of deployment (Figure 3). In the past a small mast was erected on the buoy with photovoltaic solar panel for ease of identification during night. Current

[2] Fiber Reinforced Plastic composites

design with its fluorescent orange color doubles a reflector during night. In the future, it would useful to develop a standardized marking system consistent VGMFG.

Figure 3: Marking on the buoy: Ministry of Fisheries embossed with the number of the FAD clearly written on each buoy.

Lost Date: Although they are not yet equipped with GPS, their positions are always known by virtue of being anchored. Also, there would be hardly any FAD that would not have been visited by at least one fishing vessel on any given day, and therefore, the reported lost date would likely to be very close to the actual date lost. As the fishing fleet grew the number of locations where FAD deployed were increased.

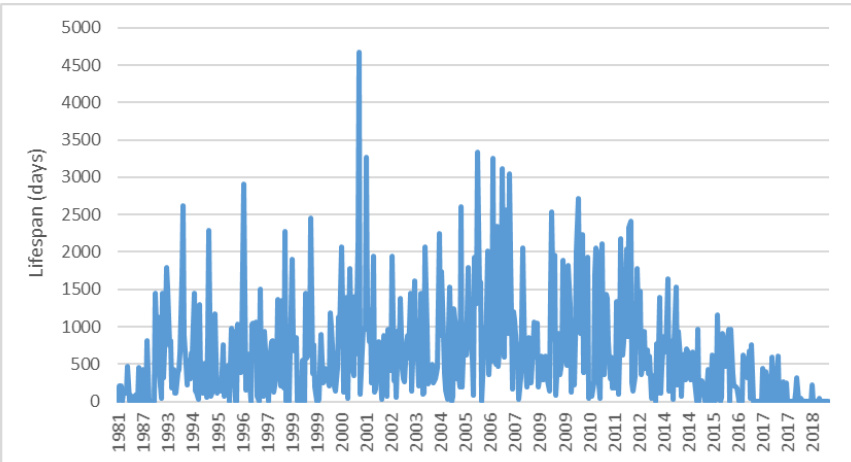

Figure 4: Life span of aFADs deployed in the Maldives. Life spans have been declining which could be due to sub-standard anchor-chains at mooring and/or fishermen using FADs at anchors during night stops.

Life Span: The lifespan is the duration form the date of deployment to the recorded lost date. With improvement in design of the buoy, mooring and the anchor, the lifespan of the FADs has improved from about 1 year to about 5-8 years in 2006 (Figure 4). However, since then lifespan of the FADs has been on declining trend, needing to replace equally same amount FADs that was deployed during previous year. The reasons declining life span may be multiple; use of lower grade link chain in anchor block and/or fishermen more frequently making use of the FAD as an anchor point during nighttime.

A summary of FADs deployed in the year and reported as lost is given in Figure 5.

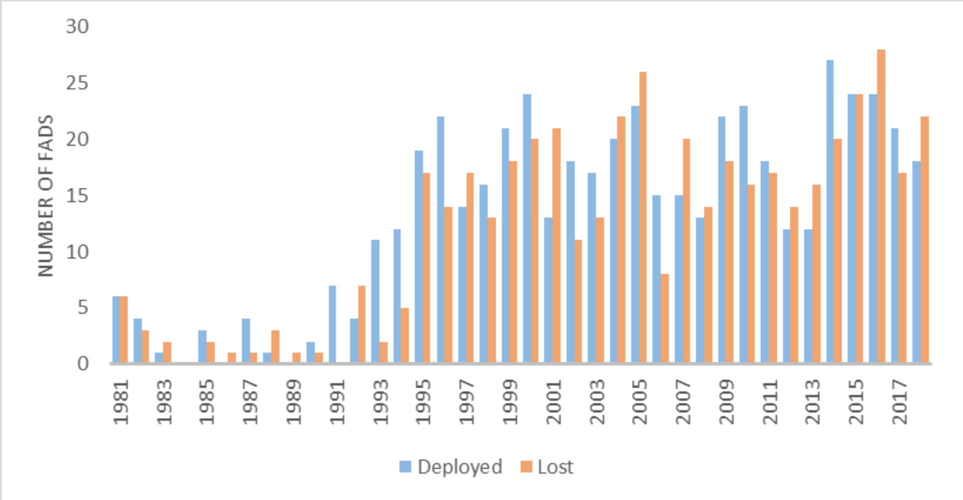

Figure 5: Number of FADs Deployed and Lost – 1981 - 2018

Recovery and Reuse: The cost of fabrication and deployment is quite high. Current cost per FAD is over USD 15,000. In order to minimize overall cost of maintaining the FAD array it is important to increase FAD's lifespan to decrease the number of FADs that would require replacing. Equally important is the recovery and reuse. The Ministry has always encouraged fisherman's help in this regard. Fishermen are currently paid US$ 330 for recovery and transport of FADs to an inhabited island of their wish. Almost in all the cases the recovery would be the buoy, rarely the mooring or section(s) of the mooring. Since buoy itself costs in excess of US$ 2,500 it is worth to have them refurbished and reused. During 2018, 12 buoys were recovered and 100% of the buoys were reused. A new unique ID number is assigned when the buoy is reused again.

Discussion

The main issue in the FAD fisheries is what happens to the FAD following its loss — deliberate or otherwise. The issue is more serious when such FAD contributes to ghost fishing (Filmalter et al. 2013), marine debris and damage to coral reefs and coastal habits in the event of a stranding (Baske et al. 2019). Equally serious is when FADs are fabricated from non-biodegradable material e.g., use of large amounts of nylon netting to increase FAD's presence, including material of the raft, and the electronic instruments mounted on it — all contributing to 'plastic marine litter'. In their assessment towards formulating the Best Practice Framework for Management of Fishing Gear, GGGI[3] (2019) assessed that FADs[4] (considering both aFAD and dFADs) would have a HIGH likelihood of being lost, or discarded or abandoned in the first place, and MEDIUM likelihood of impacting the environment (i.e., risk of entanglement with marine mammals, reptiles, birds as well as possible habitat damage).

If aFADs of the Maldives were assessed for their contribution to ALDFG and its impact of marine environment, it will be obvious aFADs are very different from dFADs used in the purse seine fishery. The Maldives FADs are anchored with the objective of allowing fishermen to visit repeatedly at the same spot. It is not practical for the aFADs be fabricated from biodegradable material which may not withstand environment conditions imposed by being tethered to ocean floor (Naeem, 1988). There

[3] Global Ghost Gear Initiative – The report was authored by Tim Huntington, Poseidon Aquatic Resource Management Ltd.
[4] GGGI considers FADs are "fishing gear" although EU proposal submitted to S24 states FADs are not strictly fishing gear!

would be a tradeoff between the objective of increasing longevity and minimizing marine debris/plastics. The longer aFADs buoys are intact, the lower aFADs need replacing and therefore contribute less to marine debris. This is an issue the Ministry is evaluating to find the right balance.

The key features of the Maldives aFADs are:

1. The number of FADs in use (active) at any given time is fixed – currently limited to only 56 FADs which when lost are replaced at the same spot.
2. they are non-entangling – only a set of float-buoys with horizontal attachment of netting underneath.
3. FADs are marked clearly – the name of the management authority and unique serial number of the buoy
4. incentives are provided for recovery – fishermen paid US$ 330 (which is currently being reviewed for possible increase).
5. Whatever is recovered is re-used as practical and feasible as possible.
6. Records are well-maintained – for the purposes of internal audits and for use for research and development.
7. The FADs are about 12 miles from the coast thus reducing the amount of fuel that fishermen use to access them.
8. There is equal access for all pole and line tuna fishermen to all the FADs.
9. The program is owned and managed exclusively by the government – allows to control the number and location of deployment

The information available from the Maldives aFAD program allows to calculate an ALDFG footprint based on number of FADs lost in relation to reported tuna catch. It can be calculated on an annual basis or an aggregated level based on the total number of FAD lost and not recovered against the reported landing. The ALDFG footprint is estimated at 0.1 per 1000 MT of fish landed.

Data on lost or recovered/reused dFADs for the Indian Ocean purse seine fishery is not available. However, a rough calculation may be made knowing number of purse seine vessels operating in the Indian Ocean and the number of dFADs likely to be deployed by each purse seiner in any given year. Resolution 18/01[5] states each vessel should not use more than 350 active dFADs at any given time and acquire no more than 700 buoys per vessel per year.

Assuming there were 35 active purse seiners in 2018 and each deployed 700 dFADs (at least only once). Also, assuming 10% is lost (which is what is commonly reported[6]) that would be 2,450 dFADs lost in 2018. PS catch of tropical (SKJ, YFT and BET) in 2018 was 523,000 MT. This would mean 4.7 dFADs lost per 1000 MT. This is close to 50 times more FADs lost in the purse seine fishery then in the Maldives pole-and-line fishery.

[5] Res 18/01 is superseded by 19/01 which sets the limit of 300 operational buoys (dFADs) at any given time and the number of buoys that may be purchased at any given year to 500.
[6] In ICCAT, it is reported that 10% of the deployed gets lost [need a reference?]

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