Report of the 5th IOTC Working Group on FADs

Online, 4 – 6 October 2023

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ACRONYMS

AFAD	Anchored Fish Aggregating Device
ALD	Abandoned, Lost or Discarded
CECOFAD	Catch, effort and ecosystem Impacts of FAD fishing
CMM	Conservation and Management Measures (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting Parties and Cooperating Non-Contracting Parties
CPUE	Catch per unit of effort
DFAD	Drifting Fish Aggregating Device
EMS	Electronic Monitoring Systems
EPO	Eastern Pacific Ocean
FAD	Fish Aggregating Device
FOB	Floating Object
IOTC	Indian Ocean Tuna Commission
MP	Management Procedure
MSE	Management Strategy Evaluation
RFMO	Regional Fisheries Management Organisation
ROS	Regional Observer Scheme
SDG	Sustainable Development Goals
TAC	Total Allowable Catch
WCPO	Western-Central Pacific Ocean

KEY DEFINITIONS

Bycatch	All species, other than the 16 species listed in Annex B of the IOTC Agreement, caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence.
Discards	Any species, whether an IOTC species or bycatch species, which is not retained onboard for sale or consumption.
Large-scale driftnets	Gillnets or other nets or a combination of nets that are more than 2.5 kilometres in length whose purpose is to enmesh, entrap, or entangle fish by drifting on the surface of, or in, the water column.

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

SC16.07 (para. 23) The SC **ADOPTED** the reporting terminology contained in Appendix IV and **RECOMMENDED** that the Commission considers adopting the standardised IOTC Report terminology, to further improve the clarity of information sharing from, and among its subsidiary bodies.

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: ***From a subsidiary body of the Commission to the next level in the structure of the Commission:***

RECOMMENDED, RECOMMENDATION: Any conclusion or request for an action to be undertaken, from a subsidiary body of the Commission (Committee or Working Party), which is to be formally provided to the next level in the structure of the Commission for its consideration/endorsement (e.g., from a Working Party to the Scientific Committee; from a Committee to the Commission). The intention is that the higher body will consider the recommended action for endorsement under its own mandate, if the subsidiary body does not already have the required mandate. Ideally this should be task specific and contain a timeframe for completion.

Level 2: ***From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:***

REQUESTED: This term should only be used by a subsidiary body of the Commission if it does not wish to have the request formally adopted/endorsed by the next level in the structure of the Commission. For example, if a Committee wishes to seek additional input from a CPC on a particular topic, but does not wish to formalise the request beyond the mandate of the Committee, it may request that a set action be undertaken. Ideally this should be task specific and contain a timeframe for the completion.

Level 3: ***General terms to be used for consistency:***

AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.

NOTED/NOTING: Any point of discussion from a meeting which the IOTC body considers to be important enough to record in a meeting report for future reference.

Any other term: Any other term may be used in addition to the Level 3 terms to highlight to the reader of and IOTC report, the importance of the relevant paragraph. However, other terms used are considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3, described above (e.g., **CONSIDERED**; **URGED**; **ACKNOWLEDGED**).

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EXECUTIVE SUMMARY

The 5th Indian Ocean Tuna Commission (IOTC) Working Group on FADs (WGFAD) was held Online on Zoom from 4-6 October 2023. A total of 116 participants (77 at the first meeting in 2023 (4th Session), 111 in 2022, 93 in 2021 and 48 in 2017) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Co-Chairs, Mr Avelino Munwane and Dr Gorka Merino, who welcomed participants and formally opened the meeting.

The following are the complete recommendations from the WGFAD04 to the Working Party on Tropical Tunas which are also provided in Appendix V.

WGFAD05.01 (para 16) The WGFAD **NOTED** issues with the current 3FA form and **NOTED** that the revised FOB data reporting form responds to research needs and potentially covers important data gaps. However, several participants were not in a position to endorse them as they **NOTED** that the forms had not been made available to participants prior to the meeting. As such the WGFAD **RECOMMENDED** that these forms be reviewed by the WPTT for endorsement as this would provide sufficient time for all participants to thoroughly review them and provide meaningful input.

WGFAD05.02 (para 34) The WGFAD **NOTED** that the Jelly-FAD is an example of how the implementation of biodegradable DFADs can be achieved, further **NOTING** that other actions have been also carried out in the Indian Ocean for BIOFAD testing using alternative designs and materials and this work has been presented to the WGFAD and WPEB for many years. The WGFAD further **NOTED** that the IATTC has recently adopted a step-wise approach to the full adoption of biodegradable DFADs (IATTC C-23-04). The WGFAD therefore **RECOMMENDED** that the SC urge the Commission to initiate an ambitious step-wise approach for the implementation of biodegradable DFADs as soon as possible.

WGFAD05.03 (para 63) The WGFAD **NOTED** the potential social and economic losses and benefits of fisheries closures, and **RECOMMENDED** further studies to be conducted by the WP on socio-economics.

WGFAD05.04 (para 112) The WGFAD **NOTED** that the quantitative analyses presented during the meeting indicated that the most positive impact on the stocks for the three tuna species, in order of the largest benefits, would be a three-month complete closure for all gears then a two-month complete closure for all gears. The third most beneficial option for the three tuna species was a 3-month oceanwide PS log school closure. The stocks would also benefit from closures on handline (skipjack), baitboat (bigeye), gillnet (skipjack) and others (skipjack). However, the WGFAD **NOTED** that these benefits were estimated under the assumption that there would not be an increase in catches from other gears during this time. The analyses further indicated that the period to have the best outcomes from the closure would be during Q1, Q3 and Q4 for BET and YFT and Q3 and Q4 for SKJ. In addition, the WGFAD **RECALLED** that Resolution 23/03 (para. 3) states that "The IOTC Scientific Committee shall provide advice and recommendations no later than 31st December 2023 on appropriate fishing closures applicable to all fishing gears.". As such the WGFAD **RECOMMENDED** the WPTT take these analyses into

account and consider further analysis to be carried out intersessionally to assess the impacts of all gears on stock status so that this issue can be comprehensively addressed.

1. OPENING OF THE MEETING

1. The 5th Indian Ocean Tuna Commission (IOTC) Working Group on FADs (WGFAD) was held Online on Zoom from 4-6 October 2023. A total of 116 participants (77 at the first meeting in 2023 (4th Session), 111 in 2022, 93 in 2021 and 48 in 2017) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Co-Chairs, Mr Avelino Munwane and Dr Gorka Merino, who welcomed participants and formally opened the meeting.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

2. The WGFAD **ADOPTED** the Agenda provided in Appendix II. The documents presented to the WGFAD are listed in Appendix III.

3. THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS

3.1 Update on Resolution 23/02

3. The WGFAD **NOTED** a brief update provided by the Secretariat on the status of Resolution 23/02.

4. The WGFAD **NOTED** that due to 11 objections being received from Member countries (>1/3 of members) by the Secretariat to the Resolution 23/02, and in accordance with paragraph 7 (Article IX) of the IOTC Agreement, Resolution 23/02 did not come into force. This does not, however, preclude any or all Members from giving effect thereto, which remains documented within IOTC-2023-SS6-R and linked here.

4. REVIEW OF DATA AVAILABLE AT THE SECRETARIAT ON FADS

5. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-03 on a recent overview of large-scale purse seine fishery operating in the Indian Ocean with drifting Fish Aggregating Devices, with the following abstract provided by the authors:

   "We describe the capacity and composition of the large-scale purse seine fishery of the western Indian Ocean using drifting fish aggregating devices (DFADS) over the last two decades. In recent years, the fishery has been composed of 46 purse seiners of about 90 m length overall, representing a total fish hold volume of 97,000 m3. Purse seiners have shown a steady increase in length and capacity since the early 2000s and were assisted in 2022 by 13 support vessels of about 40 m length overall which are essentially devoted to the management of DFADs and the satellite-tracked buoys used for locating them and estimating the size of tuna aggregations. An average of about 13,600 DFADs have been reported to have been annually deployed in the fishery during 2019-2022, suggesting that more than 20,000 deployments occur every year in absence of data for Seychelles, and Oman and Tanzania in 2022. This figure is corroborated by the daily buoy position data available at the Secretariat since 2020." (see paper for full abstract)

6. The WGFAD **NOTED** that the total capacity of the Indian Ocean large-scale purse seine fishery expressed through its cumulative fish hold volume was close to 100,000 m^3 in 2022, corresponding to about 75,000 t of fish, less than the capacity of about 83,000 t estimated in 2020 for the purse seine fishery of the Atlantic Ocean.

7. The WGFAD **ACKNOWLEDGED** the uncertainties in the form 3FA which is used to report data associated with the Floating Objects (FOB) to the Secretariat, and **NOTED** the incompleteness or lack of data for certain fleets, including Seychelles, Oman, and Tanzania for the year 2022.

8. Some participants raised the concern that the ratio of support vessels to purse seine vessels presented in this paper may exceed what is permitted through Paragraph 18 of Resolution 21/01 and the WGFAD **NOTED** that this ratio is being monitored by the Compliance Committee.

9. The WGFAD **NOTED** that some progress on FOB-related data collection, entry and submission has been made by the Seychelles Fishing Authority (SFA) for 2022 and **URGED** Seychelles to manage the backlog and submit all data covering the period 2015-2022 to the Secretariat to make them available at the next session of the WGFAD.

10. The WGFAD **NOTED** that data on FOB types in relation to materials used for construction (i.e., limited to the inclusion of fishing nets as materials) were missing or inconsistent for certain fleets, and that the available data (driven by information submitted by EU,Spain) showed a decreasing trend in the use of DFADs using nets between 2015 and 2022 in line with the evolution of the applicable obligations defined by successive IOTC Resolutions.

11. The WGFAD **NOTED** that FOB-related data on types and materials used for construction mostly come from DFAD logbooks filled by skippers/captains including information on DFADs encountered and retrieved at sea (both belonging to the vessel and not). Some participants referred to anecdotal data collected from approximately 60 derelict DFADs in coastal countries across the Indian Ocean which indicated that all of these DFADs presented some risk of entanglement through design and/or materials (as they included shade cloth covers which some participants consider to have entangling properties), although there is no evidence that these were deployed before or after the ban on the use of entangling FADs came into force. This contradictory information requires further investigation and, therefore, the WGFAD **SUGGESTED** that observer data could be investigated to confirm the trends.

12. The WGFAD was **INFORMED** that data collected by scientific and electronic observers (EMS) onboard Spanish and Seychelles vessels indicated a substantial decrease in the proportion of entangling DFADs between 2015 and 2017 (IOTC-2019-WPEB15-33) which indicates a similar trend to that seen in DFAD logbook data. However, data collected through opportunistic sampling and presented to the Compliance Committee through information papers suggest that entangling DFADs designs are still found in derelict DFADs although there is no evidence that these were deployed before or after the ban on the use of entangling DFADs started.

13. The WGFAD **ACKNOWLEDGED** that information available from scientific observers would be instrumental to assess the extent of the use of non-entangling DFADs and biodegradable materials in the fishery and **REQUESTED** CPCs with purse seine fisheries to analyse observer data and report to the next WGFAD.

14. The WGFAD **AGREED** that the reporting of FOB-related data would benefit from the revision of the IOTC classifications on FOB types and activities, with the latter making the distinction between FOB- and buoy-related activities, **NOTING** how the extended classifications arising from the EU-funded CECOFAD project[1] would address scientific needs. Some participants were concerned however, that this improved classification may be less easily understood at the Commission level. However, it was specified that it responds to scientific needs as was highlighted to the WGFAD. The WGFAD further **NOTED** that the field on *FOB ownership* could be improved to include the flag and Vessel ID number of the vessel(s) to which the buoy was assigned and reflect whether or not the information on buoy

[1] Gaertner, D., Ariz, J., Bez, N., Clermidy, S., Moreno, G., Murua, H., Soto, M. (2016) Catch, Effort, and eCOsystem impacts of FAD-fishing (CECOFAD). Final Report***. N° MARE/2012/24, DG Mare European Commission. Polycopié 73 pp. + Annexes 94 pp.*** (www.cecofad.eu) *[IOTC-20216-WPTT18-35]*

position was available to the vessel. The WGFAD **NOTED** that introducing the time of the activity (GMT) would also be helpful to distinguish between individual activities in a day.

15. The WGFAD **NOTED** the drafts of two distinct types of new data reporting forms, which may replace form 3FA and were previously presented at the WGFAD04 and reviewed intersessionally by the Secretariat in collaboration with some experts of purse seine fisheries, **NOTING** that the final versions of the forms were not provided back to the group for information or feedback.

16. The WGFAD **NOTED** issues with the current 3FA form and **NOTED** that the revised FOB data reporting forms respond to research needs and cover important data gaps. However, several participants were not yet able to endorse them as they **NOTED** that the forms had not been made available to the public prior to the meeting. As such the WGFAD **RECOMMENDED** that these forms be reviewed by the WPTT for endorsement as this would provide sufficient time for all participants to thoroughly review them and provide meaningful input.

5. COMMISSION REQUESTS TO THE SC UNDER RESOLUTIONS 23/03 AND 23/04

5.1 Alternative FAD management options

5.1.1 Mitigating by-catch

17. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-05 titled 'Significant underreporting of Bycatch and Ecosystem Impacts in Tuna Purse Seine Fisheries', with the following abstract provided by the authors:

> *"While it is well known that purse seine fleets capture more juvenile tuna and more bycatch species when setting their nets around drifting Fish Aggregating Devices (dFADs), the broader ecosystem impacts caused by dFADs are not well quantified. Some research into the bycatch rates associated with tuna purse seine fishing has aimed to quantify the direct bycatch of animals that is noted by observers aboard vessels, but many feel that those estimations do not provide the full story of purse seine fleets impacts upon non-tuna species and their habitats. This is because what an observer records aboard a fishing vessel that is actively fishing does not capture the entanglement, pollution and direct habitat damage caused by drifting FADs. Ultimately, quantifying the bycatch captured within a purse seine net when it is hauled onboard only deals with a potentially small proportion of the real damage actually caused by drifting FADs, and the survivorship of animals discarded overboard as bycatch has only been lightly assessed for a few of the species that face these impacts."*

18. The WGFAD **NOTED** that some participants highlighted that the information in this paper is based on work conducted in the last decade but that some of the studies pre-date the implementation of the Resolution now in place in the IOTC area.

19. The WGFAD **NOTED** that the recommendation to release silky sharks from nets may not always be practical as in many cases there will be several individuals found in each net. The WGFAD **NOTED** that avoiding bycatch interactions is the best strategy for reducing mortality of silky sharks, however to date, effective deterrents have not been developed for IOTC fisheries and more research is required on spatial risk assessments. The WGFAD **NOTED** a paper that was presented during the WPEB (IOTC-2023-WPEB19-17) which highlighted that on Spanish purse seine vessels, unobserved catches of silky sharks had been found in the wells of the vessels during port sampling and **NOTED** that the two hypotheses of this paper were: that this could be another potential source of underreporting of catches of this species or it could be a fraction of bycatch which could not be observed at the moment of loading of the catch. The WGFAD **NOTED** that this requires further investigation.

20. The WGFAD **NOTED** that the latest studies on silky shark mortality when using shark release devices showed that the post release survivorship can increase up to 40% for silky shark (IOTC-2021-WPEB17(DP)-13 and IOTC-2022-WGFAD03-09) and up to 82% for oceanic whitetip shark (IOTC-2023-WPEB19-18). The WGFAD also **NOTED** a paper presented during the last WPEB based on observer information which suggested a stable or increasing abundance of silky sharks in purse seines between 2012 and 2021 (IOTC-2023-WPEB19-34_rev1). Some participants disagreed with the conclusion of this paper of an increasing abundance of silky shark, stating that the decrease in the rates of encounters between purse seiners and silky sharks may in fact be due to a decline in the silky shark population.

21. Some participants **NOTED** that many papers cited during this presentation are now fairly dated (such as Filmalter et al. 2013) and further **NOTED** that a lot has changed in the fishery since the paper was published, including the mandatory use of fully non-entangling DFADs and the prohibition on the use of entangling materials and mesh in the construction of DFADs as implemented by Resolution 19/02 since 2020.

22. The WGFAD was **INFORMED** that purse seine fleets have been implementing a number of mitigation measures with the objective of reducing the mortality of sharks including the development of DFAD designs with no netting since the 2010s and the increased use of techniques and releasing devices onboard vessels to improve post-release survival of sensitive bycatch species. The WGFAD **NOTED** that future work to help reduce shark mortality could include spatial risk assessments to be used for management and trialling deterrents as a mitigation measure.

23. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-07 which described guidelines to reduce the impact of drifting Fish Aggregating Devices on sea turtles, with the following abstract provided by the authors:

> *"Scientific assessments of the impact of tropical tuna purse seine fishery on sea turtle populations indicate historically low turtle bycatch rates. This conception has been derived from direct capture or interaction of sea turtles with purse seine gear, where turtles have been hauled on board with targeted schools of tunas. However, the massive increase in the use of drifting Fish Aggregating Devices (FADs) by the tropical tuna purse seine fishery worldwide raises concerns about potential impacts on sea turtles. The two main concerns are related to the potential entanglement of sea turtles on FAD structures (i.e., ghost-fishing issues) and the potential impact of these structures when lost or abandoned on sea turtle essential habitats. Therefore, this document presents a series of guidelines to reduce the impact of FADs on sea turtles. These guidelines resulted from workshops between fishers and scientists conducted within a Pacific-wide project led by the International Seafood Sustainability Foundation in partnership with the Inter-American Tropical Tuna Commission, The Pacific Community, and Hawaii Pacific University."*

24. the WGFAD **NOTED** the observation explained by the authors that the impact of tropical tuna purse seine fishery on sea turtle populations indicate historically low turtle bycatch rates related to the active catch of turtles with the purse seine gear. However, there is not a scientific assessment on the potential impact of entanglement by DFAD structures on sea turtle populations. The WGFAD **NOTED** that nowadays the use of netting is forbidden in DFADs and thus, the entanglement risk should be very low. Furthermore, the authors are working to develop biodegradable non-entangling DFADs that degrade within one year which the authors believe to be a good solution for reducing sea turtle mortality in DFADs.

25. The WGFAD **NOTED** that onboard observers collect data on DFAD design and materials during DFAD deployments and that these data can be used to better understand the risk of entanglement of

deployed DFADs. The WGFAD **NOTED** that at the time of entanglement of turtles or other animals, it can be challenging to determine the type of DFAD design so it is important to collect this information at the time of deployment. The WGFAD further **NOTED** that onboard and EMS observers may help to record information on DFAD designs during DFAD deployment and that clear marking of DFADs, as required under Resolution 19/02, would need to be implemented at scale to enable further research and facilitate the monitoring of the whole lifecycle of a DFAD.

26. The WGFAD **NOTED** that while this study was carried out only in the Pacific Ocean, the guidelines and best practice recommendations arising from it are likely to also be applicable in the Indian Ocean.

27. The WGFAD **NOTED** that for biodegradable DFADs, retrieval is less important than for non-biodegradable DFADs to reduce pollution, but it should still be encouraged to avoid stranding of DFADs, and because of the plastic and hazardous materials present within the satellite buoys used to track DFADs and logs.

28. The WGFAD **NOTED** that DFADs with no netting or other meshed materials should cause minimal risk of turtle entanglement while **ACKNOWLEDGING** that there may be potential impacts on turtle habitats (through DFAD beaching) that have not been measured.

5.1.2 Mitigating habitat impact (FAD loss, beaching, etc.)

29. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-06 which provided information on new results on the performance of Jelly FADs, including the following abstract provided by the authors:

> *"Fishers and scientists in the three tropical oceans are investigating different designs of biodegradable FADs (bio-FAD) efficient for fishing. The tactic followed by most fishers is to maintain the same conventional drifting FAD (dFAD) design (submerged netting panels hanging from the raft) but made of organic ropes and canvas (e.g., cotton, yute, abaca, etc.). Results of those experiences show that the lifetime of bio-FADs that maintain the conventional dFAD design but made of organic materials, is shorter than that required by most fishers. The short lifespan of those bio-FADs is due to the structural stress suffered by dFAD designs conventionally used. We present the Jelly-FAD, a new concept on bio-FAD design that mirroring jellyfish, drifts with quasi-neutral buoyancy, which reduces (i) the structural stress of the FAD at sea and (ii) the need for additional plastic flotation. The jelly-FAD is not necessarily a fixed design; it is more of a change in the concept of conventional dFAD construction."* – see document for full abstract.

30. The WGFAD **NOTED** that currently there is no evidence to show that the catch or size composition under jelly-FADs differs from that for other DFAD designs. As such they should not affect the target catches for the fishers. The WGFAD **NOTED** that there is no scientific evidence about the effect of the structure type on the species composition found under FADs.

31. Some participants suggested that it would be beneficial to encourage fleets to build their DFADs on land in order to certify that the specified DFAD designs have been followed. The WGFAD **NOTED** that this solution is already in place for some fleets and has been tested by others, but further **NOTED** that this may be more challenging for smaller companies with fewer vessels and fewer facilities to be able to do so.

32. The WGFAD **NOTED** that while bamboo has been used as a raw material for jelly-FAD construction, it may not be the only suitable material and further **NOTED** the intention to conduct tests with other materials in controlled conditions. The WGFAD **NOTED** the view of some participants that it could be challenging to use bamboo in some regions (such as Seychelles) where there is frequently a lack of availability of this material.

33. The WGFAD **NOTED** that while there have been no scientific trials of jelly-FADs in the Indian Ocean to date, other biodegradable FAD designs have been trialled and it is likely that similar results will be obtained in this region as have been seen in the Pacific Ocean with the Jelly-FAD. The WGFAD further **NOTED** that Jelly-FADs and other BIOFAD designs can be adapted to the specific case of the Indian Ocean.

34. The WGFAD **NOTED** that the Jelly-FAD is an example of how the implementation of biodegradable DFADs can be achieved, further **NOTING** that other actions have been also carried out in the Indian Ocean for BIOFAD testing using alternative designs and materials and this work has been presented to the WGFAD and WPEB for many years. The WGFAD further **NOTED** that the IATTC has recently adopted a step-wise approach to the full adoption of biodegradable DFADs (IATTC C-23-04). The WGFAD therefore **RECOMMENDED** that the SC urge the Commission to initiate an ambitious step-wise approach for the implementation of biodegradable DFADs as soon as possible.

35. Some participants were of the view that the cotton canvas used in jelly-FAD designs could be considered a meshed material, and therefore may pose an entanglement risk as it degrades and that this should be further investigated. However, this comment was not supported by any scientific evidence or paper presented during the meeting.

36. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-08 which assessed Drifting Fish Aggregating Device (dFAD) Abandonment under International Marine Pollution Law, including the following abstract provided by the authors:

> *"This article addresses the debated question whether the abandonment of drifting fish aggregating devices (dFADs) is illegal from the perspective of international marine pollution law. It first provides a brief overview of the general international legal framework for the protection of the marine environment contained in Part XII of the United Nations Convention on the Law of the Sea (UNCLOS). Next, this article examines the specific international legal regime concerning pollution by dumping, namely the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC) and its 1996 Protocol (LP). Thereafter, it analyzes the international legal regime concerning pollution from vessels under the International Convention for the Prevention of Pollution from Ships (MARPOL), Annex V of which contains provisions on the discharge of garbage, including fishing gear. The article concludes that while the delimitation of the two regimes is difficult, the abandonment of dFADs contravenes either the LC/LP or, if a different interpretation is adopted, MARPOL Annex V."* – see document for full abstract.

37. The WGFAD **NOTED** that while it is important to take the legal landscape into account while designing CMMs for DFADs, some participants **SUGGESTED** that this is probably not the appropriate forum for this discussion but it would likely be of interest to the Compliance Committee (CoC). The WGFAD therefore **REQUESTED** that this paper be discussed during the WPICMM to report to the CoC.

38. The WGFAD **NOTED** the view of some participants that one of the potential consequences of DFAD closures could be the increased deactivation of operational buoys of DFADs lost outside fishing grounds during a closure and difficulties in DFAD recovery during a closure which could lead to an increase in pollution from this equipment although the legality of this abandonment would need to be discussed in the relevant forum. Some participants raised concerns about the potential increase in pollution associated with a DFAD closure due to the difficulty in collecting DFADs from areas where vessels are not actively fishing.

39. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-09 titled "Evidence of ongoing non-compliance of drifting FADs, and the associated impacts this has on Indian Ocean biodiversity." No abstract was provided by the authors.

40. The WGFAD **ENCOURAGED** the author to collaborate with organisations that have access to DFAD trajectory data in order to better understand the situation with the adoption of non-entangling DFADs in the Indian Ocean.

41. Some participants **NOTED** that it was not clear from the paper whether the DFADs encountered were constructed before the requirement to use non-entangling gear was implemented.

42. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-10 which provided feedback from the ISSF Workshop on Different Approaches to Limit the Number of FADs in the Oceans, including the following abstract provided by the authors:

> *"At its October 2022 meeting, the ISSF Scientific Advisory Committee recommended that ISSF convene a workshop with a small group of experts to consider different principles of economic theory which could be used to make Fish Aggregating Devices (FAD) limits more effective. The rationale for such a workshop was that the use of FADs, both drifting (dFAD) and anchored (aFAD), has a number of known impacts on target tuna stocks, non-target species and the broader ecosystem. Limiting the number of FADs in each Ocean region, together with other measures such as biodegradable FADs, can be a tool to address several, if not most, of these impacts. Recommendations are given on actions that can be taken to incentivize fewer FAD deployments and higher rates of FAD recovery"* – see document for full abstract.

43. The WGFAD **NOTED** a number of suggestions to best manage DFADs including the use of a centralised system to monitor and control the deployment of DFADs. The WGFAD **NOTED** a suggestion that the introduction of fees to maintain such a system should cover the entire life cycle of each DFAD including the period when the fishing vessels are no longer interested in using the DFAD. This would cover the cost of DFAD retrieval and clean up. The WGFAD **NOTED** the further suggestion that the information contained within the system should be made available to retrieval programs.

44. The WGFAD **NOTED** a recommendation from the paper for a DFAD register which could help to improve the amount of responsibility taken by DFAD owners for their DFADs, in particular at the end of life, which had support from some participants.

45. Some participants **NOTED** that the sharing of DFADs between fleets, and sharing of the data they produce, should be encouraged to reduce the number of DFADs needing to be deployed and used at sea.

46. Some participants suggested that the DFAD Register and independent DFAD monitoring system proposed under Resolution 23/02 were not too dissimilar to, and could result in similar benefits to, those recommended through this paper.

47. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-18 which described developing a data standard for the retrieval of abandoned and lost FADs in the Indian Ocean, including the following abstract provided by the authors:

> *"The Indian Ocean has seen a significant increase in the number of dFADs used in purse seine fisheries, which has resulted in an exponential rise in tropical tuna catches. However, the negative impacts such as catches of juvenile tunas, increase in several non-targeted species, ghost fishing and abandoned and lost fishing gear remain a significant concern of*

developing coastal States. As fisheries managers debate the trade-offs between mitigating adverse environmental impacts and economics around the value of tuna landings, there is very little data regarding lost and abandoned FADs in the Indian Ocean, and the ecological implications of these. When there are data, there is little cohesion between different data collection systems. This paper aims to review the data protocols used by member countries, RFMOs, and independent entities for collecting data on abandoned and lost dFADs, and to propose a tool to collect data on retrieval of abandoned and lost FADs. The proposed data collection tool is based on four different elements: dFAD retrieval information, dFAD material information, the fate of dFAD/the buoy, and the impacts on the marine environment."

48. The WGFAD **NOTED** a set of proposed data collection forms for DFADs which are aimed at collecting information on lost and abandoned DFADs stranded in and retrieved from coastal areas. The WGFAD **ENCOURAGED** the authors to review the data collection forms developed by the IOTC Secretariat on all types of activities on FOBs to assess the amount of overlap between the two sets of forms.

49. However, in the meantime, the WGFAD **NOTED** the interest in the proposed data form for the retrieval of abandoned and lost FADs in the Indian Ocean and **REQUESTED** coastal states to utilise the form to maintain consistency across different FAD retrieval programs led by IOTC CPCs and independent entities. The form can be seen in Appendix IV.

50. The WGFAD **NOTED** that in the Indian Ocean there are a number of different gears (in comparison to the Pacific Ocean where purse seine is the predominant gear) so data collection forms could also be developed for reporting other lost fishing gears, considering the impacts of other gears in the Indian Ocean.

51. The WGFAD **NOTED** that the preliminary data shows that 93% of the 102 DFADs recovered in coastal areas in Somalia had identification marks and/or buoys still attached when they were recovered showing that DFAD marking as required under Resolution 19/02 is achieved already through their instrumented buoys. However, while the ID number provided by the instrumented buoy manufacturer is regularly marked on recovered buoys, none of the DFADs recovered by this initiative had the IOTC registration number of the deploying vessel marked on them as is required by Resolution 19/02.

52. The WGFAD **NOTED** that due to the practice of transferring DFADs between vessels and fleets, even if identifying marks are still attached, it may not reflect the actual current owner or last user of the DFAD, meaning that it is not always possible to link these marks with the owner of the DFAD. The WGFAD further **NOTED** that this means that it would be difficult to cross-reference data collected in coastal areas with those collected by observers when the DFADs are being deployed.

53. The WGFAD **NOTED** that in many coastal countries, it is not feasible to recover DFADs while they are still at sea, particularly in the absence of positional data available to those coastal countries, meaning that the majority of DFADs found in coastal areas are retrieved from beaches or reefs. The WGFAD **NOTED** that results from the presented study are therefore likely to reflect only a relatively small proportion of the abandoned and lost DFADs stranded within coastal state waters.

54. The WGFAD **NOTED** the low DFAD recovery numbers compared with the number of DFADs being deployed. The WGFAD **NOTED** that a mechanism should be developed for facilitating the recovery of DFADs. The WGFAD **NOTED** that there is currently no centralised mechanism for reporting the end of life of DFADs or for DFAD recovery. The view of some participants was that the implementation of the DFAD register and independent DFAD monitoring system proposed under Resolution 23/02 could help resolve this issue.

5.2 On closures (area, period modalities, full closure, DFADs closure, exploring other gears etc.)

55. The WGFAD **RECALLED** that a workplan for evaluating and assessing the effects of the DFAD closure and several related issues was created during WGFAD04 meeting in May. A variety of workstreams were subsequently conducted with the aim of providing advice to the Commission on the subject.

5.2.1 Review of closures in tuna RFMOs

56. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-11 which provided a review of drifting FAD Closures across tuna RFMOs, their histories, context and socioeconomic considerations, including the following abstract provided by the authors:

> *"Over the past decade it has become common practice to implement either drifting FAD (dFAD) or more complete Fishing Closures covering the entire Area of Competence (1) of tropical tuna RFMOs covering periods of 72 days or more. As such, FAD Closures have become standard and important conservation measures across all tropical tuna RFMOs globally, except for in the Indian Ocean under the IOTC to date. In all instances, these closures have been initially applied as precautionary management measures seeking to address the stock and habitat damage caused by dFADs that continues to be a key concern raised by a wide range of scientists over many decades. Fishing around drifting FADs is the largest driver of juvenile bigeye and yellowfin tuna harvests in the Indian Ocean and globally, making it logical that halting the use of dFADs through FAD Closures would help to mitigate the negative stock and habitat impacts caused by these devices. A persistent lack of operational and data transparency among tuna purse seine fleets (2,3) is another reason why dFAD closures have generally been developed and initiated as precautionary measures (4). It is therefore particularly unfortunate that calls for a scientific approach to be applied, is often hampered by a lack of scientific data sharing by CPCs involved in purse seine fishing using dFADs."*

57. The WGFAD **ACKNOWLEDGED** that the IOTC is one of the two tropical tuna RFMOs (IOTC and IATTC) that does not yet have a DFAD closure in place, another two (WCPFC, ICCAT) do have a PS closure in place. The other tropical tuna RFMO that does not have a DFAD closure, the IATTC, has a fishing closure in place specifically for larger purse seine vessels, which takes over 90% of the total catch in the IATTC.

58. The WGFAD **NOTED** that in ICCAT and WCPFC, DFAD closures now occur for at least 72 days and cover the entire Area of Competence for each RFMO, and these were implemented after initially trialling closures in smaller areas which were compromised by compliance issues and geographic shifts in purse seine fishing effort. In IATTC there is a full purse seine closure implemented for 72 days for large purse seine vessels with no specific measures relating to DFADs.

59. Some participants were of the opinion that the implementation of a DFAD closure is anticipated to have a substantial positive socio-economic benefit for Indian Ocean coastal States.

60. The WGFAD **NOTED** that since the WCPFC and ICCAT implemented DFAD closures, the stock status of their bigeye stocks may have somewhat improved but, in the case of Atlantic bigeye, have not yet fully recovered from being in an overfished state. Although the WGFAD **ACKNOWLEDGED** that closures can contribute to lowering the fishing mortality of these stocks, especially for juveniles, some participants of the WGFAD **NOTED** that the change in estimated stock status for the ICCAT and WCPFC bigeye tuna stocks may have been caused by changes in stock assessment methodology (i.e., a different growth curve that assumed the fish has a smaller maximum length than previously thought for WCPFC, and a different approach to CPUE standardisation was than had been previously taken for ICCAT). As a result, it is unclear to what extent the recovery can be attributed to the closure.

61. The WGFAD **NOTED** that fishing on anchored FADs also results in high catches of juvenile bigeye and yellowfin tuna, comparable in terms of percentage to catches on DFADs, so their impacts should also be considered in management discussions. The WGFAD also **NOTED** that catches around anchored FAD are much lower in absolute terms than those from drifting FADs.

62. The WGFAD **NOTED** that there are many available studies on the social economics implications of fisheries closures, which can be an important subject for the newly formed Working Party on socio-economics while further **NOTING** that it would be important for this new Working Party to conduct further research on this topic.

63. The WGFAD **NOTED** the potential social and economic losses and benefits of fisheries closures, and **RECOMMENDED** further studies to be conducted by the Working Party on socio-economics.

64. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-17 on a review of fisheries closures in tropical tuna RFMO, including the following abstract provided by the authors:

> *"There are different management approaches in the tuna RFMOs that manage tropical tunas, ranging from input or effort control in the Pacific Ocean tuna RFMOs to output or catch control in the Atlantic and Indian Oceans. In some cases, input controls are used for some fisheries and catch controls for others. Among the various management options and tools, full purse seiners closures and FAD closures are also utilized, each serving distinct overarching management objectives. For instance, full closures are the primary management tool employed by the IATTC for purse seiners, whereas FAD closures serve as supplementary management options to attain various objectives within ICCAT and WCPFC."* – see document for full abstract.

65. The WGFAD **NOTED** that WCPFC has been implementing DFAD closures for more than 15 years. The WGFAD **NOTED** that DFAD closures could have several advantages but that the type and length of a necessary closure, will depend on the fisheries and stock's characteristics as well as the management goal. The WGFAD **NOTED** that the closing of the FAD fishery may reduce the fishing mortality for juveniles in the region. However, the WGFAD further **NOTED** that considering catch and fishing mortality reductions or closures across all fishing gears fleets will be more effective if the management goal is to reduce the overall fishing mortality.

66. The WGFAD **NOTED** that during the DFAD closure, purse seine fleets in other tRFMOs have switched to fishing on free schools. The WGFAD **NOTED** that for the yellowfin fishery in IOTC, setting on free schools results in catching a mixture of juvenile and adult fish while the FAD fishery, which targets skipjack tuna, also catches juvenile yellowfin and bigeye tuna. Therefore, the fleet can still reduce the fishing mortality of juvenile yellowfin and bigeye even if it switches to fishing on free schools, although this will represent a loss in terms of catches of skipjack. However, the WGFAD further **NOTED** that at IOTC, under the existing yellowfin catch limit, the fleet may purposefully avoid free schools to prevent the quota from filling up too rapidly so that they can continue to fish for skipjack tuna, the main target species.

67. The WGFAD **NOTED** that although tRFMOs have different management objectives their main goal is common, which is to protect tuna resources. The WGFAD further **NOTED** that while output controls are more directly aligned with management goals, some RFMO are using input controls (effort based controls) as a main measure to manage purse seine fisheries, while other are using output controls as primary measure (TAC and catch limits or quotas).

68. The WGFAD **NOTED** that in IOTC, Resolution 19/02 provides provisions for the management of supply vessels and that supply vessels can increase fleet efficiency and fishing pressure while also being used for DFAD retrieval. The WGFAD **NOTED** that the best management practices must also

take into account costs and benefits, as well as the various fisheries' characteristics and management goals.

69. The WGFAD **AGREED** that there should be specific management goals when evaluating the DFAD closure. For example, when WCPFC first initiated the FAD closure, the objective was to decrease the catches of juvenile bigeye tuna in accordance with the length of closure but juvenile bigeye catches have remained at the same levels. Given that there are sometimes several rounds of FAD closure measures at various RFMOs, the WGFAD **REQUESTED** that the authors look at whether the closure was able to achieve the original goals it was intended for.

5.2.2 Consequences of temporal/spatial closures

70. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-12 on whether drifting FADs should be managed with closures in IOTC including what can be learned from experiences in other RFMOs, including the following abstract provided by the authors:

> *"In the Indian Ocean, the potential benefits of implementing a "DFAD closure period" has been extensively discussed in recent years, as a means to reduce catches of juveniles of yellowfin and bigeye tunas, so as to improve stock status for these two species in the Indian Ocean. In this document, we provide an overview of existing closures in IATTC, ICCAT and WCPFC and past closures in IOTC. Using catch data in the Indian Ocean, Eastern Pacific Ocean, Western and Central Pacific Ocean and Atlantic Ocean and a review of existing Conservation and Management measures, we examine the following questions: (1) how do purse seine FOB fisheries look like in each tuna RFMO? (2) why have closures been implemented in t-RFMOs and how? (3) how is the efficiency of closures assessed in t-RFMOs and are they reaching their objectives? (4) are there alternative options in place in other t-RFMOs that may be useful to consider in IOTC? The comparison of closures across t-RFMOs indicate that this management option has been adopted in other oceans with the primary objective of mitigating catches of juvenile bigeye tuna, through a limitation of FOB catches and/or a limitation of PS fishing effort. Experience in other t-RFMO tends to indicate that the sole implementation of closures is not sufficient and complementary measures are explored or implemented in other oceans (other measures on FOBs, limits on fishing effort, catch limits for other gears, etc)."*

71. The WGFAD **NOTED** that several time-area closures concerning purse seine fisheries have been implemented by the different tRFMOs since the late 1990s, and that all of them were initially established to reduce the fishing mortality on juveniles of bigeye tuna and/or yellowfin tuna.

72. The WGFAD **NOTED** that two time-area closures concerning purse seine fisheries were implemented in the Indian Ocean in the past: (1) an industry voluntary 2-month (November 15, 1998 to January 01, 1999) closure to DFAD fishing, including a ban on DFAD deployments and buoy transfers in an area delimited by 5°S-10°N and 53°E to the African coast and (2) a 1-month full closure to purse seine fishing in November between 2011 and 2014 in an area extending from 0-10° N and 40°-60° E (IOTC Resolution 10/01 and IOTC Resolution 12/13).

73. The WGFAD **NOTED** that the effects of time-area closures for purse seine fisheries across tRFMOs have generally been assessed through the changes in catches of juveniles of bigeye and yellowfin tunas, identification of catch hotspots, and effects on stock MSY estimated through modelling approaches.

74. The WGFAD **NOTED** that the success of time-area closures in terms of reaching the objectives initially defined was generally difficult to assess due to the multiple factors involved in the dynamics of tuna stocks and fisheries, the adaptation of fishers to the closures through changes in strategies (e.g.,

effort reallocation), and changes in the configuration and input parameters (e.g., growth) of assessment models.

75. In the case of the Indian Ocean, the WGFAD **NOTED** that the abandonment of the time-area closures was due to the month selected for the closure, the relatively small size of the closure area, redistribution of effort in other fishing grounds, and the possibility for support vessels to operate in the area during the closure to deploy and maintain DFADs within the area.

76. The WGFAD **NOTED** that the main purse seine fishing season is between August and October and that a PS or FOB closure during this period would have a large impact on catches of skipjack.

77. The WGFAD **NOTED** that support vessels would need to be properly managed or potentially banned if the Commission decides to adopt a closure. However, the WGFAD **ACKNOWLEDGED** the view of some participants that support vessels also have a role in retrieving DFADs that may be lost otherwise and that their ban from the area might also result in increased numbers of derelict DFADs in the Indian Ocean.

78. The WGFAD **NOTED** that the acronym FOB, standing for "floating object", currently includes both human-made objects built and deployed by fishers to attract fish and natural objects (e.g., tree logs; LOG) opportunistically encountered, both of which may be equipped with satellite-tracked buoys and used for fishing on associated schools in the purse seine fishery. The WGFAD further **NOTED** that, other than skipjack tuna, which is the target of the fishery, both human-made and natural FOBs have a similar effect of attracting juvenile tunas.

79. The WGFAD **NOTED** that the distinction between DFADs and LOGs is not only useful for scientific purposes, but it is also important for management as it allows the identification of the source of marine pollution or risks of entanglement.

80. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-14 which discussed whether FAD fishing is an 'economic trap'. It also noted the effects of a seasonal closure and other management measures on the IO purse-seine tuna fishery, including the following abstract provided by the authors:

> *"The management of drifting Fish Aggregating Devices (dFADs) creates heated debates in tuna fishery management organizations striving to reduce the number of deployed floating objects. Through several econometric models and a machine learning approach, we first evaluate the consequences of three management scenarios on the catch and profit of the French purse-seine fleet operating in the Indian Ocean: 1) a half reduction in the number of authorized buoys per vessel, 2) a 72-day closure of dFAD fishing with re-allocation of effort on free schools and 3) a 72-day closure of dFAD fishing without re-allocation of effort on free schools. The results show a significant decrease of fleet profits by 7%, 10% and 18%, respectively. We hypothesize an "economic trap" of dFAD fishing caused by the dilemma between using dFADs increasingly to avoid the large yellowfin caught on free schools and, in case of reallocation towards free-school fishing, the catch limitation of yellowfin and bigeye tunas in the Indian Ocean*

81. The WGFAD **THANKED** the authors and **CONGRATULATED** them for the work, **NOTING** that there are few economic studies dealing with the effects of management measures on Indian Ocean tuna fisheries.

82. The WGFAD **NOTED** that the number of DFADs in the fishery may be too high and that reducing their number may help to reduce catches of yellowfin.

83. The WGFAD **NOTED** that the 'economic trap' as referred to in the paper concept refers to the economic dependency of some coastal countries (i.e., Seychelles, Mauritius) on purse seine fishing

activities through stevedoring, ship-chandling, fishing fees, and post-harvest activities (e.g., processing factories, transport).

84. The WGFAD **AGREED** that the assessment of the effects of DFAD closures should go beyond the macroeconomic dimension of the target fisheries and include microeconomic as well as social and cultural impacts for the entire fishery, e.g., contribution to food security, livelihoods and social welfare which are an integral part of the UN SDGs.

85. The WGFAD **NOTED** that the study was focused on the French component of the purse seine fishery and **ENCOURAGED** the authors to extend the work to also include the Spanish fleet as there are differences between the two fleets in terms of vessel size, structure, costs, and DFAD fishing strategy.

86. The WGFAD **NOTED** that even though the relationship between the number of buoys used and catch per vessel was low, the results of the study should be interpreted with caution when it comes to defining an optimal maximum number of buoys available to each purse seiner.

87. The WGFAD **NOTED** the simulation scenarios developed in the study to identify the potential impacts on the Seychelles from a 72-day DFAD closure. The presented simulation scenarios resulting from a 72-day ban without effort reallocation estimates that there will be a 12% decrease in supply available to the Seychelles cannery based on interviews with relevant stakeholders. The WGFAD further **NOTED** that this scenario would affect all sectors along the supply chain and eventually result in an increase of the public debt in Seychelles by 4.4% after 7 years.

88. Some participants suggested that the cost of inaction should also be further analysed from a socio-economic perspective. Some participants considered the effects of the closure to be overestimated as the fish storage facilities in Seychelles combined with imports from other oceans would be expected to buffer the shortage of supply during the period of the ban. The authors indicated that the figures on storage capacity were based on surveys of the managers of IOT Ltd. (Seychelles) and IBL (Mauritius) and that fish stored in the factories could supply the cannery activities for a maximum of ~4-6 weeks.

89. Some participants were of the view that during a DFAD closure, purse seiners are likely to switch to targeting free schools (which will help to enable a continuous supply to the canneries) while acknowledging that many vessels do not like to target free schools as they tend to catch more larger yellowfin which leads to them approach their catch limits more quickly.

90. The WGFAD **ACKNOWLEDGED** that the study only covered the large-scale purse seine fishery and that the expected potential regionwide social and economic effects of the DFAD closure on coastal fisheries should also be considered.

91. The WGFAD **NOTED** that the paper was a combination of two papers that were in review in a scientific journal and that the authors would share the equations and scripts with anyone interested as soon as they have been accepted for publication.

5.2.3 Statistical analysis to assess the effect on spatial/temporal juvenile catch.

92. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-15 which provided information on size composition of yellowfin and bigeye tuna in IOTC fisheries, including the following abstract provided by the authors:

> *"The Indian Ocean Tuna Commission (IOTC) is responsible for managing tuna and tuna-like species in the Indian Ocean, including yellowfin tuna (Thunnus albacares) and bigeye tune (Thunnus obesus) throughout the IOTC area of competence. The report of the IOTC performance review panel highlighted that it is necessary for IOTC to adopt the FAO*

Precautionary Principle which requires that management advice is based on the best scientific evidence, taking account of uncertainty. A clear understanding of the size distributions of yellowfin and bigeye tuna caught by the different fleets in the Indian Ocean, including impacts of different gear types and spatial differences will be vital in understanding the potential impact of any proposed spatio-temporal closures on fishing activities. The purpose of this paper is to present data that already exist in IOTC datasets through a summary of the size frequency data, catch and catch distribution data for yellowfin tuna available for all Members to support any decision-making process at this Working Group. This paper does not recommend any particular option or direction for management of FADs it is here purely for information."

93. The WGFAD **THANKED** the authors for the work and availability of R scripts to analyse and visualise the size-frequency distributions of yellowfin and bigeye tunas available from the IOTC Secretariat.

94. The WGFAD **NOTED** the graphical presentation on the yellowfin tuna size-frequency data from the IOTC Secretariat database of several fisheries, particularly of the large purse seine fisheries, **NOTING** that the analysis of the samples available by regions in the Indian Ocean indicated gaps with areas with low sampling coverage for future sample enhancement.

95. The WGFAD **NOTED** that the monthly size-frequency distributions observed between August and October suggest that those months could be good candidates for a potential closure period for DFADs, further **NOTING** that the effects of the closure on other fisheries, including the free school purse seine fishery, should also be considered.

96. The WGFAD **NOTED** that the size-frequency distribution of the majority of yellowfin tuna caught on DFADs by purse seine fisheries and around AFADs by baitboats and purse seines are below the length of first maturity estimated at about ~100 cm and **NOTED** that the FAD closure would likely reduce the numbers of juvenile yellowfin tunas caught and their associated exploitation rates, provided that the catches of other fisheries remain at status quo levels.

97. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-16 which provided information on TS measurements of ex-situ yellowfin tuna (*Thunnus albacares*) and frequency-response discrimination for tropical tuna species, including the following abstract provided by the authors:

"Tuna fisheries support one of the world's most valuable markets, with over 50% of the catch coming from drifting fish aggregating devices (DFADs). To locate and quantify tuna on DFADs, fishermen mostly use acoustic technologies, which significantly reduce the nominal fishing effort, especially in tropical purse seine fisheries. However, to date, discrimination between species using purely acoustic methods has not been refined due to a lack of information on the acoustic response of each species at different frequencies. Three tuna species can be found simultaneously at DFADs: skipjack or SKJ (Katsuwanus pelamis), bigeye or BET (Thunnus obesus), and yellowfin or YFT (Thunnus albacares), of which only the acoustic frequency responses of SKJ and BET have been published. In this study, we present the frequency response obtained from ex situ measurements of YFT recorded at 38, 70, 120 and 200 kHz. Records based on two data sets were used to describe the relationship between acoustic signal or target strength (TS; dB re 1m2) and fish length across frequencies." – see document for full abstract.

98. The WGFAD **CONGRATULATED** the authors and **NOTED** the methodology was based on acoustic signals for discriminating tropical tuna species and estimating their relative biomass around DFADs, **NOTING** that the discrimination required at least two frequencies to discriminate non-swimmbladdered tuna, such as skipjack, from swimmbladdered tuna, like yellowfin and bigeye tuna. For more precise discrimination among these three tuna species, it would be ideal to employ three

frequencies. This would enable fishers to determine the species composition of the schools they are targeting before deploying the net.

99. The WGFAD **NOTED** that the advent of the use of echo-sounder buoys in the French purse seine fishery was found to have surprisingly resulted in a switch towards more skipjack tuna catches, and **QUERIED** whether the interpretation of the signal could be affected by the presence of non-tuna species for which the response to acoustics remains unknown. The WGFAD further **NOTED** that this switch could be explained by the presence of species without swim-bladders because they could be misinterpreted as skipjack. However, the complex interpretation of acoustic signals would require further research to understand the case for the French fleet.

100. The WGFAD **NOTED** that the presence of other species may indeed affect the acoustic signal and that to discriminate between species, both among different tuna species and bycatch from tuna species, acoustic data are not used in isolation but are instead combined with information about the behaviour of the species present at FADs. Typically, multiple sources of information, such as acoustic responses, eco-traces, and species behaviour, are combined for more accurate discrimination.

101. The WGFAD **NOTED** that the target strength used for the size range of the species depends on the development of the swim bladder which is not developed in yellowfin tunas of less than 45 cm fork length, so it will not be possible to differentiate small yellowfin from skipjack tunas through the comparison of the acoustic frequency response. However, other methods could be developed to discriminate between non-swimmbladdered species, i.e., some bycatch species, skipjack and yellowfin tuna of less than 45 cm in length.

102. The WGFAD **NOTED** that the work was solely based on 6 yellowfin tunas comprising a range of 51-64 cm fork length, and that more samples would be useful to improve the accuracy of the relationship between target strength and fish length, **NOTING** that larger yellowfin tunas were sampled in the wild through another ISSF-funded project.

103. The WGFAD **NOTED** that fishers in the Indian Ocean use both buoys with one frequency and buoys with multiple frequencies, however, the use of more than one frequency is increasing. Buoys with two frequencies (low and high) can mostly discriminate species with a swim bladder (i.e., bigeye and yellowfin tuna >45 cm) from species without swim bladders like skipjack tuna.

104. The WGFAD **NOTED** that the sharing of acoustic data for science collected from the buoys used to monitor LOGs and DFADs would be very useful for supporting more scientific studies, as indices of abundances of tuna and other pelagic fish communities, behaviour of tuna at different FAD densities, among others.

5.2.4 Analyses from stock assessment model projections to evaluate recovery with alternative scenarios.

105. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-04 which assessed the response of Indian Ocean yellowfin tuna (*Thunnus albacares*) stocks to variations in DFAD fishing effort, including the following abstract provided by the authors:

> *"The Indian Ocean Tuna Commission (IOTC) and the regional Indian Ocean stakeholders have noted concern over the extensive use of DFAD fishing (drifting Fishing Aggregation Devices) by the industrial purse seine fleets. One of the major concerns is the increased fishing mortality of juvenile yellowfin tuna (Thunnus albacares) due to DFAD fishing. In 2020, sustainable biomass levels were exceeded by ~27-32%, propelling long-term declines in the stock. Furthermore, with the current stock status subject to overfishing and overfished there is potentially a threat to the global supply chains and employment. In this paper, we perform medium-term deterministic projections for the yellowfin tuna stock in*

the Indian Ocean considering four scenarios for the industrial purse seine fishing effort compared to the reference or base case relating to 2020 effort levels (scenario 1): a 50% reduction of DFAD sets without re-allocation of effort on free school sets (scenario 2a), a 50% reduction of instrumented buoys deployed in the water (scenario 2b), a seasonal closure of DFAD fishing during the third quarter of the year (scenario 3), and finally an extreme case called DFAD-free, i.e. zero DFAD sets all year (scenario 4)." – see document for full abstract.

106. The WGFAD **NOTED** that the analysis indicated that the third quarter FAD closure would potentially have the greatest impact on juvenile yellowfin and that the purse seine fishery accounts for the highest portion of catch.

107. The WGFAD **NOTED** that the analysis made the assumption that no effort would be diverted towards free schools in the event of DFAD closure. The WGFAD **NOTED** that the DFAD associated fishery accounts for 80–85% of catches by purse seine vessels. Some participants pointed out the consequences of fishing practices of other CMMs such as Resolution 21/01 and that given the catch limits on yellowfin tuna and bigeye tuna, a switch to free school might be unlikely. Other participants considered that it would be more reasonable to predict that the switch to free school will occur as it has in other oceans. The WGFAD **SUGGESTED** it would be beneficial to evaluate these possibilities in future iterations of the study, to determine whether a PS fishing closure similar to the one implemented by IATTC may actually be required to support stock recovery in line with the projections, further **NOTING** that PS fisheries accounted for an average of 94% of catches of tropical tunas from the last 5 years in IATTC while this proportion is 45 % in IOTC. The WGFAD further **NOTED** that there is a plan for expanding the study to include skipjack tuna, as well as to incorporate TAC constraints in the projections and establish a multi-species methodology that would take into account both yellowfin and skipjack tunas.

108. The WGFAD **NOTED** that the study can be expanded to allow for the evaluation of several combinations of alternative closure options, and the author is currently working on creating an app that stakeholders could use to assess the trade-offs between various strategies.

109. The WGFAD **NOTED** that the report currently only takes French vessels into account and suggested that it would be useful to incorporate Spanish vessels because the two fleets function differently.

110. The WGFAD **NOTED** that the study shows that closing the FAD fishery performs better than restricting the number of operational buoys and that there are clear benefits to spawning stock and recruitment. The authors suggested that it is preferable to consider a temporal closure of the whole PS fishery than to introduce too much granularity in the level of closure (e.g., restricting the number of buoy or DFADS). The WGFAD **NOTED** however, that if catches in the other fisheries are not limited, closing one particular fishery might not be effective at reducing total fishing mortality. The WGFAD further **RECALLED** the experiences learned through implementation of the yellowfin tuna rebuilding measures, where several fleets and CPCs that were exempt from the catch limit later increased their catches, making the yellowfin tuna rebuilding measures ineffective.

111. The WGFAD **NOTED** paper IOTC-2023-WGFAD05-13 which noted the responses of tuna stocks to closure strategies in the Indian Ocean, including the following abstract provided by the authors:

"Implementing temporal closures is a potential management tool to control the fishing pressure and for stock rebuilding plans. In the Indian Ocean, the yellowfin and bigeye stocks are estimated to be overfished and subject to overfishing, and the Commission has requested to investigate diverse management measures to improve the status of these stocks. In this study, we used the assessment models implemented in Stock Synthesis 3 (SS3) to evaluate the impacts on the future stock status of different closure strategies for

yellowfin, bigeye, and skipjack. We found that closing any quarter to all the fisheries would result in stocks not being overfished and not being subject to overfishing by the last year of the projection period. Analyzing fleet-specific closures, we found that closing only the purse seine fishery that uses fish aggregating devices (PS-FAD) would produce the largest positive effect on the stock status compared to the other fisheries. We also compare the status of the stock in the last year of the projection period under the current recommendations for catch reduction".

112. The WGFAD **NOTED** that the quantitative analyses presented during the meeting indicated that the most positive impact on the stocks for the three tuna species, in order of the largest benefits, would be a three-month complete closure for all gears then a two-month complete closure for all gears. The third most beneficial option for the three tuna species was a 3-month oceanwide purse seine log-school closure. The stocks would also benefit from closures on handline (skipjack), baitboat (bigeye), gillnet (skipjack) and others (skipjack). However, the WGFAD **NOTED** that these benefits were estimated under the assumption that there would not be an increase in catches from other gears during this time. The analyses further indicated that the period to have the best outcomes from the closure would be during Q1, Q3 and Q4 for BET and YFT and Q3 and Q4 for SKJ. In addition, the WGFAD **RECALLED** that Resolution 23/03 (para. 3) states that "The IOTC Scientific Committee shall provide advice and recommendations no later than 31st December 2023 on appropriate fishing closures applicable to all fishing gears.". As such the WGFAD **RECOMMENDED** that the WPTT take these analyses into account and consider further analysis to be carried out intersessionally to assess the impacts of all gears on stock status so that this issue can be comprehensively addressed.

113. The WGFAD **SUGGESTED** that it would be useful to evaluate combinations of various measures and strategies, such as combining the current catch limits or TAC (Resolution 21/01 and Circular 2023-47 rev1) and closures, as well as including scenarios that consider multi-species interactions, such as decreased yellowfin tuna catches coupled with higher skipjack tuna catches.

114. The WGFAD **NOTED** that redistribution of catches is a problem that can drastically reduce the effectiveness of closures.

115. The WGFAD **NOTED** that the bigeye tuna catch limit is now set through a management procedure (Resolution 22/03) tested through MSE (with the same relative catch contribution among gears in the simulation testing) and that the MP shall direct the stock to recover to the management target of having a 60% probability that the bigeye tuna spawning stock biomass achieves the target reference point of SB_{MSY} by 2034-2038. The WGFAD **QUERIED** the authors on whether bigeye tuna, which is regulated by the MP and implemented by Resolution 23/04 through catch limits by CPCs, should be excluded from the forecasts for evaluating fisheries closures. However, the WGFAD **NOTED** that the MSE for evaluating the MP is based on a longer time period while the forecast in the current analysis only considered a 10-year period.

116. The WGFAD **NOTED** that during the discussion, for any scenario investigated, the importance of avoiding reallocation of catches outside the investigated closure period was highlighted because this will decrease the positive impact of any potential measure. The WGFAD also **NOTED** the importance of taking cumulative management (a combination of measures) into account, i.e., including the current catch limits for YFT and BET by CPC/fleet and the overall catch limit for SKJ, when evaluating possible closure options.

117. The WGFAD also **NOTED** that the status of the stock of YFT will greatly improve in a scenario of full compliance by all CPC with the YFT catch limits.

118. The WGFAD **SUGGESTED** further investigating scenarios of cumulative management. More specifically, considering scenarios where the current TAC is fully implemented (as the TAC scenario

of the paper), with all gear closures including FADs for 1, 2, 3 months, with and without catch redistribution. Ideally the scenario should take into account how fleets may respond e.g., whether they will stop fishing or switch to catch free school in the case of PS during the closure. It is also necessary to account for how much reallocation of FAD effort is actually possible (i.e., whether it is possible for a 100% reallocation strategy or the vessels are already at maximum effort). The WGFAD also **SUGGESTED** considering various levels of over-catch of the TAC. The work shall be reviewed by the upcoming WPTT25 meeting in November.

119. The WGFAD **NOTED** that various types of closures have been, and continue to be, implemented in IATTC, ICCAT and WCPFC.

6. Wrap Up, Summary of Discussions and Recommendations

120. The consolidated list of Recommendations made by the WGFAD are found in Appendix V.

7. Remarks and Closing of the 5th Session of the Working Group on FADs

121. The report of the 5th Session of the Working Group on FADs (IOTC–2023–WGFAD05–R) was **ADOPTED** by correspondence.

APPENDIX I
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APPENDIX II
AGENDA FOR THE 5TH AD-HOC WORKING GROUP ON FADS MEETING

Date: 4 - 6 October 2023
Location: Zoom
Venue: Virtual
Time: 12:00 – 16:00 (Seychelles time)

Co-Chair: Dr. Gorka Merino (European Union); **Co-Chair:** Mr. Avelino Munwane (Mozambique)

1. **OPENING OF THE MEETING** (Co-Chairs)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Co-Chairs)
3. **THE IOTC PROCESS: OUTCOMES, UPDATES, AND PROGRESS**
   - 3.1. Update on Resolution 23/02
4. **REVIEW OF ANY ADDITIONAL DATA AVAILABLE AT THE SECRETARIAT ON FADS** (IOTC Secretariat)
5. **COMMISSION REQUESTS TO THE SC UNDER RESOLUTIONS 23/03 and 23/04 (All)**
   - 5.1. Alternative FAD management options
     - 5.1.1. Reducing mortality of juveniles of BET/YFT and facilitate recovery.
     - 5.1.2. Mitigating by-catch
     - 5.1.3. Mitigating habitat impact (FAD loss, beaching, etc.)
   - 5.2. On closures (area, period modalities, full closure, DFADs closure, exploring other gears etc.)
     - 5.2.1. Review of closures in tuna RFMOs
     - 5.2.2. Consequences of temporal/spatial closures
     - 5.2.3. Statistical analysis to assess the effect on spatial/temporal juvenile catch.
     - 5.2.4. Analyses from stock assessment model projections to evaluate recovery with alternative scenarios.
6. **WRAP UP, SUMMARY OF DISCUSSIONS AND RECOMMENDATIONS** (Co-Chairs)
7. **REMARKS AND CLOSING OF THE 5th SESSION OF THE AD-HOC WORKING GROUP ON FADs** (Co-Chairs)

APPENDIX III
LIST OF DOCUMENTS

Document	Title
IOTC-2023-WGFAD05-01a	Draft: Agenda of the 5th Working Group on FADs Meeting
IOTC-2023-WGFAD05-01b	Draft: Annotated agenda of the 5th Working Group on FADs Meeting
IOTC-2023-WGFAD05-02	Draft: List of documents of the 5th Working Group on FADs Meeting
IOTC-2023-WGFAD05-03	Review of the statistical data on FADs (IOTC Secretariat)
IOTC-2023-WGFAD05-04	Assessing the response of Indian Ocean yellowfin tuna (Thunnus albacares) stocks to variations in DFAD fishing effort (Tidd A, Capello M, Guillotreau P, Fu D)
IOTC-2023-WGFAD05-05	Significant Underreporting of Bycatch and Ecosystem Impacts in Tuna Purse Seine Fisheries (Shark Guardian)
IOTC-2023-WGFAD05-06	The Jelly-FAD: new results on its performance (Moreno G, Zudaire I, Uranga J, Grande M, Salvador J, Murua J, Salgado A, Murua H, Santiago J, Restrepo V)
IOTC-2023-WGFAD05-07	Guidelines to reduce the impact of drifting Fish Aggregating Devices on sea turtles (Moreno G, Lopez J, Escalle L, Lynch J, Roman M, Phillips JS, Swimmer Y, Murua H, Royer S-J, Murua J, Hutchinson M, Aires-da-Silva A, Restrepo V)
IOTC-2023-WGFAD05-08	Assessing Drifting Fish Aggregating Device (dFAD) Abandonment under International Marine Pollution Law (SFACT)
IOTC-2023-WGFAD05-09	Evidence of ongoing non-compliance of drifting FADs, and the associated impacts this has on Indian Ocean biodiversity (Marinas Guardian)
IOTC-2023-WGFAD05-10	ISSF Workshop on Different Approaches to Limit the Number of FADs in the Oceans (ISSF)
IOTC-2023-WGFAD05-11	Review of drifting FAD Closures across tuna RFMOs, their histories, context and socioeconomic considerations (IPNLF)
IOTC-2023-WGFAD05-12	Should we manage drifting FADs with closures in IOTC? What can we learn from experience in other RFMOs? (Maufroy A et al.)
IOTC-2023-WGFAD05-13	Responses of tuna stocks to closure strategies in the Indian Ocean (Correa G, Merino G, Santiago J, Urtizberea A)
IOTC-2023-WGFAD05-14	Is FAD fishing an 'economic trap'? Effects of a seasonal closure and other management measures on the IO purse-seine tuna fishery (Guillotreau P, Antoine S, Capello M, Dagorn L, Dupaix A, Dissou Y, Salladarré F, Tidd A)
IOTC-2023-WGFAD05-15	Size composition of yellowfin and bigeye tuna in IOTC fisheries (Pearce J, Feary D, Stacy R)
IOTC-2023-WGFAD05-16	TS measurements of ex-situ yellowfin tuna (Thunnus albacares) and frequency-response discrimination for tropical tuna species. (Sobradillo B, Boyra B, Uranga J and Moreno G)
IOTC-2023-WGFAD05-17	A review of fisheries closures in tropical tuna RFMOs (Murua H et al.)
IOTC-2023-WGFAD05-18	Developing a data standard for the retrieval of abandoned and lost FADs in the Indian Ocean (Heile AS, Sinan H, Dyer E, Bailey M)

APPENDIX IV
PROPOSED IOTC FAD RETRIEVAL FORM

FAD RETRIEVAL DATA

Name of the CPC: *Click here to enter a date*

Data collected regarding FADs, FAD debris and/or satellite buoys found.

Contact Details

Completed on: *Click here to enter a date* **Contact name:** *Click here to enter text* **Phone:** *Click here to enter text* **Email:** *Click here to enter text*

Retrieval information

Date of finding: *Click here to enter a date* **Coordinates:** *Click here to enter text* **In absence of coordinates, location**: *Click here to enter text*

FAD number: *Click here to enter text* **FAD Flag State:** *Click here to enter text*

Type of FAD: ☐ drifting FAD ☐ anchored FAD

FAD components *(Tick one or several)* ☐ **Raft** ☐ **Tail/curtain** ☐ **Satellite buoy (dFADs)** ☐ Other: *Click here to enter text*

Environment: ☐Beach ☐Coral reef ☐Lagoon ☐Open Ocean ☐Rocky shore ☐Mangrove ☐ Seagrass ☐Other: *Click here to enter text*

Upload photos (Raft frame, covers, buoy, tail, and the location/environment) **Number of pictures:** *Click here to enter text*

FAD Information

FAD Markings: *Click here to enter text* **Buoy markings:** *Click here to enter text* **Buoy Serial Number:** *Click here to enter text*

Buoy size: *Click here to enter text*

FAD condition: ☐Complete ☐Beginning to break ☐Mostly fallen apart

Raft frame materials: ☐ Metal ☐Bamboo ☐Wood ☐Plastic ☐Other: *Click here to enter text*

Raft cover materials: ☐Shade cloth ☐Bamboo ☐Leaves ☐Rope ☐Netting ☐Plastic ☐Hessian ☐Other: *Click here to enter text*

Raft size dimensions *Click here to enter text*

Tail materials: ☐Open net ☐Sausage net ☐Synthetic rope ☐Biodegradable rope ☐Plastic ☐Biodegradable material ☐Polystyrene tubing ☐Cotton piece ☐Other: *Click here to enter text*

Mesh size: *Click here to enter text* **Meshed material weight:** *Click here to enter text*

Tail length *Click here to enter text* **Tail weight** *Click here to enter text*

Upload photos (buoy marks, FAD structure, Raft materials & tail materials) **Number of pictures:** *Click here to enter text*

Fate of FAD/the buoy

FAD removed? ☐No ☐Yes **If no, why?** *Click here to enter text*

If yes, where?☐Junkyard ☐Burned ☐ Recycled ☐Research ☐Storage ☐Re-used (*specify*): *Click here to enter text*

Buoy removed? ☐Yes ☐No **If no, why?** *Click here to enter text*

If so, why? ☐Landfill ☐Burned ☐Recycled ☐Research ☐Storage ☐Re-used (*specify*): *Click here to enter text*

Impact on Marine Life

Entangled animals? ☐None ☐Turtle ☐Shark ☐Coral ☐Fish ☐Marine mammal ☐Other: *Click here to enter text*

Status: ☐Dead ☐Alive ☐ Unknown **Species** (if known): *Click here to enter text* **Number of individuals**: *Click here to enter text*

Fish or other species aggregated around the FAD ☐Yes ☐No **Species** (if known): *Click here to enter text*

If FAD is beached on habitat, please state approximate size of area impacted: *Click here to enter text*

Upload photos of the marine life impact: *Click here to enter text* **Number of pictures:** *Click here to enter text*

Comments: *Click here to enter text*

APPENDIX V
CONSOLIDATED RECOMMENDATIONS OF THE 5TH SESSION OF THE WORKING GROUP ON FADS

WGFAD05.01 (para 16) The WGFAD **NOTED** issues with the current 3FA form and **NOTED** that the revised FOB data reporting form responds to research needs and potentially covers important data gaps. However, several participants were not in a position to endorse them as they **NOTED** that the forms had not been made available to participants prior to the meeting. As such the WGFAD **RECOMMENDED** that these forms be reviewed by the WPTT for endorsement as this would provide sufficient time for all participants to thoroughly review them and provide meaningful input.

WGFAD05.02 (para 34) The WGFAD **NOTED** that the Jelly-FAD is an example of how the implementation of biodegradable DFADs can be achieved, further **NOTING** that other actions have been also carried out in the Indian Ocean for BIOFAD testing using alternative designs and materials and this work has been presented to the WGFAD and WPEB for many years. The WGFAD further **NOTED** that the IATTC has recently adopted a step-wise approach to the full adoption of biodegradable DFADs (IATTC C-23-04). The WGFAD therefore **RECOMMENDED** that the SC urge the Commission to initiate an ambitious step-wise approach for the implementation of biodegradable DFADs as soon as possible.

WGFAD05.03 (para 63) The WGFAD **NOTED** the potential social and economic losses and benefits of fisheries closures, and **RECOMMENDED** further studies to be conducted by the WP on socio-economics.

WGFAD05.04 (para 112) The WGFAD **NOTED** that the quantitative analyses presented during the meeting indicated that the most positive impact on the stocks for the three tuna species, in order of the largest benefits, would be a three-month complete closure for all gears then a two-month complete closure for all gears. The third most beneficial option for the three tuna species was a 3-month oceanwide PS log school closure. The stocks would also benefit from closures on handline (skipjack), baitboat (bigeye), gillnet (skipjack) and others (skipjack). However, the WGFAD **NOTED** that these benefits were estimated under the assumption that there would not be an increase in catches from other gears during this time. The analyses further indicated that the period to have the best outcomes from the closure would be during Q1, Q3 and Q4 for BET and YFT and Q3 and Q4 for SKJ. In addition, the WGFAD **RECALLED** that Resolution 23/03 (para. 3) states that "The IOTC Scientific Committee shall provide advice and recommendations no later than 31st December 2023 on appropriate fishing closures applicable to all fishing gears.". As such the WGFAD **RECOMMENDED** the WPTT take these analyses into account and consider further analysis to be carried out intersessionally to assess the impacts of all gears on stock status so that this issue can be comprehensively addressed.