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Progress Report of Project 110 and 110a: Non-entangling and Biodegradable FAD Trial in the Western and Central Pacific Ocean

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Executive Summary

WCPFC Projects 110 and 110a are conducting trials of non-entangling and biodegradable drifting Fish Aggregation Devices (dFADs) in the Western and Central Pacific Ocean (WCPO), with the objective to provide essential information to the Western and Central Pacific Fisheries Commission (WCPFC) and tuna fishing industry on the designs, types of materials, performance, implementation challenges and cost-effectiveness of non-entangling and biodegradable dFADs in the WCPO context. The project supports industry to uptake more ecologically sustainable dFAD designs and provide the WCPFC with information to support consideration of Conservation and Management Measures (CCMs) related to non-entangling and biodegradable dFADs. SPC is also collaborating closely with the International Seafood Sustainability Foundation (ISSF) on non-entangling and biodegradable dFAD trials in the Pacific Ocean, involving both this project and their NOAA funded Bycatch Reduction Engineering Program (BREP) project with the US purse seine fleet, so that data, skills and resources can be leveraged across all the biodegradable dFAD work in the Pacific Ocean. Results presented in this paper cover jelly-FADs deployed as part of both projects in the Pacific Ocean and are an update from previous reports presented at the Scientific Committee (SC) of the WCPFC.

Five fleets, representing more than 56 vessels, are engaged as project partners: the American Tunaboat Association (ATA, USA), FCF CO. Ltd (Chinese Taipei), Silla (Korea), Caroline Fisheries Corporation (CFC, Federated States of Micronesia), Fishing Industry Association (FIA, Papua New Guinea), Koo's (Marshall Islands), China (Zhongyu Global Seafood Corporation, Shanghai Kaichuang Deep Sea Fisheries Co. Ltd and Zhejiang Ocean Family Co.) and KAIMAKI (Japan). The projects involve 56 vessels testing 665 jelly-FADs across different countries and fleets. However, the fishing companies participating in the project manage a total of around 90 vessels.

A total of 645 non-entangling and biodegradable dFADs (jelly-FADs) have been constructed, as part of Project 110 and 110a (429) and the BREP (216) projects. A total of 321 jelly-FADs have been deployed to date. The design tested is the jelly-FAD, including the original 3D cubic structure, as well as a newly developed cylindrical jelly-FAD design, which is lighter, easier to handle, and further reduces the potential impact when stranded. The materials for both types include bamboos (poles or bamboo stripes), canvas and ropes made of cotton, and for 30% of the jelly-FADs tested by the Chinese fleet, a new high-strength cellulose-based material (Lyocell) called "Suncell".

The performance of the jelly-FADs is then compared with conventional dFADs, deployed nearby. Both types were monitored for on average 9 months (the longest so far being more than 2 years), which is an indicator of their usefulness/longevity at sea. The spatial distribution of the deployed non-entangling and biodegradable dFADs and the conventional dFADs is very wide, covering most of the tropical WCPO and Eastern Pacific Ocean (EPO).

Visits to the non-entangling and biodegradable dFADs that have been deployed are low (25 in total, including fishing sets), indicating that the condition of the jelly-FADs was good until at least 3 months, and for one jelly-FAD visited after 6 months, the main rope was still in good condition. However other components were no longer intact. The low number of jelly-FADs visited so far (20 fishing sets and 5 visits without sets) limits the conclusions that can be drawn regarding their condition after prolonged periods at sea. We also note that, so far, no sets or visits have been made for either the conventional or jelly-FADs after 6 months post-deployment.

Despite the limited visits to the deployed dFADs, considerable data has been obtained from their acoustic satellite buoys. This data shows that the drift speed of conventional dFADs and jelly-FADs was similar. Biomass data from the echosounder buoys attached to the dFADs indicated that tuna aggregation patterns were similar between conventional and jelly-FADs, with a peak in biomass at 2 months after deployment. Twenty fishing sets have been performed on the jelly-FADs with an average catch of 53.3 t per set. More sets were made on the paired conventional dFADs (58), that showed a higher catch per set with an average of 72.7 t. This compares to an average of 49.0 and 54.5 t per set across over 22,380 dFAD sets in the WCPO in 2023 and 2024. The median catch on jelly-FADs and all WCPO sets in 2023 and 2024 were however similar at 35.0; and 30.0 t and 35.0 t, respectively.

The trials of non-entangling and biodegradable dFADs in the Pacific are ongoing and providing essential information and capacity building, and have so far trained 125 fishing industry staff that will support the industry to transition to non-entangling and biodegradable dFADs. The training and collaboration with industry will allow them to constructively contribute to the development of conservation and management measures related to dFAD use in the WCPO. Final report from the project will be presented at SC22.

We invite SC21 to:

- Note non-entangling and biodegradable dFAD training workshops, including construction, were held in six ports in the Pacific, including four main purse seine ports of the WCPO; and that five fleets, representing more than 90 vessels (56 directly participating), are engaged as project partners.
- Note that 645 jelly-FADs have been constructed, including 429 as part of WCPFC Projects 110 and 110a; an additional 20 are under-construction, and that 321 jelly-FADs have been deployed under the WCPFC and BREP project collaboration.
- Note that the drift speed and monitoring period of conventional FADs and jelly-FADs were similar.
- Note that aggregation patterns measured using biomass data from echosounder buoys attached to dFADs, were similar between the conventional and jelly-FADs, with a peak biomass at 2 months after deployment.
- Note that 20 fishing sets have been performed on jelly-FADs in this trial so far, representing 6.2% of the jelly-FADs deployed, with an average tuna catch of 53.6 t per set. The median catch per set on the jelly-FADs for this trial were similar to that of the traditional dFADs across the whole fleet over the same period (i.e., 32.5 vs 30 t per set, respectively).
- Note that these trials and the associated industry engagement are providing essential capacity building for transition to the use of more ecologically friendly dFADs in the Western and Central Pacific Ocean.
- Note the importance of outreach to fishing fleets regarding the construction and use of biodegradable FADs. Raising awareness and sharing lessons learned from other fleets and collaborating with scientists to effectively disseminate the knowledge acquired through previous bio-FAD trials. Such efforts will encourage fleets that have not yet been involved to engage in these initiatives.

Contents

1. Introduction

The number of drifting Fish Aggregating Device (dFAD) buoy deployments in the Western and Central Pacific Ocean (WCPO) is estimated to vary between 23,000 and 40,000 per year (Escalle et al., 2020, 2021a). Up until recently, dFADs included netting materials that could result in entanglement of Species of Special Interest (SSIs; i.e., sharks, turtles). Since January 1st 2024, netting has been banned under CMM 2023-01 (Conservation and Management Measure for bigeye, yellowfin and skipjack tuna in the western and central Pacific Ocean). As a result, dFAD designs and construction materials are evolving rapidly, with fishers replacing netting with alternative materials such as canvas or ropes. However, the use of petroleum-derived plastics is still predominant in dFAD's construction (Escalle et al., 2023c) and continues to raise concerns related to marine pollution. In addition, the rate of subsequent loss or abandonment, and stranding of deployed dFADs, is estimated at 44.8% and 11.3%, of tracked dFADs, respectively (Escalle et al., 2023a). This is concerning for coastal states of the Pacific region, NGOs and fishery stakeholders, and is increasingly eroding the social license of the purse seine tuna industry in the WCPO. To mitigate these undesirable impacts of dFAD use, there is a growing need to transition to dFADs that are constructed from materials that are both organic and biodegradable and continue to mitigate the entanglement of SSIs. In CMM 2023-01, WCPFC also encourages the use of biodegradable materials to construct dFADs.

There is however a recognition that facilitating the fishing industry´s transition to fully non-entangling and biodegradable dFADs requires continued research and development in close collaboration with the fishing industry. This includes designing and testing dFADs made of non-entangling biodegradable materials and demonstrating their functionality, cost-effectiveness, and practicality compared to traditional designs made primarily of synthetic materials. In addition, options for biodegradable materials' supply should be investigated and capacity building in Pacific ports should be carried out.

Since 2021, trials of non-entangling and biodegradable dFADs have started in the WCPO, through WCPFC *Project 110: non-entangling and biodegradable FAD trial in the WCPO*; as well as a similar parallel project; *the National Oceanic and Atmospheric Administration's Bycatch Reduction Engineering Program (BREP) project*, led by the International Seafood Sustainability Foundation (ISSF) in collaboration with The Pacific Community (SPC). While generating valuable information, both projects highlighted the fact that large numbers of non-entangling and biodegradable dFADs needed to be deployed to generate statistically robust results. This is mainly due to the limited number of visits by fishing vessels to dFADs in general. A follow-up project, WCPFC *Project 110a*, was therefore added in 2024 to build on the two other projects by increasing both the number of biodegradable dFADs deployed and the regional industry involvement, training and capacity building.

The current paper provides an update on the activities of WCPFC *Project 110 and 110a*, as well as the *BREP project*.

2. Methodology

2.1 WCPFC project 110 and 110a

Project 110 and 110a (the projects) aim to conduct trials of non-entangling and biodegradable dFADs in the WCPO to contribute to the data required to deliver robust information to industry on the designs, types of materials, performance and cost-effectiveness of non-entangling and biodegradable dFADs in the WCPO. It has the following objectives:

1. Explore designs and cost-feasibility of non-entangling and biodegradable dFADs.
2. Undertake at-sea experiments to compare the performance/functionality of non-entangling and biodegradable dFADs to conventional dFADs.
3. Provide scientific advice to industry and national fisheries managers on the performance of non-entangling and biodegradable dFAD designs.
4. Increase regional support, capacity building and partnerships on non-entangling and biodegradable dFAD research with various stakeholders in the WCPO.

The project is led and coordinated by WCPFC Science Services Provider, SPC, with the support of the ISSF, and donor funds from the EU (majority), US and the ISSF. Analyses are carried out in collaboration with AZTI, Spain. The work is in collaboration with fishing industry, government and national fisheries agencies. Project 110 aims to construct and deploy a minimum of 200 non-entangling and biodegradable dFADs and an additional 150 will be deployed under Project 110a. These experimental non-entangling and biodegradable dFADs are compared with 200 'conventional' (currently used) synthetic dFADs, deployed in the close vicinity to the biodegradable FADs. In addition to increasing the sample size of trialed non-entangling and biodegradable dFADs, Project 110a will also allow additional fishing companies and fleets to engage in the trials, run more training in the construction of jelly-FADs in alternative locations, and identify additional options for biodegradable materials.

2.2 NOAA project

The project "Towards the Use of Biodegradable Fish Aggregating Devices (FADs) in the Pacific Ocean", under the framework of a National Oceanic and Atmospheric Administration Fisheries (NOAA)'s funded BREP project is being led by ISSF, in collaboration with SPC. It also aims to construct and trial non-entangling and biodegradable dFADs, but more widely across the Pacific Ocean (including the IATTC area) in collaboration with the US fleet (the American Tunaboat Association "ATA", including Cape Fisheries). The project has similar objectives and methods to projects 110 and 110a and the data from both projects can be combined and compared.

3. Updates on activities of the projects

3.1 Stage 1. Information and planning workshops

In terms of activities already performed, a literature review has been undertaken on the designs and materials of non-entangling and biodegradable dFADs that have already been used globally as well as summarising previous initiatives in terms of their efficiencies, effectiveness, cost and the lessons learned (Escalle et al., 2022; Lopez et al., 2016; Moreno et al., 2020; Moreno et al., 2023; Zudaire, 2017).

Following the review (Escalle et al., 2022), and discussion with project collaborators at ISSF and fishing companies, it was decided to adopt the jelly-FAD design (Moreno et al., 2023) for this trial (Figure 1). The review, as well as early experiments with the jelly-FAD, highlighted that cotton rope (20 mm for the main rope) and cotton canvas were strong enough to last several months to a year at-sea if used in a dFAD design, such as the jelly-FAD, that drifts sub-surface in the water without structural stress and with quasi-neutral buoyancy (Moreno et al., 2019). In addition to the jelly-FAD model previously tested, which features a 3D cubic structure (Figure 1), a new cylindrical jelly-FAD design will be trialled for the first time in the next few months as part of this project (Figure 2). This cylindrical structure is significantly lighter, easier to handle and construct, and further reduces the potential impact when stranded. The materials are similar to the cubic jelly-FAD, although bamboo stripes are used instead of bamboo poles, making the structure lighter. In addition, as part of Project 110a, different materials were also considered with one fleet (China), canvas and ropes made of i) cotton (breaking strength of 3,300 kgf); ii) jute (breaking strength of 1,400 kgf) and iii) a new cellulose-based material called "Lyocell" ("Suncell"; breaking strength of 5,500 kgf).

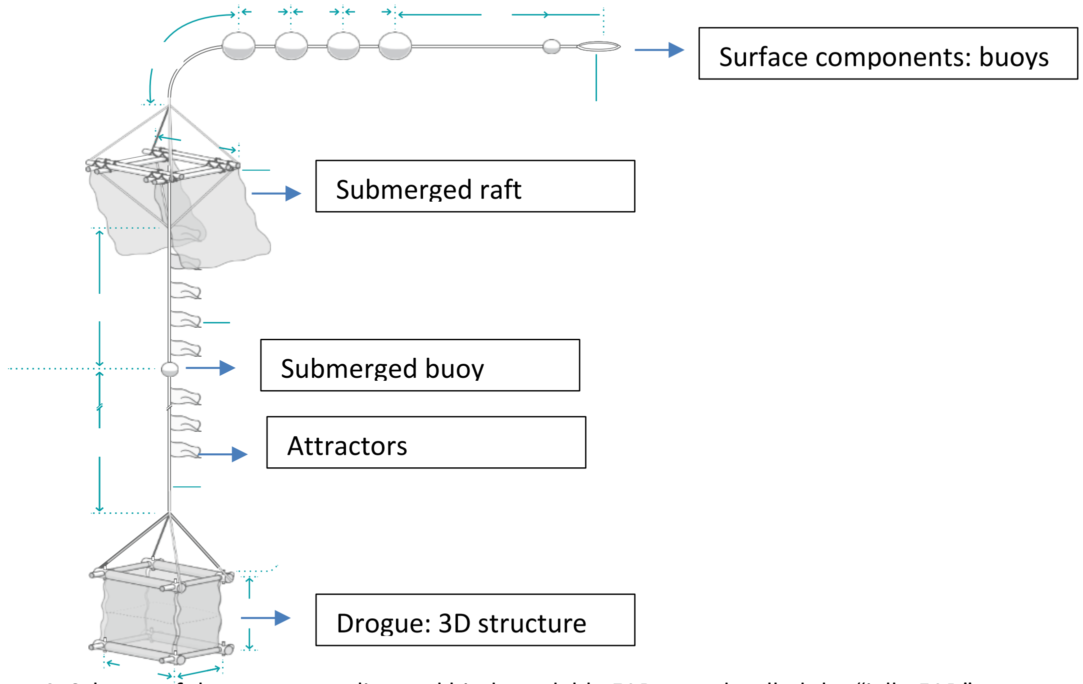

Figure 1. Scheme of the non-entangling and biodegradable FAD tested, called the "jelly-FAD".

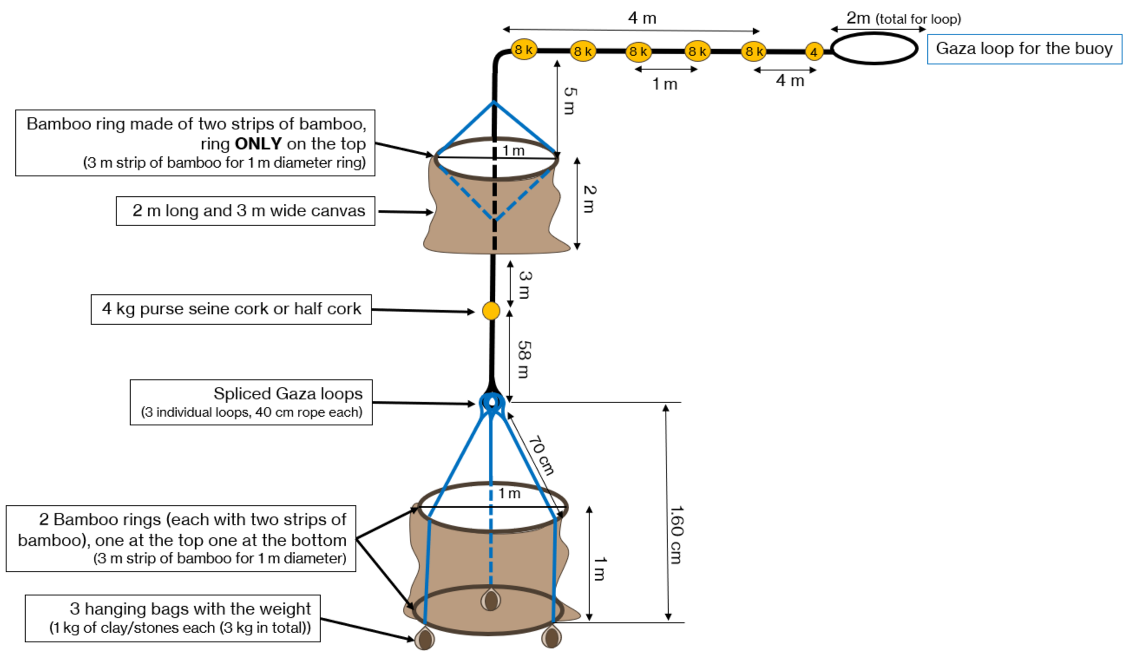

Figure 2. Scheme of the newly developed "cylinder jelly-FAD".

Partners involved in the non-entangling and biodegradable dFAD trials are operating in; i) the western part of the WCPO, mostly based or transshipping in Pohnpei (CFC, FCF, Silla, Koos, Zhongyu Global Seafood Corporation, Shanghai Kaichuang Deep Sea Fisheries Co, Ltd and Zhejiang Ocean Family Co, and Kaimaki), or ii) the central and eastern WCPO and the Eastern Pacific Ocean (EPO) (ATA) and based out of Pago Pago and Manta (Table 1). The initial construction locations were therefore chosen to be: Pohnpei, Pago Pago and Manta. Additional training ports for jelly-FADs have been added recently, including Lae (PNG), Weihai (China) and Majuro (MH), with an upcoming workshop planned for Yaizu (JP). To note a major challenge in using Majuro as a base port for non-entangling and biodegradable dFADs is the lack of bamboo availability on the islands. For the project, bamboo has been shipped from Pohnpei.

Table 1. Partner fishing companies in the non-entangling and biodegradable dFAD trials in the WCPO, construction location and number of non-entangling and biodegradable dFADs (BioFADs) to be tested.

Partners	**No. of vessels**	**Flag**	**Project**	**Construction location**	**No. of BioFADs**	
					WCPFC 110	**BREP**
Caroline Fisheries Corporation (CFC)	6	FM	WCPFC 110	Pohnpei (FM)	50	
FCF Co. ltd	8	TW	WCPFC 110	Pohnpei (FM)	50	
Silla	2	KR	WCPFC 110	Pohnpei (FM)	34	
American Tunaboat Association						
- Cape Fisheries	6	US	WCPFC 110 & BREP	Manta (EC)	30	108
- Others	10	US	WCPFC 110 & BREP	Manta; Pago Pago (AS)	50	108
Fishing Industry Association (FIA)	12	PG	WCPFC 110a	Lae (PG)	60	
Koo's	2	MH	WCPFC 110a	Majuro (MH)	10	
Chinese fleet	8	CN	WCPFC 110a	Weihai (CN)	145	
KAIMAKI	2	JP	WCPFC 110a	Pohnpei (FM)	20	
TOTAL	56				449	216

Partner fishing companies are listed below:

- **CFC Fleet**: Operating 6 vessels under the flag of the Federated States of Micronesia, this fleet tested 50 jelly-FADs, constructed in Pohnpei. All six vessels participated in the trial.
- **FCF Co. ltd**: With more than 20 vessels flying the Taiwanese flag, FCF Co, has tested 50 jelly-FADs, all constructed in Pohnpei.
- **US Fleet**: 10 U.S. based fishing companies — including Cape Fisheries LLC, GS Fisheries, AACH Holding CO LLC, AACH Holding Company No. 2 LLC, Xuk S.A., Tumbaco Fishing Industries S.A., Pacific Princess Partnership LTD, De Silva Sea Encounter Corp, Western Pacific Fisheries, and Tradition Mariner LLC — across 16 vessels that deployed 296 jelly-FADs. The construction locations for these jelly-FADs are Manta and Pago Pago.
- **Silla**: Comprising 6 vessels from Korea, will test 34 jelly-FADs, constructed in Pohnpei.
- **Fishing Industry Association (FIA):** this fleet of 12 vessels from Papua New Guinea (PNG) will deploy 60 jelly-FADs, all constructed in Lae (PNG).
- **Koo's:** This fishing company, based in the Republic of the Marshall Islands, will be testing 10 jelly-FADs with 2 fishing vessels participating. Jelly-FADs were constructed in Majuro in May 2025.
- **Chinese fleet:** comprising three fishing companies Zhongyu Global Seafood Corporation, Shanghai Kaichuang Deep Sea Fisheries Co., Ltd and Zhejiang Ocean Family Co., LTD with 18

vessels (8 vessels participating); with the support of Shanghai Ocean University will deploy 145 jelly-FADs. This fleet will exclusively test the newly developed cylinder jelly-FADs (Figure 2), with canvas and ropes made of cellulose (Lyocell "Suncell"; 30%) or cotton (70%) (Figure 3). The construction of the jelly-FADs has just been finalized in Weihai (China).

- **Kaimaki:** the Japanese Far Seas Purse Seine Fishing Association will be deploying 20 jelly-FADs that will be constructed in Pohnpei, with an in-person training workshop planned in Yaizu (JP) in October.

In total, the projects involve 56 vessels testing 665 jelly-FADs across different countries and fleets. However, the fishing companies participating in the project manage a total of around 90 vessels. The knowledge and insights gained from these trials will be disseminated across all the vessels managed by the participating companies, thus enhancing the overall understanding and implementation of bio-FADs in general and jelly-FADs in particular.

The communication and engagement strategy, including training workshops and materials developed as part of the project are described in Escalle et al., (2023c).

3.2 Stage 2: Construction of non-entangling and biodegradable dFADs and capacity building

Materials, cost and construction guidelines for non-entangling and biodegradable jelly-FADs are detailed in Escalle et al., (2023c). In addition, the ISSF has developed a construction guide (ISSF 2024) that is available via this link: https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/jelly-fad-construction-guide/. A similar construction guide is under development for the cylindrical jelly-FAD. The construction guidelines, using the specifications for the construction of the jelly-FADs for the Chinese fleet are available in Appendix 1.

Construction and training workshops have been held in Zadar (Croatia), Pohnpei (FM), Pago Pago (AS), Manta (EC), Lae (PNG), Weihai (CN) and Majuro (MH), with more than 125 people attending from fisheries departments, purse seine companies, crew, staff in companies building FADs, scientists and material suppliers (Table 2). Supply of materials have been identified in Spain, Chinese Taipei and China.

Table 2. Location and dates of jelly-FADs Construction and training workshops as part of the projects.

	Dates	Number of participants
Zadar	June 2022	4 participants
Manta (EC)	July 2022 and remote	20 participants
Pohnpei (FM)	December 2022	20 participants
Pago Pago (AS)	May 2023	15 participants
Lae (PG)	July 2024	29 participants
Weihai (CN)	March 2025	30 participants
Majuro (MH)	May 2025	8 participants

Figure 3. Photos from the jelly-FAD construction workshop held in Weihai (China) in March 2025, which included training on the cube jelly-FADs and the newly developed cylinder jelly-FAD. Tests with the Chinese fleets will include jelly-FADs with ropes and canvas made of cotton and Lyocell (cellulose), but jute jelly-FADs were also explored during the workshop.

3.3 Stage 3: Conduct at sea trials and broader industry communications program

Table 3 compares the jelly-FADs and conventional dFADs deployed by different fleets, including the US fleet and other international fleets. The data includes the number of dFADs deployed, deployment periods, number of sets, visits without sets, buoy deactivations, and stranding events:

- **Number of deployments**: The US fleet deployed 196 jelly-FADs and 171 conventional dFADs, while other fleets (FM TW, KR and PNG only so far) deployed a total of 125 jelly-FADs and 72 conventional FADs (Figure 4).
- **Sets and visits**: The US fleet recorded more sets with conventional dFADs (58) compared to jelly-FADs (15). Other fleets recorded 5 sets with jelly-FADs and none with conventional FADs. Additionally, there were visits without sets recorded for jelly-FADs in the FM (3), PNG (1) and US (1) fleets.
- **Buoy deactivation**: There were more buoy deactivations for jelly-FADs (77) compared to conventional FADs (42).
- **Stranding events**: 7 stranding events were detected by the fleets for jelly-FADs in the TW, KR, US and PNG fleet but none for conventional FADs. Note that this corresponded only to what is detected and communicated by the fleet, more stranding may have occurred and will be further examined in the future using buoy trajectory data.

Table 3. Summary of deployments and activities performed on the non-entangling and biodegradable jelly-FADs and conventional FADs from the project.

	FM		KR		TW		US fleet	
	Jelly	Conv.	Jelly	Conv.	Jelly	Conv.	Jelly	Conv.
Convention Area	WCPFC		WCPFC		WCPFC		WCPFC & IATTC	
Nb FADs to be tested	50	50	34	34	50	50	296	296
Deployments	50	27	14	14	47	30	196	171
Deployment period	03/04/23 – 12/04/24		12/04/24		02/03/23 – 11/07/23		04/09/22 – ongoing	
Sets	1	0	0	0	4	0	15	58
Visit (without set)	3	0	0	0	0	0	1	0
Buoy deactivation	0	0	13	5	23	11	33	26
Stranding events	0	0	1	0	3	0	1	0

	PNG		MH		CN		JP	
	Jelly	Conv.	Jelly	Conv.	Jelly	Conv.	Jelly	Conv.
Convention Area	WCPFC		WCPFC		WCPFC		WCPFC	
Nb FADs to be tested	60	60	10	10	145	145	20	20
Deployments	14	1						
Deployment period	28/08/24 – ongoing							
Sets	0	0						
Visit (without set)	1	0						
Buoy deactivation	8	0						
Stranding events	2	0						

Figure 4. Deployments of jelly-FADs at sea in the WCPO. Photos from FCF and CFC.

Table 3 underscores the challenge of obtaining data on experimental dFADs, both for jelly-FADs and their conventional counterparts. Out of a total of 312 jelly-FAD deployed, only 24 were visited or fished, representing only 8.0%. Similarly, out of 243 paired conventional dFAD deployed, only 58 were visited or fished, accounting for 23.9% of the total deployments. These percentages are consistent with other bio-FAD experiments, where approximately 5-10% of deployed dFADs were visited by the deploying fleets alone. This emphasizes the significance of deploying a large number of dFADs for trials, or alternatively, systematically deploying a percentage of bio-FADs to yield meaningful insights into their performance. It also highlights that many dFADs are probably never fished on by the deploying company vessels.

The spatial distribution of deployments, sets and trajectories of jelly-FADs and their conventional counterparts are depicted in Figure 5. In the EPO, both types of dFADs were deployed within the same area. It is a common practice to deploy dFADs off Ecuador at around 0° latitude and fish on these within the region spanning from 10°S to 10°N (Lopez et al., 2023). Once dFADs drift beyond these latitudes, typically further north than 10°N or south than 10°S, they are deactivated. During the trials, the fleet has, to date, followed deployment practices for experimental dFADs that closely mirror those used in their standard fishing activities.

For the WCPO, we observed deployments along the equator in the central part of the WCPO, as well as along the boundary with the EPO, known as a hotspot of dFAD deployments (Escalle et al., 2023). The spatial distribution of the jelly-FADs and conventional dFADs is broad, covering the whole WCPO (Figure 5).

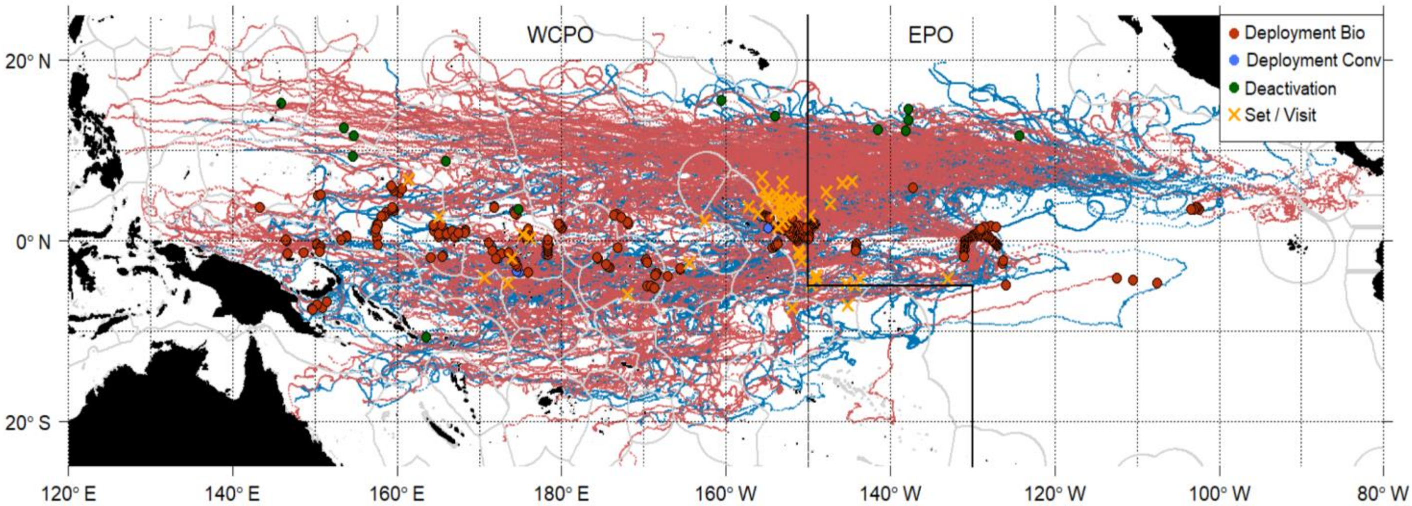

Figure 5. Trajectories, deployments, deactivations, fishing sets and visits of drifting biodegradable (red) and conventional (blue) dFADs in the trial.

3.4 Stage 4: Data analysis and reporting

3.4.1 Duration at-sea

The duration at sea is tracked through two primary methods: direct observation by fishers during visits and sets made on the experimental dFADs (both jelly-FADs and their conventional pairs), and indirect tracking via satellite buoy datat attached to each dFAD.

The visits made by fishers involve filling out forms detailing the state of the dFAD, any catches, and other relevant information. This method offers direct insights into the condition and activity on the dFAD while at sea.

On the other hand, the buoy tracking system provides data on biomass and other parameters indirectly related to the duration of the dFAD's deployment, as well as dFAD speed and trajectories. Although the dFAD itself is not monitored in real-time, the echosounder data from the buoy serves as an indicator of the presence and amount of fish around the dFAD, thus providing valuable information about its effectiveness. In addition, fishers typically continue to monitor dFADs that are deemed active and productive, while deactivating those that are no longer deemed useful for fishing operations. Thus, active dFADs, or transmissions from the buoy are an indicator of the useful lifespan of dFADs for fishing operations.

The average number of buoy transmissions before a buoy is no longer monitored is very similar between non-entangling and biodegradable dFADs and conventional dFADs and varies from 3 to 6,000 transmissions, with an average of 618 and 647, respectively (Table 4).

Table 4. Summary of deployments, number of transmissions and duration at-sea for the non-entangling and biodegradable jelly-FADs and conventional FADs at time of last data extracts (from 02/03/2023 to 14/04/2025).

	Jelly-FADs	Conventional
Deployments	321	243
Data available	285	218
Transmissions (positions or biomass)		
Min	3	5
Mean	618	647
Max	4,958	6,000
Duration (days)		
Min	0	0
Mean	269	260
Max	837	718

Interestingly, the monitoring duration for jelly-FADs compared to their conventional counterparts is quite similar, with averages of 269 and 260 days, respectively (Table 4 and Figure 6). Additionally, the graph depicts how only 50% of both jelly and conventional dFADs are monitored after 300 days at sea. The percentage of conventional dFADs' monitored drops below 25% after 1 year, while bio-FADs continued to be monitored for a longer duration (below 25% after 1.5 years; Figure 6).

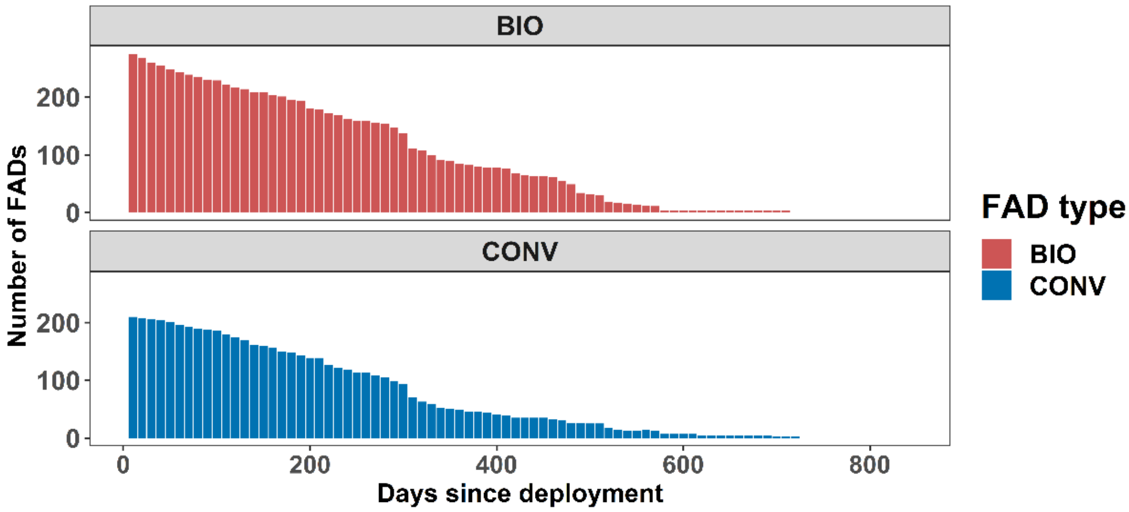

Figure 6. Days of dFAD monitoring from deployment to the end of signal transmission (based on satellite and echosounder buoys) of biodegradable and conventional dFADs of the trial.

DFAD pairs, which are deployed together, may remain within the same water masses throughout their entire lifespan, stay together for a limited period and then separate, or separate immediately after deployment (Figure 7). Only those that drifted in the same water mass have been compared directly for performance (i.e., the top 2 examples from Figure 7). DFAD pairs typically remain relatively close for the first month, but can be found very far from each other after six months and more (Figure 8).

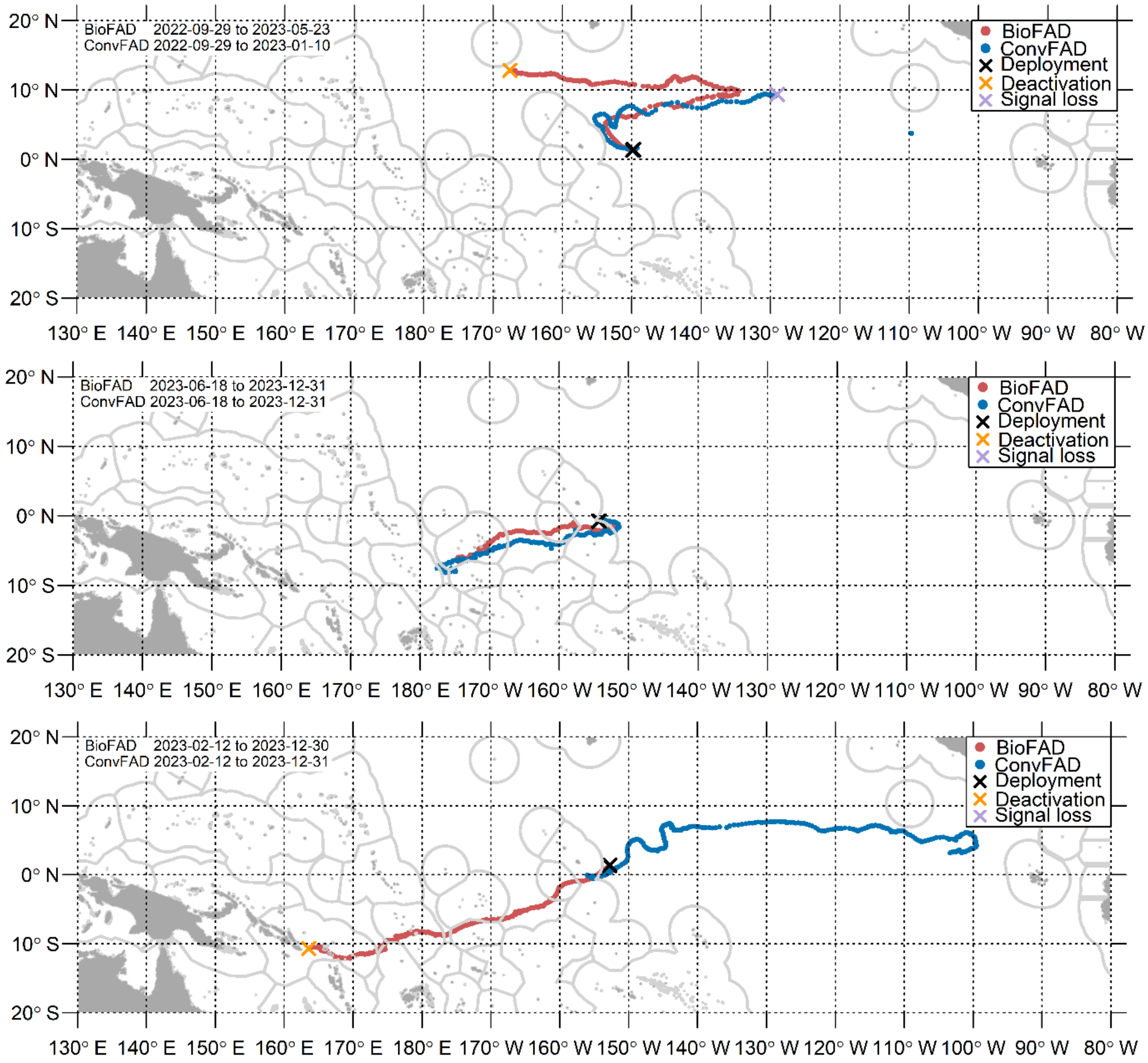

Figure 7. Example drift trajectories (based on satellite and echosounder buoys) of paired releases of biodegradable and conventional FADs in the trial.

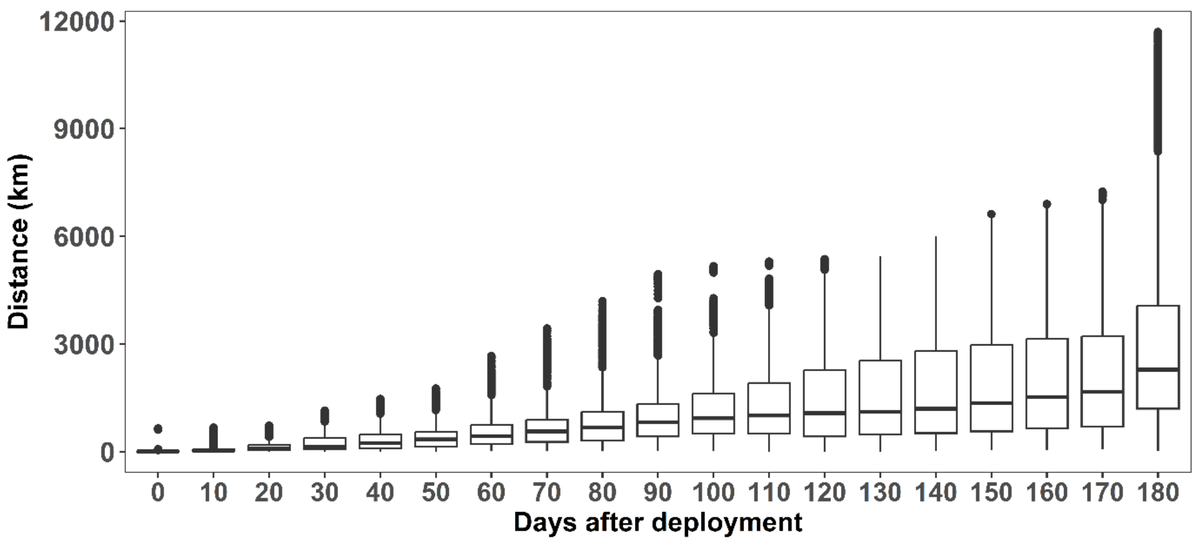

Figure 8. Distances between released pairs of biodegradable and conventional dFADs at time periods from 0 to ≥180 days post-deployment (180 days includes all data ≥180 days).

3.4.2 Speed

From the fishers' perspective, one of the requirements for a productive dFAD is the slow drift. This characteristic helps the dFAD remain in the fishing ground to aggregate fish for longer and reduce its risk of being lost or abandoned early due to drifting quickly out of the fishing zone. Therefore, we compared the drift speed of conventional dFADs with that of jelly-FADs, to see if there was any significant difference in this key performance feature between the two types of dFADs (Figure 9 and Table 5). Speed of conventional dFADs and jelly-FADs that drifted under the same oceanographic and weather conditions indicated that there was no significant difference in the drift speed of the jelly-FAD and the conventional dFAD.

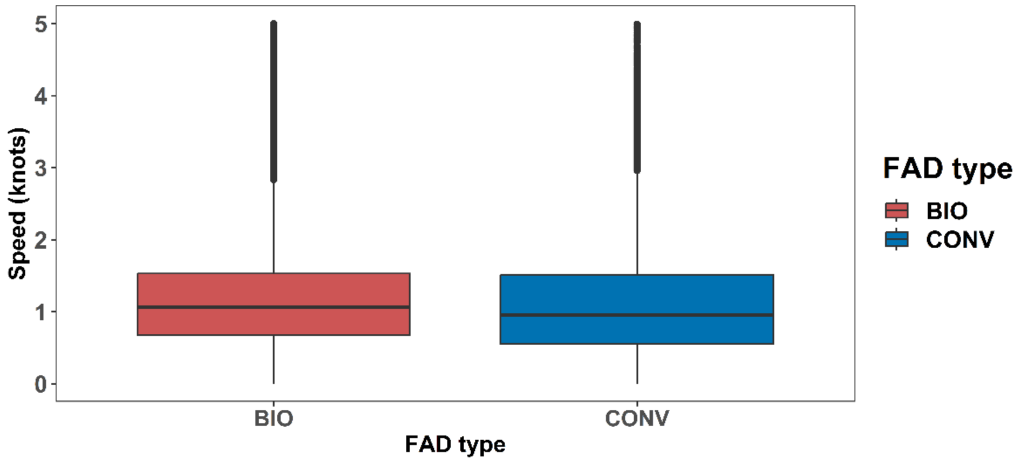

Figure 9. Speed of drifting at-sea for jelly FADS and conventional dFADs in the trial.

Table 5. Summary of drift speed values (knots) of the jelly-FADs and conventional dFADs.

	Jelly-FADs	Conventional
Min	0.0	0.0
Mean	1.15	1.11
Max	4.9	4.9

3.4.3 Aggregation patterns

Tuna aggregation patterns were studied using biomass data from the echosounder buoys attached to the dFADs (Figure 10). The 90th percentile of the biomass estimated by the echosounder buoys was used for this analysis and only the pairs of conventional dFADs and jelly-FADs that drifted under the same oceanographic and weather conditions were considered (214 pairs included). Both types of dFADs (jelly-FADs and conventional dFADs) showed similar aggregation patterns from deployment until 100 days of drifting. Maximum tuna biomass was detected from around 2 months at-sea for both types of dFADs.

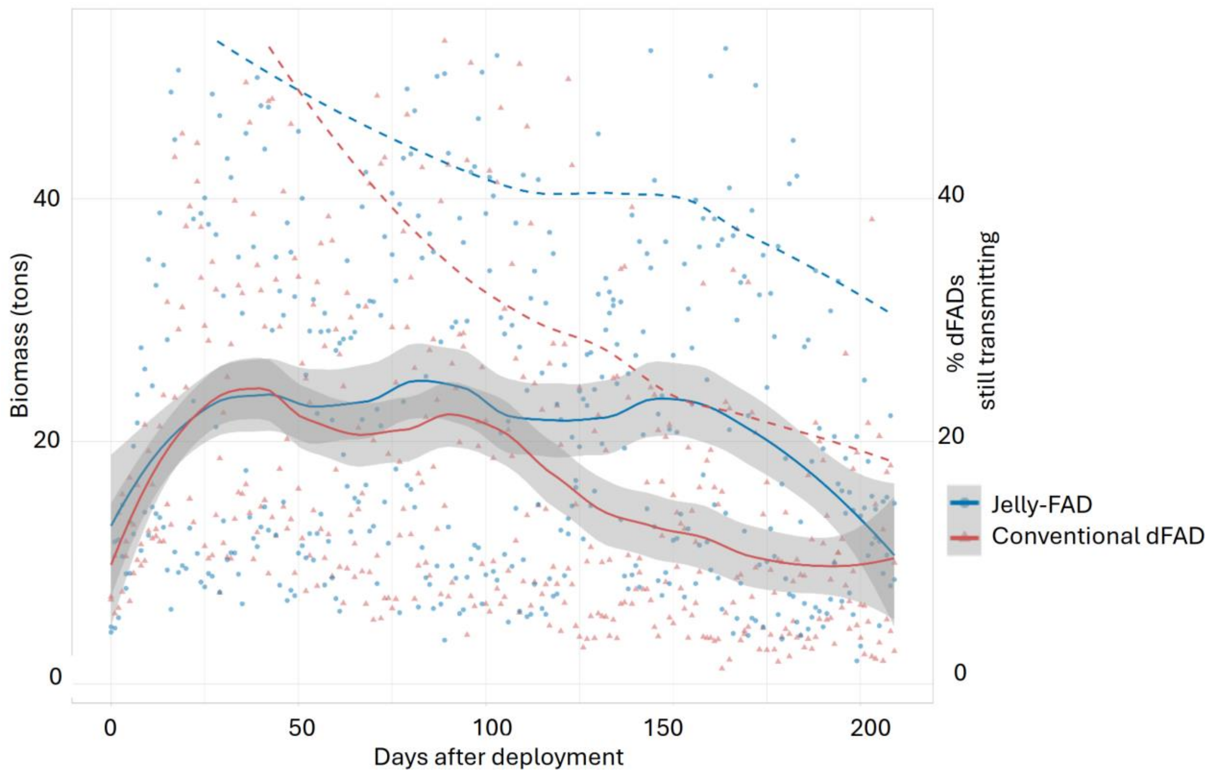

Figure 10. Biomass aggregation over time after deployment compared between pairs of biodegradable jelly-FADs and conventional FADs. The dashed line indicates the % of FADs still transmitting data after certain number of days after deployments (from 100% at time of deployment).

3.4.4 Catch

A total of 20 sets were performed on the jelly-FADs, with total catch ranging from 0 to 185 tons (t), and an average of 53.6 t (Table 6). More sets were made on the paired conventional FADs, with 50 sets recorded, and catch ranging from 5 to 260 t at an average of 71.3 t. This is higher than the average catch made on dFADs in the WCPO in 2023 of 46.3 t (0–481 t). Overall, the catch made on the jelly-FADs from the trial is higher than the WCPO 2023 average but lower than the catch on the paired conventional FADs. While the limited number of sets so far limits the robustness of the comparisons, the results do not indicate that the jelly FADs perform very differently to conventional dFADs. One potential source of bias in FAD visit patterns is that fishers tend to trust conventional FADs more than experimental ones, leading them to prioritize, monitor, and visit conventional FADs more frequently than bio-FADs (Moreno et al., 2025).

Table 6. Summary information on catches from sets made on the jelly-FADs and conventional dFADs from the project and average catch per set for the whole fleet in the WCPO in 2023.

FAD type	Number of sets	Total tuna catches (mt)			
		Min	Mean	Median	Max
Jelly-FAD	20	0	53.6	35.0	185
Conventional	58	5	72.7	42.5	260
2023 WCPO dFADs	13,322	0	49.0	30.0	481
2024 WCPO dFADs	9058	0	54.5	35.0	581

Table 6 shows that the performance of the jelly-FAD, in terms of metric tons per set, is close to the median and mean for the entire WCPO fleet in 2023. There is no scientific evidence suggesting that a particular dFAD design is more or less capable of aggregating fish (Moreno et al., 2023). Both fishers and scientists agree that tuna presence in the area and oceanographic conditions are likely the major factors influencing tuna aggregation around any given dFAD, irrespective of design features.

In Figure 11 it is noteworthy that both, jelly-FADs and conventional dFADs can be fished at any time within the first 6 months. This timing is highly dependent on the strategy of the fleet, in terms of proximity to a given dFAD and also on the time needed for the dFAD to aggregate fish. This probably depends on the presence of tuna in the water masses it crosses. Although the data is insufficient to draw significant conclusions, an interesting observation is that neither type of dFAD was fished after six months at sea.

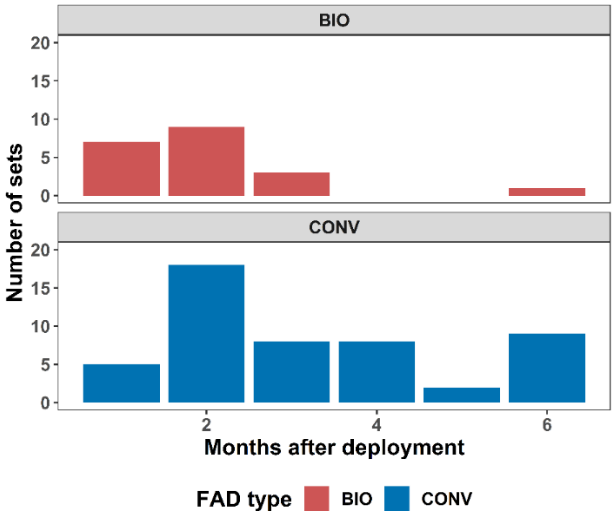

Figure 11. Soaking time for the jelly FADs and conventional dFADs fished.

3.4.5 Degradation of materials

For the few *in situ* observations, Figure 12 shows that the main rope used to sustain the non-entangling and biodegradable dFAD structure, made of recycled cotton, remained in good condition after 6 months. The submerged raft and the attractors needed repair or were missing after 6 months at sea. For the cube, the single observation after six months showed that the cube was destroyed. More data is needed to draw significant conclusions and account for the diverse stressors that dFADs suffer over their lifespan at sea.

Figure 12. State of the different components of the 24 jelly-FADs visited with time at sea. Number at the top of each bar corresponds to the number of dFADs visited that month.

4. Summary, conclusion and next steps

This report presents updates on WCPFC project 110 and 110a: Non-entangling and Biodegradable FAD Trial in the Western and Central Pacific Ocean, led by SPC and with the support of ISSF and the BREP project led by ISSF. In 2024, the second phase of the project, WCPFC Project 110a, started, with additional fleets joining from PNG, CN, MH and JP; and jelly-FAD construction training workshops in Lae (PNG), Weihai (China) and Majuro (MH). In addition, a new design of jelly-FAD, the cylinder jelly-FAD, which is lighter, easier to handle and construct, and further reduces the potential impact when stranded has been constructed and will be tested in the upcoming months.

In total, five fleets, representing more than 56 vessels, are engaged as project partners: the American Tunaboat Association (ATA, USA), FCF CO. Ltd (Chinese Taipei), Silla (Korea), Caroline Fisheries Corporation (CFC, Federated States of Micronesia), Fishing Industry Association (FIA, Papua New Guinea), Koo's (Marshall Islands), China and KAIMAKI (Japan).

Seven planning and training workshops have been held, including six in construction locations: Pohnpei (Federated States of Micronesia), Manta (Ecuador), Pago Pago (American Samoa), Lae (Papua New Guinea), Weihai (China) and Majuro (Republic of the Marhsall Islands). The prototype of non-entangling and biodegradable dFAD tested is the jelly-FAD developed by ISSF and the Insitute de Ciències del Mar in Barcelona, AZTI (Spain) (Moreno et al., 2023), including the newly developed cylindrical jelly-FAD. Materials used are mostly bamboos, cotton canvas and cotton ropes, except for the 145 jelly-FADs tested by the Chinese fleet, where 30% will be bamboos and a new cellulose-based material (Lyocell) for the ropes and canvas.

To date, 645 jelly-FADs have been constructed and 321 deployed as part of Projects 110 and 110a led by SPC and ISSF led BREP project. The costs associated with materials and construction of the jelly-FADs, as part of this trial, were 500–550 USD / jelly-FAD, but 350–362 USD / jelly-FAD if only materials and their shipment are considered (i.e., no labour or shipyard costs).

The main conclusions regarding the monitoring of the jelly-FADs tested by fleets in the Pacific Ocean in this updated report are similar to the preliminary ones presented at SC20:

- It is important to deploy a large number of non-entangling and biodegradable dFADs to get meaningful results, or regularly deploy systematically a given number of dFADs made of biodegradable materials.
- The drift speed of the conventional and jelly-FADs is similar.
- Jelly-FADs were monitored for the same duration or longer than the conventional dFADs, being an indicator of the usefulness and durability of the dFADs at sea.
- Similar aggregation patterns are detected using biomass data from echosounder buoys attached to dFADs, with a peak at 2 months after deployment.
- Conventional dFADs showed a higher catch per set compared to jelly-FADs however the median catch per set on the jelly-FADs for this trial were similar to that of the whole WCPO fleet in 2023 and 2024.
- Jelly-FAD condition for the monitored periods so far, shows that the jelly-FAD can remain useful for at least 6 months with the cotton rope intact, there were no observations after that time, both, for conventional and jelly-FADs.

Results from Projects 110 and 110a will be critical to supporting industry transition to non-entangling and biodegradable dFADs and for the WCPFC to consider Conservation and Management Measures related to the use of dFADs in the WCPO.

We invite WCPFC-SC21 to:

- Note non-entangling and biodegradable dFAD training workshops, including construction, were held in six ports in the Pacific, including four main purse seine ports of the WCPO; and that five fleets, representing more than 90 vessels (56 directly participating), are engaged as project partners.
- Note that 645 jelly-FADs have been constructed, including 429 as part of WCPFC Projects 110 and 110a; an additional 20 are under-construction, and that 321 jelly-FADs have been deployed under the WCPFC and BREP project collaboration.
- Note that the drift speed and monitoring period of conventional dFADs and jelly-FADs were similar.
- Note that aggregation patterns measured using biomass data from echosounder buoys attached to dFADs, were similar between the conventional and jelly-FADs, with a peak biomass at 2 months after deployment.
- Note that 20 fishing sets have been performed on jelly-FADs in this trial so far, representing 6.2% of the jelly-FADs deployed, with an average tuna catch of 53.6 t per set. The median catch per set on the jelly-FADs for this trial were similar to that of the traditional dFADs across the whole fleet over the same period (i.e., 32.5 vs 30 t per set, respectively).
- Note that these trials and the associated industry engagement are providing essential capacity building for transition to the use of more ecologically friendly dFADs in the Western and Central Pacific Ocean.
- Note the importance of outreach to fishing fleets regarding the construction and use of biodegradable FADs. Raising awareness and sharing lessons learned from other fleets and collaborating with scientists to effectively disseminate the knowledge acquired through

previous bio-FAD trials. Such efforts will encourage fleets that have not yet been involved to engage in these initiatives.

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Appendix 1. Specifications for the construction of the cylindrical jelly-FAD.