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ISSF SKIPPERS' WORKSHOPS ROUND 8

Photo: J. Murua

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Abstract

This report summarizes bycatch mitigation findings from Round 8 of the ISSF Skippers Workshops conducted in 2018 at 15 locations. Fishers from multiple tropical tuna purse seine fleets working in all oceans provided feedback on bycatch release in the net and on deck, use of non-entangling biodegradable FADs, FAD retrieval, bycatch utilization, fishing technology and fishing strategies.

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ISSF is a global coalition of scientists, the tuna industry and World Wildlife Fund (WWF) — the world's leading conservation organization — promoting science-based initiatives for the long-term conservation and sustainable use of tuna stocks, reducing bycatch and promoting ecosystem health. Helping global tuna fisheries meet sustainability criteria to achieve the Marine Stewardship Council certification standard — without conditions — is ISSF's ultimate objective. ISSF receives financial support from charitable foundations and industry sources.

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Executive Summary

In 2018 round 8 of the ISSF Skippers Workshops reached out to 694 tropical tuna purse seine stakeholders, most participants being skippers (302) and crew (220). The workshops continued to expand to new locations including Prigi and Pekalongan in Indonesia, Dakar in Senegal or Yaizu in Japan. In total 15 workshops were conducted targeting key fleets operating in the Atlantic and Indian Oceans (Ghana, Senegal, Spain, France), Eastern Pacific (Ecuador, Panama, Peru) and Western and Central Pacific (Indonesia, USA, Marshall Islands and Federate states of Micronesia).

During this round, fishers have continued to learn about the latest advances in bycatch mitigation methods and minimizing impacts associated with FAD fishing. A focus in 2018 has been marine litter reduction caused by synthetic FAD materials by promoting the use of biodegradable non-entangling FADs (BNEFADs) and exploring FAD retrieval options. Fishers provided feedback on the EU/ISSF/ FAO-GEF Common Oceans sponsored BIOFAD project, testing 1000 BNEFADs in the Indian Ocean. Some skippers also participated in an ISSF workshop dedicated to FAD retrieval in San Sebastian (Spain). The workshops have provided a forum for discussion with skippers and crew on how to best approach this impact. In addition, new ideas have been proposed on ways to release bycatch from deck, especially large sized individuals like adult sharks that are difficult to handle safely and manta rays. Meanwhile, ISSF continues to test at sea ways to release sharks before arriving on deck such as fishing the shark inside the net. With regards to small tuna catches of yellowfin and bigeye, skippers evaluated the recent introduction of quotas per vessel (e.g. TACs) in the Atlantic and Indian Oceans and their implications on FAD fishing strategies.

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Key Findings:

1. **Round 8 delivered 15 workshops with 694 participants, most being fishers**
2. **Non-entangling biodegradable FADs are being tested for the first time in a large- scale experiment in the Indian Ocean**
3. **Hoppers are a good option to sort bycatch on deck.**
4. **There is a need for safe release tools for large and dangerous bycatches.**
5. **Fishers thought that TACs on BET and YFT are leading to a greater focus on FAD fishing.**

Research Questions

- **How are FAD designs changing in recent times in each ocean?**
- **What kind of Biodegradable non-entangling FADs (BNEFADs) should be tested in each ocean?**
- **What are the best options to ensure FADs are retrieved after their working life?**
- **Which is the best way to manage tuna stocks to ensure their long-term sustainability?**
- **Which fishing tools (e.g. echo-sounder buoys, supply vessel, etc.) are resulting in a greater fishing efficiency?**
- **What kind of bycatch options are available for small purse-seine vessels?**
- **When and where are the principal hotspots for sharks and manta rays?**
- **Are there ways to avoid catching sharks before the net is set or at least before sacking up the net?**
- **Which release tools can be used on deck to release safely large bycatch species?**
- **Is utilization of non-vulnerable bycatch species a valid option?**

INTRODUCTION

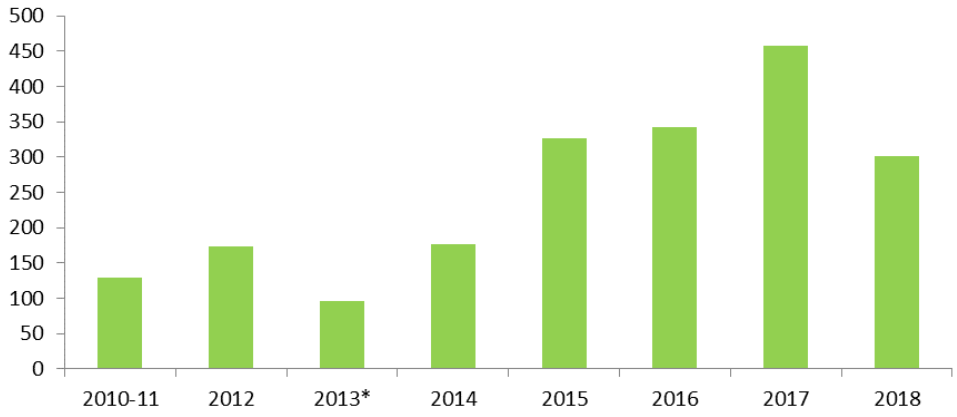
Launched in 2009, the ISSF Bycatch project aims to find and implement bycatch mitigation solutions in tuna fisheries. From the start of the project the great diversity between fleets was clear, with their different vessels and fishing technology onboard, and unique oceanographic characteristics in each ocean. To address this diversity and create tailor-suited solutions for each region, ISSF used an ocean-by-ocean approach trying to reach out to as many fleets as possible. The ISSF Skippers Workshops have helped shed light on the different factors affecting fleets in each ocean. A total of 90 workshops in 22 countries have reached out to virtually every key tuna purse seiner fleet at some point. Most participants are fishers, mainly skippers (e.g. fishing masters and captains) with many years of experience in the fishery, who can provide educated guesses on ways to improve practices and equipment. The workshops are strongly interconnected to the research cruises that ISSF organizes in large-scale tuna purse seiners to test novel ways to reduce bycatch. The ISSF Bycatch Mitigation Steering Committee (BMSC) often takes ideas proposed at workshops by fishers and puts them to the test under real conditions during commercial fishing trips (e.g. shark escape windows, fishing sharks in the net). Research cruises cover a range of bycatch related activities going from acoustic discrimination with echo-sounders, releasing sharks in the net, testing methods to release bycatch from deck, tests with BNEFADs, etc. Lessons learned from these trials are passed back to fishers during the workshops, hoping they voluntarily uptake mitigation options that work best.

2018 SKIPPERS' WORKSHOPS FLEET COVERAGE

In 2018, a total of 12 countries were visited with workshops conducted at 15 different locations (**Table 1**). By continent there were 3 workshops in South America, 1 in North America, 3 in Europe, 6 in Oceania and 2 in Africa. The total number of participants in Round 8 was 694, making the number of participations since 2009 a grand total of 3675. The number of skippers certified in good practices in 2018 was 302 (**Fig. 1**), while 209 crew (e.g. deck bosses, deck crew, chief engineers) also took part. Other stakeholders such as fleet managers, ship-owners, national scientists, NGOs and government managers also were present but in smaller numbers (**Fig. 2**). While most of these fishers work in industrial sized purse seiners (e.g. > 500 GT), there were specialized workshops addressing artisanal and semi-industrial vessels (e.g. 80-300 GT) operating principally in Indonesia. All participating fishers received a certificate in skipper education valid for ISSF's Proactive Vessel Register (PVR). Other means of being certified are available for fishers who cannot attend a workshop, including online tools such as the guidebooks and workshop videos.

Table 1 – Skippers' Workshop locations and participation by work group category in 2018.

WS	LOCATION	DATE	SKIPPERS	CREW	SHIP-OWNERS	FLEET MANAGERS	FLEET REP.	GOV. OFFICIALS	SCIENTISTS	TOTAL
8.1	TEMA (GHANA)	26-27/02/2018	22	30	4	4	10	5	2	77
8.2	MAJURO (MARSHALL ISLANDS)	12/04/2018	15	6	0	1	4	1	0	27
8.3	POHNPEI (MICRONESIA)	17/04/2018	7	4	1	0	0	0	0	12
8.4	BINTUNG (INDONESIA)	07/05/2018	32	7	0	0	1	9	2	51
8.5	PRIGI (INDONESIA)	09/05/2018	19	1	0	0	3	8	0	31
8.6	PEKALONGAN (INDONESIA)	11/05/2018	18	21	0	0	0	4	2	45
8.7	DAKAR (SENEGAL)	11/06/2018	4	3	0	3	3	3	2	18
8.8	VIGO (SPAIN)	16/07/2018	29	60	0	0	0	0	0	89
8.9	MANTA (ECUADOR)	14/08/2018	65	58	1	3	6	0	2	135
8.10	PANAMA CITY (PANAMA)	16/08/2018	6	0	0	0	2	3	1	12
8.11	SAN DIEGO (USA)	20/08/2018	9	0	3	0	3	0	0	15
8.12	YAIZU (JAPAN)	29/08/2018	1	0	0	0	17	0	11	29
8.13	LIMA (PERU)	01/10/2018	17	5	0	1	9	7	15	54
8.14	CONCARNEAU (FRANCE)	15/10/2018	17	2	0	3	2	0	0	24
8.15	SUKARRIETA (SPAIN)	15-21/11/2018	41	23	0	2	7	0	2	75
TOTAL			302	220	9	17	67	40	39	694



**2013 – only 5 workshops were conducted.*

Figure 1. Historical number of skippers participating in the ISSF Skippers' Workshops.

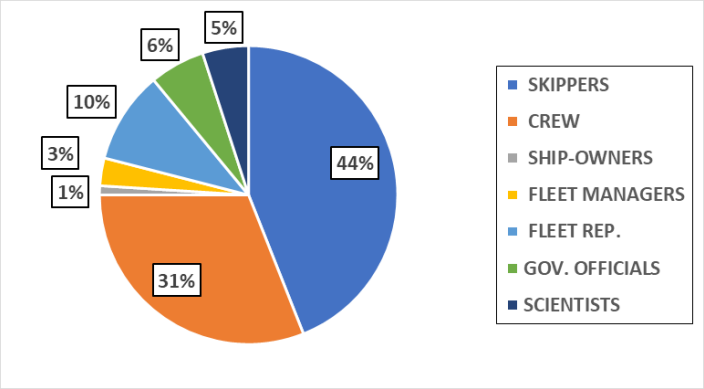


Figure 2. Participation by work group category in 2018 Skippers Workshops.

Figure 3. Record number of participants (135) in a single Skippers' Workshop at Manta (Ecuador) August 2018.

Figure 4. Small-scale training during visit to boat at port of Pohnpei (FSM) in April 2018

Table 2 – Skippers' Workshop locations and participation by work group category since 2009.

LOCATION	DATE	SKIPPERS	CREW	SHIP-OWNERS	FLEET MANAGERS	FLEET REP.	GOV. OFFICIALS	SCIENTISTS	TOTAL
SUKARRIETA (SPAIN)	27/11/2009	15	1	1	1	6	1	0	25
MANTA (ECUADOR)	18/09/2010	56	18	1	0	1	0	0	76
PANAMA CITY (PANAMA)	22/09/2010	6	6	1	0	0	3	6	22
ACCRA (GHANA)	10/11/2010	2	0	0	2	21	6	1	32
SUKARRIETA (SPAIN)	13-17/12/2010	32	0	0	0	6	0	5	43
MAHE (SEYCHELLES) / PORT LOUIS (MAURITIUS)	1-19/02/2011	11	5	0	0	1	0	0	17
PAGO PAGO (AMERICAN SAMOA)	05/03/2011	2	0	2	1	4	3	2	14
MAJURO (MARSHALL ISLANDS)	22/06/2011	2	1	0	0	1	1	0	5
POHNPEI (MICRONESIA)	24/06/2011	3	1	0	0	4	0	0	8
ACCRA (GHANA)	14/03/2012	2	0	0	2	18	6	0	28
MAHE (SEYCHELLES)	21-18/05/12	5	2	0	0	1	0	0	8
PAGO PAGO (AMERICAN SAMOA)	11/06/2012	3	2	0	0	3	0	2	10
GENERAL SANTOS (PHILIPPINES)	08/09/2012	26	4	0	1	3	0	21	55
BINTUNG (INDONESIA)	11/09/2012	20	0	0	0	0	25	3	48
JAKARTA (INDONESIA)	13/09/2012	13	1	0	0	0	10	3	27
MANTA (ECUADOR)	26-27/09/2012	17	4	4	0	1	0	1	27
SUKARRIETA (SPAIN)	09/10;27/11-5/12/2012	87	3	2	2	9	0	6	109
ACCRA (GHANA)	08/05/2013	13	0	2	1	18	7	0	41
LIMA (PERU)	05/08/2013	0	0	2	2	16	2	15	37
MANTA (ECUADOR)	08/08/2013	37	5	0	3	4	1	0	50
PANAMA CITY (PANAMA)	12/08/2013	2	0	2	1	7	0	7	19
SUKARRIETA (SPAIN)	07/11-10/12/2013	44	6	2	2	5	0	0	59
BUSAN (KOREA)	14/02/2014	8	9	0	1	10	3	12	43
KAOHSIUNG (TAIWAN)	18/02/2014	1	0	0	6	12	0	0	19
CANGAS (SPAIN)	28-29/05/2014	20	10	0	0	0	0	0	30
ACCRA (GHANA)	15/07/2014	7	6	10	9	11	4	1	48
MANTA (ECUADOR)	12/08/2014	35	1	0	0	1	0	3	40
JAKARTA (INDONESIA)	19/08/2014	21	2	0	0	1	1	3	28
GENERAL SANTOS (PHILIPPINES)	05/09/2014	24	6	0	0	2	0	2	34
SUKARRIETA (SPAIN)	18/09-14/10/2014	52	5	0	1	3	1	1	63
PAGO PAGO (AMERICAN SAMOA)	15-20/10/2014	8	1	0	0	4	0	1	14
MANZANILLO (MEXICO)	12/01/2015	34	20	1	1	2	4	0	62
MAZATLAN (MEXICO)	14/01/2015	65	46	0	1	1	4	1	118
SAN DIEGO (USA)	12/02/2015	5	0	0	1	3	0	0	9
TEMA (GHANA)	08/05/2015	10	5	2	9	18	0	1	45
JAKARTA (INDONESIA)	19/06/2015	8	14	1	0	5	0	4	32
BINTUNG (INDONESIA)	22/06/2015	21	13	0	0	1	1	2	38
SIBOLGA (INDONESIA)	25/06/2015	22	15	0	0	0	1	1	39
LIMA (PERU)	11/08/2015	10	5	1	1	16	3	6	42
MANTA (ECUADOR)	14/08/2015	83	8	3	8	6	0	0	108
BUSAN (KOREA)	15/09/2015	8	0	0	1	8	2	25	44
CONCARNEAU (FRANCE)	13/10/2015	14	6	0	2	2	0	2	26
SUKARRIETA (SPAIN)	8,26-30/10/2015	49	5	4	1	2	0	0	61
SHANGHAI (CHINA)	06/04/2016	10	0	0	6	5	0	6	27
TEMA (GHANA)	04/05/2016	8	6	2	5	20	4	2	47
VIGO (SPAIN)	20/07/2016	51	23	0	1	0	0	0	75
MANTA (ECUADOR)	03/08/2016	33	17	0	2	3	0	1	56
POSORJA (ECUADOR)	05/08/2016	8	5	0	1	0	0	0	14
JAKARTA (INDONESIA)	05/09/2016	27	0	0	1	3	0	0	31
BINTUNG (INDONESIA)	07/09/2016	27	1	1	0	0	1	10	40
KENDARI (INDONESIA)	09/09/2016	32	0	1	3	1	3	10	50
BENOA (INDONESIA)	10/09/2016	21	0	0	0	6	0	0	27
SIBOLGA (INDONESIA)	14/09/2016	15	0	0	7	1	2	0	25
BANDA ACEH (INDONESIA)	16/09/2016	23	0	0	0	8	0	0	31
QUY NHON (VIETNAM)	17/09/2016	42	0	0	0	13	0	3	58
SUKARRIETA (SPAIN)	24-28/10/2016	42	5	1	0	3	0	1	52
MADEIRA (PORTUGAL)	01/11/2016	4	19	0	0	2	0	1	26
MANTA (ECUADOR)	10-11/01/2017	95	16	0	1	3	0	2	117
TEMA (GHANA)	21/02/2017	22	20	1	5	6	1	1	56
SAN DIEGO (USA)	27/03/2017	7	1	2	4	3	1	1	19
MAJURO (MARSHALL ISLANDS)	03/04/2017	5	4	0	0	2	0	0	11
POHNPEI (MICRONESIA)	06/04/2017	8	6	1	0	2	0	2	19
KENDARI (INDONESIA)	03/04/2017	23	9	0	0	0	4	0	36
PAOTERE-MAKASSAR (INDONESIA)	05/04/2017	20	8	0	0	0	3	0	31
TUMUMPA-MANADO (INDONESIA)	07/04/2017	35	6	0	0	0	1	0	42
AMBON (INDONESIA)	11/04/2017	22	1	0	0	0	4	0	27
ZHOUSHAN (CHINA)	01/08/2017	8	1	0	4	8	0	3	24
VIGO (SPAIN)	10/08/2017	24	68	0	0	0	0	0	92
SIBOLGA (INDONESIA)	04/09/2017	16	19	0	3	0	0	0	38
LAMPULO (INDONESIA)	07/09/2017	23	4	1	1	0	2	0	31
JAKARTA (INDONESIA)	19/09/2017	33	3	0	0	0	0	0	36
LIMA (PERU)	29/'9/2017	14	8	0	1	8	3	4	38
MANTA (ECUADOR)	04/10/2017	29	41	0	0	0	1	1	72
CONCARNEAU (FRANCE)	09/10/2017	27	7	0	1	1	0	2	38
SUKARRIETA (SPAIN)	16-20/10/2017	46	16	0	3	1	0	1	67
TEMA (GHANA)	26-27/02/2018	22	30	4	4	10	5	2	77
MAJURO (MARSHALL ISLANDS)	12/04/2018	15	6	0	1	4	1	0	27
POHNPEI (MICRONESIA)	17/04/2018	7	4	1	0	0	0	0	12
BINTUNG (INDONESIA)	07/05/2018	32	7	0	0	1	9	2	51
PRIGI (INDONESIA)	09/05/2018	19	1	0	0	3	8	0	31
PEKALONGAN (INDONESIA)	11/05/2018	18	21	0	0	0	4	2	45
DAKAR (SENEGAL)	11/06/2018	4	3	0	3	3	3	2	18
VIGO (SPAIN)	16/07/2018	29	60	0	0	0	0	0	89
MANTA (ECUADOR)	14/08/2018	65	58	1	3	6	0	2	135
PANAMA CITY (PANAMA)	16/08/2018	6	0	0	0	2	3	1	12
SAN DIEGO (USA)	20/08/2018	9	0	3	0	3	0	0	15
YAIZU (JAPAN)	29/08/2018	1	0	0	0	17	0	11	29
LIMA (PERU)	01/10/2018	17	5	0	1	9	7	15	54
CONCARNEAU (FRANCE)	15/10/2018	17	2	0	3	2	0	0	24
SUKARRIETA (SPAIN)	15-21/11/2018	41	23	0	2	7	0	2	75
		1964	**747**	**60**	**124**	**396**	**159**	**225**	**3675**

TRAIN-THE-TRAINER PROGRAM

The ISSF established train-the-trainer program in Indonesia was run for the third year in a row. These workshops are presented by local Indonesian scientists from the Indonesian Centre for Fisheries Research and Development (CFRD). Several Eastern Asian Countries such as Indonesia, Philippines or Vietnam have numerous small-scale PS tuna vessels (e.g. < 80 GT) scattered among many coastal ports. These fleets tend to operate within their EEZs and fish on anchored FADs. Bycatch mitigation options for these smaller boats differ greatly from those proposed for high-tech "superseiners", hence the specialized workshops for these fleets.

In round 8 several workshops targeted the principal ports of Indonesia, such as Bitung, but also reached out to new locations such as Prigi and Pekalongan, where fishers had not been previously exposed to bycatch mitigation training. A total of 127 participants intervened in this years' workshops, most being skippers and some crew (**Fig.5**)

Figure 5. Small scale purse seine vessel at port of Prigi (Java) and participants at the 2018 Bitung Skippers' Workshop (Sulawesi) conducted by CFRD scientists in Indonesia

The evolution of acceptance levels for different activities is monitored over the years for each fleet. The acceptance grade is simply an indicator based on majoritarian views expressed during the workshop by participants and may not necessarily reflect everyone's views in a fleet or actual uptake at sea. Most tested mitigation activities focus on the gear and fishing operations used by large super-seiners and may not apply to smaller scale vessels like those of Indonesia, due to differences in fishing practices and utilization of caught species.

As in previous years many fleets seemed to agree on the need to move to NEFADs and test biodegradable floating objects. Also, improving the release of bycatch species from deck was welcome, as long as the releases did not entail high injury risk. Other activities such as fishing sharks in the net or short tail FADs to reduce catches of small bigeye tuna have received poorer reviews. Acceptance feedback on some activities from previous rounds, such as shark escape windows, small sets, or catching tuna away from the FAD have been discontinued due to consistent poor acceptance levels or because scientists thought these activities had limited potential and prefer to center discussions with fishers on more promising options.

Table 3 – Acceptance level of activities proposed in 2018 workshops by fleets. H-High, M-Medium, L-Low, NA-No Answer. *WCPO – combination of skippers from fleets operating in the Western and Central Pacific Ocean (e.g. Taiwan, China, Korea, USA, PNA countries).

GROUP	MEASURES	GHANA	ECUADOR	PERU	PANAMA	USA	WCPO*	JAPAN	INDONESIA	SPAIN	FRANCE	SENEGAL
	FISHING IN THE NET	M-L	M-L	M-L	M	NA	M-L	NA	NA	M-L	M-L	M-L
	RELEASE PRACTICES	H	H-M	H-M	H-M	H-M	H-M	H-M	H	H	H	H-M
	NON-ENTANGLING FADS	H	H	H	H	H-M	H-M	H	H	H	H	H
	BIODEGRADABLE FADS	H	H-M	H-M	H-M	H-M	H-M	H	H-M	H	H	H-M
ELASMOBRANCHS	FAD RETRIEVAL	H	M-L	H-M	L	H-M	H-M	H-M	NA	M-L	NA	H
	ECHO-SOUNDER BUOYS	H	H	H	H	H	H	H	NA	H	H	H
	CLOSURES/REDUCE FADS	H	H	H-M	H	H	H	H	H	M-L	H	M-L
SMALL TUNA	SHORT APPENDAGE FADS	L	L	M	L	L	L	L	NA	L	NA	L
BONY FISH	UTILIZATION	H	H	H	M	M	M	H	H	H	H	H

Shark release from the net

The idea with this mitigation activity is to fish sharks inside the purse seine net with a fishing line and release them out of the net alive before sacking up. This bycatch reduction initiative has been tested in several research cruises in the Atlantic and Indian Oceans (Restrepo et al. 2018) with some success for small juvenile silky sharks, which are the most common species and sizes found at FADs. On average, 20% of the sharks present in the net were released and tagged showing 100% of survival. However, large adult sharks encircled by the purse seine net in association with free-swimming schools of tunas never bit the bait, thus this releasing technique was successful just for small sharks around FADs. Despite showing fishers the promising results from these experiments, including very high survival rates of released sharks, the acceptance level for this activity has been mid to low (**Table 4**). Main concern of skippers in many workshops were that (i) they would lose a member from deck to assist with shark fishing from the speedboat, (ii) when sea conditions are rough fishing from the speedboat would not be possible, as it would be dangerous for the crew or simply that it would not be applicable in those sets, and (iii) also showed safety concerns when handling sharks. Regarding the second concern, it was discussed that due to safety reasons, this operation should not be carried out under adverse fishing conditions. With regards to safety while handling sharks, ISSF scientists showed that current protocol to release sharks out the net, do not require the fisher to touch the animal since it is dragged out of the net from the water and released with the hook

attached, after having cut the line. Discussions on shark handling safety showed that the risk when the shark arrives on the deck might be higher than releasing them from the net.

Table 4 – Evolution in the acceptance level of fishers for the use of shark fishing in the net by different tuna fleets in ISSF Skippers' Workshops between 2015 and 2018.

	FLEET	ACCEPTANCE LEVEL		
		2015-16	2016-17	2017-18
FISHING SHARK IN NET	ECUADOR	MID	LOW-MID	LOW-MID
	MEXICO	-	-	-
	PERU	-	LOW-MID	LOW-MID
	PANAMA	-	-	MID
	USA	-	LOW-MID	-
	INDONESIA	NA	NA	NA
	KOREA	-	-	-
	PHILIPPINES	-	-	-
	TAIWAN	-	-	-
	WCPO*	-	LOW-MID	LOW-MID
	FRANCE	-	LOW-MID	LOW-MID
	SPAIN	MID	MID	LOW-MID
	GHANA	MID	MID	LOW-MID
	PORTUGAL	MID-HIGH	-	-
	VIETNAM	NA	NA	NA
	CHINA	LOW-MID	LOW-MID	-
	SENEGAL	-	-	LOW-MID
	JAPAN	-	-	-

Best release practices from deck

For several years now, many fleets have learned about best bycatch release methods on deck. Despite a generally high acceptance level of this activity (**Table 5**), the uptake of these methods in practice has been moderate. Many fishers believe that ideas such as canvases and nets to release mantas and sharks are good in principle but often do not apply them and opt to release these animals manually. Those that have tried release tools such as stretcher beds or cargo nets, provide mixed feedback of their experiences. For some these tools have worked very well and highly recommend their use while others said they were not useful and slowed down fish loading. Part of this divergence may be explained by the fact that the release equipment is self-constructed in each boat and some designs, sizes of the nets used could have been suboptimal (e.g. cargo nets or canvases too small to accommodate well large manta rays). Also, it takes several trials and errors to master these release methods and some fishers might have given up after trying them out once or twice.

It is apparent from fishers' comments that there is room for improvement for bycatch releases from deck. Skippers that use the hopper (e.g. a large metallic tray in which the bycatch is unloaded before entering the loading hatch; **Fig. 6**) thought this tool greatly assisted with a fast and efficient release of bycatches and does not slow down the brailing process as some people suggest. The hopper importantly prevents most bycatch reaching the lower deck, where the release of live individuals is further delayed. It has also proven to be useful to minimize accidental storage of sharks in wells. This is especially useful in some WCPO regions where strong fines are starting to be implemented for each shark detected when unloading.

Options to construct rigid framed grids that could be placed on the unloading hatch to prevent manta rays or large sharks going into the lower deck were discussed. It was also apparent that in punctual sets where large numbers of adult sharks appear (e.g. > 50 individuals) it is very difficult do conduct best practices due to the volume of sharks and the higher risk of injury. Hotspots such as Gabon and Angola in the Atlantic were identified and options here might entail opening the net if a high number of sharks is observed inside the net (e.g. slipping).

Some skippers pointed out that the current configuration of the deck in purse seine vessels does not allow an appropriate handling of the bycatch and that protocols or tools under consideration now, are simply patches to temporarily solve this problem. These skippers said that new vessels when built should take into account the releasing of bycatch alive (in terms of space and tools included onboard, hydraulic ramps, etc.), or that ship-owners should invest to adapt the deck configuration in current operating vessels to facilitate releases.

Skippers also believed that in addition of workshops training officers (e.g. fishing masters, captains), it should also target deck crew because they will be the people handling directly and releasing the bycatches. Many fishers in the Atlantic and Indian Oceans come from African nations like Senegal, Madagascar, etc. and often are not present at the Skippers Workshops. Video material or in person workshops in their native language (many speak French) should be provided. Similar materials and workshops could be done to target PNA crew working in the WCPO.

Fishers also pointed out that in some regions there is a high degree of corruption by human observers trying to obtain money for misreporting bycatch incidents (e.g. dolphins, sharks, turtles, etc.). It is possible that in certain fisheries bycatch data has been manipulated to some degree. Studies using electronic monitoring systems to cross check validity of human observer information would be highly recommended.

Figure 6. Hopper and brailer on the top deck of a purse seiner while at port in Majuro (Marshall Islands, 2018).

Table 5 – Evolution in the acceptance level of fishers for the use of best release practices from deck by different tuna fleets in ISSF Skippers' Workshops between 2010 and 2018.

BEST RELEASE PRACTICES	FLEET	ACCEPTANCE LEVEL							
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
	ECUADOR	MID	MID	MID-HIGH	HIGH	MID-HIGH	HIGH	HIGH	MID-HIGH
	MEXICO	-	-	-	-	HIGH	-	-	-
	PERU	-	-	MID-HIGH	-	MID-HIGH	-	HIGH	MID-HIGH
	PANAMA	MID-HIGH	-	MID-HIGH	-	-	-	-	MID-HIGH
	USA	MID	MID-HIGH	-	MID-HIGH	HIGH	-	MID-HIGH	MID-HIGH
	INDONESIA	-	-	-	LOW	LOW-MID	MID	MID-HIGH	HIGH
	KOREA	-	-	-	MID-HIGH	MID-HIGH	-	-	-
	PHILIPPINES	-	MID	-	MID	-	-	-	-
	TAIWAN	-	-	-	MID-HIGH	-	-	-	-
	WCPO*	-	-	-	-	-	-	MID-HIGH	MID-HIGH
	FRANCE	HIGH	MID	-	-	MID	-	HIGH	HIGH
	SPAIN	MID	MID-HIGH	MID-HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
	GHANA	LOW-MID	MID	MID	HIGH	HIGH	HIGH	HIGH	HIGH
	PORTUGAL	-	-	-	-	-	HIGH	-	-
	VIETNAM	-	-	-	-	-	MID	-	-
	CHINA	-	-	-	-	-	LOW-MID	MID	-
	SENEGAL	-	-	-	-	-	-	-	MID-HIGH
	JAPAN	-	-	-	-	-	-	-	MID-HIGH

Non-entangling FADs

The use of NEFADs is now general in three out of four oceanic regions (Atlantic, Indian and Eastern Pacific Ocean). This widespread use of NEFADs, while initially adopted voluntarily by many companies is now compulsory due to conservation measures adopted by ICCAT, IOTC and most recently IATTC. The only RFMO which had not made NEFADs compulsory at the time of this round of workshops is WCPFC (in December 2018, WCPFC members agreed to use only NEFADs starting in 2020). RFMOs and other organizations are considering FADs built with small mesh (e.g. < 2.5 inches) and mesh tied into coils or "sausages" still as non-entangling. Thus, a category for lower entanglement risk (LERFADs) as described in the ISSF guide of NEFADs in 2015 does not exist. In fact, most NEFADs today are of the LERFAD type, using small mesh nets (e.g. Medina panels, or reused anchoveta or small pelagic PS netting). Only in the Indian Ocean has the presence of rope and canvas in FAD tail appendages been observed more regularly. In addition, new types of FADs have been evolving in the last few years including submerged FADs and "cage" FADs, which still are constructed with entanglement-minimizing materials. In the WCPO ocean some fleets are now trying NEFADs during regular fishing trips. Several companies from the USA fleet and some PNA countries have increasingly been using "sausage" tied netting FADs. NEFAD acceptance in the WCPO has gone from mid-low to mid-high in the last year (**Table 6**).

In general fishers from the Indian, Atlantic and Eastern Pacific oceans pointed out that they have been recently encountering more sharks in sets than in previous years. They did not know which the cause of this increase in shark presence in sets was, whether it was due to oceanographic conditions or perhaps due to the reduction of ghost-fishing caused by entangling FADs.

Table 6 – Evolution in the acceptance level of fishers for the use of FADs that minimize entanglement by different tuna fleets in ISSF Skippers' Workshops between 2010 and 2018. Estimated number of large purse seiners (> 335 m3 fish holding volume) by fleet and level of use of FADs

			ACCEPTANCE LEVEL							
	FLEET	FAD USE	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
NON-ENTANGLING FADS	ECUADOR	HIGH	LOW	MID	MID-HIGH	MID-HIGH	MID-HIGH	HIGH	HIGH	HIGH
	MEXICO	LOW	-	-	-	-	HIGH	-	-	-
	PERU	LOW	-	-	MID	-	MID-HIGH	-	HIGH	HIGH
	PANAMA	MID	MID	-	MID-HIGH	-	-	-	-	-
	USA	MID	MID-HIGH	HIGH	-	MID-HIGH	MID-HIGH	-	LOW-MID	MID-HIGH
	INDONESIA	HIGH	-	-	-	HIGH	HIGH	HIGH	HIGH	HIGH
	KOREA	HIGH	-	-	-	HIGH	MID	-	-	-
	PHILIPPINES	HIGH	-	MID-HIGH	-	MID-HIGH	MID-HIGH	-	-	-
	TAIWAN	MID	-	-	-	MID-HIGH	-	-	-	-
	WCPO*		-	-	-	-	-	-	LOW-MID	MID-HIGH
	FRANCE	MID	HIGH	HIGH	-	-	HIGH	-	HIGH	HIGH
	SPAIN	HIGH	MID-HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
	GHANA	HIGH	LOW	LOW-MID	MID	MID	MID-HIGH	MID-HIGH	MID-HIGH	HIGH
	PORTUGAL	MID	-	-	-	-	-	HIGH	-	-
	VIETNAM	NONE	-	-	-	-	-	NA	-	-
	CHINA	MID	-	-	-	-	-	MID	LOW-MID	-
	SENEGAL	MID	-	-	-	-	-	-	-	HIGH
	JAPAN	LOW	-	-	-	-	-	-	-	HIGH

Biodegradable FADs

The acceptance of BNEFADs has been high across fleets consulted in 2018 (**Table 7**). There are worldwide campaigns these days against the pollution of plastics in the sea, and fishers acknowledge that synthetic material-built FADs contribute in some degree to marine debris. While options for FAD retrieval have been consulted with fishers, including having specialized boats collecting lost FADs, avoiding FAD seeding near coastal areas or even developing self-propelled FADs, skippers think that the best option to prevent pollution is to construct FADs with biodegradable natural materials. In 2018, an EU/ISSF sponsored project in the Indian Ocean called BIOFAD started. In this project the Spanish and French fleet in this ocean aims to seed 1000 BNEFADs. While these BNEFADs use synthetic floatation in the form of PVC balls, to ensure the FAD does not sink, they are mostly composed of natural degradable materials such as bamboo, and cotton canvas and ropes. The project is still in progress, but so far similar numbers of sets have been made on experimental biodegradable FADs and synthetic material FADs. There were some concerns by fishers about the durability of the cotton materials used. Large scale biodegradable FAD projects are planned for 2019 including trials by the Ghanaian fleet in the Atlantic and a large sector of the Ecuadorian fleet in the EPO.

Table 7 – Evolution in the acceptance level of fishers for biodegradable FADs by different tuna fleets in ISSF Skippers' Workshops between 2015 and 2018.

	FLEET	ACCEPTANCE LEVEL		
		2015-16	2016-17	2017-18
BIODEGRADABLE FADS	ECUADOR	MID-HIGH	HIGH	MID-HIGH
	MEXICO	-	-	-
	PERU	-	HIGH	MID-HIGH
	PANAMA	-	-	MID-HIGH
	USA	-	MID	MID-HIGH
	INDONESIA	HIGH	HIGH	MID-HIGH
	KOREA	-	-	-
	PHILIPPINES	-	-	-
	TAIW AN	-	-	-
	WCPO*		MID	MID-HIGH
	FRANCE	-	HIGH	HIGH
	SPAIN	MID-HIGH	HIGH	HIGH
	GHANA	MID	MID-HIGH	HIGH
	PORTUGAL	MID-HIGH	-	-
	VIETNAM	NA	-	-
	CHINA	LOW -MID	LOW -MID	-
	SENEGAL	-	-	MID-HIGH
	JAPAN	-	-	HIGH

Acoustic selectivity of tuna species and sizes

Fishers are very interested in the development of acoustic technology capable of discerning tuna species and sizes composition at FADs (**Table 8**). This technology could be used both from echo-sounder buoys attached to FADs and from the acoustic equipment onboard purse seiners. Due to the recent adoption of BET and YFT quotas per vessel in the Atlantic and Indian Oceans, respectively, knowledge on the amount of each species present at FADs has become even more important for fishers. They could use this information to plan their trips to a given FAD or area, following the information provided by echo-sounder buoys. Many boats in the Atlantic and Indian Oceans for example have had to stop fishing in the last quarter of 2018 because they had used up all their BET or YFT quota for the year.

Although buoy manufacturers are trying to improve their biomass estimates and provide tuna species composition, fishers said that current acoustic equipment is not able to provide this information and that they can be driven erroneously to areas where the species of tuna or their sizes are not desirable.

The change overtime to a higher acceptance level of acoustic selectivity by some fleets can be due to the fact they were not using acoustics either onboard or in the buoys and could not envisage its potential. Nowadays the same fleets are using practically 100% echo-sounder buoys and see very useful having information of tuna species and sizes composition at FADs in order to conduct a selective fishing.

Table 8 – Evolution in the acceptance level of fishers for the use of selective echo-sounder buoys by different tuna fleets in ISSF Skippers' Workshops between 2010 and 2018.

ECHO-SOUNDER SELECTIVITY	FLEET	ACCEPTANCE LEVEL							
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
	ECUADOR	MID	MID	MID	HIGH	MID-HIGH	MID-HIGH	HIGH	HIGH
	MEXICO	-	-	-	-	MID	-	-	-
	PERU	-	-	MID	-	MID	-	HIGH	HIGH
	PANAMA	MID	-	MID	-	-	-	-	HIGH
	USA	MID-HIGH	MID	-	MID	MID	-	MID-HIGH	HIGH
	INDONESIA	-	-	-	NA	NA	NA	NA	NA
	KOREA	-	-	-	MID	HIGH	-	-	-
	PHILIPPINES	-	LOW	-	MID	-	-	-	-
	TAIWAN	-	-	-	MID	-	-	-	-
	WCPO*	-	-	-	-	-	-	MID-HIGH	HIGH
	FRANCE	MID-HIGH	MID	-	-	-	-	HIGH	HIGH
	SPAIN	MID	MID	MID	MID	HIGH	HIGH	HIGH	HIGH
	GHANA	LOW	LOW	MID	MID	MID	MID	HIGH	HIGH
	PORTUGAL	-	-	-	-	-	HIGH	-	-
	VIETNAM	-	-	-	-	-	NA	NA	NA
	CHINA	-	-	-	-	-	MID	MID-HIGH	-
	SENEGAL	-	-	-	-	-	-	-	HIGH
	JAPAN	-	-	-	-	-	-	-	HIGH

FAD number reduction and BET/YFT quotas

In the last decade the number of FADs had risen sharply in most oceans. To contain the rapid growth in FAD use RFMOs have introduced various limits on the use of active buoys per vessel (used to locate the FADs), ranging from 325 to 500 per vessel. Many fishers think that putting a cap on the number of FADs is a positive measure (**Table 9**). Note that RFMO limits are not on the number of FADs used per year but rather on the number of active buoys at sea at a given time. This means that to maintain a given number of FADs active at sea, it is necessary to deploy a lot more. Due to the complexity of maintaining large numbers of freely drifting FADs at sea, a high percentage are lost to other vessels, sink or drift away from the fishing zone. To keep within the active buoy limit, fishers often deactivate buoys as soon as FADs move away from productive fishing grounds, so the fate of these abandoned FADs becomes unknown. This might result in an overall greater number of lost FADs per year, thus increasing the generation of marine debris.

Note that only one RMFO, the IOTC, has a limit on the number of buoys that can be purchased per boat annually (700 buoys). Some fishers from the Indian Ocean agreed that maintaining 325 active buoys at sea and using a total of 700 per year was difficult, however this was the case of fleets focused mainly on FAD fishing and working with high numbers of FADs, close to the limit. Fishers in other fleets and oceans said that they do not reach the limit as their strategy is more opportunistic fishing on their FADs but also on encountered free swimming schools and FADs belonging to other vessels (Lennert-Cody et al. 2018). While many fishers agreed that having a limit on the number of buoys was a good thing, some also questioned if there was a scientific basis when setting FAD limit regulations, as some oceanic regions of smaller size have higher limits than other much larger oceans (e.g. 500 FADs for the Atlantic and 450 FADs for the EPO). According to fishers, current YFT and BET per vessel quotas have been driving fishers to focus on FAD sets, because if they catch free school sets of these species, they quickly consume their annual quota and have to spot the boat for more months.

During the Senegal workshop it was also observed that pole and line tuna vessels, which traditionally have used no or few FADs, have started to adopt PS-like fishing strategies, with a high number of FADs equipped with echo-sounder

buoys. One exception to the global tendency in higher reliance on FAD fishing was observed in Japan during the Yaizu workshop. In recent years the Japanese PS fleet has specialized on free school fishing of large adult quality tuna for their market and use very few FADs per vessel (e.g. < 50 FADs).

Table 9 – Evolution in the acceptance level of fishers for FAD limits and spatial-temporal closures by different tuna fleets in ISSF Skippers' Workshops between 2016 and 2018.

		ACCEPTANCE LEVEL	
	FLEET	2016-17	2017-18
FAD LIMITS/ CLOSURES	ECUADOR	MID	HIGH
	MEXICO	-	-
	PERU	MID-HIGH	MID-HIGH
	PANAMA	-	HIGH
	USA	MID-HIGH	HIGH
	INDONESIA	HIGH	HIGH
	KOREA	-	-
	PHILIPPINES	-	-
	TAIWAN	-	-
	WCPO*	MID-HIGH	HIGH
	FRANCE	HIGH	HIGH
	SPAIN	LOW	LOW-MID
	GHANA	MID-HIGH	HIGH
	PORTUGAL	-	-
	VIETNAM	NA	NA
	CHINA	MID-HIGH	-
	SENEGAL	-	LOW-MID
	JAPAN	-	HIGH

Short tail FADs

The idea of using short tail appendages to avoid attraction of juvenile BET in FADs has little acceptance among fishers (**Table 10**). Many fishers think that the fishing area determines the presence of BET in FADs rather than the depth of the FAD. In addition, the tendency in recent years has been to make deeper reaching FADs (e.g. 50 to 100 m deep) in the belief that FADs with longer tails drift slowly, helping attract more tuna. Fishers thought that shallow tail FADs would drift too quickly for tuna to aggregate under them consistently. One notable exception to deep reaching FADs are the "cage" FADs observed in the last year in the Indian Ocean which only reach a few meters in depth (e.g. < 5 m).

Fishers thought that real-time communication systems to alert of temporary areas of high incidence of BET or YFT could be a better way of preventing high catches of juvenile tuna, where an effort to preserve these species is needed.

Table 10 – Evolution in the acceptance level of fishers for the use of FADs with short tail appendages by different tuna fleets in ISSF Skippers' Workshops between 2014 and 2018.

		ACCEPTANCE LEVEL			
	FLEET	2014-15	2015-16	2016-17	2017-18
SHORT TAIL FADS	ECUADOR	LOW	MID	LOW	LOW
	MEXICO	-	-	-	-
	PERU	-	-	-	MID
	PANAMA	-	-	-	LOW
	USA	-	-	LOW	LOW
	INDONESIA	-	NA	NA	NA
	KOREA	MID-HIGH	-	-	-
	PHILIPPINES	-	-	-	-
	TAIWAN	-	-	-	-
	WCPO*	-	-	LOW	LOW
	FRANCE	-	-	-	-
	SPAIN	MID	MID-HIGH	LOW	LOW
	GHANA	-	MID-HIGH	LOW	LOW
	PORTUGAL	-	LOW-MID	-	-
	VIETNAM	-	NA	NA	NA
	CHINA	-	MID-HIGH	LOW-MID	LOW-MID
	SENEGAL	-	-	-	LOW
	JAPAN	-	-	-	LOW

Utilization

Utilization of bony fish bycatches including small tuna species and other pelagic species such as dolphinfish, wahoo, marlin, or barracuda continues to grow (**Table 11**). In the Atlantic most bycatch fish are sold locally as "faux poisson", and in the EPO several factories buy bony fish for processing. In the Indian Ocean companies are increasingly selling to restaurants and processors these non-tuna fish species and often rather than keeping them in brine, they are kept fresh frozen so that the market value is higher. In the WCPO the amount of these bycatches at FADs tend to be smaller in these oligotrophic waters and markets sparser. This is why some fishers gave only a mid-acceptance level. However, increasingly these species are being sold in local islands and some international fish dealers are also starting to buy them.

Table 11 – Evolution in the acceptance level of fishers for bony fish bycatch utilization by different tuna fleets in ISSF Skippers' Workshops between 2010 and 2018.

	FLEET	ACCEPTANCE LEVEL							
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
BYCATCH UTILIZATION	ECUADOR	MID-HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
	MEXICO	-	-	-	-	MID	-	-	-
	PERU	-	-	HIGH	-	HIGH	-	MID	HIGH
	PANAMA	MID-HIGH	-	MID-HIGH	-	-	-	-	MID
	USA	MID-HIGH	MID-HIGH	-	HIGH	LOW-MID	-	MID-HIGH	MID
	INDONESIA	-	-	-	HIGH	HIGH	HIGH	HIGH	HIGH
	KOREA	-	-	-	LOW-MID	LOW	-	-	-
	PHILIPPINES	-	HIGH	-	HIGH	-	-	-	-
	TAIWAN	-	-	-	HIGH	-	-	-	-
	WCPO*	-	-	-	-	-	-	MID-HIGH	MID
	FRANCE	HIGH	HIGH	-	-	MID	-	MID	MID-HIGH
	SPAIN	MID	MID	HIGH	MID-HIGH	HIGH	MID-HIGH	MID-HIGH	MID-HIGH
	GHANA	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
	CHINA	-	-	-	-	-	LOW	LOW	-
	PORTUGAL	-	-	-	-	-	MID-HIGH	-	-
	VIETMAN	-	-	-	-	-	HIGH	-	-
	SENEGAL	-	-	-	-	-	-	-	MID-HIGH
	JAPAN	-	-	-	-	-	-	-	MID-HIGH

NOVEL IDEAS AND IMPROVEMENTS FOR BYCACTH MITIGATION ACTIVITIES

Hopper with side ramp

Fishers in the Eastern Pacific using hoppers were convinced that this tool enabled easy spotting of bycatch for release from deck. Different models of hoppers exist, for example those used in the Pacific are slightly inclined and have a door that can be open and closed at will to regulate the catch going down the loading hatch. These hoppers are put during unloading between the net roller and the unloading hatch. Other hoppers like those used by the French fleet in the Indian Ocean rest directly on top of the loading hatch. Hoppers fit approximately 4-5 t of catch but can be custom-built to fit in smaller top decks if necessary.

In all cases bycatches like bony fishes or sharks are lifted manually from the hopper's tray and released on the side of the boat over the railing. A fisher suggested that an extra side door should be built into hoppers and a ramp or even a gravity roller conveyor fitted going straight to the waters' edge. In this way animals for which there is a high risk when handling them, like sharks, would only have to pass through the side door onto the ramp and would go directly to sea, avoiding risky manual contact. However, fishers pointed out that ship-owners need to be willing to make an investment to provide these types of solutions. Note that for the type of budget a large-scale purse seiner manages, the acquisition of a hopper or other similar release tools have a relatively minor cost.

Manta ray release grid

Currently many manta rays are released manually, but this can be very tricky when large specimens are caught. Especially because they are awkward to handle due to their slippery surface and lack of appendages to get a firm grip. Some boats release the manta ray directly with the brailer and this is a very safe option. However, note that not all boats have a long enough brailer pole to reach outside the net area. Use of canvases and cargo nets have been suggested also in the past, but if these net beds are small in size, they can result in excessive bending of the manta's wings while lifting and injure the animal.

In previous years a fisher suggested using a portable bamboo grid that goes on the unloading hatch if a manta is spotted in the brail, which lets tuna go through while keeping the manta on top. However, a few skippers who tried this method said that the weight of large manta rays had crushed the bamboo structure. Instead, they suggested using a metallic rim that would lay on top of the unloading hatch. A metallic cross or even strong flexible material (e.g. Sampson ropes) could form the grid panel. Due to the size of the structure and metallic frame it would probably need to be lifted with a crane both to position it over the hatch and also to lift the manta and release it over the port side.

FAD retrieval

Several novel options were discussed between scientists and fishers to maximize FAD retrieval and prevent FADs beaching. One such option was the identification of hotspot areas for beaching in which tender vessels could be collecting lost FADs. Also, providing the position of FADs to local fishermen in exchange for picking them up was contemplated. For example, at certain times of the year in areas off the Maldives there are many FADs drifting which are too far away for PS vessels to pick up. Here, local tuna pole and line fishers could benefit from these FADs and take them back to land after. However, the weight and volume of FADs makes the retrieval of the structure quite difficult for artisanal fishers.

The option of having self-propelled FADs (e.g. with a small solar panel fed propeller) to keep FADs within productive areas and away from shallow coastal waters was also discussed and thought of a good option to prevent beaching.

FAD fishing strategies

Learning how fleets operate and try to maximize their catches is key to understand the impacts on the fishery and its ecosystem. Some common denominators have been observed across oceans such as the general strong increase FAD usage (except for the Japanese fleet), the now widespread almost 100% use of echo-sounder buoys or FAD-information sharing between company boats to maximize fishing efficiency by working in group. Many fishers also noted that having supply vessels assisting with FAD-related tasks is paramount to be able to manage high numbers of FADs. The use of deeper and larger FADs to "compete" for tuna aggregation with other floating objects is also a commonly observed pattern, which results in greater quantities of synthetic material drifting at sea. Fisheries are dynamic and understanding how fleets adapt and change practices in their daily activities is key to design meaningful conservation measures that achieve their intended objectives.

Recommendations

Recommendation 1:

- Encourage testing of biodegradable non-entangling FADs to minimize marine pollution.

Recommendation 2:

- Construct and test bycatch release tools to be tried on deck for large animals and promote the use of hoppers. Encourage investments by ship-owners to modify purse seine deck to allow safe and rapid release of by-catch alive.

Recommendation 3:

- Continue dialogue with fishers to understand changes in operational practices and fishing strategies, relevant to design appropriate management measures for each ocean

Recommendation 4:

- Promote the use of electronic monitoring systems to cross check human observer data and compliance with conservation measures

Related Reports

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