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Analyses of the regional database of stranded drifting Fish Aggregating Devices (dFADs) in the Pacific Ocean

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Executive Summary

This paper presents initiatives started or under-development by Pacific Island Countries and Territories (PICTs) and in collaboration with the Pacific Community, local organisations, and/or Non-Governmental Organisations, to collect data on lost/abandoned Fish Aggregating Devices (FADs) reaching coastal waters and/or becoming stranded, as well as the potential impacts of these events on coastal environments. Preliminary analyses of this regional database are presented in this paper, with four objectives defined: (i) quantify and characterize stranding events using data collected directly in-situ; ii) evaluate number of entanglements and area of habitat impacted; (iii) assess the design and materials of FADs found stranded; (iv) highlight any origins areas of FADs found stranded in relation to areas of deployment and owner fleets. A total of 2,249 stranding events have been reported in the regional database across 18 PICTs in 2006—2023, with dedicated programs in place in 11 PICTs (Australia; Cook Islands; Federated States of Micronesia; Galapagos; Hawai'i; Marshall Islands; New Caledonia; French Polynesia; Palmyra; Tuvalu; and Wallis and Futuna). A higher number of stranding events per 1° cell were reported in French Polynesia, Wallis and Futuna and the Cook Islands, but it could be due to higher data collection efforts rather than reflecting actual higher levels of stranding events.

Most of the stranding events were satellite buoys (41%), followed by FADs alone (29%), and by FADs with buoys attached (26%). Considering FADs only, 85% were drifting FADs, and 5% were anchored FADs mostly found in the Federated States of Micronesia and the Republic of the Marshall Islands. Most dFADs were found with no submerged appendages attached (45%). The condition of the dFAD raft was also investigated, with 27% found intact, 19% mostly falling apart and 12% beginning to break up (information not recorded in 41% of FADs). Most of the structure and flotation materials detected in stranded FADs were i) bamboo and plastic flotation together (41%); ii) bamboo (37%); and iii) plastic flotation (13%). Netting and/or rope were typically found as raft covering (79% of FAD rafts with netting) and as submerged appendages (84%). Netting mostly corresponded to small mesh size (<7cm; 45–47%), large mesh netting (>7cm; 24–35%), or both.

From all stranding events (FADs or buoys), 40% were found on a beach, 9% were drifting in the ocean and 6% were entangled on coral reefs. An important part of the data collected relates to objects previously collected by local communities and recorded as found in gardens or private homes, accounting for 29% of the data. Entanglement of dFAD on corals could be recorded (3% of all FADs) and corresponded mostly to dFADs with submerged appendages (7% of all appendages found). While only corresponding to few records, most of dFADs with submerged appendages found entangled on corals involved netting with small mesh size (23%) or with open panels (29%) However, high proportion of dFADs did not present any submerged appendages (45%), likely lost at-sea or while previously entangled on corals. Damages to coral reef are therefore probably highly underestimated. Entangled animals, such as turtles and sea birds were also detected (0.6% of all FADs but 0.7% of appendages found).

The origins of the stranded dFADs and buoys were investigated by using markings on the buoys and satellite buoy serial numbers. Markings were compared with the Inter-American Tropical Tuna Commission (the IATTC) and Western and Central Pacific Fisheries Commission (WCPFC) vessel registry; while buoy serial numbers were matched with records in the IATTC and WCPFC observer data and the Parties to the Nauru Agreement (PNA) FAD tracking data. Across all PICTs, buoys found

stranded were from vessels fishing in the IATTC Convention Area (47%), the WCPFC Convention Area (43%) or both (11%).

Overall, this data collection programme is highly informative by providing i) information on stranding events of dFADs often not observed using FAD tracking data, ii) details on the type of stranding events and environmental damages; and iii) includes stranding events of industrial aFADs. At this stage, it however only provides an incomplete picture of the level of dFAD strandings on the Pacific Islands. We therefore suggest that additional countries and territories should consider implementing similar data collection programs and participating in this regional initiative. Greater coverage of the dFAD stranding data is important to better understand the extent and potential implications of this issue and to help inform dFAD management options in the Pacific Ocean.

We invite WCPFC-SC19 to:

- Note the preliminary results from analyses of the regional database presented in this paper;
- Highlight the need for in-situ data collection to better quantify FAD stranding events and the impacts of FADs on marine and coastal environments;
- Encourage the expansion of the in-country stranded FAD data collection programs to other Members, Cooperating Non-Members and Participating Territories (CMMs);
- Note the need for FAD-buoy trajectory data, including for historical periods, to better determine the origin of FADs and buoys found stranded and explore spatial management options to reduce stranding events;
- Highlight the need to promote FAD retrieval, before FADs reach coastal areas;
- Promote Pacific-wide collaboration on dFAD research, in particular on homogenising data collection processes, increasing non-confidential data exchanges and collaborating on data analyses.

Contents

1. Introduction

Abandoned, Lost or Otherwise Discarded Fishing Gear (ALDFG) is a growing concern for sustainable fisheries in terms of environmental, social and economic impacts (Burt et al., 2020; Gilman et al., 2021; Giskes et al., 2022; Richardson et al., 2019) and represents a substantial part of the global marine debris (10%, following Macfadyen *et al.*, 2009). In the case of Fish Aggregating Devices (FADs), dedicated assessments of their loss, abandonment and related consequences are still lacking (Macfadyen et al., 2009; Richardson et al., 2019). In the Western and Central Pacific Ocean (WCPO), almost half of the catch by the purse seine fishery is made using drifting FADs (dFADs) (48% in 2022, while industrial anchored FADs (aFADs) make up ~1.0% of the sets (Williams and Ruaia, 2023). In addition, recent estimates of dFAD buoy deployments are 30,000–40,000 per year in the WCPO only, and 46,000–65,000 for the whole Pacific (Escalle et al., 2021a; Lopez et al., 2021), but the rate of loss and abandonment is unknown.

Generally, dFADs consist of a floating raft structure made of bamboo, purse seine float and/or PVC tubes; and are often wrapped up in nets to avoid detection from other vessels. They also have submerged appendages commonly made of old purse seine nets (Abascal et al., 2014; Bromhead et al., 2003; Dagorn et al., 2013) that are used to slow down dFAD drift and create volume to attract fish (Dagorn et al., 2013). In both the raft and the submerged appendages, dFADs commonly include some synthetic materials in their construction (Escalle et al., 2023c). Satellite and echosounder buoys are also attached to dFADs, allowing fishermen to track their location and biomass underneath at any given time (Lopez et al., 2014). Industrial aFADs, on the other hand, are usually a metal or fiberglass drum, attached to the sea floor at >1000m depth and used in the western part of the WCPO only.

The economic importance of the tuna purse seine fisheries to Pacific Island countries and territories (PICTs) cannot be understated, but there are trade-offs between the positive benefits of dFAD use and their negative impacts. To better understand and manage this trade-off, and develop mitigation strategies, we need more information on the negative impacts dFAD use, often linked with the extensive use of dFADs and their current design. The predominant negative impacts include higher catches of juvenile bigeye and yellowfin tuna; higher bycatch rates (Dagorn et al., 2013); and risks of entanglement and/or ghost fishing to Species of Special Interests (SSI) (Balderson and Martin, 2015; Dagorn et al., 2013; Escalle et al., 2019b; Filmalter et al., 2013; Franco et al., 2009). These impacts are generally well studied, and Conservation and Management Measures (CMMs) are in place to mitigate them, however, others are less studied.

This is the case of environmental impacts linked to dFAD loss and abandonment. Once dFADs are abandoned or lost, they drift with marine currents and can strand on shorelines or near-shore habitats (Balderson and Martin, 2015; Escalle et al., 2019b; Maufroy et al., 2015), and may impact SSI and marine habitats, for instance, through entanglements and damage to coral reefs. The latter are important ecosystems in terms of economic, cultural and social values for PICTs who rely on subsistence and artisanal fishing, as well as tourism, and for which coastal protection is highly important (Hoegh-Guldberg, 2004; Banks and Zaharia, 2020; Gilman et al., 2021). Nets, ropes or other components used in dFAD construction can entangle or snag on coral reefs (Balderson and Martin, 2015; Consoli et al., 2020). In addition to entanglements and ghost fishing, stranded dFADs may represent a significant part of coastal marine pollution and can also represent navigation hazard (Balderson and Martin, 2015; Escalle et al., 2019b). As mentioned above, current dFAD components are mostly synthetic and thus break apart into smaller pieces and contribute to plastic pollution, including micro-plastics. Satellite buoys can also add pollution, from their plastic casings which can break up into microplastics but also regarding their many electronic components that include toxic substances. The price for removing plastic waste can be high, particularly for PICTs, with often limited collection plans or specific recycling infrastructures (Burt *et al.*, 2020; Escalle *et al.*, 2020).

In the WCPO, several CMMs have been implemented to reduce the impacts of dFADs on tuna stocks and the environment. Firstly, the WCPFC implemented a 3 to 4 month closure period where all FAD-related activities are prohibited (WCPFC, 2021). This measure was primarily implemented to reduce the catches of small bigeye tuna. In addition, vessels can only monitor 350 satellite buoys at any given time (WCPFC, 2021). Additional CMMs have recently been implemented to reduce the impact of dFAD use on the environment, especially related to their design. For instance, mandatory use of Low Entanglement Risk FADs (LER FAD, Appendix 6) has been put in place from 1st January 2020 (WCPFC, 2021) and stipulates that if netting is present in the sub-surface appendage, it should be either a mesh size less than 7 cm or should be tied as a sausage bundle to reduce potential entanglement of SSI (Franco et al., 2009; Murua et al., 2021; WCPFC, 2018). In addition, as of 1st January 2024, the use of non-entangling dFADs (NE FAD, Appendix 6) will be required (WCPFC, 2021), with the use of netting completely prohibited in any part of dFADs. Finally, WCPFC also encourages the use of biodegradable and plastic-free materials in dFAD construction to avoid plastic pollution, and is supporting scientific research related to the development of biodegradable dFADs (BNE FAD, Appendix 6), work which is currently ongoing (WCPFC, 2021; Escalle et al., 2023b). Finally, WCPFC encourages purse seiners to have a responsible use of dFADs, as well as making efforts to retrieve and prevent the stranding events happening in Pacific Island states and territories (WCPFC, 2021).

Several stakeholders, Non-Governmental Organisations (NGOs) as well as PICTs, have voiced their concerns about the increasing number of marine debris, including dFADs, stranding on their shores, including PICTs without purse seine activities in their EEZs (e.g., Australia, French Polynesia, Hawai'i, New Caledonia and Palmyra). Studies based on trajectories from satellite buoys deployed on dFADs operating in the WCPO estimated that 11.3% of dFADs end up stranded (Escalle et al., 2023a). Based on results from Escalle et al. (2019a), it was estimated that 4 to 6 km^2 of coral reef habitat could be affected per year in all the Parties of the Nauru Agreement (PNA) countries (Banks and Zaharia, 2020). However, studies highlighted the fact that the number of stranding events and level of ecosystem impacts are likely under-estimated, given that the dataset used corresponded mostly to data from PNA member Economic Exclusive Zones (EEZs), but also because satellite buoys are commonly deactivated by fishers when they drift outside the main fishing grounds (Banks and Zaharia, 2020; Escalle et al., 2023a). Thus, there is no data currently available to determine the fate of buoys and/or dFADs after deactivation, or to determine environmental impacts. Overall, estimates of dFAD loss, abandonment and stranding, as well as assessment of the environmental impacts of lost and abandoned dFADs are important components to design effective CMMs to mitigate against potential impacts.

This paper presents initiatives started or under-development by PICTs and in collaboration with the Pacific Community (SPC), local organisations, and/or NGOs, to collect data on lost/abandoned dFADs reaching coastal waters and/or stranding, as well as the potential environmental impacts (areas of habitat impacted and SSI entanglements). Data collection is carried out in each PICT and then compiled by SPC into a regional database with data from all PICTs. Preliminary analyses of this regional database are presented in this paper, with four objectives defined: (i) quantify and characterize stranding events using data collected directly *in-situ*; ii) evaluate potential environmental impact; (iii) assess the design and materials currently used in the dFAD construction and compare to the designs and materials of dFADs found stranded in the WCPO; (iv) highlight origins of dFADs found stranded in relation to areas of deployment and owner fleets.

2. Materials and methods

2.1. PICTs included in the regional database

Dedicated data collection programs to collect *in-situ* data related to the quantification and characterisation of FAD stranding events and their environmental impact assessment are now ongoing in the WCPO (Figure 1).

Firstly, some data collection programs involve collaboration between fisheries departments, NGOs and SPC, these include by order of implementation date, Cook Islands, Wallis and Futuna, Federated States of Micronesia, Republic of the Marshall Islands, New Caledonia, and Tuvalu. These programs involve local communities reporting lost or stranded FADs and satellite buoys to fisheries officers who enter data into a local database. This data collection is highly reliant on reports from local communities, either through an existing program or opportunistic reports, and communication and awareness activities are essential. Posters, newspaper articles, radio announcements or TV broadcasts are used as communication tools to raise awareness around the topic of stranded FADs and the data collection programs (Appendix 3) (Escalle et al., 2022). For the first few months of the program in each PICT, reports included dFADs and buoys previously picked up by the public. This information is important for creating a baseline inventory and for capturing and identifying new events. Data is also collected through dedicated visits to outer islands by SPC staff, national fisheries departments, and local staff (e.g., fisheries observers or fisheries officers). Island coastlines were then surveyed on a specific day, and data were collected for every dFAD found.

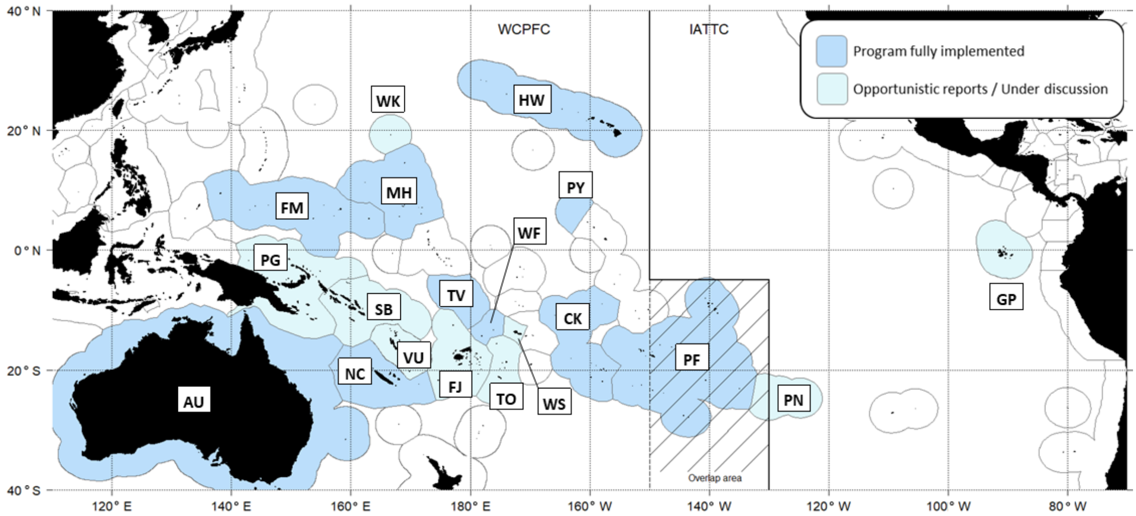


Figure 1. *Map of the Pacific Ocean with the convention area of the WCPFC and the IATTC. In cross-hatched, the overlap area of the WCPFC and IATTC convention area, and in blue, countries involved in the stranded data collection program. AU = Australia; CK = Cook Islands; FJ = Fiji; FM = Federated States of Micronesia; GP = Galapagos; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PG = Papua New Guinea; PN = Pitcairn; PY = Palmyra; SB = Solomon Islands; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; WS = Samoa.*

Secondly, in addition to, or prior to existing programs, opportunistic data collection has been reported to SPC since 2018, including through SPC's existing data collection networks. This includes additional records from Alaska, Australia, Fiji, Papua New Guinea, Pitcairn Islands, Tonga, Vanuatu, Wake Atoll and Samoa.

Thirdly, other programs have been developed in Australia, French Polynesia, the Galapagos Islands, Hawai'i and Palmyra prior to or in parallel with the regional data collection from SPC, with data added to the regional database.

In Australia, Tangaroa Blue Foundation (TBF) coordinates the Australian Marine Debris Initiative® (AMDI), the largest marine debris database in the southern hemisphere, with data on dFAD strandings recorded since 2004 across Australia's coasts, indicating that the majority are found along the coast of Queensland. The AMDI is an on-ground network of volunteers, communities, organizations and agencies around the country removing, documenting, and preventing marine debris and plastic pollution. Historical data transferred to the regional database focused mainly on satellite buoys, however, historical information related to dFADs exists and will be transferred to the regional database in the future.

At Palmyra Atoll, The Nature Conservancy (TNC) and the U.S. Fish and Wildlife Service (USFWS) have collected data on dFAD stranding since 2009. Initially, visual surveys across shallow reefs, lagoon flats, and beaches have been opportunistically linked with other projects. Nowadays specific surveys are being scheduled across all 12 months of the year, particularly in areas with higher stranding rates. Designs of the stranded dFADs, the materials used, and the environmental impacts are described, as well as the satellite buoy identification number. A dFAD watch-type program (Zudaire et al., 2018) has also been in place at Palmyra Atoll since June 2021. In this program, fishing companies alert local partners if a dFAD comes close to Palmyra Atoll's shores, so it can be removed before causing any environmental damage.

In Hawaiʻi, data collection related to stranded dFADs was first initiated in 2014 by Sarah-Jeanne Royer as a member of Nikolai Maximenko's group at the University of Hawaiʻi at the International Pacific Research Center. The program is now being monitored by the Center for Marine Debris Research (CMDR) at Hawai'i Pacific University (HPU) and has expanded to include several collaborators that report the findings to the research group. Since 2021, CMDR has operated an ALDFG bounty program that incentivizes commercial fishers from Oʻahu, including the Hawaiian longline fleet of 145 vessels, to remove ALDFG found at sea, including dFADs. These are then included in the CMDR database and transferred to the regional database. Manybuoys found around the Hawaiian archipelago are stored in the CMDR warehouse onthe island of O'ahu to potentially repurpose the buoys to tag and track marine debris like fishing nets.

In French Polynesia, a large programme is ongoing to quantify the number of dFADs drifting within its EEZ, including the number of stranded dFADs, and their environmental impacts. It involves several components: i) data reported by local communities through a form that can be directly downloaded or filled in on the marine resources authority's website (http://www.ressources-marines.gov.pf/dcpech); ii) dedicated surveys in 9 islands of the Tuamotu (Hao, Amanu, Raroia, Rangiroa, Reao, Tikehau, Tureia, Raraka, Fakarava), with visits to local communities, shoreline surveys using a drone, shore cleanings, and FAD recycling operations.

In the Galapagos Islands, dFADs are a key research topic in the Eastern Pacific regional network Pacific Plastics: Science to Solutions (PPSS, https://www.pacificplasticssciencetosolutions.com) as well as a management concern for the Galapagos National Park Directorate. A data collection programme is under development by Galapagos Conservation Trust (launch is planned in 2024) to build on both opportunistic sightings of dFADs and a pilot data collected where dFADs have been quantified along remote coastlines using drone surveys and during coastal clean-up activities. However, these data are not included in the results presented in this paper due to a lack of time for processing and analysing them.

2.2. Data collection

Generally, all the data collection programs aimed at:

- quantifying the number of dFAD stranding events or dFADs drifting nearshore;
- assessing the resulting pollution and environmental impacts, including on SSIs and key habitats;
- evaluating materials and designs of dFADs found stranded, in relation to past and current use of dFADs in the Pacific Ocean;
- evaluating how communities and PICTs may repurpose or recycle dFAD materials and satellite buoys locally, when possible;
- considering ways to mitigate the impacts of dFADs and provide scientific-based advice to guide the management of dFADs in the Pacific Ocean.

The data collected is the same across all programmes. For each floating object found (i.e., FAD and/or buoy), the name and the contact of the person/organisation that found the object is filled in, as well as the date, location, and environment where it was found. If a buoy is present, the unique identification alphanumeric code, the brand, any painted marks on the buoy (which is often the vessel name) and the fate of the buoy are recorded. If a FAD is present, information on materials used in the different parts of the FAD is recorded, as well as its condition, size and any observed environmental impacts (e.g., coral reef damage or entanglement of SSI). A FAD sighting form has been developed to facilitate the data collection and to have a standardized data collection format (Appendix 4). Once information is collected, it is entered by local partners into Google spreadsheets, specific to each PICT, which can be updated at any time by partners and SPC. Finally, the individual databases were merged by SPC into a unique regional database. Recently, a “coastal survey form” has been developed for dedicated coastline surveys to quantify the surface surveyed, but due to limited numbers so far, this is not included in this paper.

2.3. Processing of the database

The regional database from the 10 PICTs involved in the data collection (and opportunistic records) was processed using several data cleaning, processing and homogenising steps. This was needed because the data collection involves citizen science and opportunistic records, potentially leading to missing or imprecise information. When some fields were not recorded or were imprecise, several steps were taken. First, the fisheries officer or the scientist involved in the data collection was contacted. Second, photos were used to double-check or complete missing information. Third, if the information was still missing, the field was marked as “unknown”.

The exact GPS coordinates were often not recorded (51.5% of records), with only the name of the island and location where the FAD or buoy was found. The Google Earth software was therefore used to access the coordinates of each stranding event. When only the name of the island was available, without precise information about the location, we associated the GPS coordinates to the centre of the island (except for Australia, with the centre of the east coast used instead).

For the environmental damage (coral and animal entanglements), we considered damage only when it was already recorded or when it was visible on the pictures. For the evaluation of the surface of coral impacted, when a FAD was meshed on coral, the surface of entanglement was visually estimated. Note that if the FAD got entangled on corals several times; or the raft broke off and the tail is still entangled; or only the buoy is found, the full environmental damages would not be assessed. In addition, photos were not always provided, and this information was sometimes lacking so there might be a significant underestimation of environmental impact from dFADs stranding events.

2.4. Matching with fishery data

Two approaches were used to determine the origin of the FADs and buoys found stranded. First, the marks painted on the buoys were used to identify the vessel monitoring the buoy. Marks on the satellite buoys were compared to the WCPFC and IATTC online vessel registry to identify the possible vessels. Flag and fishing Convention Area (CA) were then derived. The second approach used to determine the origin of the stranded buoys consisted of identifying the unique buoy ID alphanumeric codes from the database and cross-referencing it against three fishery databases: i) the Parties of the Nauru Agreement (PNA) FAD tracking database; ii) the WCPFC observer database; and iii) the IATTC observer database. For the three fishery databases, the buoy ID number was the key to link with the stranded database.

The PNA FAD tracking data is a large database of over 107,011 buoys (Escalle et al., 2023a). Through their licensing requirements, vessels fishing in PNA waters have to transmit the position of the buoys attached to their dFADs. Since 2016, the database includes buoy trajectories, with GPS positions available at a regular frequency (often hourly, otherwise daily), vessel name and fishing company. Data outside PNA waters were often missing, however, since 1st January 2023, positions from high seas areas between 20° North and 20° South within the WCPFC convention area should also be transmitted. Additional information is also derived from the data available, such as deployment position and fate of the buoy, using a random forest classification, speed and distance to shore (see Escalle *et al.*, 2021c).

Information from the GEN-5 form of the WCPFC observer program (the Pacific Islands Regional Fisheries Observer) was also used, as it presents practical information such as the date and location of each FAD related activity (Appendix 5). It includes, when possible, the unique ID number of the satellite buoy attached, as well as GPS coordinates and the date at the time of each observation. However, the preciseness of the information depends on the observer accessing the FAD (often in the water), therefore some information is often lacking or is imprecise (materials or buoy ID number).

Information from the IATTC database was available through a specific request for information linked to each activity from buoys found in the stranded FAD database. This included the buoy ID number, the date and location (GPS coordinates) of each activity from buoys and/or FADs found in the stranded FAD database.

The last known position in the PNA FAD tracking data and/or the last activity recorded in the observer data from WCPFC and IATTC was identified for each buoy that had a unique ID number that matched a number in the corresponding database. The time difference between the last known date and the date found stranded was then calculated and categorized into three classes: less than one year; between one and two years; and more than two years.

3. Results

3.1 Summary of stranding events

A total of 2,249 stranding events could be identified during 2006–2023 from all programs around the Pacific region (Table 1). Most of the programs started around 2019 and 2020 and show high numbers of stranding events, such as French Polynesia with 1,043 records (Table 1).

Table 1. *Summary of data collected through stranded dFAD data collection programs in the Pacific Ocean and number of events recorded since the beginning of each programme.*

PICT	Start of the program	Events recorded
French Polynesia	2019	1,043
Cook Islands	2020	248
Australia	2004	221
Wallis and Futuna	2020	178
Federated States Micronesia	2021	156
Galapagos	Opportunistic & pilot project / Planned for 2024	est. >150*
Marshall Island	2021	102
Hawai'i	2014	84
Palmyra	2009	63
Tuvalu	2022	58
New Caledonia	2022	50
Vanuatu	Opportunistically	20
Wake Island (US)	Opportunistically	8
Tonga	Opportunistically	7
Pitcairn	Opportunistically	7
Fiji	Opportunistically	1
Alaska	Opportunistically	1
PNG	Opportunistically/under discussion	1
Samoa	Opportunistically/under discussion	1
Solomon Islands	Under discussion	0
Total		~2,399

*Due to time constraints, data from the Galapagos could not be processed and analysed for this current report and are not included in the results presented in this report.

Most of the stranding events were satellite buoys (40.9%), followed by FADs alone (29%), and by a FAD with a buoy attached (25.8%) (Table 2). FADs could either be dFADs or anchored FADs (aFADs), such as large metal drums used by some purse seine fleets in the WCPO (Figure 2 and Figure 3). The remaining events corresponded to a few radio buoys, and oceanographic CO_2 monitoring buoys (Figure 2 and Figure 3), as well as a proportion of data where the type of floating object was not recorded (9.5%).

Table 2. *Percentages of the type of objects found stranded and number of objects in parentheses. The findings of FADs included dFADs, aFADs and dFAD parts (such as float, bamboo, or net found alone); buoys include FAD satellite buoys, radio buoys, and oceanographic buoys.*

		FADs		
		Presence	Absence	Unknown
Buoy	Presence	25.8% (580)	40.9% (920)	3% (67)
	Absence	29% (653)	0	0% (1)
	Unknown	0.9% (20)	0.2% (4)	0.2% (4)

The number of stranding events recorded in the regional database has been increasing with the development of data collection programmes and the growing number of PICTs participating (Figure 2). Data collection and awareness activities have been expanding since 2016, resulting in a gradual increase in the number of stranding events being reported. As a result, more than 1,000 stranding events were reported in 2022. In many countries, the first stage of the data collection program included an inventory of all buoys and FADs previously collected by local communities and often accumulating in gardens or ports. Hence, the date of stranding is sometimes uncertain (12.8% of all stranding events) or unknown (4.5% of all stranding events). The dominant types of floating objects found in stranding events included satellite buoys, dFADs, and dFADs with a satellite buoy attached (Figure 2). The type of floating objects found stranded was slightly different between the PICTs (Figure 3). For instance, in the Federated States of Micronesia and the Marshall Islands, respectively, 20.5% and 20.6% of the stranded events were aFADs (Figure 3).

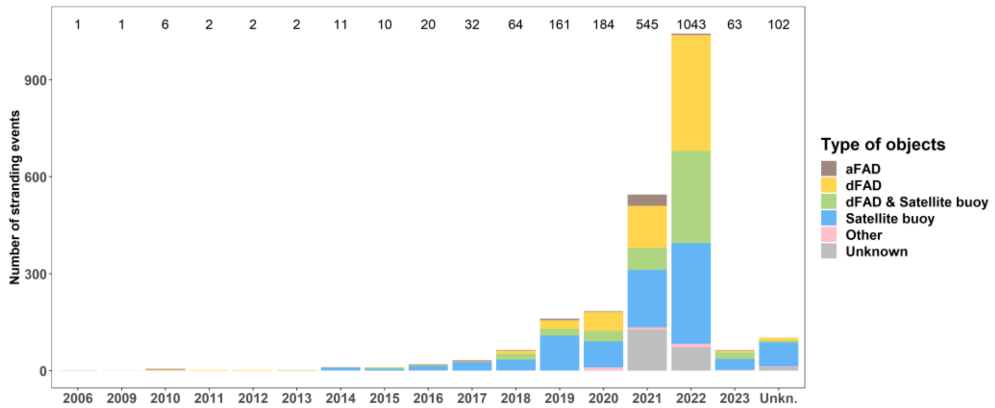


Figure 2. *The number of stranded events found by year and type of materials. The numbers on the top of the figure correspond to the number of stranded events per year (data for 2023 is incomplete).*

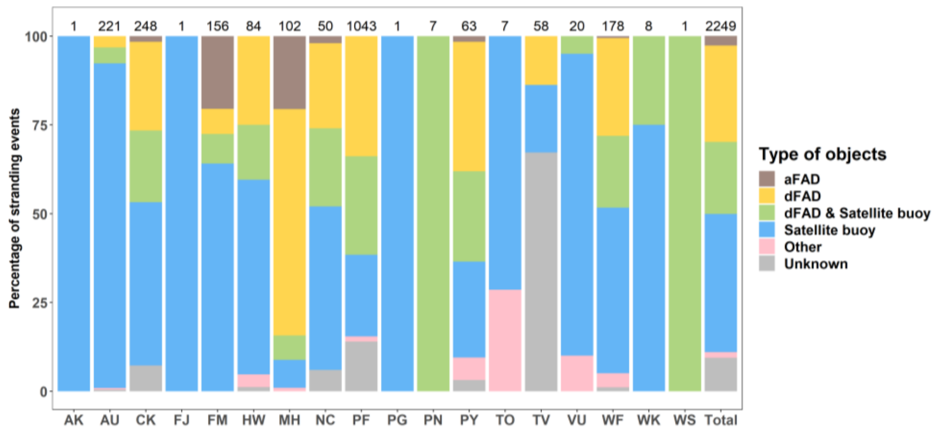


Figure 3. *Percentages of stranding events found by country and type of materials. The numbers on the top of the figure correspond to the number of stranded events per country. See Figure 1 for country codes.*

Most of the buoys found were one of the three following brands: Satlink (37.1%), Marine Instruments (23.1%), and Zunibal (13.8%), and some were Ryokusei and Kato buoys (Table 3). Note that the brand was unknown for 22.9% of the buoys. Small differences between countries were detected (e.g., a higher proportion of Kato buoys (13.3%) was found in the Federated States of Micronesia).

Table 3. *Brand of buoys found stranded.*

	Buoy brand	
	Number	%
Satlink	581	37.1 %
Marine Instruments	362	23.1 %
Zunibal	216	13.8 %
Kato	26	1.7 %
Ryokusei	19	1.2 %
Sofar*	3	0.2 %
Elimat**	1	0.1 %
Unknown	359	22.9 %
Total	1,567	

*Oceanographic buoy (wave buoy); ** signalling buoy

3.2 Spatial distribution of stranding events

The spatial distribution of FAD stranding events in the Pacific Ocean shows a wide distribution over the PICTs where the data collection program is implemented (Figure 4 and Figure **5**). A higher number of stranding events per 1° cell were reported in French Polynesia, Wallis and Futuna and the Cook Islands. However, it should be noted that this could be due to higher data collection efforts in particular locations rather than reflecting true higher levels of stranding events. Additional years of data and/or accounting for the effort in data collection are needed to better understand the spatial differences detected.

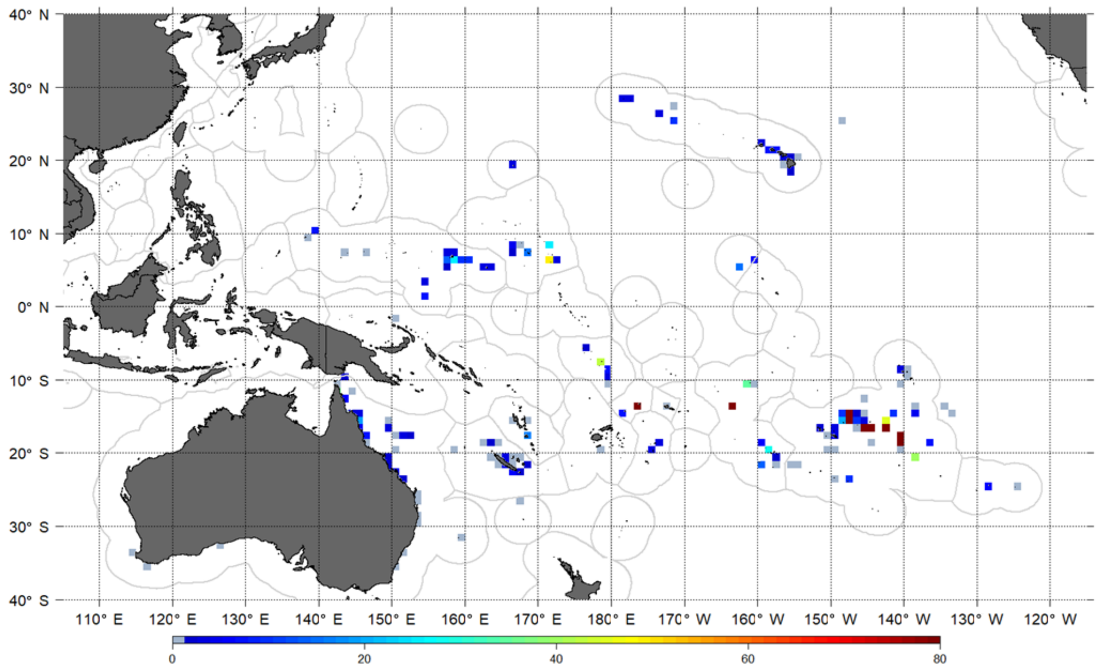


Figure 4. *Aggregated map of stranded FADs found in the Western and Central Pacific Ocean, between 2006–2023. The legend represents the numbers of stranding events per 1° cells (1 to 80).*

Figures 6.1 to 6.8 and Appendix 1 show locations in some PICTs where stranded FADs and/or buoys (i.e., raft, buoy, both or an unknown object), were the highest. For several PICTs, stranding events were greater on one side of the coast, (e.g., the case for some islands in the Tuamotu (French Polynesia) (Figure 6.1), or the Main Hawaiian Islands (Figure 6.2). In the case of the Tuamotu Islands, higher stranding events were detected on the east coasts (see for instance Rangiroa, Fakarava, Raraka, Figure S1.2 and Figure S1.3), but it should be noted that the eastern coasts presented higher data collection effort. One interesting case is the atoll of Raroia (Figure S1.6), with stranding events detected in the lagoon and the coasts inside the lagoon, likely after entering the lagoon on the east side. Some islands, such as Palmyra Atoll (Figure 6.3) and New Caledonia (Figure 6.7) have a high density of coral reefs around their coastlines, making them sensitive locations to stranding events.

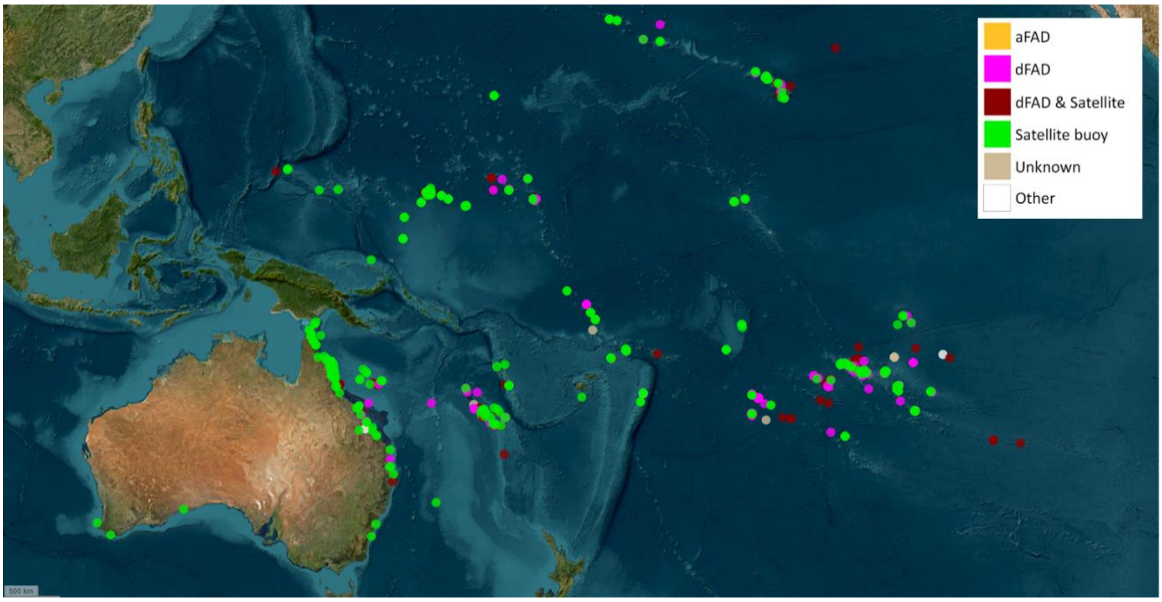


Figure 5. *Map of stranding events with known positions (2,218) by type of object found in 2006–2023.*

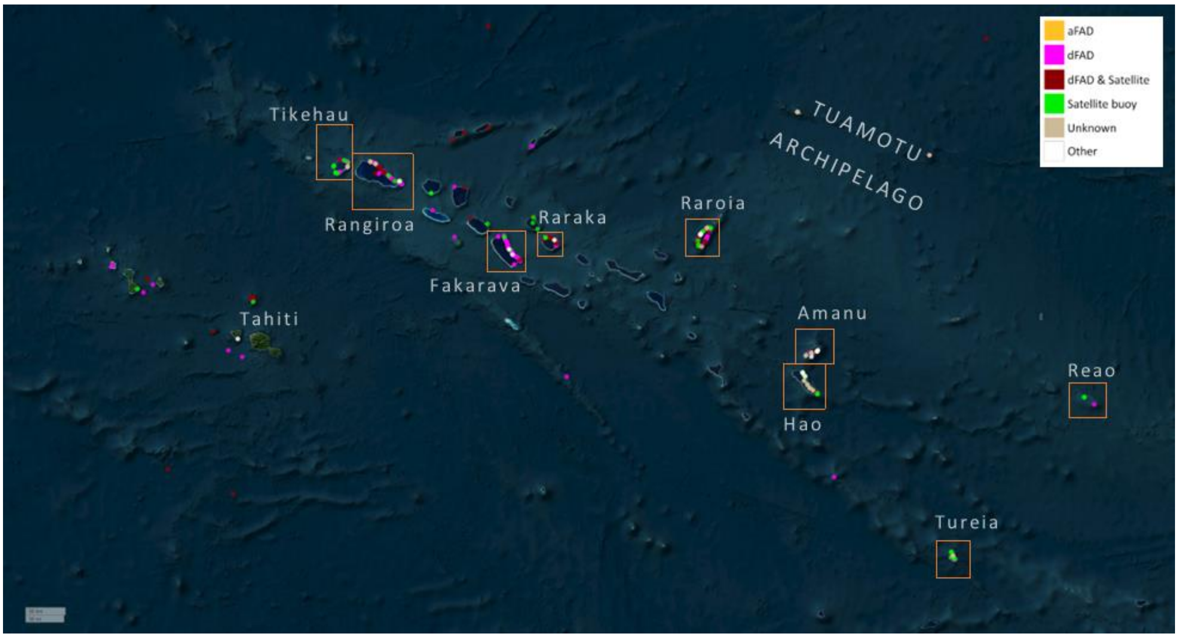


Figure 6.1. *Map of stranding events by type of object in some islands of the Tuamotu Archipelago (French Polynesia) in 2019–2023. Islands inside orange squares are the 9 Tuamotu Islands where dedicated surveys using drones occurred.*

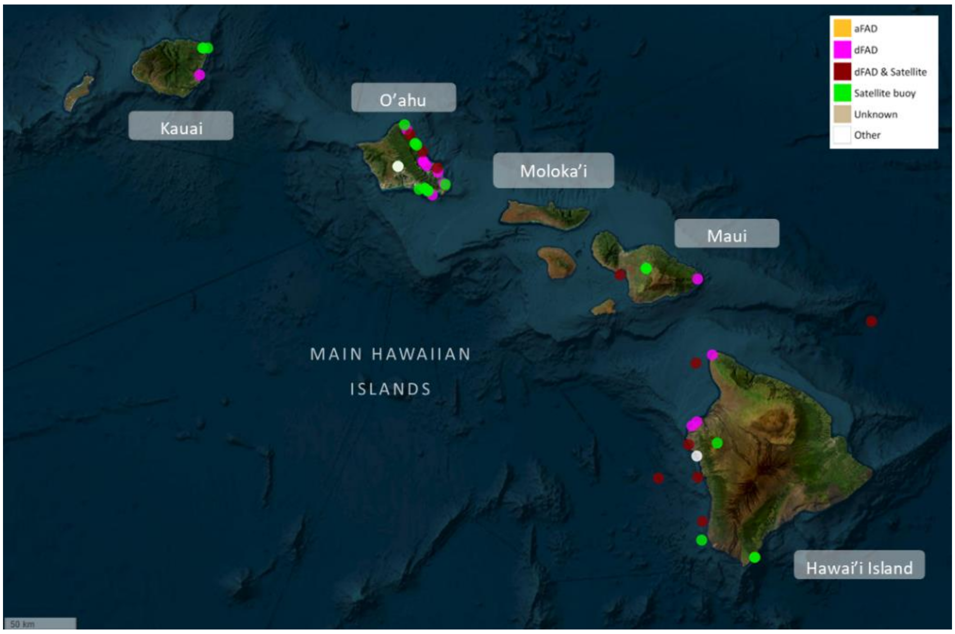


Figure 6.2. *Map of stranding events in the Main Hawaiian Islands (Hawai'i) by type of object in 2014–2022.*

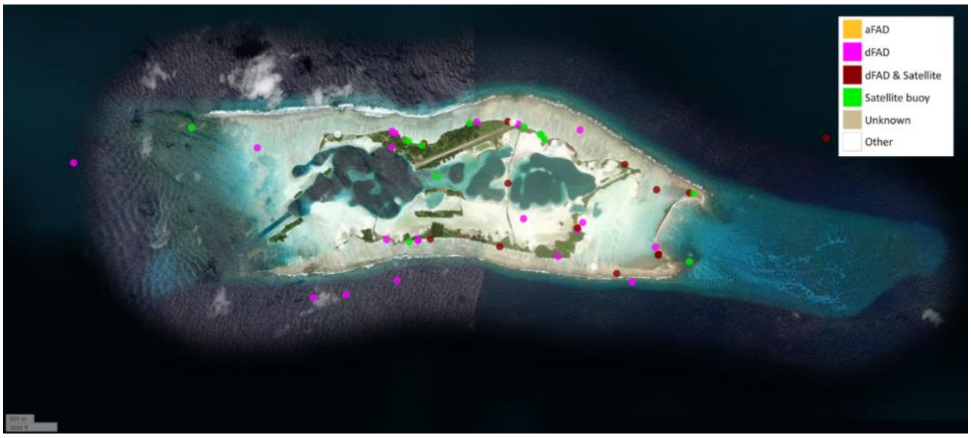


Figure 6.3. *Map of stranding events in Palmyra Atoll by type of object in 2009–2021.*

Figure 6.4. *Map of stranding events in Rarotonga (left) and in Aitutaki (right) (Cook Islands) by type of object in 2018– 2023.*

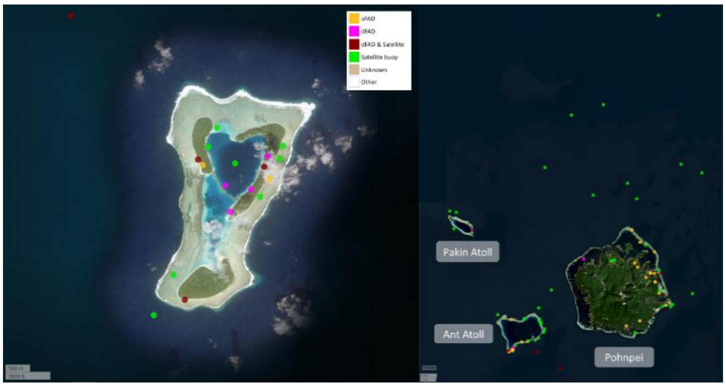


Figure 6.5. *Map of stranding events in Mokil Atoll (left), and Pohnpei, Ant Atoll and Pakin Atoll (right) (Federated States of Micronesia) by type of object in 2010–2022.*

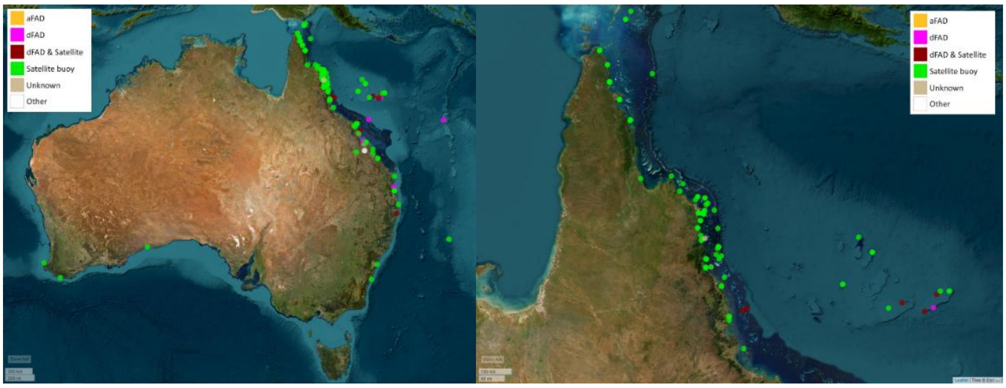


Figure 6.6. *Map of stranding events in Australia (left) and on the North-east coast (right) of Australia, by type of object in 2006–2023.*

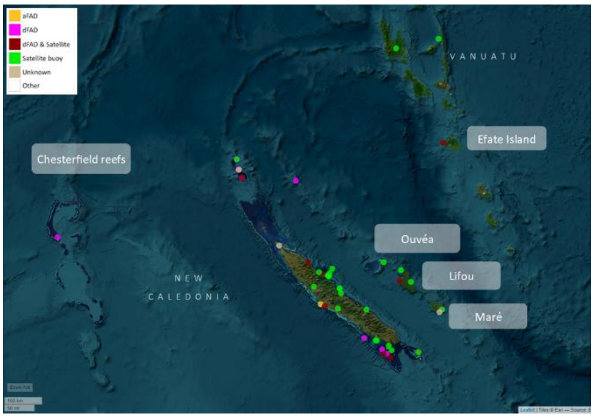


Figure 6.7. *Map of stranding events in New Caledonia and Vanuatu (Southwest Pacific example) by type of object in 2016–2023.*

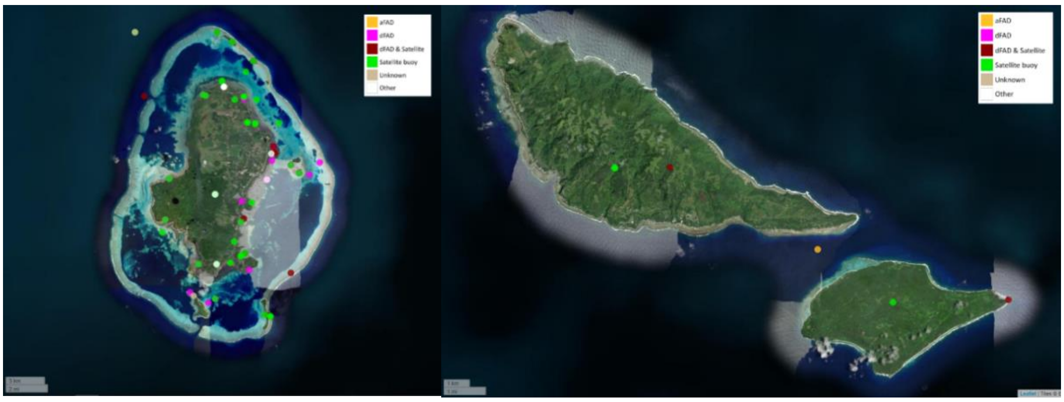


Figure 6.8. *Map of stranding events in Wallis (left) and Futuna (right) by type of object in 2013–2023.*

3.3 Habitats impacted

FAD stranding events can occur in sensitive environments such as coral reefs and therefore can pose a risk to marine life and habitats. Out of the 2,240 stranding events recorded (FADs or buoys), 40.1% were found on a beach, 8.5% were drifting in the ocean and 5.7% were entangled on coral reefs (Table 4). An important part of the data collected relates to objects previously collected by local communities and recorded as found in gardens or private homes, accounting for 29.0% of the data.

Results differ slightly when the type of object is considered separately (i.e., FAD or buoy). Buoys were mostly found in gardens and private homes (category "previously collected" in Table 4) (35.2%), followed by beaches (31.9%) and then other habitats. Buoys were often dismantled to recover electronic materials. In contrast, FADs were mostly found on a beach (44.9%), in gardens and private homes (21.5%), and on coral reefs (8.4%). The aFADs were mostly found on a beach (50.8%), a coral reef (9.8%), a shore (13.1%) or were previously collected (13.1%). Results for dFADs varied depending on the presence of submerged appendages. DFADs with submerged appendages were more often found drifting in the ocean (24.6%), stranded on coral reefs (10.2%), or drifting in the lagoon (4.2%), compared to dFADs without any appendages (4.8%; 7%; and 1.2%, respectively). The most common location of stranded dFADs without submerged appendages was a beach (68%).

Table 4. *Percentages and number (in parentheses) of stranded events by habitat type and FAD type/component.*

Environment	Total	FADs	Buoys	dFADs with tail**	dFADs without tail**	aFAD
Anchored	0 % (1)	0.1 % (1)	0.1 % (1)	0	0	1.6 % (1)
Beach	40.1 % (899)	44.9 % (563)	31.9 % (500)	29.1 % (103)	68 % (272)	50.8 % (31)
Coral reef	5.7 % (128)	8.4 % (105)	3.9 % (61)	10.2 % (36)	7 % (28)	9.8 % (6)
Drifting in the lagoon	1.8 % (40)	2.6 % (33)	1.7 % (27)	4.2 % (15)	1.2 % (5)	4.9 % (3)
Drifting in the ocean	8.5 % (190)	11.3 % (142)	10.5 % (165)	24.6 % (87)	4.8 % (19)	1.6 % (1)
Mangrove	0.3 % (6)	0.4 % (5)	0.1 % (2)	0	0.5 % (2)	4.9 % (3)
Previously collected*	29 % (649)	21.5 % (270)	35.2 % (552)	29.1 % (103)	10.5 % (42)	13.1 % (8)
Shore	3.6 % (80)	3.5 % (44)	3.1 % (48)	1.1 % (4)	4.2 % (17)	13.1 % (8)
Unknown	11 % (247)	7.2 % (90)	13.5 % (211)	1.7 % (6)	3.8 % (15)	0

*Found in a garden, wharf or landfill. **The term "tail" referred to submerged appendages of dFADs.

The type of environment where FADs and buoys were found differed depending on the PICTs considered. Figure 7 and Figure 8 show that a large proportion of objects were previously collected by local communities, who transformed and recycled materials, especially for buoys in the Cook Islands (22.4%) and New Caledonia (15.4%), and for both buoys and FADs in the Federated States of Micronesia (62.8%; 16.1%), French Polynesia (54.2%; 25.1%), Marshall Islands (21.05%; 52.7%) and Wallis and Futuna (15.7%; 22.6%). New Caledonia (25.0%), Palmyra Atoll (21.95%), the Federated States of Micronesia (17.9%), Australia (16.7%), Pitcairn Islands (14.3%) and Wallis and Futuna (14.0%), also presented higher rates of FADs stranded on coral reefs.

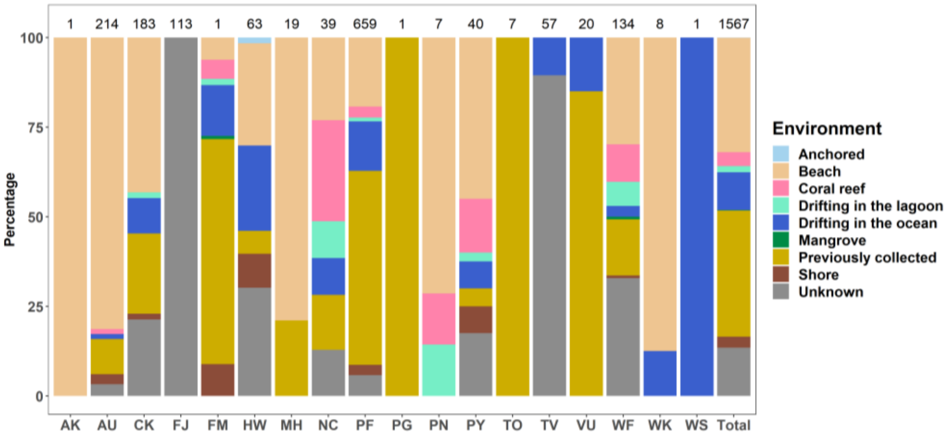


Figure 7. *Percentages of stranded buoys by habitat type and country. The numbers on the top of the figure correspond to the number of stranding events for each country. See Figure 1 for country codes.*

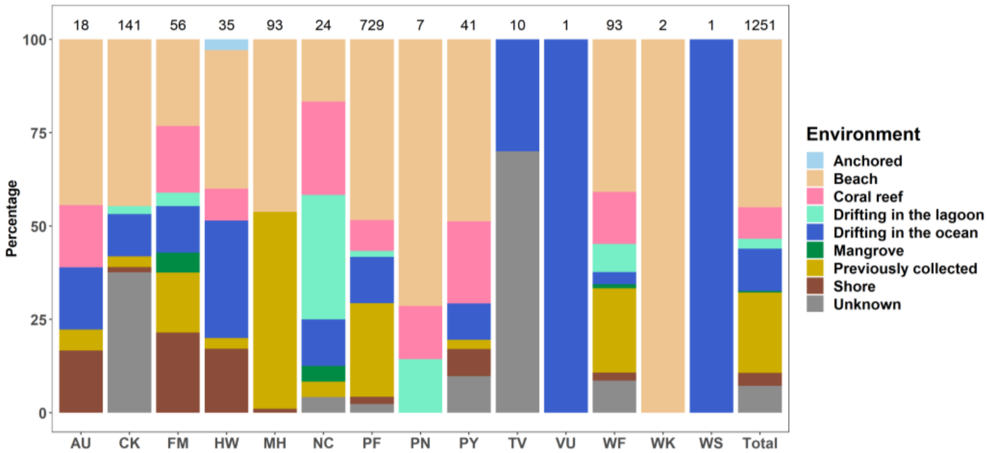


Figure 8. *Percentages of stranded FADs by habitat type and country. The numbers on the top of the figure correspond to the number of stranding events for each country. See Figure 1 for country codes.*

3.4 Type of FADs found stranded

The type of FADs (i.e., dFAD and aFAD) found stranded was investigated. Most FADs were found with no submerged appendages attached (44.8%). However, while 38.8% of the FADs were found with submerged appendages attached; this information was not recorded for 16.4% of FADs (Table 5).

Table 5. *Number (N) and percentages of stranded FADs with submerged appendages. The percentages of FAD conditions and the number of FADs are in parentheses.*

Submerged appendages			Condition			
	N	%	Intact	Beginning to break	Mostly fallen apart	Unknown
Present	486	38.8	8.3% (104)	3.0% (37)	8.4% (105)	19.2% (240)
Absent	560	44.8	16.9% (211)	8.4% (105)	9.2% (115)	10.3% (129)
Unknown	205	16.4	1.9% (24)	0.9% (11)	1.8% (23)	11.8% (147)
Total	1251		27.1% (339)	12.2% (153)	19.4% (243)	41.2% (516)

The condition of the FADs when found was also investigated, although this information was mostly not recorded (41.2%). The rest of the FADs were found intact (27.1%), mainly without submerged appendages, followed by mostly falling apart (19.4%) and finally classified as beginning to break up (12.2%) (Table 5).

Materials were also investigated separately for the raft's main structure, the raft covering, and the submerged appendages. Structure and flotation materials were examined for 737 FADs (Figure 9). Most of the structure and flotation materials detected in stranded FADs were i) bamboo and plastic flotation together (41.0%); ii) bamboo (37.2%); and iii) plastic flotation (13.2%) (Figure 9). In the Federated States of Micronesia and the Marshall Islands, many of the stranding events were aFADs, and therefore flotation materials were recorded as metal drums or fiberglass (respectively 58.2% and 43.1%). The remaining materials were a mix of bamboo, metal drum, and fiberglass (Figure 9, A).

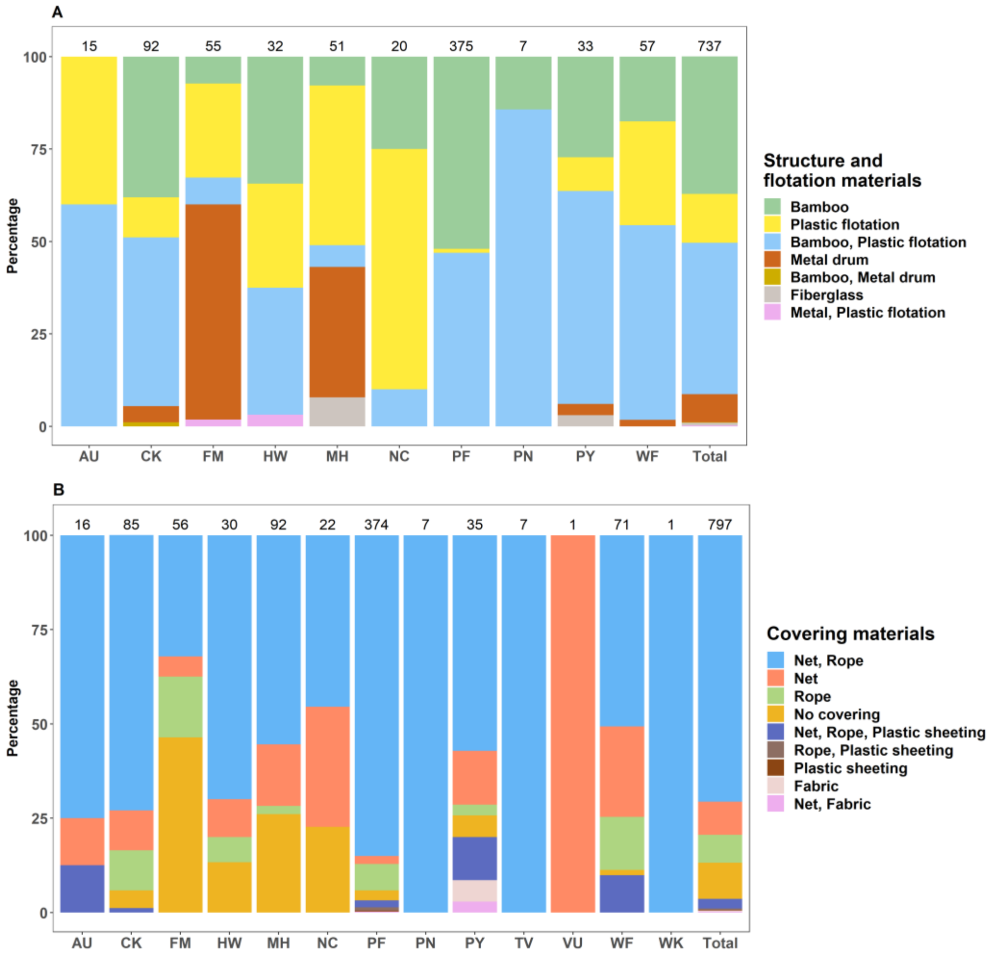


Figure 9. *Flotation and structure materials (A) and covering materials (B) of FADs that were found stranded with materials unknown or removed (41.1% and 36.3% respectively) by country. The numbers on the top of each figure correspond to the number of stranded events with materials recorded by country. Bamboo, includes bamboo and/or log. Plastic flotation materials include float, PVC tube, plastic drum, polystyrene, and plastic foam. See Figure 1 for country codes.*

Raft covering was typically made of netting and/or rope (86.8%). A higher percentage of FADs with no covering was also detected in the Federated States of Micronesia and the Marshall Islands, mainly corresponding to aFADs (Figure 9, B). When covering materials included nets, the mesh size was also investigated (Figure 10). When this information was recorded, 21.2% of FADs did not have any netting mostly aFADs). When mesh size was recorded[1], 45.5% of FADs had small mesh netting, (<7cm), 23.8% had large mesh netting (>7cm) and 9.5% had both small and large mesh netting (Figure 10).

[1] Note that small and large mesh are defined as < or ≥ 7 cm, respectively, and used in the definition of Low-Entanglement risk dFADs by WCPFC and the International Seafood Sustainability Foundation (ISSF).

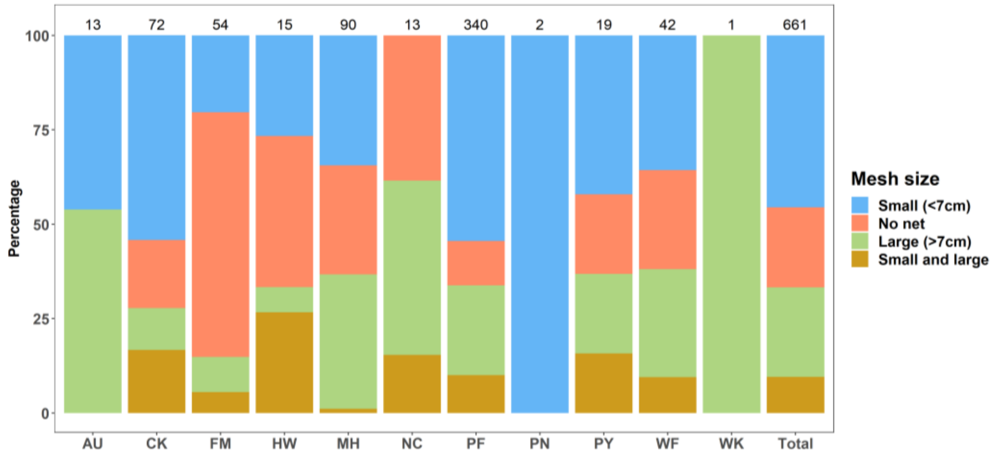


Figure 10. *The percentage of visually estimated mesh size (small: <7cm, large: ≥7cm; or a combination of small and large netting), when recorded by observers (47.2% unknown removed) used to cover the rafts of FADs found stranded by country. The numbers on the top of the figure correspond to the number of stranded events with materials recorded by country. See Figure 1 for country codes.*

The most common materials used to construct the submerged appendages attached to FADs were netting and/or rope (83.8%). The remaining 16.2% were constructed with a combination of bamboo, plastic materials, net, and weights (Figure 11). In New Caledonia, all the FADs found stranded with attachments were composed of netting, presenting a higher risk for coral entanglement. Despite the high numbers of submerged appendage materials recorded as unknown (46.7%), when netting was recorded, the mesh size, as well as the design, were also examined (Table 6). Small mesh netting (<7 cm) was found in 47.5% of records, compared to 35.3% with large mesh netting. Most of the FADs found were designed with large mesh sizes but with an unknown design (21.2%) followed closely by submerged appendages with small mesh sizes in an open panel (17.2%) or with an unknown design (17.2%) (Table 6).

Table 6. *Design (left) and mesh size (right) of netting used as submerged appendages of stranded FADs.*

Design	Small (<7 cm)	Large (>7 cm)	Small & large	Unknown mesh size
Open panel	17.2% (35)	7.4% (15)	2% (4)	3.9% (8)
Rolled up into bundle	10.3% (21)	6.9% (14)	0	9.9% (20)
Mixed design	2.5% (5)	0	1% (2)	0
Unknown design	17.2% (35)	21.2% (43)	0.5% (1)	0

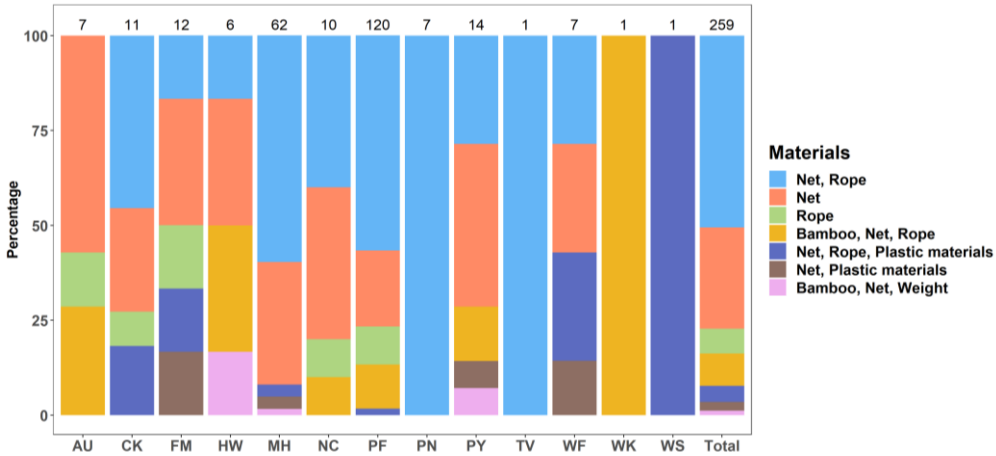


Figure 11. *Materials used for the construction of submerged appendages of FADs found stranded, recorded by country. The numbers on the top of the figure correspond to the number of stranded events with materials recorded by country. Plastic materials include plastic sheeting, plastic drums, fishing line, and float. See Figure 1 for country codes.*

Only 38.1% of the FADs found stranded with submerged appendages still attached presented a visually estimated submerged appendages length recorded (on-site or photos). Most of the appendages presented a length between 0 and 19 m (85.4%) with a maximum length of 65 m.

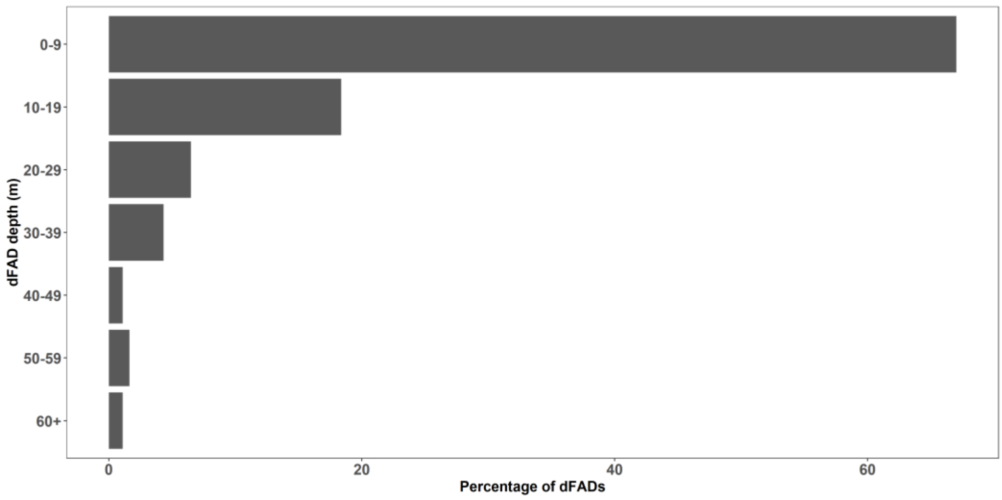


Figure 12. *Percentage of stranded dFADs found with submerged appendages of different depths (m).*

In 53.2% of the stranding events, the shape of the FAD rafts was recorded, and different shapes of rafts were detected (Table 7). Rectangular and square rafts were the most common (24.1% and 12.3%, respectively), followed by cylindrical which correspond to aFADs (5.2%).

Table 7. *Shapes of the FADs found stranded in all the Pacific Islands countries and territories.*

Shape of the raft	Unknown	Rectangular	Square	Cylindrical	Buoy sausage	Octagonal	Boat shape
Percentage (Number)	53.2% (666)	24.1% (302)	12.3% (154)	5.2% (65)	4.9% (61)	0.2% (2)	0.1% (1)

3.5 Environmental impacts

The fate of buoys and FADs found stranded was investigated (Table 8). Most of the buoys (74.0%) were removed from the environment, while a lower number of FADs (20.7%) were removed. It should be noted that in a large portion of the stranding events, the fate was not recorded (22.5% of buoys and 71.1% of FADs).

Table 8. *The fate of buoys and FADs found stranded.*

	Buoy		FAD	
	Number	%	Number	%
Left	56	3.6	88	7.0
Removed	1,159	74.0	259	20.7
Removed partly	0	0	6	0.5
Fished and removed	0	0	3	0.2
Fished and left	0	0	6	0.5
Unknown	352	22.5	891	71.1

The purpose of the removal of buoys and FADs from the environment was recorded when possible (Table 9). This information was available for 39.7% of the buoys and 66.8% of the FADs. Buoys were mostly removed to be placed in a landfill (10.8%), stored (7.2%), or left with the finder (7.0%). Communities also reused some buoys, with electronic components such as solar panels or batteries repurposed (0.5%) or reused for other purposes such as furniture or fishing activities (6.5%). Most of the FADs removed from the environment were reused (37.3%) either for fishing activities (3.0%) or transformed into house furniture (30.2%). Some of the remaining FADs were placed in a landfill (7.8%) or stored at the finder's home (2.2%). It should be noted that the fate and purpose of removed buoys and FADs were highly variable between PICTs and not necessarily classified the same way everywhere.

Table 9. *Investigation of the purpose and fate of buoys and FADs removed from the environment.*

	FADs		Buoys	
Purpose	Number	Percentage	Number	Percentage
Unknown	89	33.2%	699	60.3%
Reused	100	37.3%	75	6.5%
Landfill	21	7.8%	125	10.8%
Research, Burned	17	6.3%	0	0
Relocated	18	6.7%	1	0.1%
Research	9	3.4%	35	3.0%
Left with the finder	5	2.2%	81	7.0%
Dismantled	2	0.7%	3	0.3%
Relocated and sunk	2	0.7%	0	0
Storage	2	0.7%	83	7.2%
Burned	1	0.4%	0	0
Dock	1	0.4%	0	0
Reused for Project ReCon	0	0	51	4.4%
Battery recycling	0	0	6	0.5%

When environmental damage was recorded, it corresponded mostly to dFADs with submerged appendages. Damage was associated with entangled coral (2.9% of all FADs but 6.6% of all appendages found) or entangled animals (0.6% of all FADs but 0.7% of appendages found) (Table 10). Specifically, regarding dFADs found entangled on corals, 30 out of 36 of those had submerged appendages (i.e., 83.3%).

Table 10. *Environmental damage, such as coral or other animal entanglements caused by stranded FADs that were recorded in the database.*

	Total FADs	dFAD	dFAD with tail	dFAD without tail	aFAD
Entangled with animals	0.6 % (7)	0.6 % (6)	0.7 % (3)	0	1.6 % (1)
Entangled on corals	2.9 % (36)	3.1 % (33)	6.6 % (30)	0.2 % (1)	3.3 % (2)
Entangled on rocks	2 % (25)	2.3 % (25)	4 % (18)	1.6 % (7)	0
Not entangled	39.5 % (494)	40.5 % (433)	23.2 % (105)	60.5 % (271)	70.5 % (43)
Unknown	55.1 % (689)	53.5 % (571)	65.6 % (297)	37.7 % (169)	24.6 % (15)

Environmental interactions, particularly related to entanglements on corals and rocks were also investigated, with only a few that were recorded (36 and 25 respectively). Most of dFADs with submerged appendages found entangled on corals or rocks involved netting with small mesh size (22.6%) (Table 11.A), or with open panels (29.0%) (Table 11.B). However, the net mesh size or the design were not always recorded (35.5% for coral entanglement and 9.7% for rock entanglements for both net mesh size and design).

Table 11. *Percentage and number (in parentheses) of FADs found with submerged appendages entangled on corals and rocks, depending on the netting mesh size (A) or the design (B).*

(A)	Small (<7cm)	Large (≥7cm)	Small and large	Unknown size
Coral entanglement	22.6% (7)	9.7% (3)	6.5% (2)	35.5% (11)
Rocks entanglement	12.9% (4)	3.2% (1)	0.0% (0)	9.7% (3)

(B)	Open panel	Rolled up into a bundle	Mixed design	Unknown design
Coral entanglement	29.0% (9)	6.5% (2)	3.2% (1)	35.5% (11)
Rocks entanglement	6.5% (2)	6.5% (2)	3.2% (1)	9.7% (3)

When the surface impacted by FADs entangled on corals could be visually estimated (13 instances), the total surface of coral impact represents 104.4 m^2 (Table 12). The total area that might be impacted by entangled FADs is however unknown as FADs may get entangled on corals several times; or the raft could break off and be found stranded, while the tail is still entangled and unobserved. Other animals were also found entangled on some FADs; with turtle body parts (3 FADs), three birds (1 FAD), fish (1 FAD), one shark (1 FAD) and one whale (1 FAD) recorded as entangled.

Table 12. *The surface of coral impacted in square meters that could be visually estimated at the time of data collection, by stranded FADs per year. The number in parentheses is the number of FADs.*

Year	2019	2020	2021	2022
Surface impacted (m^2)	32.0 m^2 (3)	29.4 m^2 (5)	8.0 m^2 (3)	35.0 m^2 (2)

3.6 Origin – Matching with observer and FAD tracking data

The first method to identify the origin of buoys found stranded was to investigate the painted marks on buoys that are often the name of the vessel that owns the buoy. Then, the flag and the CA was determined (Figure 13). A painted mark was found on 56.8% of the 1,567 satellite buoys found; 14.0% of the buoys did not have any marks, and the presence of any marking was unknown for 29.2% of the buoys. However, markings on the buoy did not always result in the identification of a vessel or a flag.

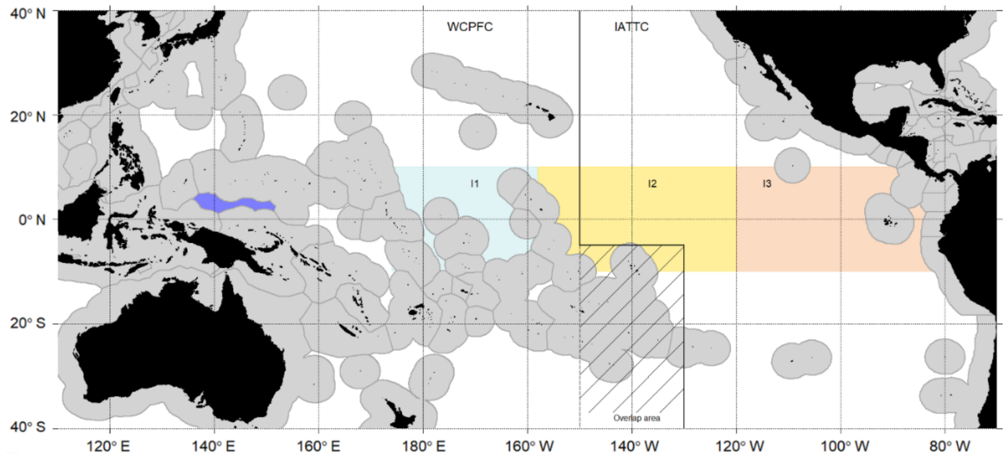


Figure 13. *Map of the WCPFC and IATTC Convention Areas, including the overlap area. Areas of international waters I1, I2, and I3, as used in Figure 17 are indicated in light blue, yellow and light red, respectively. The High Seas Pocket 1 is indicated in purple.*

Among all the satellite buoys that had markings, the flag and the CA were identified for more than 32%. When it could be determined, the origin of vessels monitoring stranded satellite buoys (attached to a dFAD or not) was highly variable (Figure 14). 33.2% of buoys were from Ecuadorian vessels; 22.7% from United States of America (US) vessels; 11.9% from Korean vessels and the rest from 16 other flags (Figure 14). Most buoys found stranded were from vessels fishing in the IATTC (46.5%), followed by WCPFC (42.7%) and both CAs (10.8%) (Figure 15).

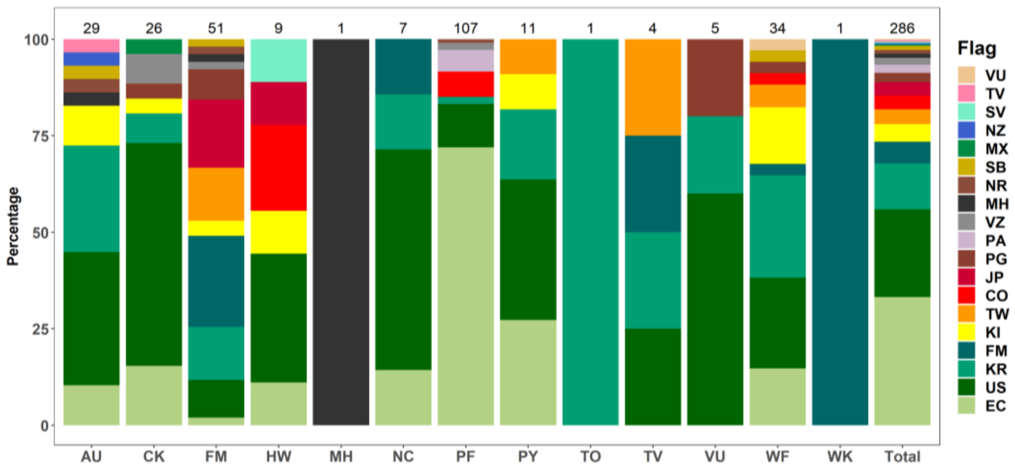


Figure 14. *The identified vessel's flag of each satellite buoy's owner based on marks painted on the buoy by stranding location. The numbers on the top of the figure correspond to the number of buoys stranded per country. AU = Australia; CK = Cook Islands; CO = Columbia; EC = Ecuador; ES = Spain; FM = Federated States of Micronesia; HW = Hawai'i; JP = Japan; KI = Kiribati; KR = Korea; MH = Marshall Islands; MX = Mexico; NC = New Caledonia; NR = Nauru; NZ = New Zealand; PA = Panama; PF = French Polynesia; PG = Papua New Guinea; PN = Pitcairn; PY = Palmyra; SB = Solomon Islands; SV= El Salvador; TO = Tonga; TV = Tuvalu; TW = Chinese Taipei; US = USA; VU = Vanuatu; VZ = Venezuela; WF = Wallis and Futuna; WK = Wake Atoll.*

When considering stranding events in each country separately, 92.5% of the marks on buoys found in French Polynesia were from vessels fishing in the IATTC-CA (Ecuador, US and, Colombia) (Figure 14). The buoys found in the Federated States of Micronesia were almost exclusively from vessels fishing in the WCPFC-CA (90.2%), although from a wide range of fleets (Japan, Korea, Chinese Taipei, US, Papua New Guinea as main fleets). The buoys found in Wallis and Futuna were mainly from vessels fishing in the WCPFC-CA (>65%) and from vessels flagged to US, Korea, Kiribati and Ecuador (Figure 14 and Figure 15). More than half of the buoys found in the Cook Islands were monitored by US vessels (57.7%) (Figure 14). In Hawai'i, stranded buoys from a large range of vessels fishing in the IATTC-CA were detected, mostly from US, Colombian, and Ecuadorian vessels (33.3, 22.2%, and 11.1%, respectively). Finally, stranding events in eastern Australia, consisted mostly of buoys from US (34.5%), Korea (27.6%) and Ecuador (10.3%) flagged vessels.

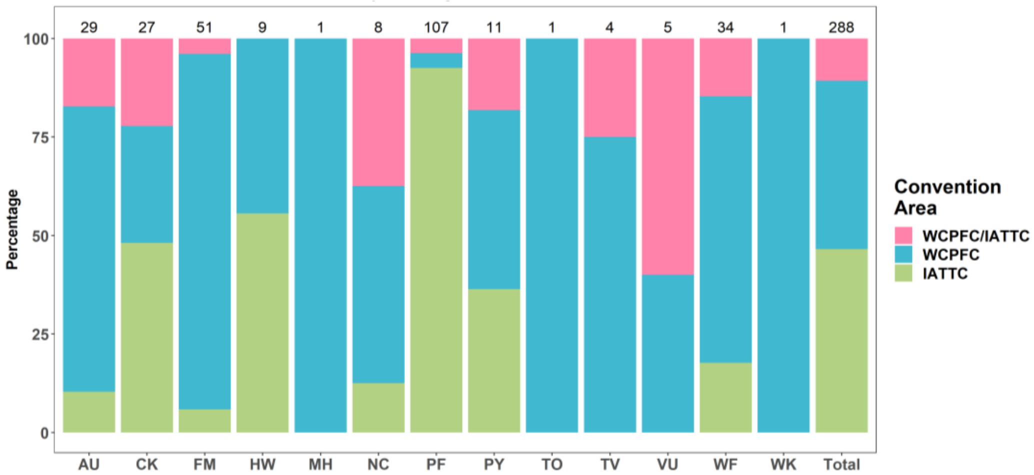
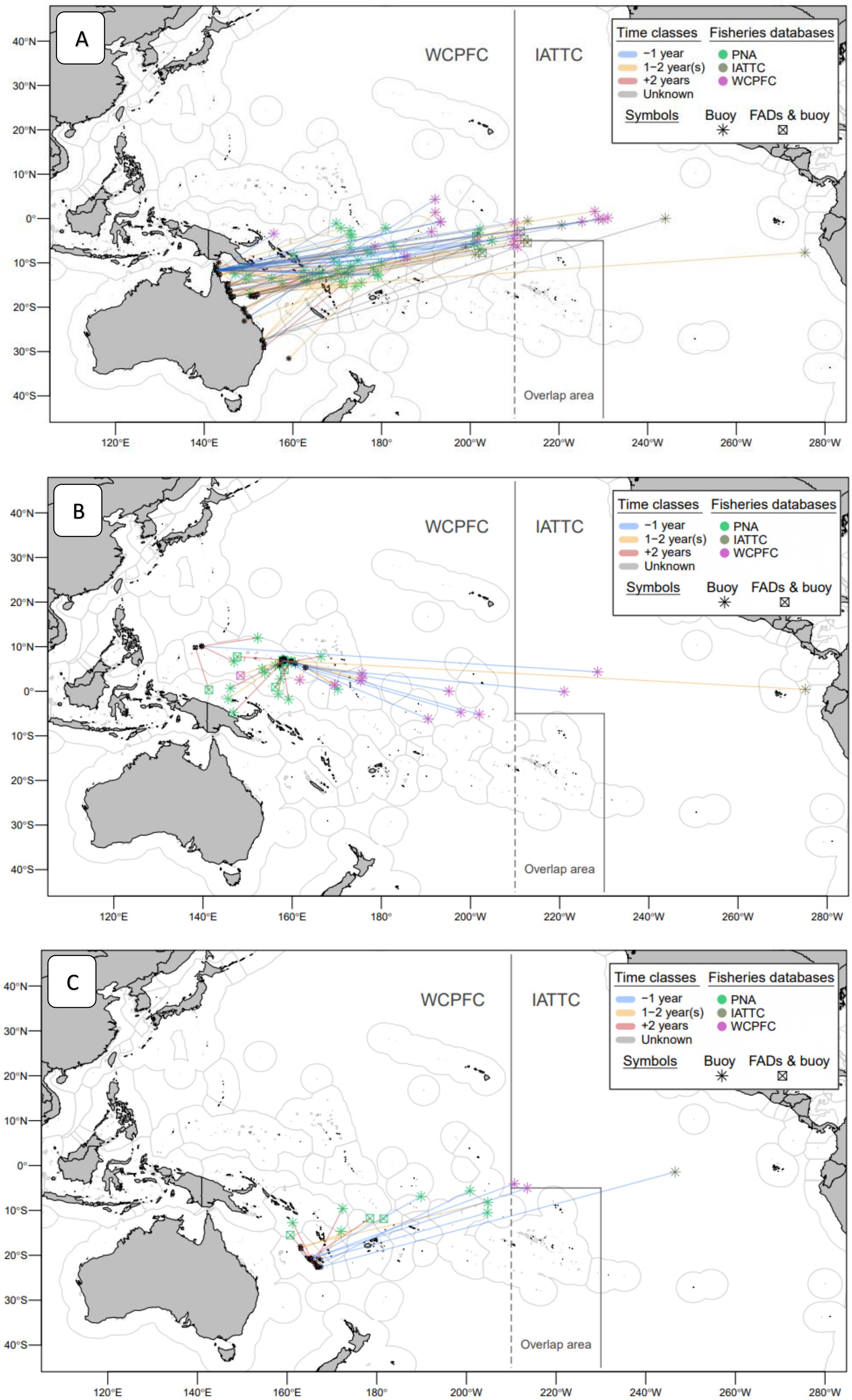


Figure 15. *The Convention Area of the owner vessel identified using marks painted on the satellite buoys by stranded location. Numbers on the top of the figure correspond to the number of buoys stranded per country. See Figure 1 for country codes.*

The second approach used to determine the origin of the stranded buoys consisted of identifying the unique buoy ID alphanumeric codes from the database and cross referencing it to observer databases from the WCPFC and the IATTC, as well as the PNA FAD Tracking database.

As previously identified, certain PICTs received satellite buoys mostly from one CA only (Figure 16). It was found that after the last recorded activity/transmission, buoys were drifting and/or stranded for between one and more than two years before being found (67.5%). Stranded buoys from French Polynesia and Cook Islands have last known positions mostly in the IATTC-CA with few in the WCPFC-CA (Figure 16). Australia received buoys mostly coming from the WCPFC-CA, which is likely linked to geographical proximity, but there are also buoys with a last known position from the IATTC-CA, that were found between one and two years after the last recorded activity (45.1%) (Figure 16).


A
WCPFC
IATTC
Time classes
−1 year
1−2 year(s)
+2 years
Unknown
Fisheries databases
PNA
IATTC
WCPFC
Symbols
Buoy
FADs & buoy
Overlap area
40°N
30°N
20°N
10°N
0°
10°S
20°S
30°S
40°S
120°E
140°E
160°E
180°
200°W
220°W
240°W
260°W
280°W
B
C

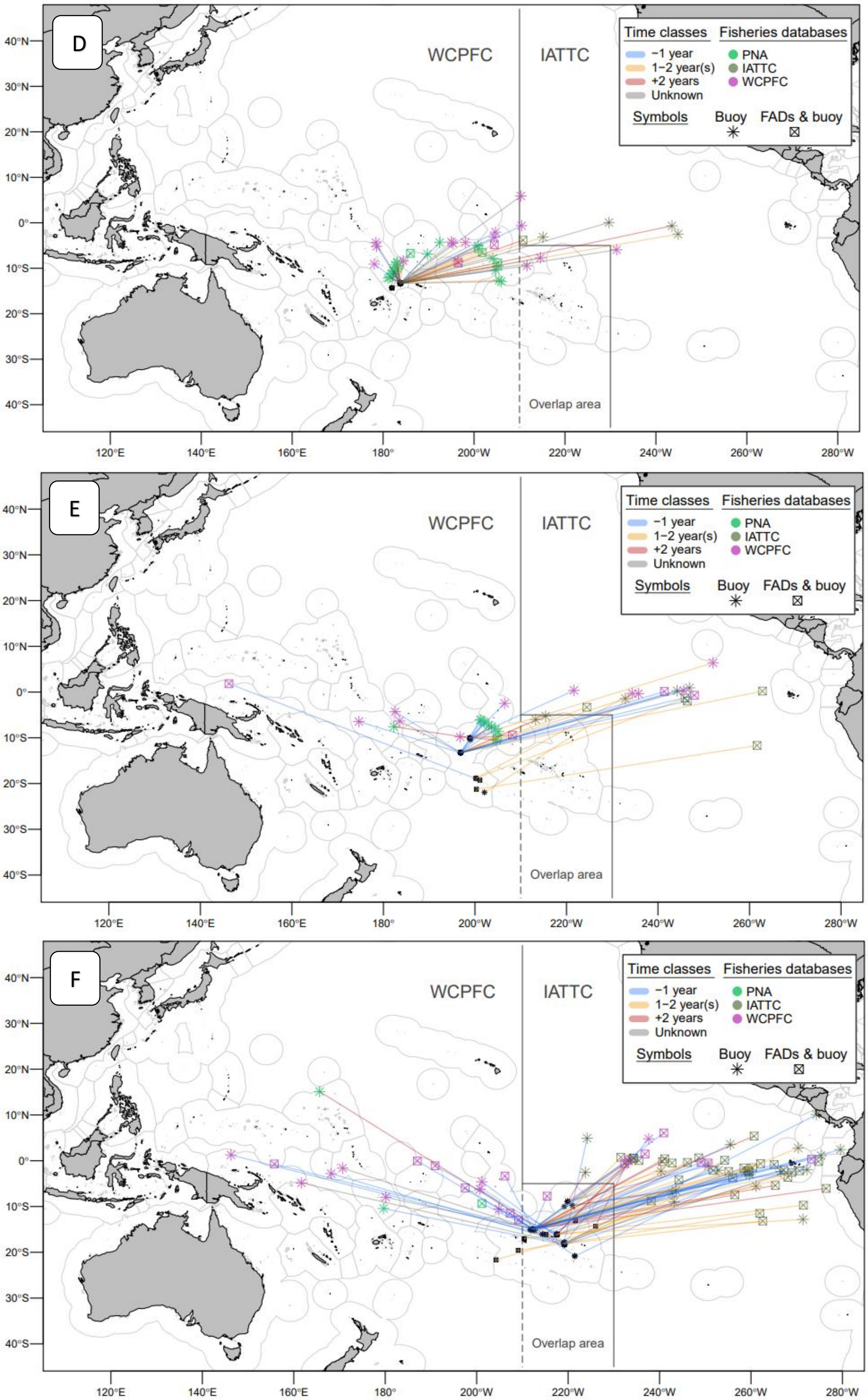


Figure 16. *Maps of Australia (A), Federated States of Micronesia (B), New Caledonia (C), Wallis and Futuna (D), Cook Islands (E) and French Polynesia (F), with buoy stranding positions (black symbols)) and the last known position of buoys from three fishery databases: the PNA FAD tracking data (blue symbols); the WCPFC (red symbols) and IATTC (orange symbols) observer data. The color of the lines indicates the time between the last known position and the date found stranded. Symbols corresponds to buoys only or buoys attached to dFADs.*

The EEZ of the last known position of buoys was investigated to detect potential patterns of origin by stranding areas (Figure 17). In the Cook Islands, most stranded FADs were last detected in the high seas in the eastern part of the Pacific Ocean (30.2%), the Kiribati Line Islands (27.9%), the high seas in the central Pacific Ocean (I2; 27.9%), Tuvalu (4.7%), and the Phoenix Islands (4.7%) (Figure 17). In the Federated States of Micronesia, most stranded FADs were last detected in Federated States of Micronesia, Kiribati Gilbert Islands, and Papua New Guinea. In New Caledonia, the buoys were last dected in the Solomon Islands (35.7%), the Kiribati Line Islands (21.4%), Tuvalu (14.3%) and the high seas in the eastern Pacific (I2, 14.3%). In Wallis and Futuna, most stranded dFADs were last detected in the WCPFC-CA, in Tuvalu (30.6%), the Line and Phoenix Islands (26.5% and 6.1%), as well as the IATTC high-seas areas in the central part of the Pacific Ocean (I2, 16.3%). Tuvalu presented the highest percentage of last detection from the central part of the Pacific Ocean (I2) (66.7%). In French Polynesia, most stranded FADs were last detected in the IATTC-CA, in the high seas of the central and eastern part of the Pacific Ocean (I2 and I3, 15.5% and 48.2%, respectively). In Hawaiʻi and Palmyra, most stranded dFADs were last detected in the IATTC-CA in the high seas of the central part of the Pacific Ocean (I2) (50% and 33.3%, respectively) the Line Islands and the Gilbert Islands EEZ (16.7% and 11.1%, for both EEZs, respectively).

	Origin areas																					
	WCPFC CA																IATTC CA					
Stranding areas	AU	PG	FM	SB	MH	WK	VU	GL	LN	PX	I1	TV	FJ	WF	TK	JV	CK	I2	I3	GP	PU	CR
AU	2.3	9.2	0	20.7	0	0	2.3	4.6	10.3	3.4	6.9	11.5	2.3	0	2.3	1.1	2.3	17.2	3.4	0	0	0
CK	0	2.3	0	0	0	0	0	0	27.9	4.7	0	4.7	0	0	0	0	2.3	27.9	30.2	0	0	0
FM	0	12.2	51.2	0	2.4	0	0	17.1	2.4	2.4	4.9	0	0	0	0	0	0	4.9	2.4	0	0	0
FP	0	1.8	0.9	0.9	0.9	0	0	1.8	5.5	1.8	1.8	1.8	0	0	0	0	1.8	15.5	48.2	13.6	1.8	1.8
HW	0	0	0	0	16.7	0	0	16.7	16.7	0	0	0	0	0	0	0	0	50	0	0	0	0
MH	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
NC	0	0	0	35.7	0	0	0	0	21.4	7.1	0	14.3	0	0	0	0	0	14.3	7.1	0	0	0
PG	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PY	0	0	0	0	0	0	0	11.1	11.1	0	11.1	0	0	0	0	11.1	11.1	33.3	11.1	0	0	0
TO	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0
TV	0	0	0	0	0	0	0	0	0	0	0	33.3	0	0	0	0	0	66.7	0	0	0	0
VU	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WF	0	0	0	0	0	0	0	0	26.5	6.1	6.1	30.6	0	4.1	2	0	4.1	16.3	4.1	0	0	0
WK	0	0	0	0	0	33.3	0	0	33.3	0	0	0	0	0	0	0	0	33.3	0	0	0	0

Figure 17. *Matrix showing EEZ of origin for FADs found stranded: stranding country (left) and EEZ or origin (top), derived from the stranding position and the last known position in the PNA FAD tracking data, the WCPFC observer data or the IATTC observer data. AU = Australia; CK = Cook Islands; CR = Costa Rica; FM = Federated States of Micronesia; FJ = Fiji; FP = French Polynesia; GL = Gilbert Islands; GP = Galapagos; HW = Hawaiʻi; JV = Jarvis; LN = Line Islands; MH = Marshall Islands; NC = New Caledonia; NR = Nauru; PG = Papua New Guinea; PU = Peru; PY = Palmyra ; PX = Phoenix islands; SB = Solomon Islands; TK = Tokelau; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; I1 = Internal waters between Gilbert, Phoenix and Line Islands (174°–202°); I2 = International waters East of the Line Islands and North of French Polynesia (202°-240°) and I3 = Eastern part of the Pacific Ocean (east of 240°), see Figure 13.*

The time difference between the date buoys and FADs was found stranded and the last known position was investigated. Overall, 18.2% of all buoys were found less than one year after the time of their last known position and 28.2% were found within two years of their last known position. Time difference between strandings and the last known position was also examined by each PICT (Figure 18). In most PICTs, the data collection programs started recently but may have included FADs and buoys found several years ago. In addition, data on stranding events were collected between 2006 and 2023. Hence, the range of years between the date found stranded and the last known position was highly variable in some PICTs. For example, it reached more than 3,000 days (about 8.2 years) for some buoys found in French Polynesia. It can also be noted that the time differences varied depending on the database used, for instance, longer time differences were detected for matches with the WCPFC observer's database, which recorded the last activity in the observer data; and shorter time differences for matchings with the PNA FAD tracking data, which is closer to the real date of last transmission. In the Federated States of Micronesia, more than 75% of the matches with the WCPFC observers' data are under 2,000 days (less than 5 years) between the last record and the recording of a stranded position whereas matches with the PNA tracking data were less than 2 years. Similar patterns were found for Australia, New Caledonia, French Polynesia, and Wallis and Futuna (Figure 18).

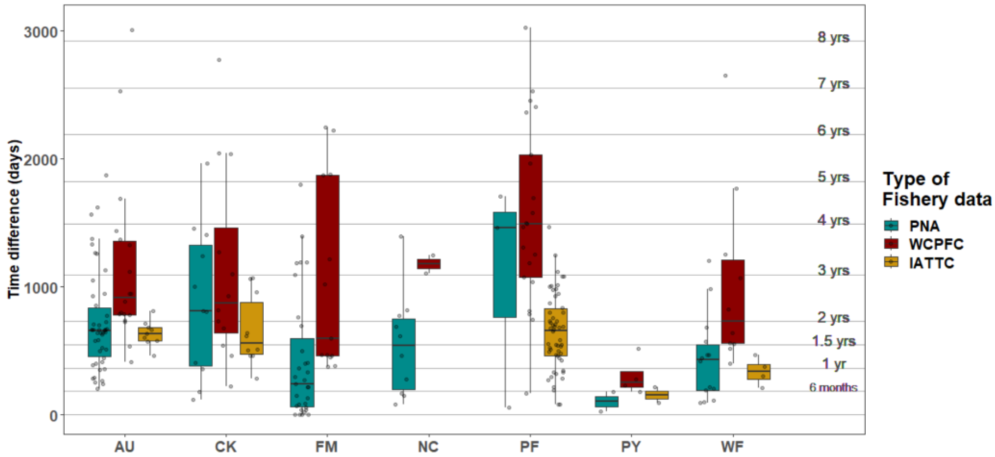


Figure 18. *Boxplots of the time difference between the date found stranded and the last known position in the fishery databases: the PNA FAD tracking data, the WCPFC observer data and the IATTC observer data; by PICT of stranding event. Grey dots indicate an individual stranding event. The lower and upper box boundaries indicate the 25th and 75th percentiles, respectively, the black line indicates the median, and the lower and upper error lines indicate the 10th and 90th percentiles, respectively. See Figure 1 for country codes.*

4. Discussion

In this paper, we presented results from analyses of the regional stranded FAD database. This highlighted the extent of FAD and buoy stranding events in the WCPO and some locations in the EPO. The type of stranding events, materials of the FADs found stranded, as well as entanglements and coral damage detected were studied. These results complement previous studies looking at the fate of dFADs using trajectory data (Escalle et al., 2023a); and may help with assessments of the impact of stranding events and consideration of management measures to limit the impacts of abandoned and lost FADs on the environment.

4.1 Data collection methods

A total of 2,249 reports of stranding events have been collected between 2006 and 2023 across 18 PICTs. Data collection programs are fully implemented in 11 PICTs using two different data collection methods. First, most of the stranding events recorded rely on community reports. This sampling method allows coverage of large spatial and temporal scales and is cost-effective. However, despite the use of a standardized form, one of the main issues with this type of "citizen-science" method is the quality and the accuracy of the information collected (Earp and Liconti, 2020), and it should be compared with the data collected via scientific protocols (Earp and Liconti, 2020). The dedicated survey is therefore the second method of data collection, but data have only been collected this way in Australia, French Polynesia and the Federated States of Micronesia. This method requires trained staff and financial resources and might be difficult to apply in some remote islands with limited access. However, in addition to quantifying effort and precise estimates in an area, these dedicated surveys could help assess the frequency of the stranding events temporally and spatially. Indeed, while an increase in the number of reports has been detected in our study, most of the data collection programs have only started recently and the number of programmes is still increasing each year. Consequently, the increase in the number of stranding events is likely linked to the increase in data collection effort, rather than an actual increase in stranding events. Accessing more dedicated surveys in several locations, with sites surveyed each year, would therefore be useful to quantify the arrival of FADs and buoys in relation to refining or targeting data collection effort.

While the size and spatial extent of the database continues to increase, alternative ways to collect data through community reports and dedicated surveys could be considered. Once collected, data regarding stranding events as well as photos are currently stored in Google Drive spreadsheets. The use of an app with data centralised into a standard database could therefore be considered. The application Tails[2], which allows the collection of artisanal fisheries data in some PICTs, could be a good candidate to collect data on stranding events, given that fisheries officers already commonly report of information using this tool. The PNA FAD logsheet application with a specific section related to data collected in the coastal environment could also be considered. The AMDI also presents an application with a specific framework to collect data related to stranded events of FADs and buoys, which can be used anywhere in the world, and accessible by the project admin team. Finally, moving away from spreadsheets to actual database system would also be beneficial with increasing reports and PICTs. Data could therefore be centralized into TUFMAN 2 (Tuna Fisheries Data Management System) along with fishery observer and logsheet data.

4.2 Characterization of stranding events

In terms of the type of objects found stranded, it was mostly satellite buoys, followed by FADs, and by FADs with buoys attached. In terms of environment, a high proportion of stranding events (FADs and buoys) occur on a beach, followed by drifting in the ocean or entangled on coral reefs. While findings were similar between PICTs, small differences were also observed. Almost half of the dFADs were found without submerged appendages attached and more than a quarter of stranded dFADs were found intact, which would indicate limited duration drifting in seas. It is also noted that aFADs stranding events were detected in the Federated States of Micronesia and in Marshall Islands and corresponded to large metal drums or “payaos”, specific to industrial aFADs used in Papua New Guinea, Solomon Islands and the Philippines in the High Seas Pocket 1 (Figure 13). In the future, collaboration with national fisheries departments would be needed to investigate the origin of these aFADs, and develop ways to reduce the rates of loss and mitigate their impacts when stranded.

A high proportion of buoys was found in gardens, as they are valued by PICTs communities, because electronic components are often scarce in remote locations. However, while recycling practices can be encouraged, some buoys found in good condition could be reused locally for their intended purposes, for instance to mark fishing gear or channels, or to deploy on community aFADs. In this way, Satlink, one of the main buoy providers (37.1% of the buoys found stranded), has recently developed the "ReCon” project, which reassigns the ownership of a buoy found stranded from purse seine companies to local organisations to reuse it for projects focused on benefiting local communities. SPC, on behalf of several member countries and territories recently joined this project ReCon, with the

[2] Tails is a mobile and tablet application (https://play.google.com/store/apps/details?id=spc.ofp.tails&hl=en) that collects fishing logbook data from artisanal and small-scale fishers. The data collected in Tails is used by Pacific countries for fisheries management and scientific analyses and is a critical source of data in a fishery that is usually data-poor.

objective of re-using Satlink buoys for artisanal fishers and other local projects. Tangaroa Blue Foundation in Australia is also already part of project ReCon.

4.3 Origin of buoys

The origin of the buoys found stranded was investigated using available data (PNA FAD tracking data and observer data). At a regional scale, the last positions of buoys found stranded indicate similar locations to the last positions of buoys from a recent report (Escalle et al., 2023a). This is consistent with areas of high FAD fishing effort and also potential areas of high buoy deactivation.

Several limits related to the analyses of the origin of FADs and buoys found stranded should however be mentioned. When using the last position from the FAD tracking database, there is no information regarding the reason for signal loss (e.g., deactivation, FAD appropriation, malfunction, dFAD sinking) (Balderson and Martin, 2015; Escalle et al., 2023a). Second, the fact that different datasets were used led to uncertainty in the calculation of the time difference between the last known position of the buoy and the date it was found stranded. In the WCPFC and IATTC observer programs, the last known position corresponds to the last activity recorded by observers on the buoy, and recent observer coverage decreased a lot due to the COVID-19 pandemic (Panizza et al., 2023). In the PNA FAD tracking database, in principle, the last position should correspond to the last transmission before remote deactivation by fishers or signal loss. However, most buoy transmissions outside PNA EEZ have been removed from the data before submission to the PNA (“geofencing") (Escalle et al., 2023a). In addition, the PNA FAD tracking database was launched in 2016, and hence no trajectories before 2016 are available. Complete trajectories from the WCPO and EPO, including the historical period, are required to better investigate the origins of FADs found stranded, as well as drift patterns and connectivity between deployment areas and stranding areas (Escalle et al., 2019b). In this regard, two recent management measures and voluntary submission should help fill in gaps in buoys trajectories. First, the PNA FAD Buoy Tracking Implementing Arrangement (4IA) requires since January 2023 that FADs owned by vessels fishing in the PNA waters cannot be voluntarily deactivated, unless stationary for 1 month, between 20°S and 20°N in the WCPO, and that their complete trajectories are transmitted to the PNA (PNA, 2020). Second, from 1st of January 2023 vessels registered as International Seafood Sustainability Foundation (ISSF) pro-active vessels need to report buoys positions data to the adequate RFMO science bodies.

4.4 Plastic Pollution

In this study, we highlighted that bamboo and plastic flotation such as purse seine floats and PVC tubes, were the most used materials to ensure flotation of the raft. In a recent study based on WCPFC observers data, completely natural dFADs represented less than 2.3% of observed FADs (Escalle et al., 2023c), and only 0.2% in our study. In terms of materials covering the raft and/or materials attached as submerged appendages, the main materials used are a combination of ropes and/or nets, which present high entanglement risk for marine species. Also, a few Lower Entanglement Risk (LER) FADs designs were recorded in the database, as the typical dFAD design (e.g., large mesh nets, open panel for attachments) is still widely used (Escalle et al., 2023c).

In the WCPO a transition is currently on-going to modify dFAD design to reduce entanglement risks of marine species and plastic pollution. As of the 1st January 2024 the use of Non-Entangling FADs (NE FADs) will be mandatory, with netting completely banned from any part of the dFAD (WCPFC, 2021), and natural materials are however recommended in the construction of dFADs (WCPFC, 2021). In addition, there is currently a large research effort to trial biodegradable dFADs and test their effectiveness (Franco et al., 2009; Zudaire et al., 2023; Escalle et al., 2023b). This includes the introduction of a new design, called the “jelly-FAD” (Moreno et al., 2023). Biodegradable and Non-Entangling (BNE) dFADs are a viable solution to mitigate both entanglements and plastic pollution issues. The lifespan of some tested BNE FADs appeared to be lower than the traditional dFADs and they could sink before reaching coastal areas, leading to less stranding events, but with unknown impact on deep habitats and very difficult to assess (Banks and Zaharia, 2020).

4.5 Environmental damage

In this study, limited environmental damages in terms of coral damage or SSI entanglements, could be detected. For entangled animals, they can be eaten by scavengers and their remains then disappear before the FADs are found, making entanglement rates difficult to assess from stranded FADs (Davies et al., 2017). When dFADs reach coastal areas, they may get entangled on corals, then break free, partly or fully, and may have caused some damage that would not be possible to identify. A higher number of dFADs with attachments were found entangled on coral reefs compared to dFAD without any attachments. In our paper, 13 dFADs could be detected entangled on corals with an estimated surface impacted, when recorded, of 104 m², and 12 of them presented submerged appendages. However, many FADs likely got entangled on corals but were only detected after breaking free and reaching shore, often losing their tails (41.9% of dFADs). More frequent dedicated surveys would help evaluate this impact, and in-situ observations, are required to effectively assess damage to corals. In particular, as dFADs are often found without submerged appendages, the latter must have broken off and remaining in the environment, underwater assessment should therefore also be included in dedicated surveys. Furthermore, additional data would be needed to better quantify coral entanglements depending on the type of attachments, although not using mesh netting at all in appendages (NE FADs) would be expected to reduce entanglement. A possible pathway of study to improve impact assessment on coral reefs would be to look more closely at the trajectories of buoys. If these buoys are still attached to dFADs, they may be repeatedly entangled on reefs, and then break free. It may therefore be possible to detect this from the buoy positional data (Appendix 1, Figure S3). This could contribute to a greater understanding of the potential to damage coral reefs.

To reduce dFAD loss and abandonment, as well as the number of stranding events and their potential environmental impacts, FAD retrieval programs at sea and/or “FAD watch” initiatives close to shore could be considered. The second option of monitoring buoys that approach identified coastal areas (i.e., FAD watch) could be a more economically viable option to prevent and mitigate damage to coastal habitats (Zudaire et al., 2018). At Palmyra, the first FAD watch program in the Pacific Ocean has been in place since 2021, and is based on the collaboration between fishing companies and local partners to warn if a dFAD comes close to shore so it can be retrieved before causing any environmental damage.

Conclusion

This study constitutes the first analysis of FAD stranding events using in-situ data at a regional scale in the Pacific Ocean and worldwide. The regional database is mostly composed of community reports, allowing coverage over large spatial and temporal scales, however data from dedicated surveys add valuable data on data collection effort, surface surveyed and number of stranding events at certain point in time. The regional data collection effort should continue, to quantify more accurately the number of stranding events and provide a basis for further assessment of environmental impact, likely underestimated in this report and others. The study highlighted that some PICTs were more subject to certain types of stranding events than others. The study indicated that stranded dFADs were rarely completely natural and that netting, including large mesh net was almost always present. It also indicated that industrial aFADs were stranded in some PICTs, causing damage to coral reefs and with limited ability to trace origin. Finally, matching buoy ID from dFAD stranding events with fishery data appear promising to study the origins of stranded buoys and dFADs and should help inform appropriate management measures to limit dFAD loss and abandonment.

We invite WCPFC-SC19 to:

- Note the preliminary results from analyses of the regional database presented in this paper;
- Highlight the need for in-situ data collection to better quantify FAD stranding events and the impacts of FADs on marine and coastal environments;
- Encourage the expansion of the in-country stranded FAD data collection programs to other Members, Cooperating Non-Members and Participating Territories (CMMs);
- Note the need for FAD-buoy trajectory data, including for historical periods, to better determine the origin of FADs and buoys found stranded and explore spatial management options to reduce stranding events;
- Highlight the need to promote FAD retrieval, before FADs reach coastal areas;
- Promote Pacific-wide collaboration on dFAD research, in particular on homogenising data collection processes, increasing non-confidential data exchanges and collaborating on data analyses.

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References

Abascal, F., Fukofuka, S., Falasi, C., Sharples, P., Williams, P., 2014. Preliminary analysis of the Regional Observer Programme data on FAD design 38.

Balderson, S.D., Martin, L.E.C., 2015. Environmental impacts and causation of 'beached' Drifting Fish Aggregating Devices around Seychelles Islands: a preliminary report on data collected by Island Conservation Society 15.

Banks, R., Zaharia, M., 2020. Characterization of the costs and benefits related to lost and/or abandoned Fish Aggregating Devices in the Western and Central Pacific Ocean. Rep. Prod. Poseidon Aquat. Resour. Manag. Ltd Pew Charit. Trusts.

Bromhead, D., Foster, J., Attard, R., Findlay, J., Kalish, J., 2003. A Review of the impact of fish aggregating devices (FADs) on tuna fisheries 122.

Burt, A.J., Raguain, J., Sanchez, C., Brice, J., Fleischer-Dogley, F., Goldberg, R., Talma, S., Syposz, M., Mahony, J., Letori, J., Quanz, C., Ramkalawan, S., Francourt, C., Capricieuse, I., Antao, A., Belle, K., Zillhardt, T., Moumou, J., Roseline, M., Bonne, J., Marie, R., Constance, E., Suleman, J., Turnbull, L.A., 2020. OPEN The costs of removing 11.

Consoli, P., Sinopoli, M., Deidun, A., Canese, S., Berti, C., Andaloro, F., Romeo, T., 2020. The impact of marine litter from fish aggregation devices on vulnerable marine benthic habitats of the central Mediterranean Sea. Mar. Pollut. Bull. 152, 110928. https://doi.org/10.1016/j.marpolbul.2020.110928

Dagorn, L., Holland, K.N., Restrepo, V., Moreno, G., 2013. Is it good or bad to fish with FAD s? What are the real impacts of the use of drifting FAD s on pelagic marine ecosystems? Fish Fish. 14, 391–415. https://doi.org/10.1111/j.1467-2979.2012.00478.x

Davies, T., Curnick, D., Barde, J., Chassot, E., 2017. Potential environmental impacts caused by beaching of drifting fish aggregating devices and identification of management solutions and uncertainties 18.

Earp, H.S., Liconti, A., 2020. Science for the Future: The Use of Citizen Science in Marine Research and Conservation, in: Jungblut, S., Liebich, V., Bode-Dalby, M. (Eds.), YOUMARES 9 - The Oceans: Our Research, Our Future: Proceedings of the 2018 Conference for YOUng MArine RESearcher in Oldenburg, Germany. Springer International Publishing, Cham, pp. 1–19. https://doi.org/10.1007/978-3-030-20389-4_1

Escalle, L., Hamer, P., PNA, 2023a. FAD-related indicators derived from analyses of the FAD tracking programmes and observer data - WCPFC-SC19-2023/EB-WP-05.

Escalle, L., Hare, S., Hunt, A., Faure, C., Pollock, K., Nicholas, T.-R.N., Tanetoa, M., James, J., Bigler, B., Pilling, G., 2020. In-country initiatives to collect data on beached and lost drifting FADs, towards a regional database of in-situ data. WCPFC-SC16-EB-IP-02.

Escalle, L., Hare, S.R., Vidal, T., Brownjohn, M., Hamer, P., Pilling, G., 2021a. Quantifying drifting Fish Aggregating Device use by the world's largest tuna fishery. ICES J. Mar. Sci. 78, 2432–2447. https://doi.org/10.1093/icesjms/fsab116

Escalle, L., Moreno, G., Wichman, J., David, D., Hamer, P., 2023b. Progress report of Project 110: Non-entangling and biodegradable FAD trial in the Western and Central Pacific Ocean. WCPFC Sci. Comm. SC19-2023/EB-WP-02. WCPFC.

Escalle, L., Mourot, J., Bigler, B., Jaugeon, B., Kutan, M., Lynch, J.M., Nicholas, T.-R.N., Pollock, K., Prioul, F., Royer, S.-J., Thellier, T., Winchman, J., Jon Lopez, PNA, Hare, S., Hamer, P., 2022. Preliminarily analyses of the regional database of stranded drifting FADs in the Pacific Ocean - WCPFC-SC18-2022/EB-IP-03 23 July 2022 [WWW Document]. URL https://meetings.wcpfc.int/node/16329 (accessed 8.27.22).

Escalle, L., Mourot, J., Hamer, P., Hare, S.R., Phillip, N.B., Pilling, G.M., 2023c. Towards non-entangling and biodegradable drifting fish aggregating devices – Baselines and transition in the world's largest tuna purse seine fishery. Mar. Policy 149, 105500. https://doi.org/10.1016/j.marpol.2023.105500

Escalle, L., Muller, B., Scutt Phillips, J., Brouwer, S., Pilling, G., PNAO, 2019a. Report on analyses of the 2016/2019 PNA FAD tracking programme. WCPFC Sci. Comm. WCPFC-SC15-2019MI-WP-12.

Escalle, L., Muller, B., Vidal, T., Hare, S., Hamer, P., PNA, 2021b. Report on analyses of the 2016/2021 PNA FAD tracking programme WCPFC-SC17-2021/MI-IP-04. WCPFC.

Escalle, L., Scutt Phillips, J., Brownjohn, M., Brouwer, S., Sen Gupta, A., Van Sebille, E., Hampton, J., Pilling, G., 2019b. Environmental versus operational drivers of drifting FAD beaching in the Western and Central Pacific Ocean. Sci. Rep. 9, 14005. https://doi.org/10.1038/s41598-019-50364-0

Filmalter, J.D., Capello, M., Deneubourg, J.-L., Cowley, P.D., Dagorn, L., 2013. Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices. Front. Ecol. Environ. 11, 291–296. https://doi.org/10.1890/130045

Franco, J., Dagorn, L., Sancristobal, I., Moreno, G., 2009. DESIGN OF ECOLOGICAL FADS 22.

Gilman, E., Musyl, M., Suuronen, P., Chaloupka, M., Gorgin, S., Wilson, J., Kuczenski, B., 2021. Highest risk abandoned, lost and discarded fishing gear. Sci. Rep. 11, 7195. https://doi.org/10.1038/s41598-021-86123-3

Giskes, I., Baziuk, J., Pragnell-Raasch, H., Perez Roda, A., 2022. Report on good practices to prevent and reduce marine plastic litter from fishing activities. FAO; International Maritime Organization (IMO); https://doi.org/10.4060/cb8665en

Hoegh-Guldberg, O., 2004. Coral reefs in a century of rapid environmental change. Symbiosis 37.

Lopez, J., Moreno, G., Sancristobal, I., Murua, J., 2014. Evolution and current state of the technology of echo-sounder buoys used by Spanish tropical tuna purse seiners in the Atlantic, Indian and Pacific Oceans. Fish. Res. 155, 127–137. https://doi.org/10.1016/j.fishres.2014.02.033

Lopez, J., Román, M.H., Lennert-Cody, C.E., Maunder, M.N., Vogel, N., Fuller, L.M., 2021. FLOATING-OBJECT FISHERY INDICATORS: A 2021 REPORT.

Macfadyen, G., Capel, R., Hutington, T., 2009. Abandoned, lost or otherwise discarded fishing gear, FAO Document technique sur les pêches et l’aquaculture. FAO, Fisheries and Aquaculture Management Division, Rome, Italy.

Maufroy, A., Chassot, E., Joo, R., Kaplan, D.M., 2015. Large-Scale Examination of Spatio-Temporal Patterns of Drifting Fish Aggregating Devices (dFADs) from Tropical Tuna Fisheries of the Indian and Atlantic Oceans. PLOS ONE 10, e0128023. https://doi.org/10.1371/journal.pone.0128023

Moreno, G., Salvador, J., Zudaire, I., Murua, J., Pelegrí, J.L., Uranga, J., Murua, H., Grande, M., Santiago, J., Restrepo, V., 2023. The Jelly-FAD: A paradigm shift in the design of biodegradable Fish Aggregating Devices. Mar. Policy 147, 105352. https://doi.org/10.1016/j.marpol.2022.105352

Murua, H., Dagorn, L., Justel-Rubio, A., Moreno, G., Restrepo, V., 2021. Questions and answers about FADs and bycatch. ISSF.

Panizza, A., Williams, P., Falasi, C., Loganimoce, E., Schneiter, E., 2023. Status of observer data management - WCPFC-SC19-2023/ST-IP02. WCPFC.

PNA, 2020. Resolution of the PNA Ministers to adopt the Fourth Arrangement Implementing the Nauru Agreement relating to FADS [WWW Document]. URL https://pnatuna.com/index.php/content/4ia-resolution (accessed 8.26.22).

Richardson, K., Hardesty, B.D., Wilcox, C., 2019. Estimates of fishing gear loss rates at a global scale: A literature review and meta-analysis. Fish Fish. 20, 1218–1231. https://doi.org/10.1111/faf.12407

WCPFC, 2021. Conservation and management measure for bigeye, yellowfin and skipjack tuna in the western and central pacific ocean.

WCPFC, 2018. Conservation and Management Measure for bigeye, yellowfin and skipjack tuna in the Western and Central Pacific Ocean | WCPFC [WWW Document]. URL https://www.wcpfc.int/doc/cmm-2018-01/conservation-and-management-measure-bigeye-yellowfin-and-skipjack-tuna-western-and (accessed 8.23.22).

Williams, P., Ruaia, T., 2023. Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions - 2022 - WCPFC-SC19-2023/GN WP-1. WCPFC.

Zudaire, I., Moreno, G., Murua, J., Hamer, P., Murua, H., T. Tolotti, M., Roman, M., Hall, M., Lopez, J., Grande, M., Merino, G., Escalle, L., C. Basurko, O., Capello, M., Dagorn, L., Ramos, M.L., Abascal, F.J., Báez, J.C., Pascual-Alayón, P.J., Déniz, S., Santiago, J., 2023. Biodegradable drifting fish aggregating devices: Current status and future prospects. Mar. Policy 153, 105659. https://doi.org/10.1016/j.marpol.2023.105659

Zudaire, I., Santiago, J., Grande, M., Murua, H., Adam, P.-A., Nogues, P., Collier, T., Morgan, M., Khan, N., Baguette, F., Moron, J., Moniz, I., Herrera, M., 2018. FAD Watch: a collaborative initiative to minimize the impact of FADs in coastal ecosystems | Bycatch Management Information System (BMIS), in: Http://Www.Iotc.Org/Documents/WPEB/14/12.

Appendices

- Appendix 1: Supplementary figures.
- Appendix 2: Description of data collection for dFADs found stranded or at-sea
- Appendix 3: Poster presenting the data collection program for the Cook Islands in English
- Appendix 4: Data collection form for fisheries officers
- Appendix 5: GEN-5 form (FAD-related information) from the WCPFC observer program
- Appendix 6: ISSF Guide for non-entangling FADs

Appendix 1. Supplementary figures

Figure S1.1. *Map of stranding events in Alaska (2023).*

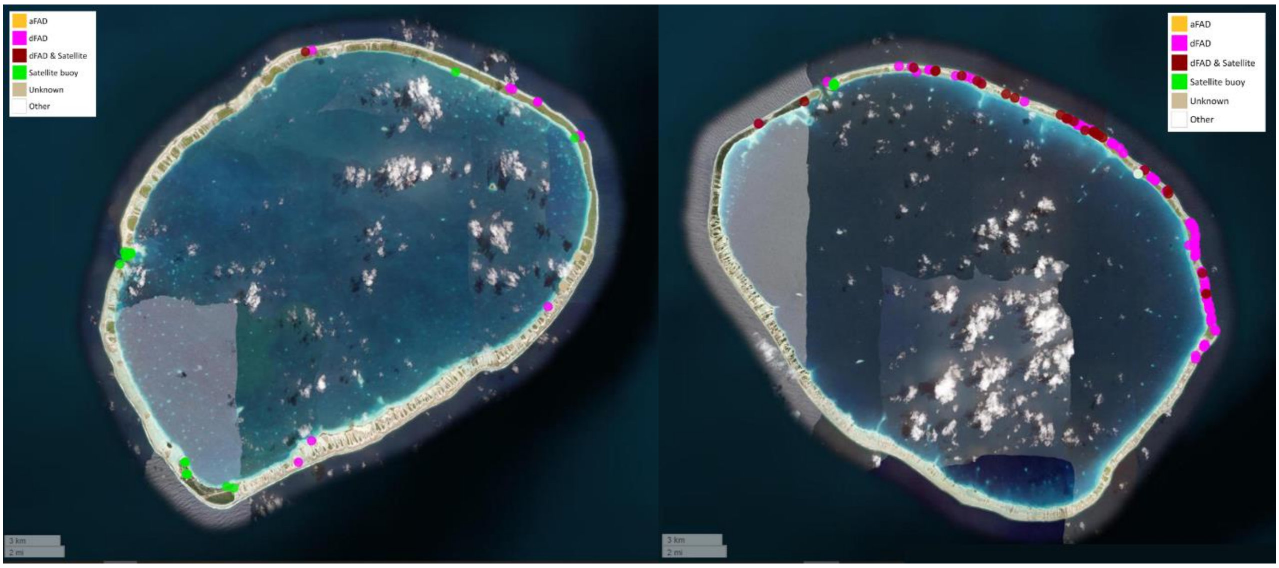


Figure S1.2. *Map of stranding events in Tikehau (left) and Raraka (right) (French Polynesia) by type of object in 2022.*

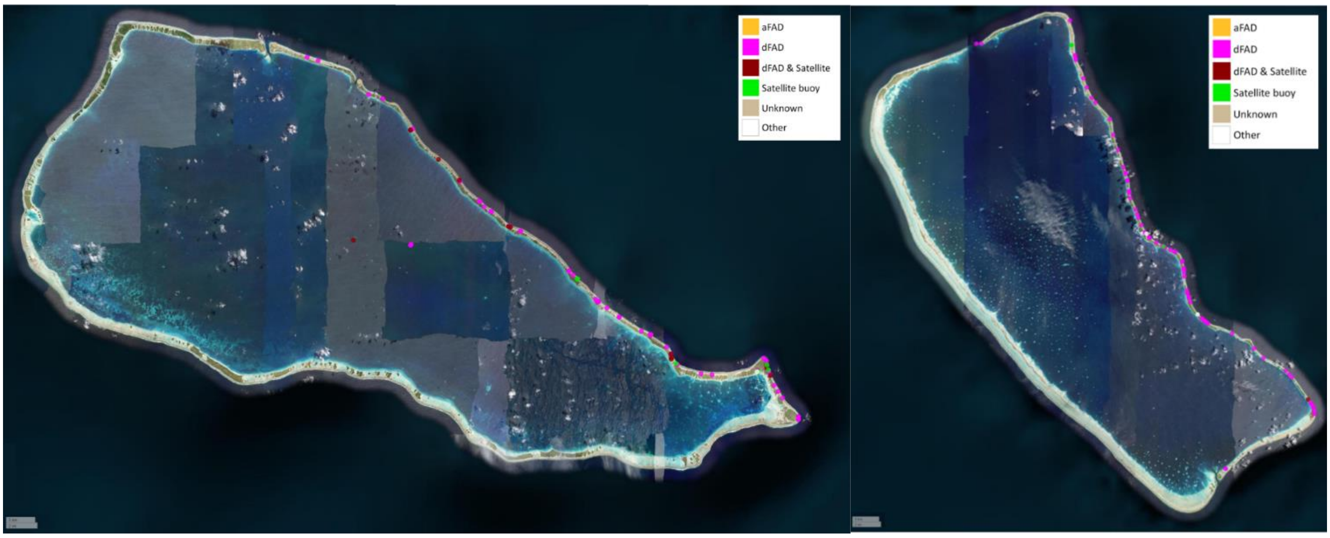


Figure S1.3. *Map of stranding events in Rangiroa (left) and Fakarava (right) (French Polynesia) between 2020–2022, by type of object.*

Figure S1.4. *Map of stranding events in Amanu (left) between 2021—2022 and Hao (right) (French Polynesia) in 2021, by type of object.*

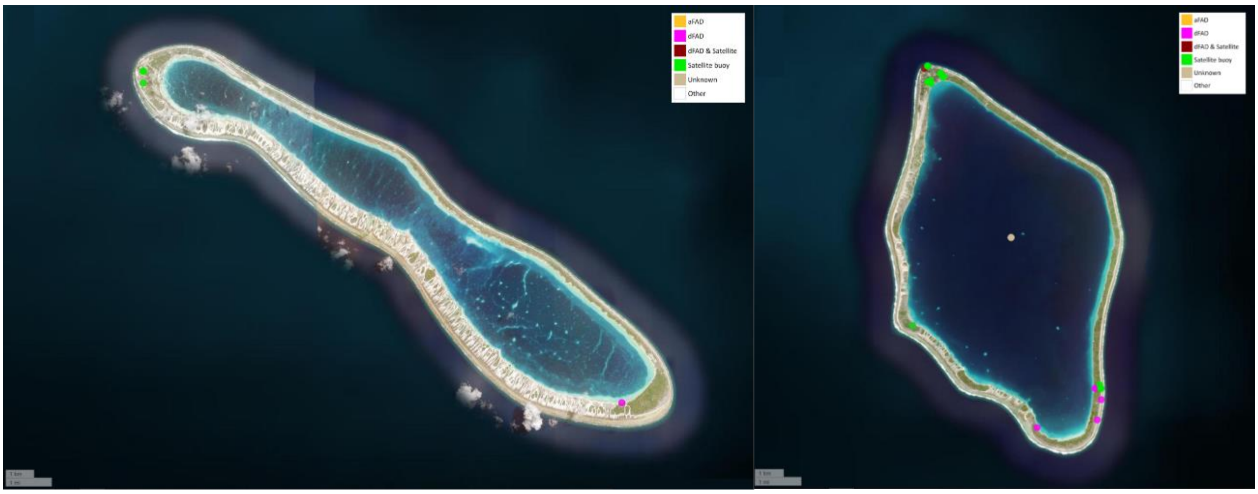


Figure S1.5. *Map of stranding events in Reao (left) in 2022 and Tureia (right) (French Polynesia) in 2020 and 2022, by type of object.*

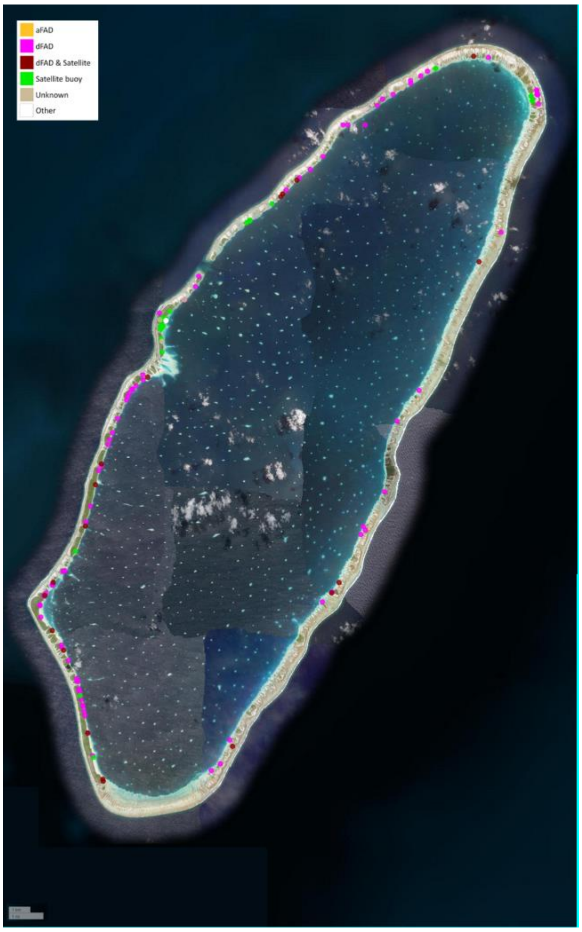


Figure S1.6. *Map of stranding events in Raroia (French Polynesia) in 2022, by type of object.*

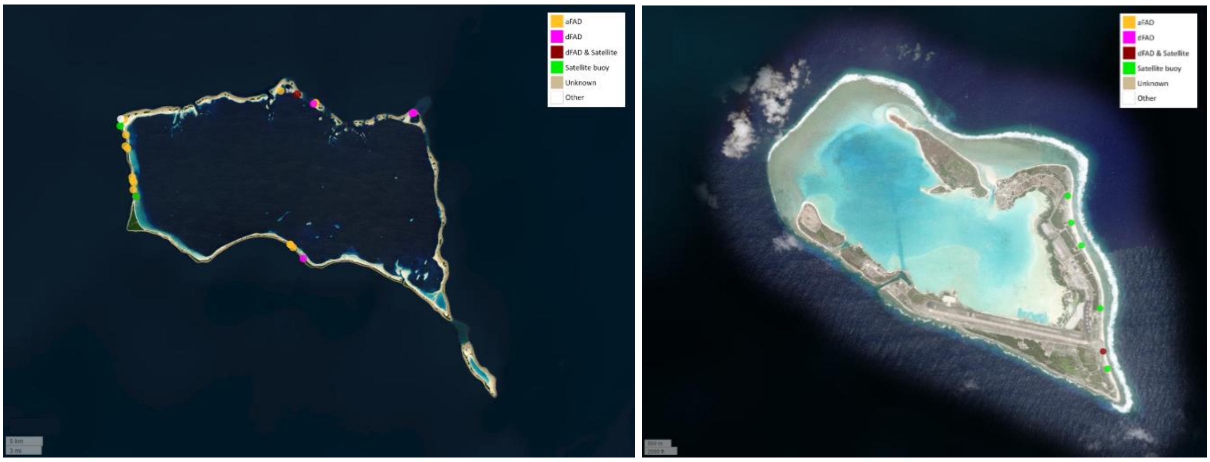


Figure S1.7. *Map of stranding events in Mili Atoll in 2021 (Republic of the Marshall Islands, left) and in Wake Atoll between 2021–2023 (US, right).*

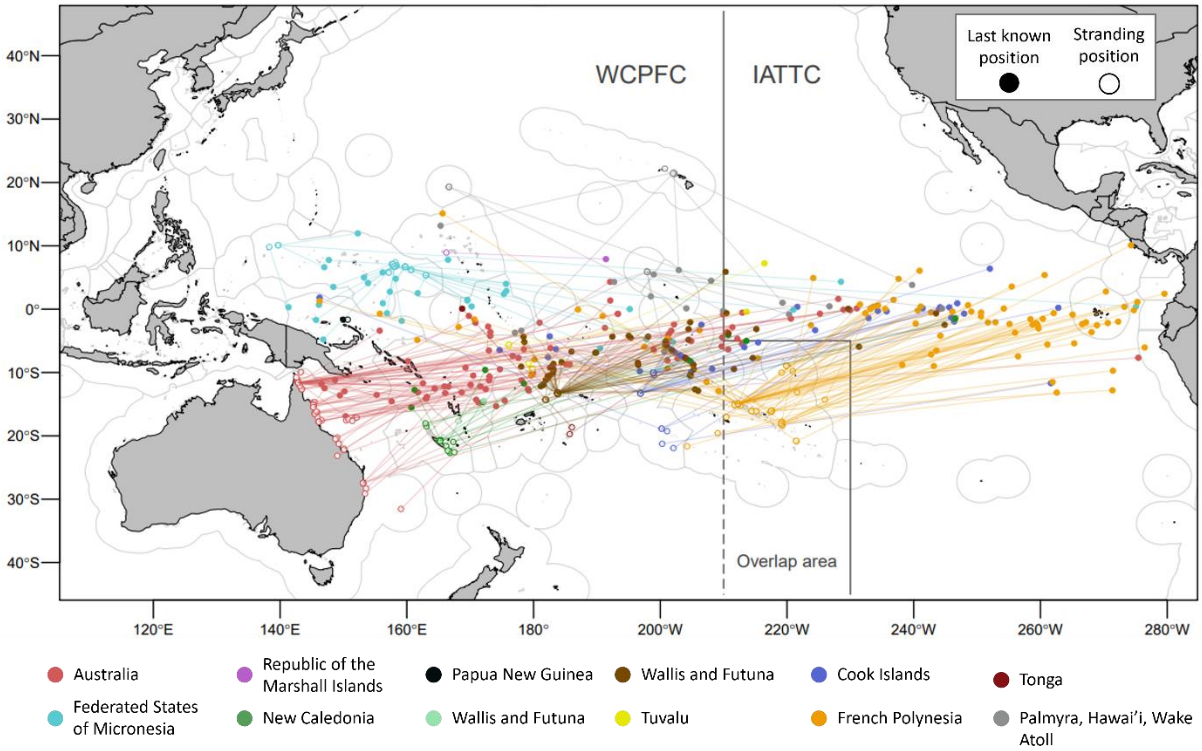


Figure S2. *Map with all recorded buoys stranding position (dots filled in white) and the last known position of buoys from the three fishery databases: the PNA FAD tracking data; the WCPFC observer data and the IATTC observer data. The color of the lines and points indicate the country where FADs and/or buoys were found stranded.*

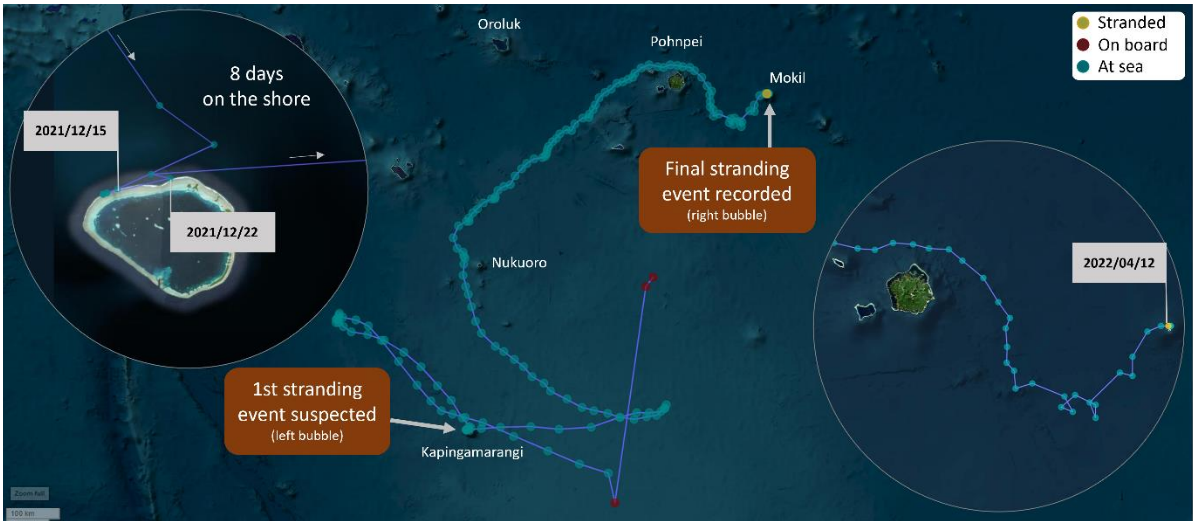


Figure S3. *The trajectory of a buoy suspected to have experienced another stranding event, before being found stranded through the data collection program implemented in the Federated States of Micronesia.*

Appendix 2. Description of data collection for dFADs found stranded or at-sea

Description of data collection for FADs found stranded or at sea

For further information, contact Jennifer Mourot jenniferm@spc.int
or Lauriane Escalle laurianee@spc.int

Why are we collecting these data?

We are collecting these data in order to quantify the number of lost and stranded FADs, and to note their impact on coastal areas, which will help improve the management of FAD fishing. Drifting FADs are always deployed with a satellite buoy, so that fishers know the position of their FADs. This buoy is usually also equipped with an echosounder to estimate the amount of tuna aggregated underneath. Fishing companies have started sharing data both of the FAD's position, as well as the echosounder data from the satellite buoys deployed on FADs. These data are used in scientific studies that guide management of FAD fishing. When FADs are found at sea or stranded, it is therefore very important to record the unique buoy ID number, to potentially match found FADs with these existing datasets.

However, fishers commonly remotely deactivate satellite buoys when FADs drift outside fishing areas. The dataset transmitted by fishing companies hence only gives a partial image of the FAD trajectories, and the number of stranding events is underestimated in this dataset. Therefore, having access to additional information on stranding events, but also on FADs drifting in coastal areas (with the buoy ID number, if still attached to the FAD), will help complement the existing dataset and better estimate the impact that FADs may have on coastal areas.

Description of the fields in the spreadsheet

- **Entry number**
  (Internal use only. Number of the object found (1 to n). Used to rename the pictures.)

- **Entry number from independent program**
  For independent programmes that already have their own numbering.

- **Entered by**
  Name of the person entering the data.

- **Date entered**
  Date of data entry. Use the yyyy/mm/dd date format.

- **Type of data**
  Specify how the data was collected, was it a dedicated survey, using a drone or by people (e.g. walking along a coastline), opportunistic reporting (not part of an existing programme) or by local communities (part of a data collection programme).

- **Found by**
  Name of the person who found the FAD and/or the satellite buoy.

- **Contact**

Enter contact detail (email address, phone number) of the person who found the FAD and/or the satellite buoy.

- **FAD present**
  Was a FAD present (i.e. FAD by itself or FAD with a buoy)? Yes/No.

- **FAD Type**
  Note if the object found was a drifting FAD (dFAD), an anchored FAD (aFAD; industrial aFADs commonly look like a giant drum) or just a part of a drifting FAD.
  Examples of a drifting FAD, drifting FAD parts, and an anchored FAD.

		
Drifting FAD	Drifting FAD parts	Anchored FAD

- **Buoy present**
  Was a satellite buoy present (i.e. buoy attached to a FAD or buoy by itself)? Yes/No.

- **Buoy type**
  What kind of buoy was found? Most of the buoys found with FADs are satellite buoys (whole or part of it), but it could also be oceanographic buoy or radio buoy (used by longline vessels for instance). If you are not sure, take photos or look at the photos below to orientate the choice.

		 
Satellite buoy	Radio buoy	Oceanographic buoy

- **Buoy part found**

If the buoy found is not complete, what part did you find? It could be the plastic case (top and/or bottom), the electronics or both.

- **Buoy ID number (very important if a buoy is present)**
  Enter the satellite buoy ID number (see the end of this document how to find the Buoy ID number depending on the buoy brand).
  Examples of satellite buoy ID number:
  DL+123456 ; **ISL**+123456 ; **DSL**+123456 ; **SLX**+123456
  M3I123456; **M3**+123456; **M4**+123456
  T07123456789; **Te7**123456789; **T7+**123456789; **T8X**123456; **F8E**123456789 ; **Z07**123456789
  P1234NF; **P**1234N; **WF**1234N; **CN**123N
  123456

- **Buoy brand**
  Record the brand of the buoy, usually written on the top or the side of the buoy. Most brand used are Satlink, Marine Instruments, Zunibal, Kato, and Ryokusei.

- **Buoy model**
  After identifying the brand of the buoy, record the model. Either another name is written inside or on the side of the buoy, or record the letters at the beginning of the buoy ID number. Examples of buoy ID number, with the buoy model in bold:
  ISL+123456 ; **DSL**+123456 ; **SLX**+123456 : These types of letters correspond to a Satlink buoy (non-exhaustive list).
  M3I123456; **M3**+123456; **M4**+123456 : These types of letters correspond to a Marine Instruments buoy (non-exhaustive list).
  T07123456789 ; **Te7**123456789 ; **T7+**123456789 ; **T8X**123456 ; **F8E**123456789 : These types of letters correspond to a Zunibal buoy (non-exhaustive list).

- **Date found**
  Date when the object has been found. Use the yyyy/mm/dd date format.
  However, if the object was previously collected by local communities some time ago (for example, stored in a garden or at the port), record here the date when the officer in charge of the data collect, found or saw this object; then enter the date when the object was actually found in the "Initial date found by communities" field (see below).

- **Island**
  Note only the name of the island where the object has been found.

- **Location**
  In particular if the lat/lon were not recorded, record where the object was found, e.g. name of beach, town, island, etc.

- **Accurate GPS coordinates**
  Specify if the exact GPS coordinates where the floating object was found are available.

- **Latitude and longitude (If provided)**
  Record latitude and longitude in decimal format.

- **Environment (if provided or visible on the pictures)**

Where the FAD has been found: drifting at-sea in the lagoon or the ocean, on a beach, a coral reef, a rocky shore, a mangrove; or previously found and reported from a garden, a wharf (if the object has been found some time ago), etc.

- **Initial date found by communities (optional)**
  When reports relates to floating objects already collected previously by communities, record the date it was originally found if it is known. If the precise date is unknown, it could be approximated. Use the yyyy/mm/dd , yyyy/mm or yyyy date format.

- **Initial location or coordinates (optional)**
  When reports relates to floating objects already collected previously by communities, record the location/coordinates where it was originally found, if they are known.

- **Initial environment when found by communities (optional)**
  When reports relates to floating objects already collected previously by communities, record the environment it was originally found, if it is known.

- **Painted marks (if provided or visible on the pictures)**
  Record any marks painted on the satellite buoy. Could be a vessel name, or the abbreviation of a vessel names, just a letter, a number, a number and a letter, and sometimes the buoy ID number.

- **Marks on the FAD (if provided or visible on the pictures)**
  Record any mark attached to the FAD or painted on it.

- **FAD condition (if provided or visible on the pictures)**
  What is the condition of the FAD when found? Intact, beginning to break, mostly fallen apart.

- **Raft shape**
  Define the shape of the FAD. Generally, FADs have a rectangular or a square shape, eventually hexagonal, but sometimes they look like a sausage of buoys wrapped in netting.

- **Raft materials – Structure and flotation (if provided or visible on the pictures, can be multiple entries)**
  List all the materials making the raft of the FAD, especially materials for the structure and the flotation: bamboo, log, floats, plastic or metal drum, polystyrene, etc.

- **Raft materials – Covering and other (if provided or visible on the pictures, can be multiple entries)**
  List all the materials making the raft of the FAD, especially covering materials or other types of materials: net, rope, canvas, plastic sheetings, etc.

- **If net is present (raft), mesh size**
  Determine the mesh size of the net used for the raft, if it is small (under 7 cm) large (more than 7 cm), or both types of netting are present.

- **Length and Width or the raft (if estimated)**
  Estimate the size of the FAD raft, Length (m) and Width (m).

- **Tail presence**
  Is there any submerged appendage under the raft structure? Yes/No.

- **Tails materials (if provided or visible on the pictures, can be multiple entries)**
  List all the materials making the tail of the FAD (underwater appendages): bamboo, log, net, cord, canvas, etc

- **If net is present (tail), mesh size**
  Determine the mesh size of the net used for the tail, if it is small (under 7 cm), large (more than 7 cm) or both types of nets are present. Determine as well, the design of the tail. It could be a open netting panel or netting could be rolled up into a bundle.

- **Tail length (if estimated)**
  Estimate the length of the FAD tail, i.e. the materials (rope, net, etc.) hanging under the FAD raft, in meters.

- **Fate of the FAD (if provided)**
  What has been done with the FAD: removed from the environment, left drifting, left on shore, sunk, fished, etc.

- **Purpose if FAD removed**
  If the FAD has been removed from the environment it was found, mention why it has been removed: for research, landfill, burned, stored (to do what?), recycled (to do what?), etc.

- **Fate of the buoy (if provided)**
  What has been done with the satellite buoy: removed from the environment, left drifting, left on shore, sunk, etc.

- **Purpose if buoy removed**
  If the buoy has been removed from the location it was found, mention why it has been removed: for research, avoid pollution, recycling (use battery, solar panels…), etc.

- **Buoy storage location**
  If the buoy has been removed from the location it was found, record where the buoy is stored (if known).

- **Environmental damage (if provided or visible on the pictures)**
  Any environmental damage recorded: e.g. corals and/or animals are entangled in the tail of the FAD.

- **Entangled animals (if provided or visible on the pictures)**
  Record if any animals were found entangled on the net hanging beneath the FAD and/or the net used to cover the raft. If possible, record the species and the number of individuals.

- **Aggregated fish and/or fished (if provided)**
  Record if any fish (or other animals) were seen aggregated under the FAD and/or if any fishing was performed. If it was the case, mention the species (if known), the number and/or the catch in kg.

- **Other comments**
  Any other comments: e.g. some tunas were aggregated under the FAD, the FAD could not be removed because too heavy, materials reused as fishing gear, etc.

- **Number of pictures received**
  Record how many pictures have been received/taken. If no pictures exist, put 0. If some pictures exist but you are waiting for their transfer, put “waiting for photos”.

- **Pictures name**
  Rename the pictures using a unique identifier containing, country, entry number (first field) and date found (if date found is unknown use the date entered).
  <CountryCode>_<Seq. No.>_<Date:YYYYMMDD>   Ex: FM_1_20190923
  Add another number if more than one picture: e.g. FM_1_20190923_P1; FM_1_20190923_P2; FM_1_20190923_P3. Then copy the pictures in the folder in google drive.

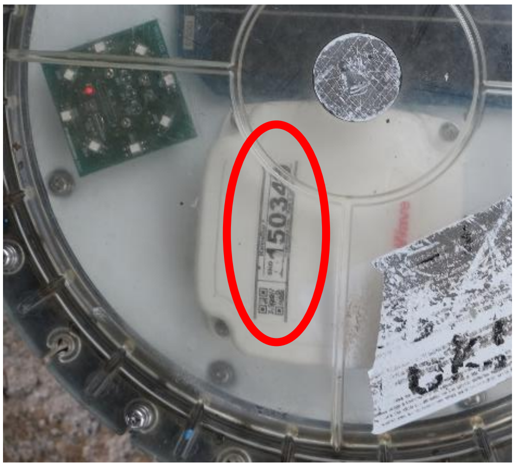
- **Buoy ID number verified**
  Has the satellite buoy ID number been verified by the fishery officer on a picture or directly: Yes/No.

- **SPC Check**
  For SPC staff only, check information related to the entry and compare with photos (if available).
  - If photos are available and there are no questions, the entry's check will be marked as "Yes".
  - If there are questions regarding entry by SPC staff, it will be marked as "Yes, but waiting for further information".
  - If there are no photos although it is recorded that they exist, and the line has been checked, it will be marked as "Yes, but waiting for photos".
  - If the line has been checked and there are no existing photos, it will be marked as "Yes, but nothing to check".
  - If the line has not been checked, it will be marked as "No".

Information on satellite buoys

Buoy brand	Special features	ID number
Marine Instruments 	• Present big black handles on sides • Often have a green bottom plastic case. • Top plastic case is higher than other buoys brand.	The ID Number is present on the side of the buoy and the top plastic case at the corners, or on a small metal plate inside between the solar panels. 

Satlink 	Often has 6 solar panels radiating from the center (looks like an asterisk/star or flower)	In the center of the buoy inside a (black) circle. 
Zunibal 	• Often 4 cross-shaped solar panels with a blue background. • The top plastic case is quite flat.	The model of the buoy (here at the top) and the number (here at the bottom) is in the center of the buoy. 
Kato 	• Often 4 solar panels arranged in a square • Dark green background • Fairly flat top plastic case	It is located on a metal plate at the ends of the solar panels. The code on the first line is the model of the buoy, the code below is the ID number. 

Ryokusei  	• Few information available. • Often 2 solar panels side by side • White background.	The ID number is on a small white box inside. 

Appendix 3. Poster presenting the data collection program for the Cook Islands in English

Appendix 4. Data collection form for fisheries officer

FAD Sighting form v2

Entered in the database ☐

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

Form

Completed on: Click here to enter a date **Completed by: First name:** Click here to enter text **Surname:** Click here to enter text

Observer/ person who found the FAD

Name: Click here to enter text **Phone number:** Click here to enter text **Email:** Click here to enter text

Sighting information

(Tick one or several) ☐ **A FAD** **and/or** ☐ **A buoy - ID Number:** Click here to enter text

☐ drifting FAD ☐ anchored FAD ☐ Satellite (used on FADs) ☐ Other: enter text here

Date of finding: Click here to enter a date **Location** (village, island, beach, bay, etc.): Click here to enter text

Coordinates *(if possible):* Click here to enter text

Precise location *(in case of absence of coordinates, describe where it was found):* Click here to enter text

Environment: ☐Beach ☐Coral reef ☐Drifting in the lagoon ☐Drifting in the ocean ☐Rocky shore ☐Mangrove ☐Garden (found previously) ☐Wharf (found previously) ☐Other: Click here to enter text

If found previously (garden, wharf, landfill**), initial date and location**: Click here to enter text

FAD Information

Painted marks on the buoy: Click here to enter text **Marks on the FAD:** Click here to enter text

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

Submerged tail presence *(i.e., part of the FAD normally under water)*: ☐Yes ☐No ☐Partial ☐Unknown

Raft materials: ☐Unknown ☐Bamboo ☐Wood ☐Metal drum ☐Plastic drum ☐Floats ☐PVC tubes ☐Cords ☐Steel ☐Nets, mesh size: Click here to enter text ☐Cotton canvas ☐Plastic sheet ☐Palm leaves ☐Polystyrene ☐Other: Click here to enter text

Shape of the raft: ☐Square ☐Rectangular ☐ Floats « sausage » ☐Cylindrical ☐Other: Click here to enter text

Submerged tail materials: ☐Unknown ☐Palm leaves ☐Open net, mesh size: Click here to enter text ☐Net tied as a "sausage", mesh size: Click here to enter text ☐Cord ☐Cotton canvas ☐Plastic sheet ☐Other: Click here to enter text

Estimated size of the raft (m) *(Length x Width)*: Click here to enter text **Estimated depth of submerged tail** (m): Enter text here

Fate of the FAD/ the buoy

FAD removed? ☐No ☐Yes* **If yes, why?**☐Landfill ☐Burned ☐Research☐Recycled☐Storage☐Re-used (*specify*): text here

If found in a garden or house, check yes* **If no, fate:☐Unknown ☐Left ☐Sunk ☐Fished, species and catch (kg): text here☐Other: text

Buoy removed? ☐Yes ☐No* **If so, why?** ☐Landfill ☐Burned ☐Recycled☐Research☐Storage☐Re-used (*specify*): text here

If found in a garden or house, check yes* **If no, fate:☐Unknown ☐Left ☐Sunk ☐Other: Click here to enter text

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

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

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

If FAD is entangled on coral reef, please state the approximate size of the area impacted: Click here to enter text

Number of pictures: text

Comments: Click here to enter text

Appendix 5. GEN-5 form (FAD related information) from the WCPFC observer program

FAD/PAYAO and FLOATING OBJECTS INFORMATION RECORD — **Form GEN-5**

REVISED 2018

OBSERVER NAME:	VESSEL NAME:	OBSERVER TRIP ID NUMBER:	PAGE OF

Date	Time *(from PS-2)*	Set No.	Object number	Origin of FAD	Deployment date	latitude dd°mm.mmm'	N S	and longitude ddd°mm.mmm'	E W	FAD as found	Beacon/ FAD lifted	FAD as left	*Comments / Change details*
											Beac/FAD/ NO		
<u>FAD materials</u> Main materials		*net/mesh size*	Attachments	*net/mesh size*	Max est. depth	FAD length	FAD width	Buoy serial number	Beacon/FAD ID markings		SSI seen	SSI trapped	
		cm		cm	M	M	M				Y / N / U	Y / N / U	

Date	Time *(from PS-2)*	Set No.	Object number	Origin of FAD	Deployment date	latitude dd°mm.mmm'	N S	and longitude ddd°mm.mmm'	E W	FAD as found	Beacon/ FAD lifted	FAD as left	*Comments / Change details*
											YES / NO		
<u>FAD materials</u> Main materials		*net/mesh size*	Attachments	*net/mesh size*	Max est. depth	FAD length	FAD width	Buoy serial number	FAD / Payao No. and or markings		SSI seen	SSI trapped	
		cm		cm	M	M	M				Y / N / U	Y / N / U	

Date	Time *(from PS-2)*	Set No.	Object number	Origin of FAD	Deployment date	latitude dd°mm.mmm'	N S	and longitude ddd°mm.mmm	E W	FAD as found	Beacon/ FAD lifted	FAD as left	*Comments / Change details*
											YES / NO		
<u>FAD materials</u> Main materials		*net/mesh size*	Attachments	*net/mesh size*	Max est. depth	FAD length	FAD width	Buoy serial number	FAD / Payao No. and or markings		SSI seen	SSI trapped	
		cm		cm	M	M	M				Y / N / U	Y / N / U	

Date	Time *(from PS-2)*	Set No.	Object number	Origin of FAD	Deployment date	latitude dd°mm.mmm'	N S	and longitude ddd°mm.mmm'	E W	FAD as found	Beacon/ FAD lifted	FAD as left	*Comments / Change details*
											YES / NO		
<u>FAD materials</u> Main materials		*net/mesh size*	Attachments	*net/mesh size*	Max est. depth	FAD length	FAD width	Buoy serial number	FAD / Payao No. and or markings		SSI seen	SSI trapped	
		cm		cm	M	M	M				Y / N / U	Y / N / U	

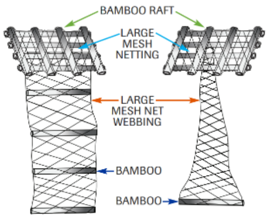
<u>**Diagrams**</u>*- label with 'Object number'*

Appendix 6. ISSF Guide for non-entangling FADs

ISSF GUIDE FOR NON-ENTANGLING FADs

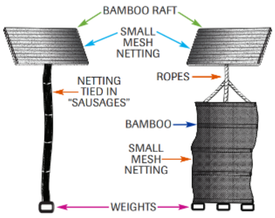
Considering the variety of designs and materials used in construction of FADs worldwide the ISSF Bycatch Steering Committee proposes a ranking of FADs according to the risk of entanglement associated with each design. Starting from highest to lowest risk of entanglement, four categories are described and illustrated examples provided of FAD designs:

HIGHEST ENTANGLEMENT RISK FADs:



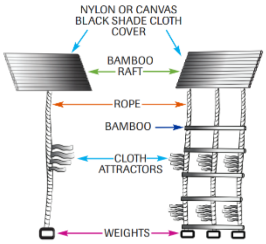
- Constructed with any netting materials, including old purse seine netting, used to cover rafts or suspended beneath in open panels
- These DFADs are known to cause entanglements with turtles and sharks

LOWER ENTANGLEMENT RISK FADs:



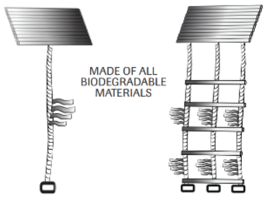
- Only small mesh netting used (e.g. < 2.5 inch (7 cm) stretched mesh)
- Rafts are tightly wrapped with small mesh netting, with no loose netting hanging from it
- The underwater structure is tightly tied into bundles (sausages)
- A single panel can be used instead of bundles, but the panel must be weighted to keep it taut
- The panel should consist of either netting with a stretched mesh of 2.5 inches (7 cm) or less, or a solid sheet (e.g., canvas or nylon)
- Despite using netting, these design elements reduce the risk of entanglement events

NON-ENTANGLING FADS:



- No netting is used in their construction
- The raft is not covered or covered with shade cloth or canvas
- The subsurface structure is made with ropes, canvas or nylon sheets, or other non-entangling materials
- These FADs are expected to have minimum risk of causing entanglement

BIODEGRADABLE NON-ENTANGLING FADS:



- In addition to having minimal risk of entanglement, they are constructed exactly like other non-entangling FADS, but using only natural and/or biodegradable materials, further reducing the environmental impact of DFADs on the oceans

HIGHEST RISK ⟵ ⟶ **LOWEST RISK**