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

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Rev1: Updated numbers (number of deployments, fishing sets and catch per set) in Tables 2, 3 and 5; Figures 10 and 11; and associated text, based on recent data received from forms filled up by captains.

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Executive Summary

WCPFC Project 110 (the project) is 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 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 will support 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, 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 bio-FADs work in the Pacific. Results presented in this paper cover jelly-FADs deployed as part of both projects in the Pacific Ocean.

Four stakeholders representing more than 15 fishing companies (Caroline Fisheries Company (“CFC”); FCF Co., Ltd (“FCF”); the American Tunaboat Association (“ATA”), which includes Cape Fisheries; and Silla) are engaged as project partners. A total of 214 and 216 Non-Entangling and Biodegradable dFADs have been constructed, as part of Project 110 and the BREP project, respectively.

A total of 286 jelly-FADs, paired with conventional dFADs, have been deployed to date. Both types were monitored for on average 5 months (up to more than 1.5 years for the jelly-FADs, and 1 year for the conventional dFADs), which is an indicator of their usefulness at sea. However, data from buoys attached to dFADs were only available until December 2023 at the time of these analyses; more data is expected to become available which should extend the monitoring times. For the available observation data, 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 4 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.

The drift speed of conventional dFADs and jelly-FADs was similar. Biomass data from 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 53.6 t per set. More sets were made on paired conventional dFADs (50), that showed a higher catch per set with an average of 71.3 t. This compares to an average of 46.3 t per set across over 11,000 dFAD sets in the WCPO. The median between catch on jelly-FADs and all WCPO sets in 2023 was however similar (35.0 t and 30.0 t, respectively).

To build on the work started as part of this project, a WCPFC follow up project has just begun (Project 110a - P19X4), which will increase the sample size for the trial of non-entangling and biodegradable FADs, engage more fishing companies, run training in construction of jelly-FADs in alternative locations, and identify locally sourced biodegradable materials. The Fishing Industry Association of Papua New Guinea (FIA PNG) will deploy 60 jelly-FADs, with a construction training workshop recently

held in Lae (PNG). Another fishing company (Koo's) based in the Republic of the Marshall Islands will also be part of this second phase of the trials.

The trials of non-entangling and biodegradable dFADs in the Pacific are ongoing, and are now progressing well after earlier delays due to COVID. The additional funding support through the new WCPFC (P19X4; funded by EU/US/ISSF) project will enable the expansion of the trials. This is important given the low rates of fishing activity or visits to any individual dFAD, irrespective of construction type. The activities and results from these trials over the coming few years will support the industry to plan for the transition to non-entangling and biodegradable dFADs and the development of conservation and management measures related to dFAD use in the WCPO.

We invite WCPFC-SC20 to:

- Note that 430 jelly-FADs have been constructed, including 216 as part of WCPFC Project 110, and that 286 jelly-FADs have been deployed under the WCPFC and BREP project collaboration.
- Note that the drift speed of conventional and jelly-FADs is similar and that jelly-FADs were monitored longer than the conventional dFADs, indicating that based on buoy data, they have comparable at sea durability to traditional dFADs. However more visits are needed after 6 months to validate this result.
- 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 2 months after deployment.
- Note that 20 fishing sets have been performed on jelly-FADs in this trial so far, representing 7% of the jelly-FADs deployed, with an average tuna catch of 53.6 t per set. While conventional dFADs showed a higher average catch per set (71.3 t), the median catch per set on the jelly-FADs for this trial were similar to that of the whole fleet in 2023 (i.e., 35.0 vs 30 t per set for jelly-FADs of the trials and conventional dFADs of the whole fleet, respectively).
- Note that this work is ongoing and complete results from the trial and analyses of all non-entangling and biodegradable dFADs from Project 110 and the follow-up project 110a - P19X4 are expected to be available by SC 22.
- Encourage fishing fleets to join these trials, to both increase the sample size and their involvement in the development of non-entangling and biodegradable dFADs.
- Note that industry involvement requires a commitment to deploy a certain number of non-entangling and biodegradable dFADs systematically along with conventional dFADs.
- Note that these trials and the associated industry engagement and training are essential to support transition to the use of more ecologically friendly dFADs in the Western and Central Pacific Ocean.

Contents

1. Introduction

Recent estimates indicate that the number of drifting Fish Aggregating Device (dFAD) buoy deployments in the Western and Central Pacific Ocean (WCPO) has varied between 23,000 and 40,000 per year over the last decade (Escalle et al., 2020, 2021a). Traditional dFAD designs can lead to entanglement and unnecessary mortality of Species of Special Interest (SSIs; i.e., sharks, turtles). Of increasing concern is the rate of subsequent abandonment, and stranding, of deployed dFADs, recently estimated at 44.8% and 11.3%, of tracked dFADs, respectively (Escalle et al., 2023a). The resulting marine pollution, ghost fishing and environmental impacts are of concern to the coastal states of the Pacific region, NGOs and fishery stakeholders, and are increasingly impacting on 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 biodegradable and mitigate the entanglement of SSIs. For the fishing industry to make this transition, research and development in collaboration with fishing industry is required to design and test dFADs made of non-entangling biodegradable materials and to demonstrate their functionality, cost and practicality relative to traditional designs dominated by synthetic materials.

In recognition of the need to reduce the environmental and ecological impacts of dFADs in the WCPO, CMM 2023-01 (Conservation and Management Measure for bigeye, yellowfin and skipjack tuna in the western and central Pacific Ocean), requires that the design and construction of any dFAD to be deployed in, or drifts into, the WCPFC Convention Area, from 1 January 2024, shall comply with the following specifications:

- all dFADs in the WCPFC Convention Area should comply with non-entangling materials and design specifications (the use of mesh net shall be prohibited for any part of a dFAD) from January 2024 and;
- the use of biodegradable materials to construct dFADs is encouraged.

A recent review of observer data (2010–2023) shows limited use of non-entangling and/or biodegradable dFAD designs in the WCPO (Escalle et al., 2023c) thus far. However, there are data limitations with the 2020 to 2023 data, due to the low observer coverage linked to the COVID-19 pandemic. It is therefore not yet possible to clearly identify recent changes in dFAD construction and materials under the requirements of CMM 2023-01 and is precedents (CMM 2018-01, CMM 2021-01). Importantly, greater support to national fisheries agencies along with information to guide construction and encourage the use of 'effective' non-entangling and biodegradable dFADs will be essential to drive wider industry change. This will require that industry is consulted and involved at every stage of this process.

While trials of non-entangling and biodegradable dFADs have been implemented worldwide for several decades (see review in Escalle et al., 2022), they are relatively recent in the WCPO (Moreno et al., 2020). Additional work and collaborative actions among scientists and industry are required if non-entangling and biodegradable dFADs are to become the 'norm' in the WCPO. The current paper provides an update on the activities of 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).

2. Methodology

2.1 WCPFC project 110

Project 110 (the project) aims 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 design and cost-feasibility of non-entangling and biodegradable dFADs. Informed by previous trials in the WCPO and other oceans, Project 110 will foster industry and national fishery agency input and utilize readily available (locally or shipped) suitable construction materials and labor where possible.
2. Undertake at-sea experiments to compare the performance/functionality of non-entangling and biodegradable dFADs to conventional dFADs.
3. Provide robust 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. The work is in collaboration with fishing industry, government and national fisheries agencies. The project aims to construct and deploy a minimum of 200 'experimental' non-entangling and biodegradable dFADs that will be compared with 200 'conventional' (currently used) dFADs. The initial project duration was 3 years from mid-2021 to mid-2024, but now extended to 2025 due to the impacts of COVID-19 (Table 1), with activities divided into 4 stages (see Appendix 1 for details of each stage):

- **Stage 1:** Information and planning workshop: identify dFAD construction locations and initiate capacity building in design and construction.
- **Stage 2:** Construction of non-entangling and biodegradable dFADs for trials
- **Stage 3:** Conduct at sea trials and broader industry communications program
- **Stage 4:** Data analysis, reporting, final workshop and industry adoption of plan of action

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 project 110 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 already performed (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 first 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).

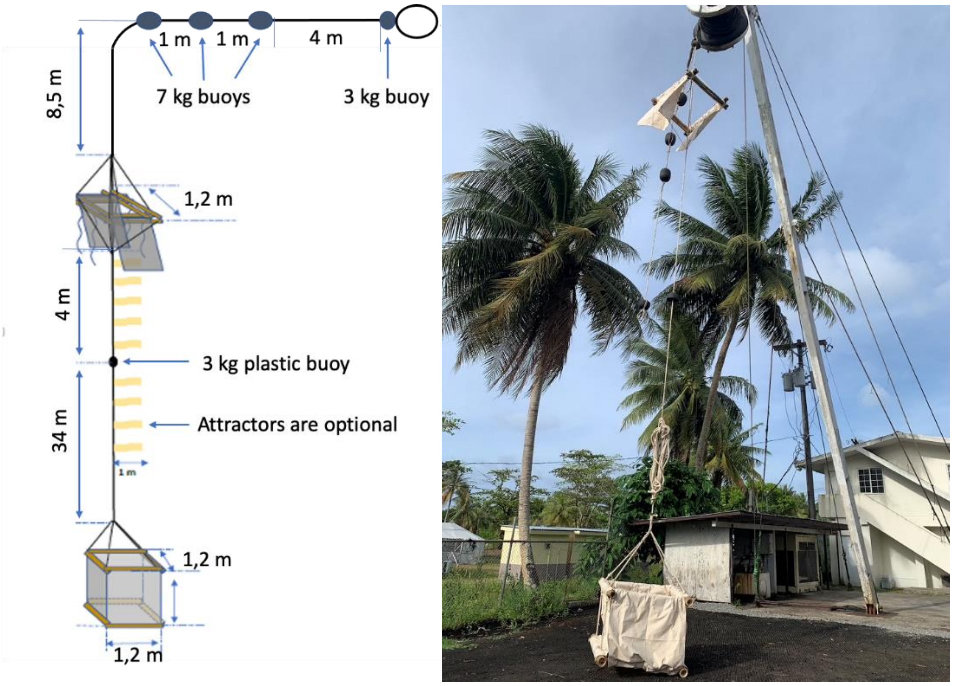

Figure 1. Design and picture of the jelly-FAD developed by ISSF and the Insitute de Ciències del Mar in Barcelona (Spain) (Moreno et al., 2023). Example photo is the first jelly-FAD constructed under Project 110 in Pohnpei.

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 and Silla), 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 decided to be: Pohnpei, Pago Pago and Manta.

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	50	
FCF Co. ltd	8	TW	WCPFC 110	Pohnpei	50	
Silla	2	KR	WCPFC 110	Pohnpei	34	
American Tunaboat Association						
- Cape Fisheries	6	US	WCPFC 110 & BREP	Manta	30	108
- Others	10	US	WCPFC 110 & BREP	Manta; Pago Pago	50	108
TOTAL	32				214	216

Partner fishing companies are the following:

- **CFC Fleet**: Operating 6 vessels under the flag of the Federated States of Micronesia, this fleet tested 50 jelly-FADs, constructed in Pohnpei, and 6 vessels participated in the trial.
- **FCF Co. ltd**: With more than 20 vessels flying the Taiwanese flag, FCF Co. tested 50 jelly-FADs, all constructed in Pohnpei.
- **US Fleet**: This fleet includes 16 vessels from the United States (American Tunaboat Association), tested a significant number (296) of jelly-FADs. The construction locations for these jelly-FADs were Manta and Pago Pago.
- **Silla**: Comprising 6 vessels from Korea, Silla will test 34 jelly-FADs, constructed in Pohnpei.

In total, the project so far involves 32 vessels testing 430 jelly-FADs across different countries, fleets and regions of the western and central Pacific Ocean. However, the fishing companies participating in the project manage a total of around 50 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 non-entangling and biodegradable dFADs in general, and, in particular, the jelly-FAD design.

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

Materials, cost and construction guidelines for non-entangling and biodegradable jelly-FADs are detailed in Escalle et al., (2023c) and the ISSF has developed a construction guide (ISSF 2024) is available here: https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/jelly-fad-construction-guide/.

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

Table 2 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 FADs deployed, deployment periods, number of sets, visits without sets, buoy deactivations, and stranding events:

- **Number of deployments**: Deployments (Figure 2), and hence the start of the at-sea trials, started in September 2022 for the BREP project and March 2023 for WCPFC Project 110. The US fleet deployed 191 jelly-FADs and 167 conventional FADs, while other fleets (FM and TW only so far) deployed a total of 95 jelly-FADs and 56 conventional FADs.
- **Sets and visits**: The US fleet recorded more sets with conventional FADs (50) compared to jelly-FADs (15). Other fleets recorded 5 sets with jelly-FADs and none with conventional FADs. Additionally, there were also visits without sets recorded for jelly-FADs by the FM fleet and one by the US fleet.
- **Buoy deactivation**: There were more buoy deactivations for jelly-FADs (26 in the US fleet and 11 in other fleets) compared to conventional FADs (24 in the US fleet and 4 in other fleets).
- **Stranding events**: 3 stranding events were detected for jelly-FADs by the TW fleet but none for conventional FADs in either the US or FM fleet. Note that this corresponded only to what

is detected and communicated by the vessels, more stranding may have occurred and will be further examined in the future using the FAD buoy drift trajectory data.

Table 2 underscores the challenge of obtaining data on experimental dFADs, both for jelly-FADs and their conventional counterparts. Out of a total of 286 jelly-FADs deployed, only 24 were visited or fished, representing just 8.3% of the total deployed. Similarly, out of the 223 paired conventional dFADs deployed, only 33 were visited or fished, accounting for just 22.4% 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 (Gala Moreno, pers. communication). This emphasizes the significance of deploying a large number of dFADs for these trials, or alternatively, systematically deploying a proportion of bio-FADs to accumulate enough data over time to yield meaningful insights into their performance.

Table 2. 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	3	3	42	26	191	167
Deployment period	03/04/23 – 12/04/24		12/04/24		02/03/23 – 11/07/23		04/09/22 – 04/05/24	
Sets	1	0	0	0	4	0	15	50
Visit (without set)	3	0	0	0	0	0	1	0
Buoy deactivation	0	0	1	0	10	4	26	24
Stranding events	0	0	0	0	3	0	0	0

Figure 2. Deployments of jelly-FADs at sea in the WCPO. Photos from FCF and CFC.

The spatial distribution of deployments, sets and trajectories of jelly-FADs and their conventional counterparts are depicted in Figure 3. 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. For the deployments in these trials, so far the fleet has applied a similar strategy to their regular fishing operations when deploying the experimental dFADs. 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).

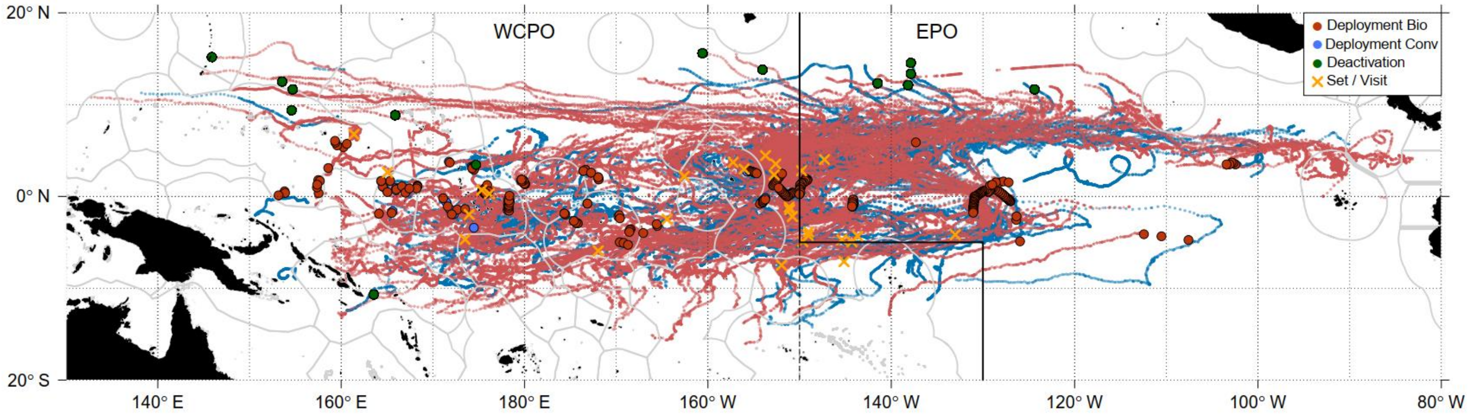

Figure 3. Trajectories, deployments, deactivations, fishing sets and visits of drifting biodegradable (red) and conventional (blue) FADs of the trial.

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 monitoring via data provided from the satellite buoys tracking 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. Although the FAD itself is not monitored in real-time, the echosounder data from the buoy serves as an indicator of fish aggregation 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 varies across fleets, ranging from 274, on average, for conventional dFADs for other fleets in the WCPO to a maximum of 460, on average, for the US fleet operating in the WCPO and EPO (Table 3). Noting that at the time of analysis, data from echosounder buoys attached to dFADs were only available until 31/12/2023, limiting our ability to compile the full monitoring periods. Notably, dFADs from the US fleets were monitored for a longer duration due to their earlier deployments (first deployments in September 2022), compared to the other fleets (first deployments in March 2023). Additional analyses of complete trajectory data, when received in the near future, will allow further investigation of differences in terms of number of buoy transmissions and monitoring duration between areas or fleets. For instance, FADs from the eastern Pacific Ocean, where dFADs have a more extended trajectory without encountering islands, may be monitored for a longer period before being deactivated by fishers. Conversely, in the western Pacific, where dFADs may encounter numerous islands along their trajectory, fishers may deactivate them sooner.

Table 3. Summary of deployments and activities performed on the non-entangling and biodegradable jelly-FADs and conventional FADs **by fleet.**

	Other fleets		US fleet	
	Jelly-FADs	Conventional	Jelly-FADs	Conventional
Deployments	95	56	191	167
Data available	74	42	129	112
Transmissions (positions or biomass)				
Min	7	5	2	25
Mean	314	274	352	460
Max	1145	1057	2019	2740
Duration (days)				
Min	0	1	1	12
Mean	123	82	160	163
Max	284*	248	457	321

*Note that this corresponds to the maximum duration of data available at the time of analyses (from 02/03/2023 to 12/12/2023). Additional data will allow for better identification of duration at sea.

Interestingly, the monitoring duration for jelly-FADs compared to their conventional counterparts in the EPO is quite similar, with averages of 160 and 163 days, respectively (Table 3). However, in the WCPO, the monitoring duration for jelly-FADs was slightly longer than that for conventional dFADs. Figure 4 illustrates that jelly-FADs were monitored for more extended periods compared to conventional dFADs across the entire Pacific Ocean. Noting that this could be a biais of the current trial, which vessels keeping the buoys attached to jelly-FADs active for longer periods. Additionally, the graph depicts how only 50% of both jelly and conventional dFADs are monitored after 180 days at sea. The percentage of conventional FADs' monitored, drops below 25% before reaching 200 days at sea, while bio-FADs continued to be monitored for a longer duration.

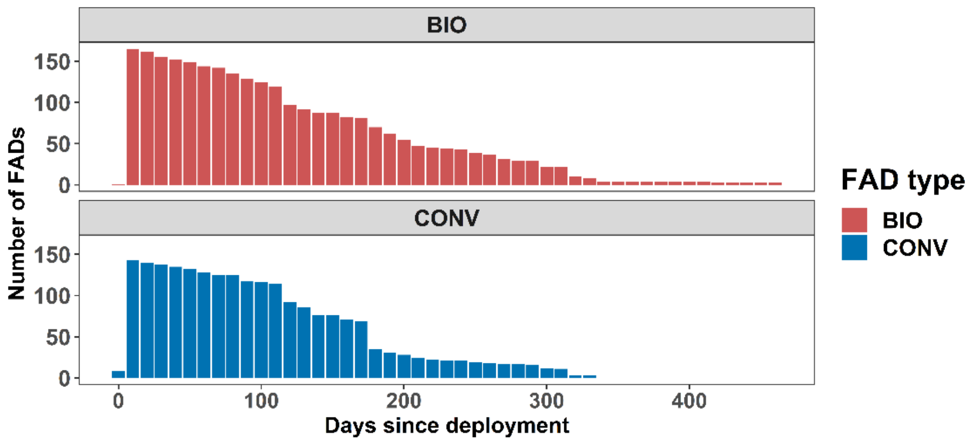

Figure 4. Days of dFAD monitoring from deployment to the end of signal transmission (based on satellite and echosounder buoys) of biodegradable and conventional FADs of the trial.

Figure 5 shows the different drift patterns for the various dFADs deployed in pairs. Only those that drifted in the same water mass will be compared (top 2 examples from Figure 5). Pairs are usually remaining relatively close for the first month, but can be found very far from each other after six months and more (Figure 6).

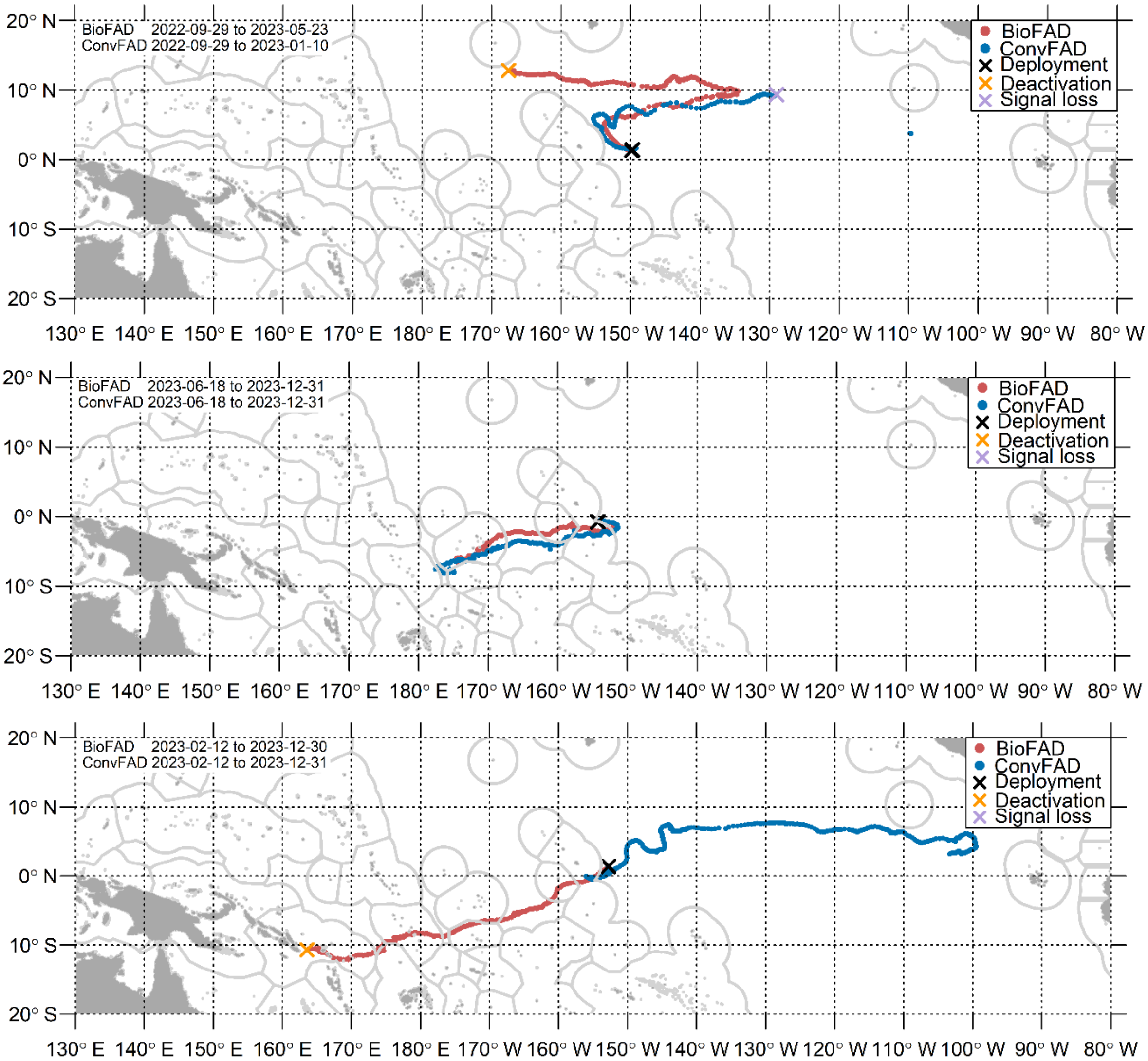

Figure 5. Example drift trajectories (based on satellite and echosounder buoys) of paired releases of biodegradable and conventional FADs in the trial.

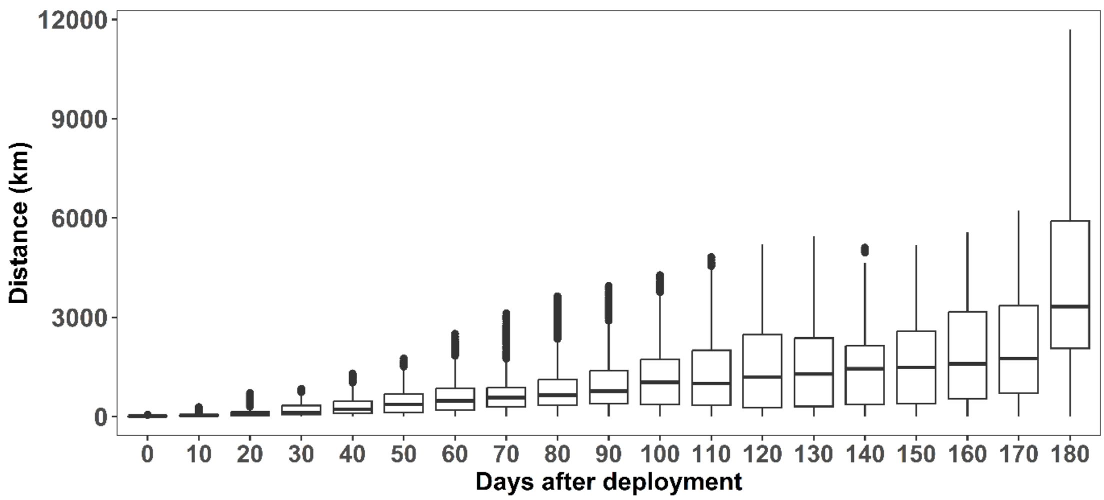

Figure 6. Distance difference between released pairs of biodegradable and conventional dFADs from 0 to 180+ days (the category 180 days include 180 days and more).

3.4.2 Speed

From the fishers' point of view, 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.

A preliminary analysis was conducted to compare only those conventional dFADs and jelly-FADs that drifted under the same oceanographic and weather conditions. It wouldn't make sense to compare dFADs that drifted in different water masses, as local conditions would cause them to drift differently. From these observations (Figures 7 and 8 and Table 4), we can infer that there is no significant difference in the drift speed of the jelly-FAD and the conventional FAD.

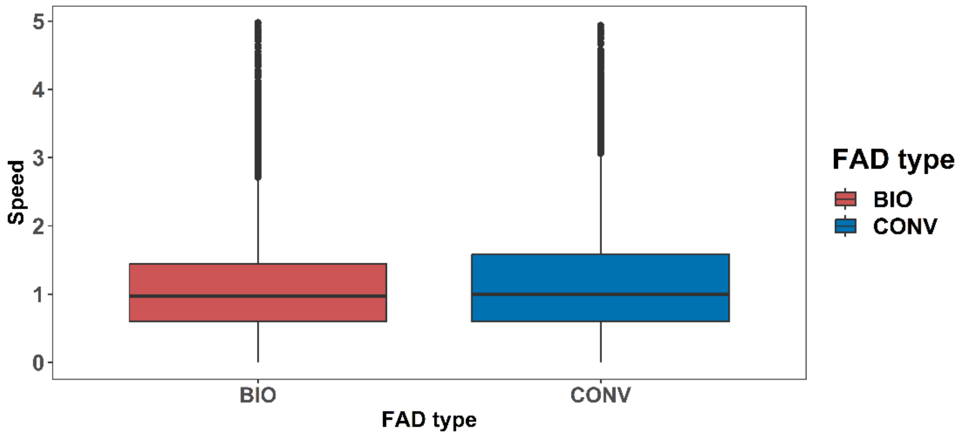

Figure 7. Speed drifting at-sea of biodegradable and conventional FADs in the trial.

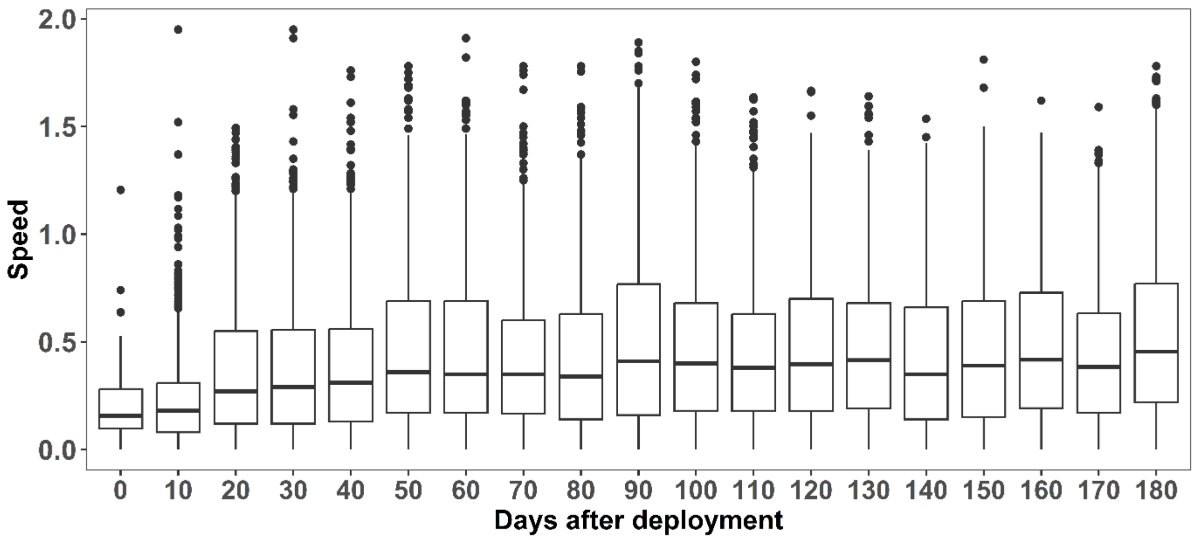

Figure 8. Difference in drift speed between pairs of biodegradable and conventional dFADs.

Table 4. Summary of drift speed values (knots) of the non-entangling and biodegradable jelly-FADs and conventional dFADs by fleet.

	Other fleets		US fleet	
	Jelly-FADs	Conventional	Jelly-FADs	Conventional
Min	0.0	0.0	0.0	0.0
Mean	0.9	0.9	1.1	1.2
Max	4.9	4.9	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 9). The 95th 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. Both types of dFADs (jelly-FADs and conventional dFADs) showed similar aggregation patterns from deployment until 100 days drifting. Maximum tuna biomass was detected from around 2 months at-sea for both types of dFADs.

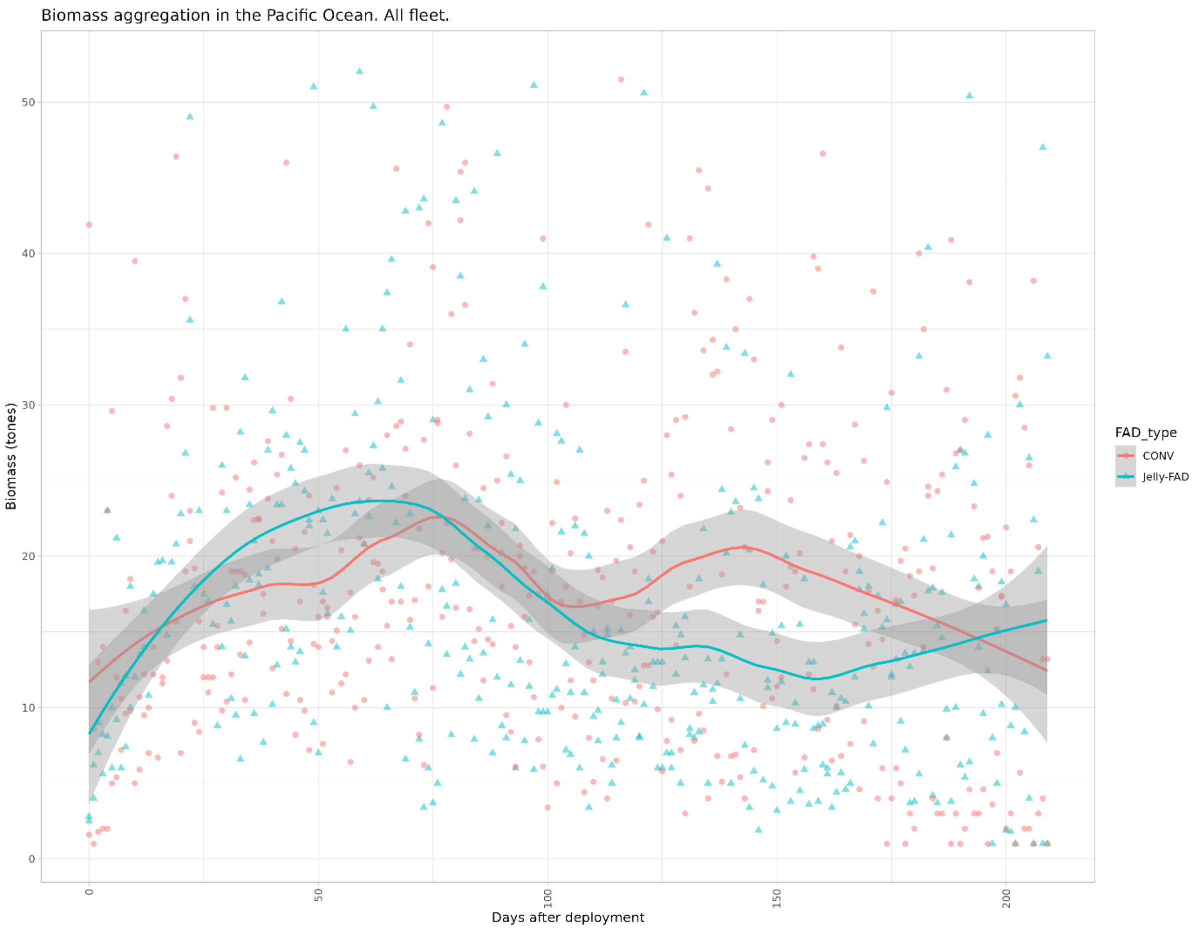

Figure 9. Biomass aggregation over time after deployment compared between pairs of biodegradable jelly-FADs and conventional FADs.

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 5). More sets were made on the paired conventional dFADs, with 50 sets recorded, and catches ranging from 5 to 260 t per set and an average of 71.3 t. This is higher than the average catch per set made of 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 lower than the WCPO average and the catch on the paired conventional dFADs. However, the limited number of sets recorded so far limits the conclusion that could be drawn. It appears fishers tend to rely more on conventional dFADs while they get accustomed to the new jelly-FADs and tend to pay more attention and visit the conventional dFADs more often than jelly-FADs.

Table 5. 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	50	5	71.3	52.5	260
2023 WCPO dFADs	11,005	0	46.3	30.0	481

Tables 5 indicates that the performance of the jelly-FAD, in terms of metric tons per set, is close to the median and mean for the entire 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 a given FAD.

In Figure 10 it is noteworthy that both, jelly-FADs and conventional dFADs can be fished at any time within the first 6 months. This is highly dependent on the strategy of the fleet, in terms of proximity to a given FAD and also on the time needed for the FAD to aggregate fish, which will probably depend 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.

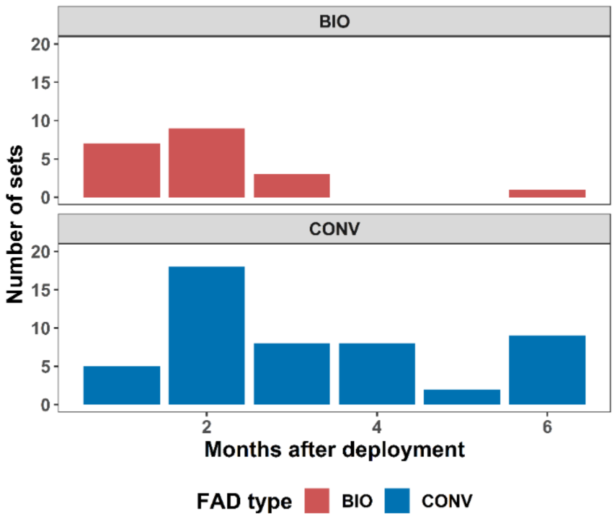

Figure 10. Soaking time for the bio-FAD and conventional FADs fished.

3.4.5 Degradation of materials

For the few *in situ* observations, figure 11 shows that the main rope used to sustain the bio-FAD 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 along their lifespan at sea.

Figure 11. State of the different components of the 17 jelly-FADs visited with time at sea. Number at the top of each bar corresponds to the number of dFADs visited that month.

4. Follow up project

To build on the work started as part of Project 110, SC19 and WCPFC20 agreed on a follow up project (P19X4 bioFADs; WCPFC 110a), which will be important to support increased sample size of non-entangling and biodegradable dFADs trialled, engage more fishing companies in the trials, run more training in the construction of jelly-FADs in alternative locations, and identify locally sourced materials.

To date, two additional fleets have agreed to be part of this follow-up project, the Fishing Industry Association of Papua New Guinea (FIA PNG), that will deploy 60 jelly-FADs, and Koo's Fishing company based in the Republic of the Marshall Islands (RMI), that will deployed 10 jelly-FADs. We are still looking for additional fishing companies to be part of this second phase of the trials.

A workshop was held in Lae (PNG) in mid-July 2024, to train the FIA fleet and Frabelle fishing company crew on how to build jelly-FADs (Figure 12), and deployments by this fleet should start in the coming months.

Figure 12. Jelly-FAD construction workshop in Lae, at Frabelle fishing companies compound in Lea (PNG) in July 2024.

More complete results from Project 110 and the first year of P19X4 will be presented to SC 21 and the full results across all the trials to SC 22.

5. Conclusion and next steps

After delays in the initial year of WCPFC Project 110 due to the COVID-19 pandemic, substantial progress has been made in 2023 and 2024, including the first results from project. The project is running in parallel with another non-entangling and biodegradable FAD trial, led by ISSF with the US fleet, that may also be extended. SPC and ISSF continue to collaborate closely on both projects. Four stakeholders representing more than 15 fishing companies are engaged as project partners. Initial planning and training workshops have been held in three construction locations: Pohnpei (Federated States of Micronesia), Manta (Ecuador) and Pago Pago (American Samoa). The initial phase of the project allowed the identification of a preferred design for the non-entangling and biodegradable dFADs to be tested, which is the jelly-FAD developed by ISSF and the Insitute de Ciències del Mar in Barcelona (Spain) (Moreno et al., 2023). To date, 214 jelly-FADs have been constructed and 142 deployed as part of Project 110 led by SPC, and 216 have been constructed and 144 deployed, as part of the 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 until now from the monitoring of the jelly-FADs tested by fleets in the Pacific Ocean are the following:

- It is important to deploy a large number of bio-FADs to get meaningful results, or regularly deploy systematically a given number of FADs made of biodegradable materials.
- The drift speed of the two types of dFADs, conventional and jelly-FAD is similar.
- Jelly-FADs were monitored longer than the conventional dFADs, being an indicator of the usefulness of the FADs 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 and average catch per set on the jelly-FADs for this trial were higher to that of the whole WCPO fleet in 2023.
- Bio-FAD condition for the monitored period, from the limited data 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 project 110, and the follow up project 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-SC20 to:

- Note that 430 jelly-FADs have been constructed, including 216 as part of WCPFC Project 110, and that 286 jelly-FADs have been deployed under the WCPFC and BREP project collaboration.
- Note that the drift speed of conventional and jelly-FADs is similar and that jelly-FADs were monitored longer than the conventional dFADs, indicating that based on buoy data, they have comparable at sea durability to traditional dFADs. However more visits are needed after 6 months to validate this result.
- 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 2 months after deployment.
- Note that 20 fishing sets have been performed on jelly-FADs in this trial so far, representing 7% of the jelly-FADs deployed, with an average tuna catch of 53.6 t per set. While conventional dFADs showed a higher average catch per set (71.3 t), the median catch per set on the jelly-FADs for this trial were similar to that of the whole fleet in 2023 (i.e., 35.0 vs 30 t per set for jelly-FADs of the trials and conventional dFADs of the whole fleet, respectively).
- Note that this work is ongoing and complete results from the trial and analyses of all non-entangling and biodegradable dFADs from Project 110 and the follow-up project 110a - P19X4 are expected to be available by SC 22.
- Encourage fishing fleets to join these trials, to both increase the sample size and their involvement in the development of non-entangling and biodegradable dFADs.
- Note that industry involvement requires a commitment to deploy a certain number of non-entangling and biodegradable dFADs systematically along with conventional dFADs.

- Note that these trials and the associated industry engagement and training are essential to support transition to the use of more ecologically friendly dFADs in the Western and Central Pacific Ocean.

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