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The use of non-entangling FADs to reduce ghost fishing

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Morena G.[1], J. Murua[2] and V. Restrepo[1]

[1] International Seafood Sustainability Foundation
[2] AZTI Tecnalia. Txatxarramendi Ugartea z/g, 48395 Sukarrieta (Spain).

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Gala Moreno[1], Jefferson Murua[2], Victor Restrepo[1]

The impacts associated to FAD structure are ghost fishing, damages in coral reefs and coastal areas and interference with other economic activities and marine pollution. ISSF scientists working on FAD research as well as fishing industry, well aware of the impacts that FAD structure can cause in by-catch species, reefs and coastal ecosystems, have been working since 2010 to develop FAD structures that minimize these impacts. The purpose of this document is to provide an overview of the research conducted to reduce ghost fishing by FADs and document the important advances towards the use of new non-entangling FAD designs to mitigate those impacts.

1. Ghost fishing

An important source of cryptic bycatch is ghost fishing caused by abandoned, lost or otherwise discarded fishing gear (ALDFG) that continue to capture fauna while at sea (Matsuoka and Nagasawa, 2005; Macfadyen et al., 2009). Ghost fishing by FAD structure is cryptic fishing mortality, but they do not entangled animals just when lost but also while they are actively monitored by fishers. FADs are capable of ghost fishing for extended periods as they are mainly built with nets which are highly durable synthetic materials. Due to their life history characterized by slow growth rate and limited fecundity, sharks and marine turtles may be especially vulnerable to indirect fishing mortality or passive fishing of FADs.

a. ISSF research to quantify ghost fishing of sharks

Until recently, fishers and scientists considered that dFAD entanglement was negligible for FAD fishing and had no substantial impacts on shark populations. However, the only study to-date examining shark ensnarement levels in dFADs, conducted by ISSF in association with MADE European project, through diving censuses combined with electronic tag data, estimated that shark entanglement in traditional FADs could be causing five to ten times higher shark mortality than active purse seine fishing itself in the western Indian Ocean (Filmalter et al., 2013). Crucially, the archival tagging information revealed that often dead entangled sharks would detach from the dFAD´s tail and sink to the seabed after just 1.2 days on average (Filmalter et al., 2013), which makes these events even more difficult to observe. As a result, a large part of the cryptic mortality goes unnoticed unless underwater observations are conducted (through divers or cameras) or the dFAD is lifted out of the water and inspected during that brief period when the shark remains entangled.

[1] International Seafood Sustainability Foundation. 1440 G Street NW Washington DC 20005
gmoreno@iss-foundation.org; vrestrepo@iss-foundation.org
[2] AZTI Tecnalia. Txatxarramendi Ugartea z/g, 48395 Sukarrieta (Spain).

There is no similar field study in other oceans to quantify the extent of this problem and some fishers remain skeptical that ghost fishing is a major issue with traditional FADs that use old netting.

An important source of information for ISSF are its skipper workshops. Between 2009 and 2018, over 80 ISSF Skippers Workshops in 20 countries have been conducted with more than 3,000 participants, the majority being large-scale vessel tropical tuna purse seine fishing masters and captains (Appendix I). The workshops main objective is to discuss ways to improve selectivity and mitigate incidental catches in tuna purse seine fisheries.

Ghost fishing by FADs is now a key component in the agenda of these workshops. Detailed information on the kinds of FADs used by each skipper are widely discussed during these meetings. At some workshops, fishers also fill in an anonymous multiple-choice questionnaire that has a section dedicated to types of FADs they use (e.g. construction materials, dimensions, designs). The questionnaires enable anonymous feedback contribution of quantitative and qualitative data by fishers. During these workshops in every ocean, entanglement has been proven to be occurring systematically. Some fleets in the western Pacific Ocean estimated as commonly found shark entanglements in 10% of their FADs. However, quantification of the overall magnitude of entanglements is difficult because, as described before, dead entangled sharks detach from the dFAD´s tail and sink to the seabed after just 1.2 days on average (Filmalter et al., 2013), which makes these events difficult to observe.

The following evidences made ISSF take urgent action to minimize shark entanglements:

- A field study in the Indian Ocean showed high mortality due to shark entanglement (higher than that of active fishing with purse seine gear) (Filmalter et al., 2013).
- In other oceans, large mesh size nets are also used in FADs and the same species of sharks are found associated to FADs and entangled (Murua et al., 2017).
- Qualitative and quantitative information from skipper workshops worldwide showed that entanglement is occurring in traditional FADs (Murua et al., 2017).
- The numbers of FADs at sea have been increasing in recent decades (Scott and Lopez, 2014)
- Shark populations continue to decline worldwide die to cumulative human impacts (Lewison et al., 2014).
- Quantification of entanglements is difficult at FADs (Filmalter et al., 2013) and there are large knowledge gaps related to ghost fishing impacts in marine megafauna (Stelfox et al., 2016).

b. ISSF action to reduce ghost fishing of sharks

The ISSF bycatch steering committee, a group of scientists that advice ISSF on bycatch mitigation, created a guide for non-entangling FADs. This guide was based on skippers workshop information as well as on the expertise on fishing technology of by-catch committee members. In this guide, three categories of FADs are defined according to entanglement likelihood (ISSF, 2015; **Fig. 1**),: (1) High Entanglement Risk (HER) FADs constructed with open panels of large mesh netting (e.g. > 2.5-inch mesh); (2) Lower Entanglement Risk (LER) FADs which use either small mesh netting (e.g. < 2.5-inch mesh), or net tightly tied into coils or bundles; and (3) Non-Entangling (NE) FADs which have no meshed elements. The distinction between LERFADs and NEFADs is made because, over time, netting tied into coils in LERFADs can become loose or small mesh breaks down into larger holes, thus potentially increasing entanglement risk. Note, though, that many organizations place LERFADs in the same category as NEFADs, because they consider them to be virtually entanglement-free. While this might be correct for newly built and well maintained LERFADs, tied netting and small mesh in lost or stranded LERFADs will start to deteriorate over time increasing their entanglement potential.

During ISSF research cruises, shark entanglements are monitored related to the type of FADs encountered and visited at sea. No shark entanglement was found at sea for Low Entanglement Risk FADs (Restrepo et al. 2016).

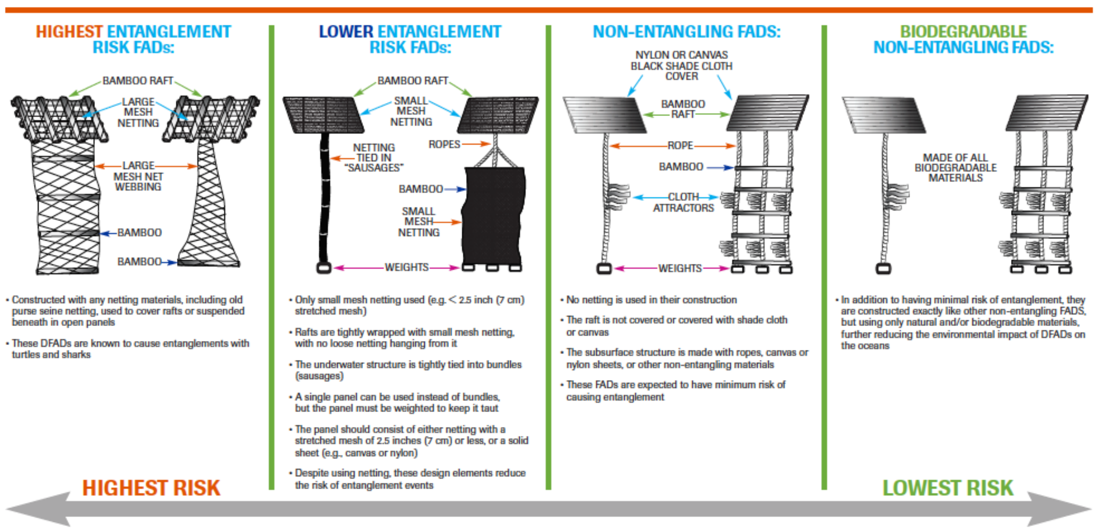

Fig 1. FAD categories based on entanglement and environmental impact (ISSF, 2015)

c. Current progress on the use of non-entangling FADs in purse seine fisheries

In the Eastern Pacific, Indian and Atlantic Oceans, tuna purse seine companies and RFMOs have adopted management measures to mitigate this impact. Conservation measures on NEFADs adopted by ICCAT, IOTC and IATTC have provided guidance and a powerful incentive for industry to take action to eliminate FADs capable of ghost fishing (Appendix 2). Collaborative fisher-scientist initiatives have also proven a powerful tool to promote bycatch mitigation. Given that the Western and Central Pacific is the principal tuna fishing ground in the world and dFAD use in this region is widespread, it would be desirable to phase out highly entangling dFADs to help prevent cryptic negative impacts on shark populations. Pilling et al., 2017, provided a comprehensive review of research on FAD structures, identified potential research activities in WCPO, and recommendations towards the use of non-entangling and biodegradable FADs in WCPO.

Table 1. Use of dFAD type by fleet according to entanglement characteristics. Source: ISSF Skippers´Workshop fishing master and captain questionaires. High Entanglement Risk (HER); Low Entanglement Risk (LER); Non-entanglement (NE). (Murua et al., 2017)

FLEET	OCEAN PRESENCE[1]	HERFAD (%)	LERFAD (%)	NEFAD (%)
Ecuador	EPO	39	43	21
Peru	EPO	0	100	0
Mexico	EPO	0	100	0
Spain	EPO, IO, AO	3	61	36
USA	EPO, WCPO	100	0	0
South Korea	WCPO	100	0	0
Taiwan	WCPO	100	0	0
China	WCPO	100	0	0
Indonesia[2]	WCPO, IO	0	0	100
France	IO, AO	0	73	27
Ghana	AO	4	88	16

Conclusion

Field research, fishers qualitative and quantitative information on shark entanglements together with the decrease of shark populations and knowledge gaps on the real impact of ghost fishing in megafauna and specially the difficulty to assess the numbers of sharks entangled, made ISSF take urgent action to avoid this cryptic, indirect fishing mortality by FAD structures. The solution, using non-entangling FADs was relatively simple, as has been proven by the adoption of these new designs by many fleets in the 3 oceans, allowing fishers to be as effective as before fishing tunas. The papers referenced in this document show research devoted to this issue, the degree of implementation in different fleets and recommendations to move towards the use of non-entangling FADs, including the WCPO.

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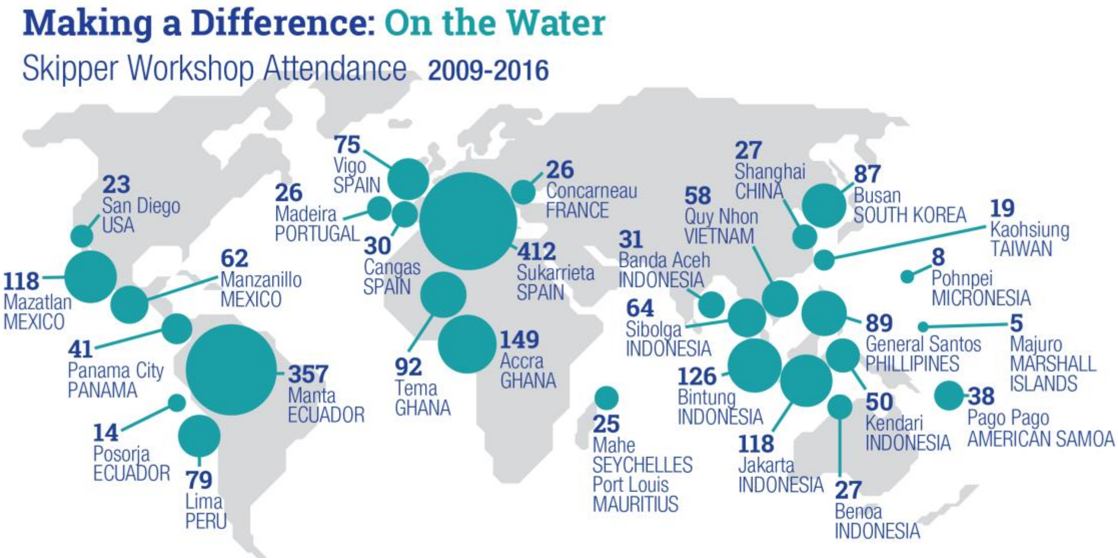
Appendix I. ISSF Skipper workshops attendance from 2009 to 2016



Appendix II. Tuna RFMO non-entangling and Biodegradable FAD related measures

Table 2. Non-entangling FAD related measures adopted by the different tuna RFMOs.

RFMO	DOCUMENT	WEB LINK
IATTC	Res. C-17-02	https://www.iattc.org/PDFFiles2/Resolutions/C-17-02-Tuna-conservation-in-the-EPO-2018-2020-and-amendment-to-Res.-C-17-01.pdf
IOTC	Res. 15/08	http://www.iotc.org/cmm/resolution-1308-procedures-fish-aggregating-devices-fads-management-plan-including-more-detailed
ICCAT	Rec. 16-01	http://iccat.int/Documents/Recs/compendiopdf-e/2016-01-e.pdf
WCPFC	N/A	–