INTER-AMERICAN TROPICAL TUNA COMMISSION

***AD-HOC* PERMANENT WORKING GROUP ON FADS**

7TH MEETING

La Jolla, California (USA)
12-13 May 2022

DOCUMENT FAD-07 INF-A

ANALYSES OF THE REGIONAL DATABASE OF STRANDED DRIFTING FISH AGGREGATING DEVICES (DFADS) IN THE PACIFIC OCEAN

Escalle L.[1], Mourot J.[1], Thellier T.[2], Lopez J.[3], Fuller L.[3], Wichman J.[1], Royer S.J.[4], Hood L.[5], Bigler B.[6], Jaugeon B.[7], Nicholas T.R.[8], Pollock K.[9], Prioul F.[10], Marks A.[11], Kutan M.[12], Jones J.[11, 13], Lynch J.M.[4], Tait H.[5], Hamer P.[1]

[1]The Pacific Community (SPC), Nouvelle-Calédonie
[2]Direction des ressources marines (DRM), Polynésie Française
[3]Inter-American Tropical Tuna Commission (IATTC)
[4]Hawaiʻi Pacific University (HPU), Center for Marine Debris Research (CMDR), Hawaiʻi
[5]Tangaroa Blue Foundation, Australia
[6]Marshall Islands Marine Resources Authority (MIRMA), Marshall Islands
[7]Department of fisheries and marine resources management, Wallis-and-Futuna
[8]Offshore Fisheries Division, Ministry of Marine Resources (MMR), Cook Islands
[9]Palmyra Atoll Program, The Nature Conservancy (TNC)
[10]Service du parc naturel de la mer de Corail et de la pêche, Nouvelle-Calédonie
[11]Galapagos Conservation Trust (GCT), United Kingdom
[12]Tuvalu Fisheries Department, Tuvalu
[13]Pacific Plastics: Science to Solutions (PPSS), Eastern Pacific network

SUMMARY

Drifting Fish Aggregating Devices (dFADs) are reaching coastal areas where they can become stranded, adding to pollution and/or causing environmental damage. To quantify these events and their impacts, several Pacific Island Countries and Territories (PICTs), in collaboration with the Pacific Community (SPC), and often with support from international Non-Governmental Organisations (NGOs), have implemented programmes to collect in-situ data. These data collection programs on stranded and lost dFADs are now fully implemented in ten PICTs: Australia, Cook Islands, Federated States of Micronesia, Hawaiʻi, Republic of the Marshall Islands, French Polynesia, New Caledonia, Palmyra, Tuvalu, and Wallis and Futuna, with data collection spanning 2006–2023. A total of 2,199 stranding events could be identified to date; 40.5% of these consisted of a buoy alone, 29.5% of a FAD alone and 25.6% of a FAD with a buoy attached (4.4% were unknowns). FADs and buoys were most commonly found on a beach (40.3%), while others had been previously collected by local communities (28.8%), and some were found drifting in the ocean (8.1%), or caught on coral reefs (5.9%). In some case environmental damage could be recorded for dFAD strandings, this was most common for dFADs with submerged appendages and corresponded to coral damage (3% of all FADs but 6.8% of all appendages found) or entangled animals (0.6% of all FADs but 0.9% 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. Stranded dFADs were in similar proportions from vessels fishing in the IATTC (47.0%), and the WCPFC area (43.2%), with 9.8% from vessels fishing in both Convention Areas. Large variability in terms of country of origin for stranding events was observed. For example, most stranding events in French Polynesia were from vessels fishing in the IATTC-CA. This programme provides an incomplete picture of the level of dFAD strandings on Pacific Islands and we 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.

RESUMEN

Los dispositivos de concentración de peces (DCP) que quedan a la deriva llegan a las zonas costeras donde pueden quedar varados, aumentando la contaminación del medioambiente y/o causando daños medioambientales. Para cuantificar estos fenómenos y sus impactos, varios Países y Territorios Insulares del Pacífico (PICT, por su sigla en inglés), en colaboración con la Comunidad del Pacífico (SPC) y a menudo con el apoyo de Organizaciones No Gubernamentales (ONG) internacionales, han puesto en marcha programas de recolección de datos in situ. Estos programas de recopilación de datos sobre DCP a la deriva, varados y/o perdidos están ahora plenamente implementados en diez PICT: Australia, Islas Cook, Estados Federados de Micronesia, Hawái, República de las Islas Marshall, Polinesia Francesa, Nueva Caledonia, el atolón de Palmira, Tuvalu y Wallis y Futuna, con un periodo de vigencia para la recogida de datos que va del 2006 al 2023. Hasta la fecha se han identificado un total de 2.199 DCP varados; el 40,5% de estos consistieron en una boya sola, el 29,5% en un DCP solo y el 25,6% en un DCP con una boya acoplada (el 4,4% eran desconocidos). Los DCP y las boyas se encontraron con mayor frecuencia en las playas (40,3%), mientras que otros fueron recogidos previamente por comunidades locales (28,8%), algunos otros se hallaron a la deriva en el océano (8,1%) o se encontraron atrapados en arrecifes de coral (5,9%). En algunos casos se pudieron registrar daños medioambientales, generados principalmente por los DCP a la deriva, de estos aquellos con apéndices sumergidos los cuales generaron daños a arrecifes coralinos (3% de todos los DCP, pero 6,8% de todos los apéndices encontrados) o animales enredados (0,6% de todos los DCP pero 0,9% de los apéndices encontrados). Los orígenes de los DCP a la deriva y de las boyas varadas fueron investigados utilizando las marcas de las boyas y los números de serie de las boyas satélite. Las marcas se compararon con el registro de buques de la Comisión Interamericana del Atún Tropical (CIAT) y la Comisión de Pesca del Pacífico Occidental y Central (WCPFC), mientras que los números de serie de las boyas se cotejaron con los datos de los observadores de la CIAT y la WCPFC y los datos de seguimiento de los DCP recopilados por los Estados Parte del Acuerdo de Nauru (PNA). Los DCP a la deriva que estaban varados procedían en proporciones similares de buques que pescaban en el área de la CIAT (47,0%), y en el área de la WCPFC (43,2%) con un 9,8% de buques que pescaban en las áreas de ambas convenciones. Se observó una gran variabilidad en cuanto al país de origen de los varamientos de DCP. Por ejemplo, la mayoría de los varamientos ocurridos en la Polinesia Francesa se debieron a buques que pescaban en la zona de la CIAT-CA. Este programa proporciona una imagen incompleta del nivel de varamientos de los DCP a la deriva en las islas del Pacífico. Se sugiere añadir otros países y territorios en la implementación de programas similares de recopilación de datos y en la participación en esta iniciativa regional. Se requiere un mayor número de datos de varamientos de DCP a la deriva para poder comprender mejor el alcance y las implicaciones potenciales de este problema y a su vez contribuir a informar sobre las opciones de gestión de los DCP a la deriva en el Océano Pacífico.

1. INTRODUCTION

Concerns regarding the number of drifting Fish Aggregating Devices (dFADs) reaching coastal waters and becoming stranded on coastlines have been raised by several Pacific Island Countries and Territories (PICTs), regional entities and international Non-Governmental Organisations (NGOs). These concerns include the potential for dFADs to damage habitats such as coral reefs, entangle wildlife such as turtles and sharks, and contribute to coastline debris when stranded (Balderson and Martin, 2015; Escalle *et al.*, 2019b).

Such concerns have intensified in recent years due to a general perception of an increasing trend in stranding events, including in PICTs with no purse-seine activities in their EEZs, and by a lack of retrieval plans and solutions to process/recycle the dFAD materials on remote islands. However, the number of studies investigating stranding events in the Pacific remains limited. This is largely due to the absence of data available to adequately quantify the number of dFADs arriving in coastal areas, stranding events, and impacts on the ecosystems. Studies based on trajectories from satellite buoys deployed on dFADs operating in the Western and Central Pacific Ocean (WCPO) estimated that 7% of dFADs end up stranded (Escalle *et al.*, 2021). 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, the number of stranding events and level of ecosystem impacts are very likely under-estimated, given that the current dataset corresponds mostly to data from PNA member EEZs, but also because satellite buoys are commonly deactivated by fishers when they drift outside their main fishing areas. To date, estimates of stranding events are also lacking in the Eastern Pacific Ocean (EPO).

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 dFADs reaching coastal waters and/or becoming stranded, as well as the impacts of these events on ecosystems. Data collection is carried out in each PICT and stored individually. These individual datasets are then compiled by SPC into a regional database with data from all PICTs, allowing for regional scientific studies to be performed, as well as the ground-truthing of existing estimates. This paper presents preliminary results from analyses of this regional database. An expansion of such data collection effort to the EPO would allow for potential Pacific-wide analyses to be carried out.

2. REGIONAL STRANDED FAD DATA COLLECTION PROGRAMME

Data collection programmes have been in place as early as 2004 (Australia), although several PICTs have either recently started or are developing programmes as a collaboration between SPC, national fisheries departments, local organisations and/or NGOs. These programmes collect data on recorded arrival events of dFADs in coastal areas and also address the need to collect in-situ data. Data collection programmes are in place in ten PICTs: Australia, the Cook Islands, the Federated States of Micronesia (FM), Hawaiʻi, the Republic of the Marshall Islands (MH), French Polynesia, New Caledonia, Palmyra, Tuvalu and Wallis and Futuna.

The main objectives of the programmes are to:

- quantify the number of dFAD stranding events or dFADs drifting nearshore;
- assess the resulting pollution and ecosystem impacts, including on species of special interest (SSIs) and key habitats;
- evaluate materials and designs of dFADs found stranded, in relation to past and current use of dFADs in the Pacific Ocean;
- evaluate how communities and PICTs may repurpose or recycle dFAD materials and satellite buoys locally, when possible;
- consider ways to mitigate the impacts of dFADs and provide scientific-based advice to guide the management of dFADs in the Pacific Ocean.

TABLE 1. Summary of data collected through stranded dFAD data collection programs in the Pacific Ocean.

PICT	Start of the program	Events recorded
French Polynesia	2019	1,044
Cook Islands	2020	238
Australia	2004	221
Wallis and Futuna	2020	165
Federated States Micronesia	2021	152
Galapagos	Opportunistic & pilot project / Planned for 2024	est. >150*
Marshall Is	2021	102
Hawai'i	2014	84
Palmyra	2009	63
Tuvalu	2022	58
New Caledonia	2022	46
Pitcairn	Opportunistically	7
Tonga	Opportunistically	7
Wake Island (US)	Opportunistically	6
Vanuatu	Opportunistically	3
Fiji	Opportunistically	1
PNG	Opportunistically/under discussion	1
Samoa	Opportunistically/under discussion	1
Solomon Islands	Under discussion	0
Total		~2,350

*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.

Since 2020, data collection programmes have been developed by SPC in partnership with local fisheries departments and have started in the Cook Islands; Federated States of Micronesia; French Polynesia; New Caledonia; Republic of the Marshall Islands; Tuvalu and Wallis and Futuna (Table 1). Samoa, Papua New Guinea, and the Solomon Islands have also shown interest in joining the data collection effort and contributing to the regional database. Opportunistic data collection has also been reported to SPC since 2018, including through SPC's existing data collection networks, and includes additional records from Fiji; New Caledonia; Papua New Guinea; Pitcairn Islands; Samoa; Tonga; Tuvalu; Vanuatu; and Wake Island. These programs involve local communities reporting their findings to fisheries officers, who enter data on forms and in their country/territory database (Appendix 3: Poster presenting the data collection program for the Cook Islands in English). Communication, dissemination, and awareness activities are essential because each programme depends on the local communities' engagement. The types of awareness activities vary but can include posters, radio and TV broadcasts, and public talks (Appendix 3: Poster presenting the data collection program for the Cook Islands in English). 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 were 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.

In parallel, other initiatives or opportunistic reports have emerged. This includes data collection at Palmyra Atoll (through The Nature Conservancy; TNC) since 2009; Hawai'i (through the Center for

Marine Debris Research) since 2014, French Polynesia since 2019 (Marine Resources Authority); Australia since 2004 (Tangaroa Blue Foundation); and, very recently, Galapagos (Galapagos Conservation Trust) (Table 1). Data collected through these independent programs were also added to the regional database and analysed in this paper excluding from Galapagos due to time constraints.
At Palmyra Atoll, TNC and the U.S. Fish and Wildlife Service (USFWS) have collected data on dFAD strandings since 2009. Visual surveys across shallow reefs, lagoon flats, and beaches have been opportunistically linked with other projects; however, now that consistent stranding areas have been established, specific surveys are being scheduled across all 12 months of the year. Designs of the stranded dFADs, the materials used, and the environmental impacts are described. When a satellite buoy is present, and the identification number is visible, it is also recorded. 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 Hawai'i, the stranded dFAD collection was first initiated by Sarah-Jeanne Royer as a member of Nikolai Maximenko's group at the University of Hawai'i 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). The data collection started in 2014 and has expanded to include several collaborators that report the findings to the research group. When the geographical location of the dFADs is known, some buoys are re-directed to the island of Oah'u and stored in a warehouse to potentially repurpose the buoys to tag and track marine debris like fishing nets.
French Polynesia has also started a large project to quantify the number of dFADs drifting within its EEZ, including the number of stranded dFADs, and their ecosystem impacts. The program 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 Australia, Tangaroa Blue Foundation (TBF) coordinates the Australian Marine Debris Initiative® (AMDI), an on-ground network of volunteers, communities, organizations and agencies around the country removing, documenting, and preventing marine debris and plastic pollution. The AMDI Database is the largest marine debris database in the southern hemisphere, with more than 23 million litter items recorded at more than 4,300 clean-up sites since 2004. Marine debris data are collected via community clean-ups or as part of regular site-specific monitoring programs. In particular, data on dFAD strandings have been recorded in the AMDI Database since 2004 across Australia's coasts, with the majority found along the coast of Queensland. In particular, satellite buoys were recorded often enough that Satlink, one of the buoy providers, partnered with TBF to develop Project ReCon: a recover, repair, reuse and recycle program of satellite buoys. TBF and their partners in the AMDI collect satellite buoys found during clean-up events and Satlink then liaises with the industry to facilitate reassigning ownership of these buoys from the commercial fishing fleet to TBF. Once a buoy is part of the project ReCon, Satlink and TBF check the buoy's condition and find a suitable re-use project, such as scientific research, tagging and recovering ghost nets, etc. Buoys are then stored by community partners from a variety of sectors, i.e., tourism, charter operators, and Aboriginal and Torres Strait Island Rangers so that they can be deployed on ghost nets that cannot be immediately recovered when located due to their size or the capacity of the vessel that found them. Previously, recordings of dFADs and buoys were limited to stranding events; however, Project ReCon helps improve understanding of dFADs found in the coastal waters of Australia. Historical data that were transferred to the regional database at SPC focused mainly on satellite buoys, however, historical information related to dFADs exist and will be transferred to the SPC database in the future.
In Galapagos, 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 larger program led by Galapagos

Conservation Trust is in development (launching in 2024), to build on both opportunistic sightings of dFADs and pilot data where dFADs have been quantified along remote coastlines using drone surveys and during coastal clean-up activities (total dFADs recorded to be confirmed). There is major support from the local fishing community to tackle the issue of dFADs due to perceived impacts on local livelihoods as well as wildlife risk from entanglement, habitat degradation, and even the transport of invasive marine species. As well as considering the logistics of a larger-scale collection and upcycling project, this programme will build upon potential technological solutions to map and track dFADs at sea. As noted above, these data are not included in the results presented in this paper due to a lack of time for processing and analysing them.

Data fields collected by the PICTs include date, location, environment, materials, size and fate of the dFAD (e.g., removed, left where it was found, fished), the buoy identification alphanumeric code and any other painted marks on the buoy (often vessel names), as well as any observed environmental impacts (e.g., coral reef damage or entanglement of SSI). Data are then transferred to SPC, where all of the data are compiled into a regional database.

3. PRELIMINARY ANALYSES

a) Summary of stranded events

A total of 2,199 stranded events could be identified during 2006–2023 from all PICTs considered. Most of the stranding events were satellite buoys (40.5%), followed by FADs alone (29.5%), and by a FAD with a buoy attached (25.6%) (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 1 and Figure 2). The remaining events corresponded to a few radio buoys, and oceanographic CO_2 monitoring buoys (Figure 1 and Figure 2), 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 (1,306)		
		Presence	Absence	Unknown
Buoy (1,549)	Presence	25.6% *(564)*	40.5% *(890)*	3.0% *(66)*
	Absence	29.5% *(649)*	0.0% *(0)*	0.0% *(1)*
	Unknown	1.0% *(22)*	0.1% *(3)*	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. The first stranding events recorded were in 2006 in Australia with the launch of the AMDI Database in 2004, followed by some records in Palmyra in 2009 (Figure 1). Data collection and awareness activities have been expanding since 2016, resulting in a gradual increase in the number of stranding events 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 is sometimes uncertain (12.1% 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 1). The type of floating objects found stranded were slightly different between the PICTs (Figure 2). For instance, in the Federated States of Micronesia and the Marshall Islands, respectively, 19.7% and 20.6% of the stranded events were aFADs (Figure 2).

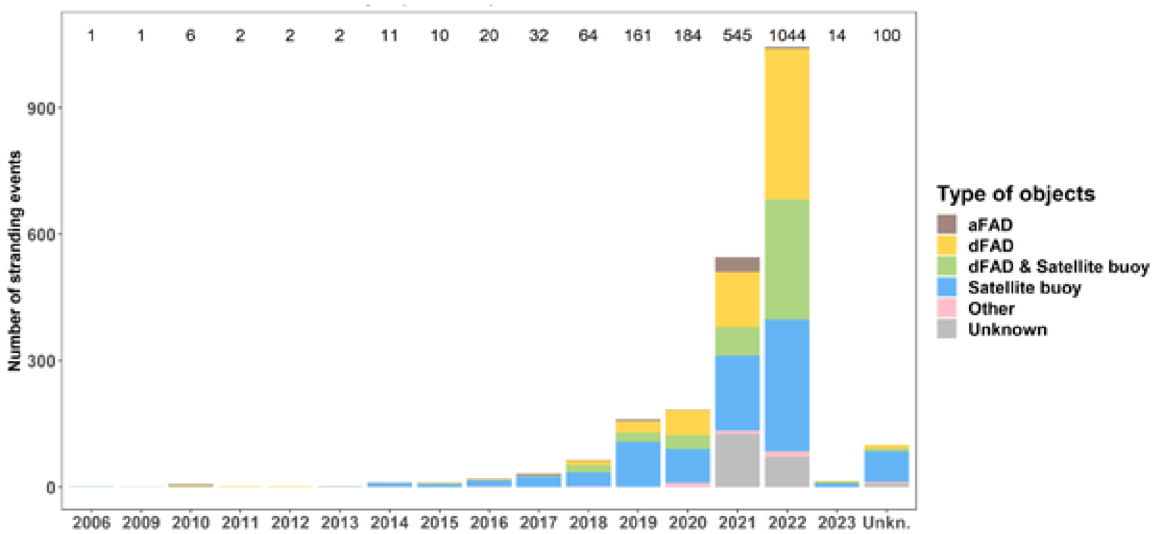

FIGURE 1. The number of stranded events found by year and type of materials. The numbers on the top of the figure correspond to the number of stranded events per year.

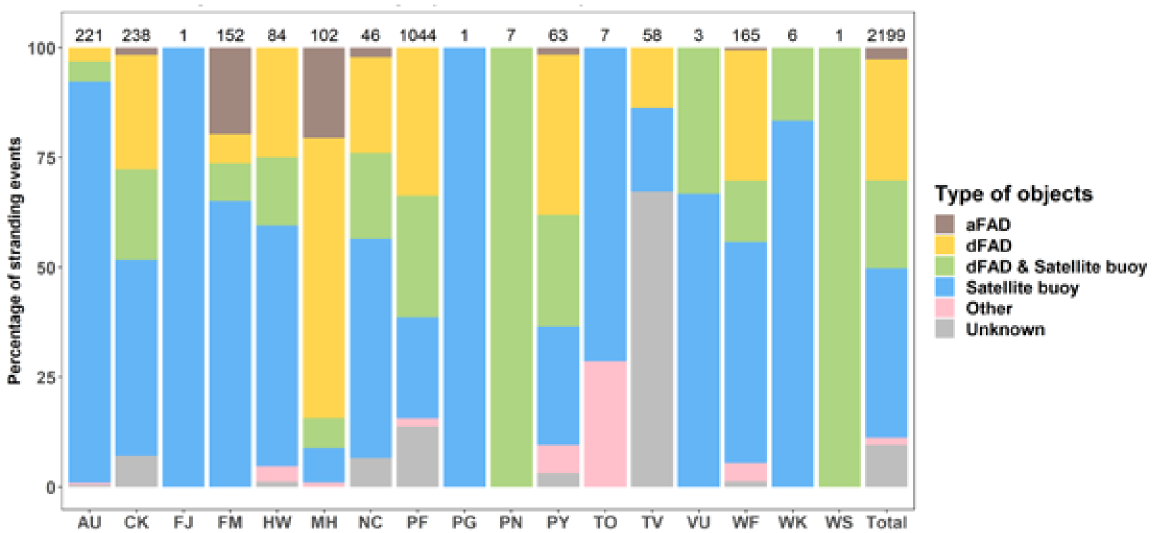

FIGURE 2. Percentages of stranding events found by country and type of materials. Numbers on the top of the figure correspond to the number of stranded events per country. AU = Australia; CK = Cook Islands; FJ = Fiji; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PG = Papua New Guinea; PN = Pitcairn; PY = Palmyra; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; WS = Samoa.

Most of the buoys found were one of the three following brands: Satlink (35%), Marine Instruments (23%), and Zunibal (14.5%), and some were Ryokusei and Kato buoys (Table 3). Note that the brand as unknown for 24.1% of the buoys. Small differences between countries were detected (e.g., a higher proportion of Kato buoys was found in the Federated States of Micronesia) (Figure 3).

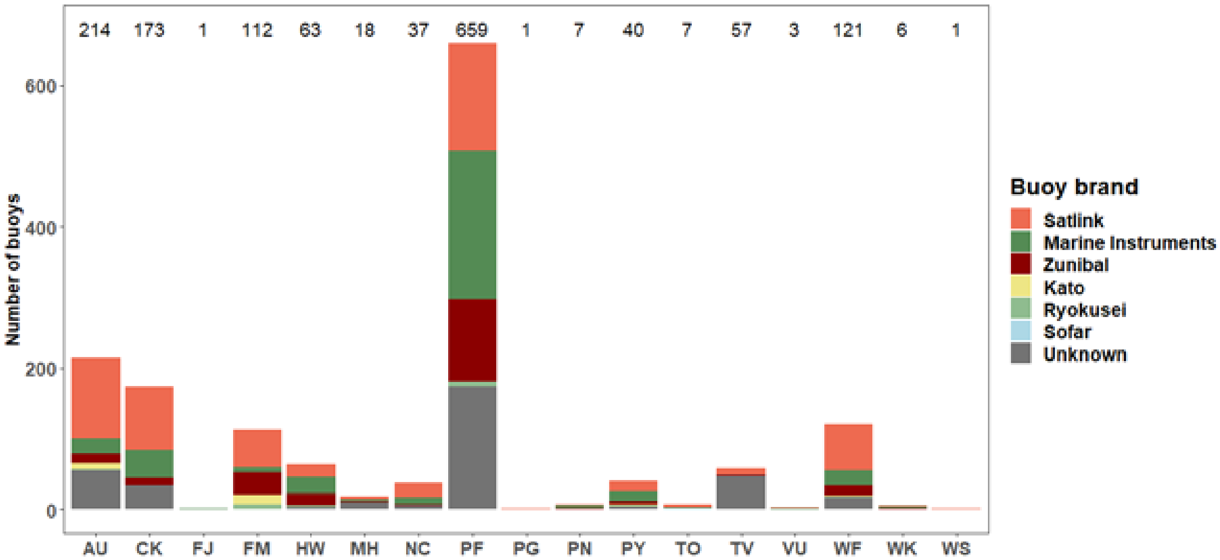

FIGURE 3. Number of buoys found stranded by buoy brand and country. AU = Australia; CK = Cook Islands; FJ = Fiji; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PG = Papua New Guinea; PN = Pitcairn; PY = Palmyra; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; WS = Samoa.

TABLE 3. Brand of buoys found stranded.

	Buoy brand	
	Number	%
Satlink	393	35.0
Marine Instruments	258	23.0
Zunibal	163	14.5
Kato	20	1.8
Ryokusei	16	1.4
Sofar*	3	0.3
Unknown	271	24.1
Total	1,124	

*Oceanographic buoy (wave buoy)

b) Spatial distribution of stranding events

The spatial distribution of FAD stranding events in the Pacific Ocean shows a large 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 was detected 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 reflect true higher levels of stranding events. Additional years of data and/or accounting for the effort in data collection is needed to better understand the spatial differences detected.

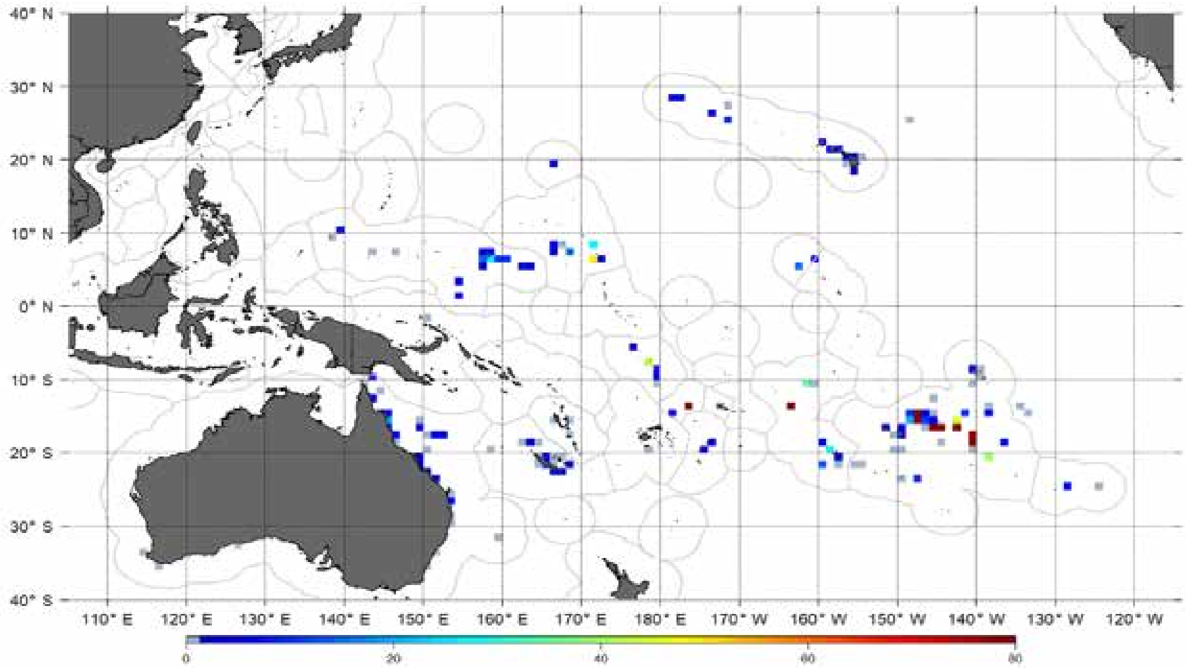

FIGURE 4. Aggregated map of FADs found in Pacific Island Countries and Territories between 2006–2023. The legend represents the numbers of stranding events per 1° cells (1 to 80).

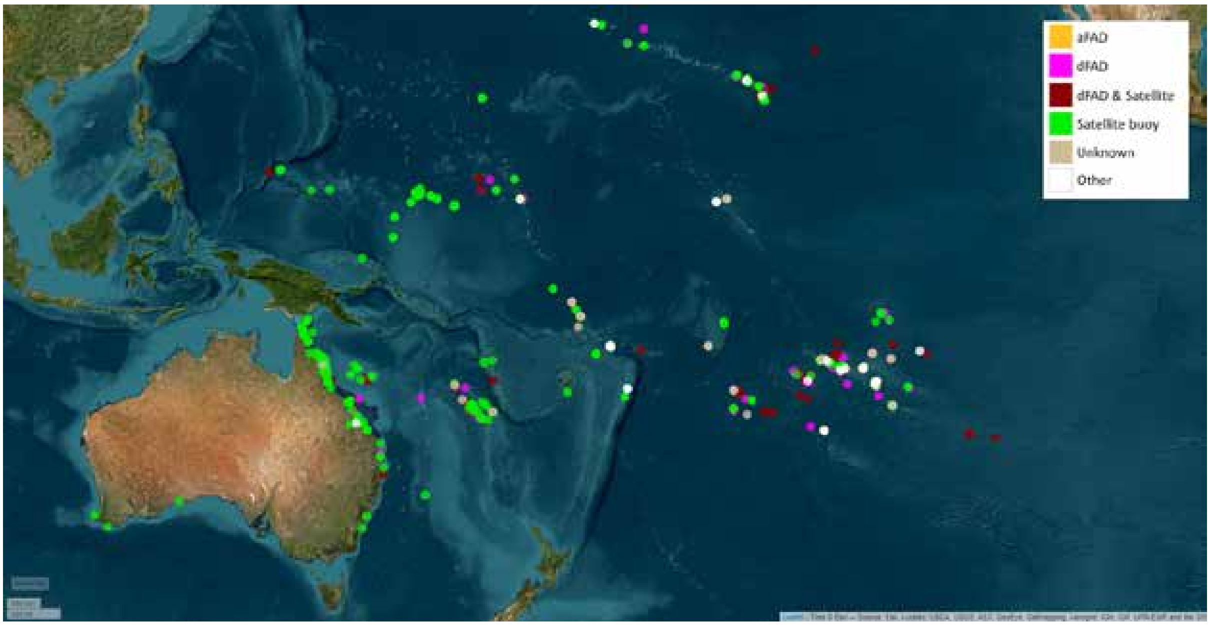

FIGURE 5. Map of stranding events with known positions (2,185) by type of object found in Pacific Island Countries and Territories and Australia between 2006–2023.

The type of stranded objects differed between countries. For instance, data from French Polynesia indicated stranded FADs alone or FADs with a buoy attached were more common than strandings of a buoy alone. Figures 6.1 to 6.10 show locations of stranded FADs and/or buoys (i.e., raft, buoy, both or an unknown object), in some PICTs located in the eastern part of the Pacific; additional maps provided as supplementary materials. 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 6.7). In the case of the Tuamotu Islands, higher stranding events were detected on the east coasts (see for instance Rangiroa, Fakarava, Raraka), but it should be noted that the eastern coasts presented higher data collection effort. One interesting case is the atoll of Raroia (Figure 6.6), 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 6.9) have a high density of coral reefs around their coastlines, making them sensitive locations to stranding events.

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

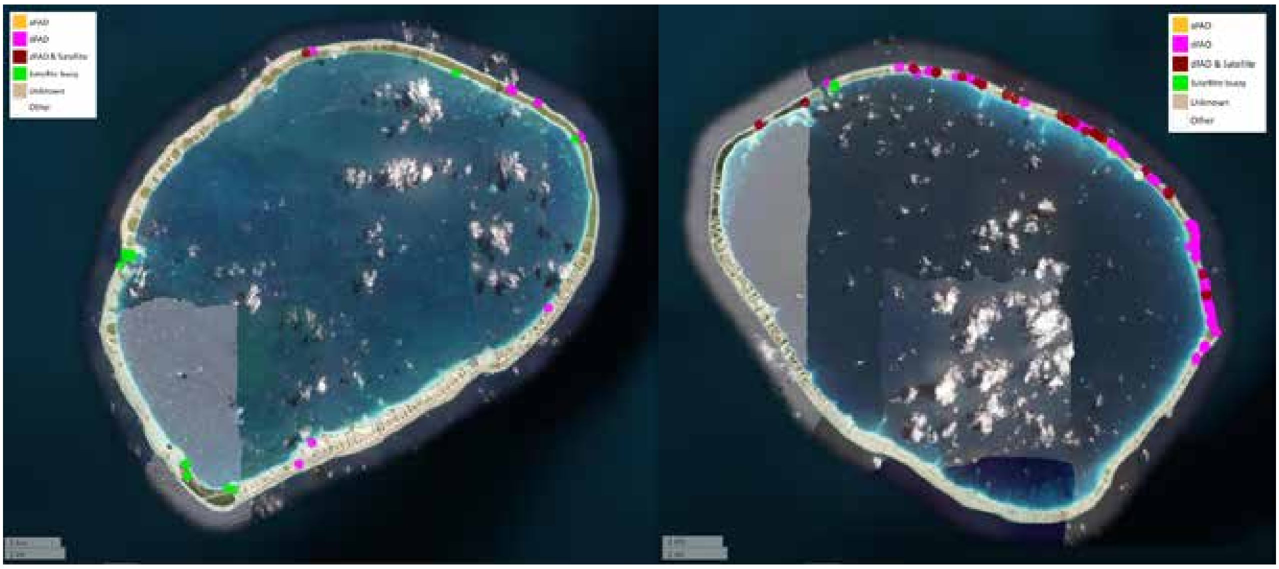

FIGURE 6.2. Map of stranding events in Tikehau (left) and Raraka (right) (French Polynesia) by type of object in 2022.

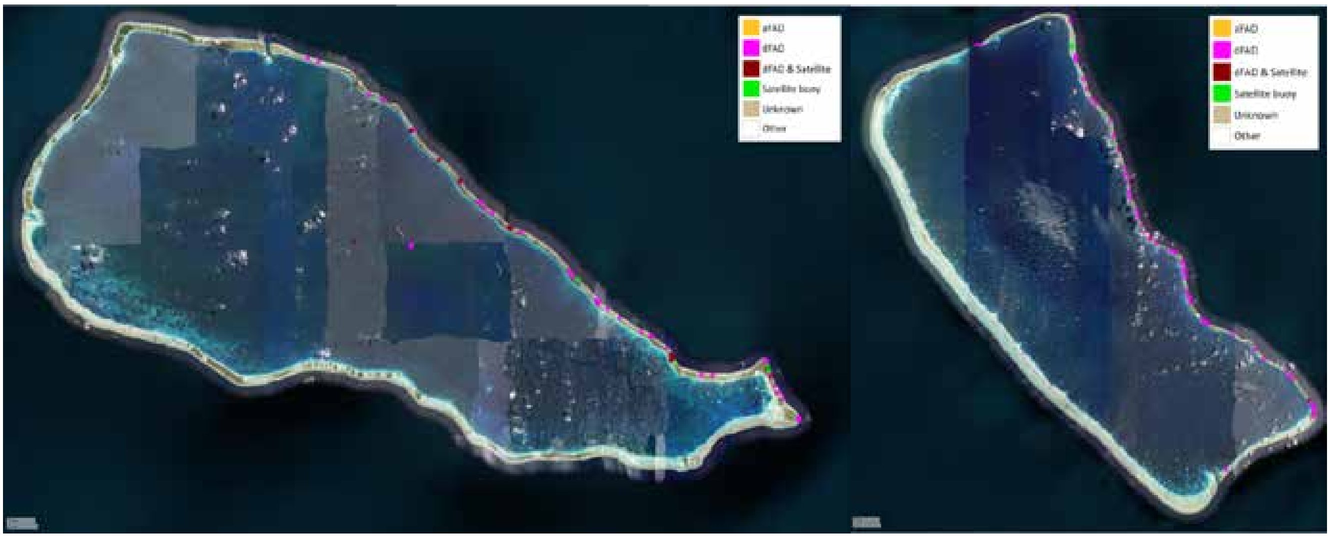

FIGURE 6.3. Map of stranding events in Rangiroa (left) and Fakarava (right) (French Polynesia) between 2020–2022, by type of object.

FIGURE 6.4. Map of stranding events in Amanu (left) between 2021—2022 and Hao (right) (French Polynesia) in 2021, by type of object.

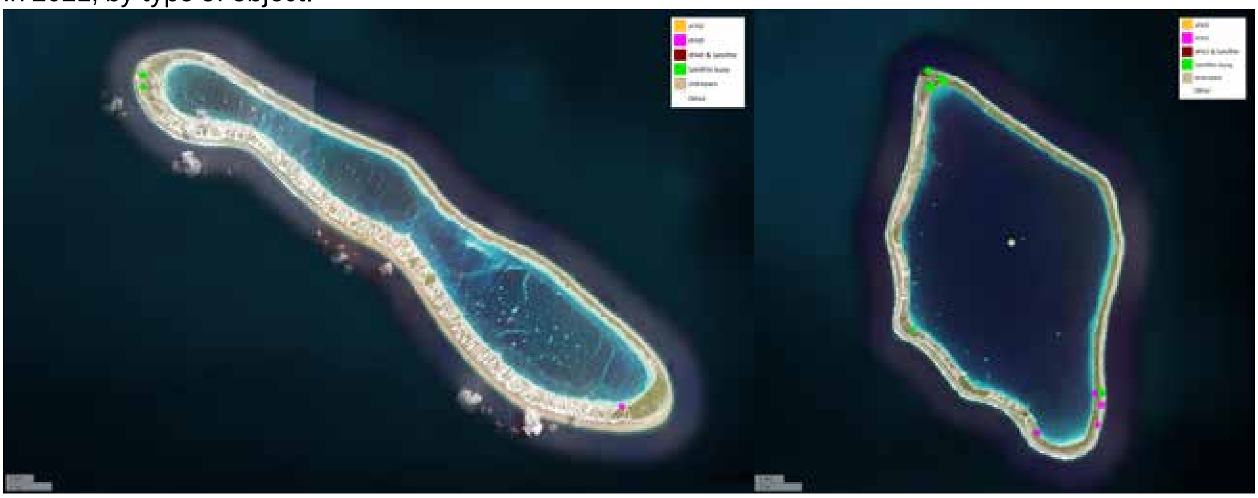

FIGURE 6.5. Map of stranding events in Reao (left) in 2022 and Tureia (right) (French Polynesia) in 2020 and 2022, by type of object.

FIGURE 6.6. Map of stranding events in Raroia (French Polynesia) in 2022, by type of object.

FIGURE 6.7. Map of stranding events in the Main Hawaiian Islands (Hawai'i) by type of object between 2014–2022.

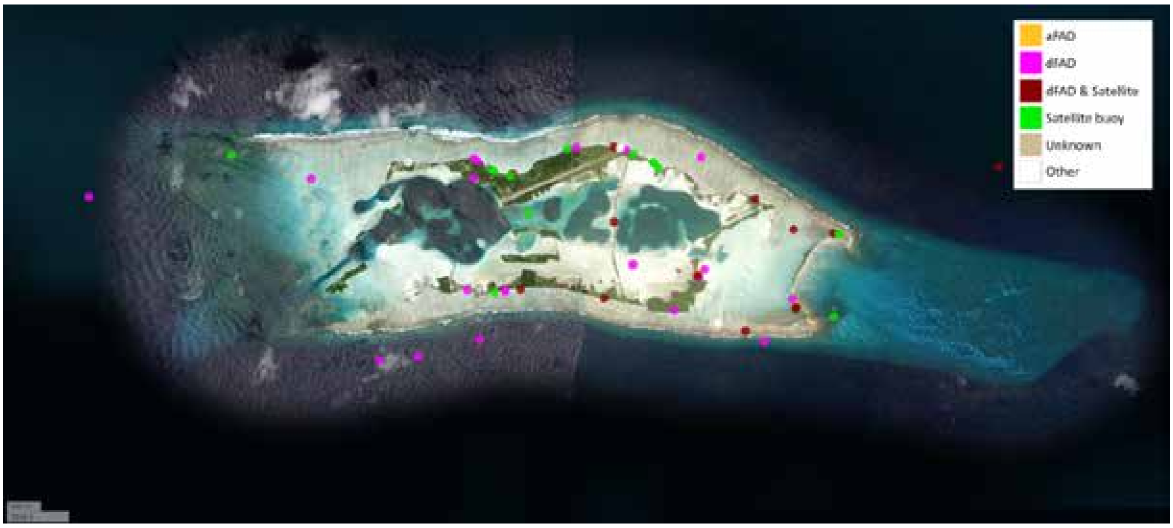

FIGURE 6.8. Map of stranding events in Palmyra Atoll by type of object between 2009–2021.

FIGURE 6.9. Map of stranding events in Rarotonga (left) and in Aitutaki (right) (Cook Islands) by type of object between 2018– 2023.

c) 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 2,191 stranding events recorded (FADs or buoys), 40.3% were found on a beach, 8.1% were drifting in the ocean and 5.9% 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 28.8% 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 (31.7%) and then other habitats. Buoys were often dismantled to recover electronic materials. In contrast, FADs were mostly found on a beach (44.5%), in gardens and private homes (21.9%), and on coral reefs (8.7%). The aFADs were mostly found on a beach (51.7%), a coral reef (10.3%), a shore (13.8%) or were previously collected (13.8%). Results for dFADs varied depending on the presence of submerged appendages. DFADs with submerged appendages were more often found drifting in the ocean (24.4%), stranded on coral reefs (10.2%), or drifting in the lagoon (4.3%), 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	dFAD with tail**	dFAD without tail**	aFAD
Anchored in the ocean	0% (1)	0.1% (1)	0.1% (1)	0% (0)	0% (0)	0% (0)
Beach	40.3% (882)	44.5% (549)	31.7% (482)	29.3% (103)	68% (272)	51.7% (30)
Coral reef	5.9% (129)	8.7% (107)	4% (61)	10.2% (36)	7% (28)	10.3% (6)
Drifting in the lagoon	1.7% (38)	2.5% (31)	1.8% (27)	4.3% (15)	1.2% (5)	5.2% (3)
Drifting in the ocean	8.1% (178)	11.3% (139)	10.1% (154)	24.4% (86)	4.8% (19)	1.7% (1)
Mangrove	0.2% (5)	0.3% (4)	0.1% (2)	0% (0)	0.5% (2)	3.4% (2)
Previously collected*	28.8% (632)	21.9% (270)	35.2% (535)	29% (102)	10.5% (42)	13.8% (8)
Shore	3.7% (80)	3.6% (44)	3.2% (48)	1.1% (4)	4.2% (17)	13.8% (8)
Unknown	11.2% (246)	7.3% (90)	13.8% (210)	1.7% (6)	3.8% (15)	0% (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 (23.7%) and New Caledonia (16.2%), and for both buoys and FADs in the Federated States of Micronesia (63.4 %; 17.0%), French Polynesia (54.2%; 25.2%), Marshall Islands (22.2%; 52.7%) and Wallis and Futuna (17.4%; 26.6%). New Caledonia (30.0%), Palmyra Atoll (22%), the Federated States of Micronesia (18.9%), Australia (16.7%), Wallis and Futuna (16.4%), and Pitcairn Islands (14.3%) also presented higher rates of FADs stranded on coral reefs.

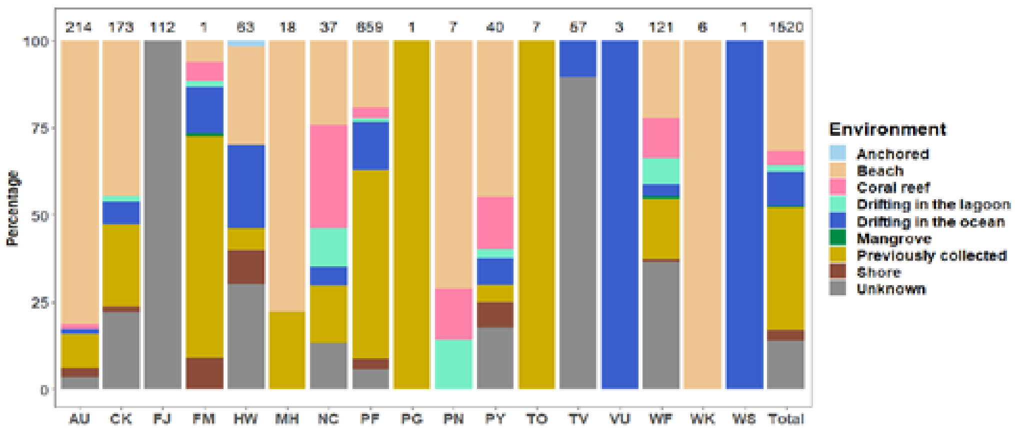

FIGURE 7. Percentages of stranded buoys by habitat type and country. Numbers on the top of the figure correspond to the number of stranding events for each country. AU = Australia; CK = Cook Islands; FJ = Fiji; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PG = Papua New Guinea; PN = Pitcairn; PY = Palmyra; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; WS = Samoa.

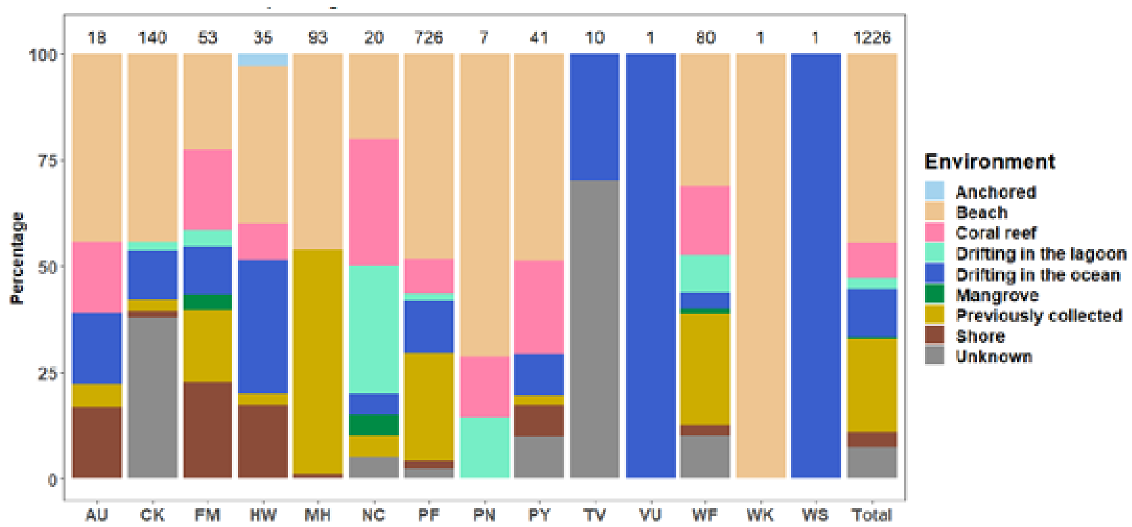

FIGURE 8. Percentages of stranded FADs by habitat type and country. Numbers on the top of the figure correspond to the number of stranding events for each country. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PN = Pitcairn; PY = Palmyra; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll; WS = Samoa.

d) 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 (45.4%). However, while 39.3% of the FADs were found with submerged appendages attached; this information was not recorded for 15.3% of FADs (Table 5).
The condition of the FADs when found was also investigated, although this information was mostly not recorded (40.7%). The rest of the FADs were found intact (27%), mainly without submerged appendages, followed by mostly falling apart (19.8%) and finally classified as beginning to break up (12.5%) (Table 5).

TABLE 5. Number (N) and percentages of stranded FADs with submerged appendages. Percentages of FAD condition and number of FADs in parentheses.

Submerged appendages			Condition			
	N	%	Intact	Beginning to break	Mostly fallen apart	Unknown
Present	482	39.3	8.3% (102)	3.0% (37)	8.5% (104)	19.5% (239)
Absent	557	45.4	17.0% (209)	8.6% (105)	9.4% (115)	10.4% (128)
Unknown	187	15.3	1.7% (21)	0.9% (11)	1.9% (23)	10.8% (132)
Total	1226		27% (332)	12.5% (153)	19.8% (242)	40.7% (499)

Materials used in the construction of FADs (i.e., classified as synthetic, natural or a mix of synthetic and natural materials) were also investigated. Materials were not recorded for almost one quarter of FADs (22.3%). The remaining FADs (including aFADs) were made with synthetic rafts and no attachments (23.3%), followed by synthetic rafts with synthetic attachments (12.6%), and mixed rafts without any submerged appendages (12.6%). Table 6 shows that for all the FADs found stranded, none were found with natural submerged appendages. Completely natural FADs did not have submerged appendages and represented only 1.0% of all stranding events.

TABLE 6. Percentages and numbers (in parentheses) of FADs with the raft and submerged appendages made of synthetic, mixed, or natural materials (including structure, flotation and covering materials).

	Raft			
	Synthetic	Mix	Natural	Unknown
Synthetic tail	12.6% (154)	4.1% (50)	0.2% (2)	2.4% (29)
Mixed tail	0.6% (7)	0.4% (5)	0.1% (1)	0.7% (9)
Natural tail	0	0	0	0
No tail	23.3% (286)	12.6% (154)	1.0% (12)	8.7% (107)
Unknown	6.5% (80)	3.3% (41)	1.3% (16)	22.3% (273)

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 1,166 FADs (Figure 9). Most of the structure and flotation materials detected in stranded FADs were i) bamboo and plastic flotation (41.3%); ii) bamboo (37.6%); and iii) plastic flotation (12.6%) (Figure 9).

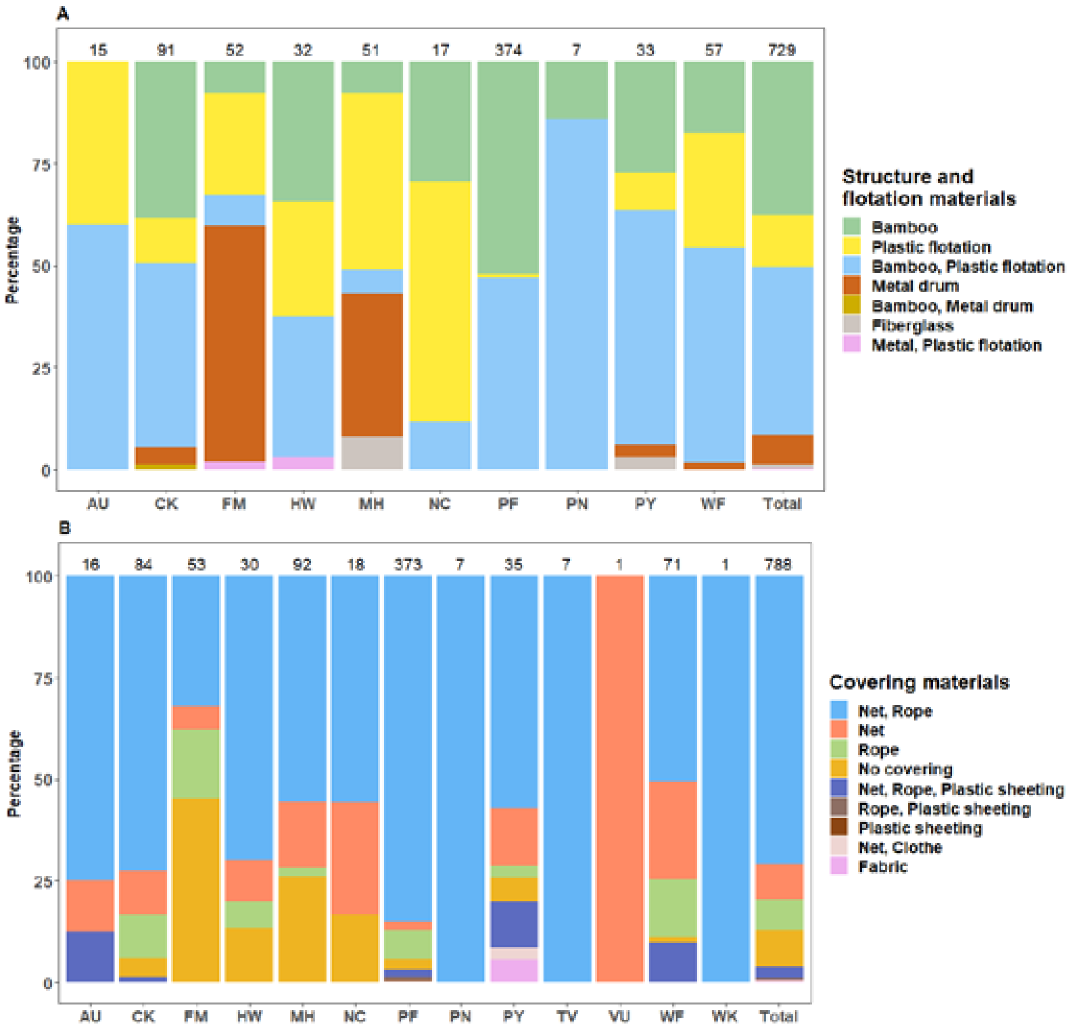

FIGURE 9. Flotation and structure materials (A) and covering materials (B) of FADs that were found stranded with materials recorded (62.5% and 64.3% respectively) and those with materials unknown or removed (35.7% and 35.7% respectively) by country. The numbers on the top of each figure correspond to 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. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i;

MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PN = Pitcairn; PY = Palmyra; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll.

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 57.5% and 43.1%). The remaining materials were a mix of bamboo, metal drum, and fiberglass. Raft covering of the FADs was typically made of netting and/or rope (87.2%). A higher percentage of FADs with no covering were also detected in the Federated States of Micronesia and the Marshall Islands, mainly corresponding to aFADs.

The presence or absence of FAD netting was often not recorded. When this information was recorded, 23.9% of FADs did not have any netting (mostly aFADs), 18.6% of FADs had some netting as covering, but details about mesh size were not recorded (Figure 10). When mesh size was recorded[1], 43.8% of FADs had small mesh netting, (<7cm), 23.0% had large mesh netting (>7cm) and 9.2% had both small and large mesh netting (Figure 10).

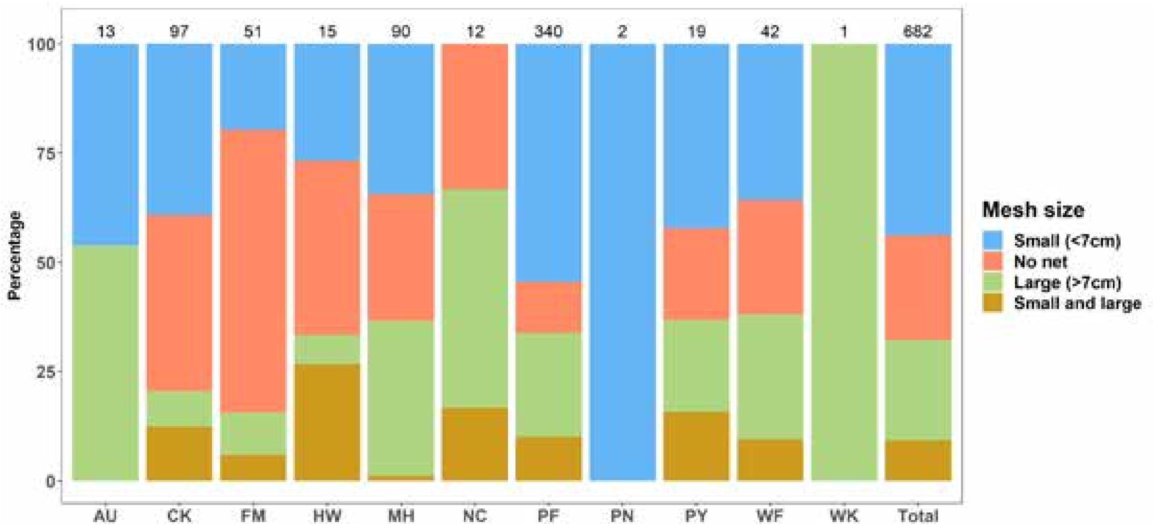

FIGURE 10. The percentage of visually estimated mesh size (small: <7cm, large: ≥7cm; or a combination of small and large netting), when recorded by observers (44.4% unknown removed) used to cover the rafts of FADs found stranded by country. The numbers on the top of the figure correspond to the number of stranded events with materials recorded by country. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PN = Pitcairn; PY = Palmyra; WF = Wallis and Futuna; WK = Wake Atoll.

The most common materials used to construct the submerged appendages attached to FADs were netting and/or rope (83.9%). The remaining 16.1% 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, which makes the FAD present a high risk for coral entanglement. Despite the high numbers of submerged appendage materials recorded as unknown (47.1%), when netting was recorded, the mesh size, as well as the design, were also examined (Table 7). Small mesh netting (<7 cm) was found in 47.5% of records, compared to 35.6% with large mesh netting. Most of the FADs found were designed with an open panel (30.2%) followed closely by submerged appendages rolled up in a bundle (27.2%) (Table 7).

[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).

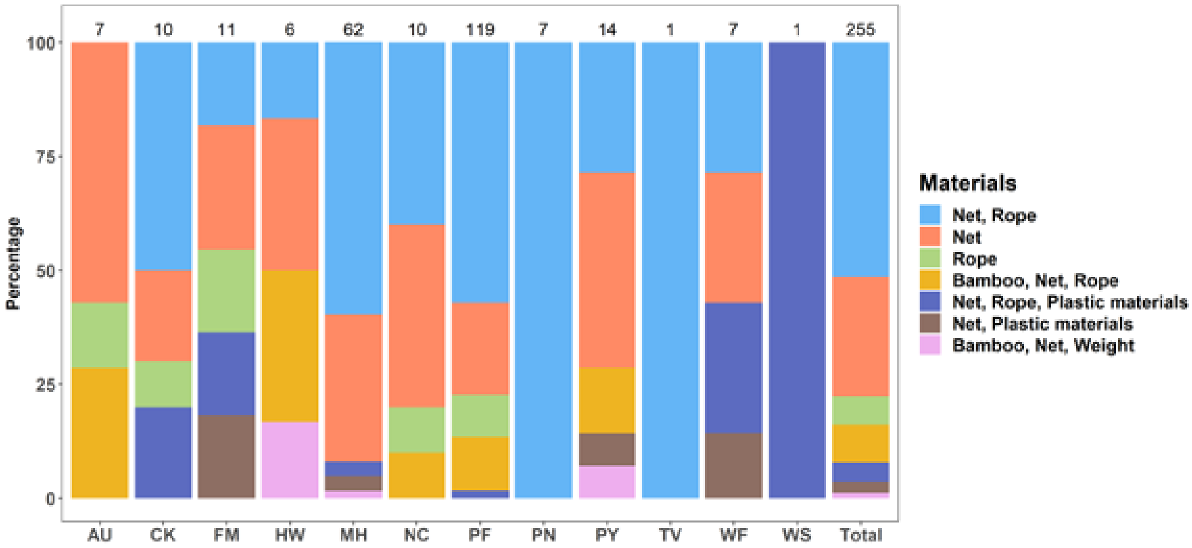

FIGURE 11. Materials used for the construction of submerged appendages of FADs found stranded, recorded by country. The numbers on the top of the figure correspond to the number of stranded events with materials recorded by country. Plastic materials include plastic sheeting, plastic drums, fishing line, and float. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PN = Pitcairn; PY = Palmyra; TV = Tuvalu; WF = Wallis and Futuna; WS = Samoa.

TABLE 7. Design (left) and mesh size (right) of netting used as submerged appendages of stranded FADs.

Design	Numbers	Percentages
Unknown design	79	39.1%
Open panel	61	30.2%
Rolled up in a bundle	55	27.2%
Mixed design	7	3.5%

Mesh net size	Numbers	Percentages
Unknown size	27	13.4%
Small (< 7 cm)	96	47.5%
Large (≥7cm)	72	35.6%
Small and large	7	3.5%

In 47.1% of the stranded events, the shape of the FAD rafts was recorded, and different shapes of rafts were detected (Table 8 and Figure 12). Rectangular and square rafts were the most common (24.5 % and 12.6%, respectively), followed by cylindrical (5.1%).

TABLE 8. 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)	52.9% (649)	24.5% (300)	12.6% (154)	5.1% (63)	4.6% (57)	0.2% (2)	0.1% (1)

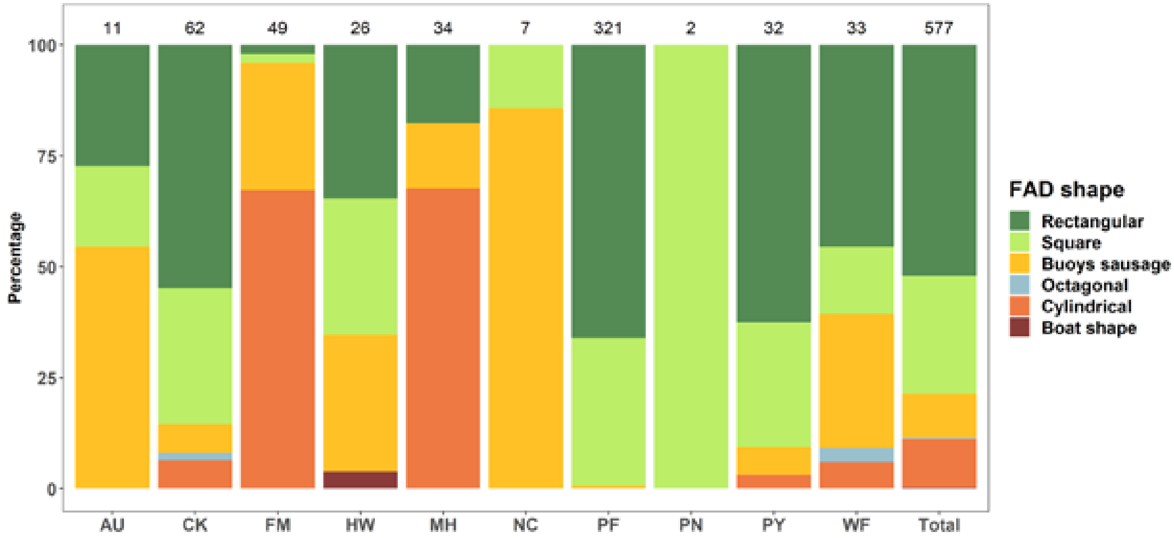

FIGURE 12. Shape of FADs found stranded by country. Numbers on the top of the figure correspond to the number of stranded events with FAD shape recorded per country. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PN = Pitcairn; PY = Palmyra; WF = Wallis and Futuna.

e) Environmental impacts

The fate of buoys and FADs found stranded was investigated (Table 9). Most of the buoys (74.0%) were removed from the environment, while a lower amount of FADs (21.3%) were removed. It should be noted that in a large portion of the stranding events, the fate was not recorded (22.3% of buoys and 71.2% of FADs).

TABLE 9. Fate of buoys and FADs found stranded.

	Buoy		FAD	
	Number	%	Number	%
Left	55	3.6	86	7.0
Removed	1124	74.0	256	20.7
Removed partly	0	0	5	0.4
Fished and removed	0	0	3	0.2
Fished and left	0	0	6	0.5
Unknown	339	22.3	879	71.2

The purpose of the removal of buoys and FADs from the environment was recorded when possible (Table 10). This information was available for 38.1% of the buoys and 66.3% of the FADs. Buoys were mostly removed to be placed in a landfill (11.1%), stored (5.8%), or left with the finder (7.1%). 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 (10.1%). Most of the FADs removed from the environment were reused (37.5%) either for fishing activities (2.7%) or transformed into house furniture (30.7%). Some of the remaining FADs were placed in a landfill (8.0%) or stored at the finder's home (1.9%). It should be noted that fate and purpose of removed buoys and FADs was highly variable between PICTs and not necessarily classified the same way everywhere.

TABLE 10. Investigation of the purpose and fate of buoys and FADs removed from the environment.

	FADs		Buoys	
Purpose	Number	Percentage	Number	Percentage
Unknown	89	33.7%	696	61.9%
Reused	99	37.5%	114	10.1%
Landfill	21	8%	125	11.1%
Research, Burned	17	6.4%	0	0
Relocated	16	6.1%	0	0
Research	9	3.4%	35	3.1%
Left with the finder	5	1.9%	80	7.1%
Dismantled	2	0.8%	3	0.3%
Relocated and sunk	2	0.8%	0	0
Storage	2	0.8%	65	5.8%
Burned	1	0.4%	0	0
Dock	1	0.4%	0	0
Battery recycling	0	0	6	0.5%

Environmental damage could be recorded and corresponded mostly to dFADs with submerged appendages. Damage was associated with coral (3% of all FADs but 6.8% of all appendages found) or entangled animals (0.6% of all FADs but 0.9% of appendages found) (Table 11). It should be noted that the environmental damage was recorded at the time of locating a FAD. However, these may be underestimated, as ghost fishing, marine pollution or coral damage can occur throughout the lifetime of FADs (at-sea or on coastal habitats). Marine pollution can also occur through microplastics from FAD parts or heavy metal pollution from electronic components and batteries in satellite buoys, but this would be difficult to quantify under the current data collection methods.

TABLE 11. Environmental damage caused by stranded FADs recorded in the database.

	Total FADs	dFAD	dFAD with tail	dFAD without tail	aFAD
Entangled with animals	0.6% (8)	0.6% (8)	0.9% (3)	0.2% (1)	1.7% (1)
Entangled on corals	3% (37)	3% (37)	6.8% (24)	0.2% (1)	3.4% (2)
Entangled on rocks	2% (25)	2% (25)	2.3% (8)	1.8% (7)	*0.0% (0)*
No damage	39.8% (492)	39.8% (492)	26.1% (92)	62.3% (249)	72.4% (42)
Unknown	54.5% (673)	54.5% (673)	63.9% (225)	35.5% (142)	22.4% (13)

Environmental damage, particularly related to coral and rock entanglements by the submerged appendages was also investigated. Few records of coral or rock damage were recorded (37 and 25 respectively). Most of dFADs with submerged appendages found entangled on corals or rocks involved netting with small mesh size (Table 12 A). Most of dFADs with submerged appendages found entangled on corals also involved a design with open panels (29.0%) (Table 12 B). However, the net mesh size, or the design were not always recorded (35.5% for coral damage and 9.7% for rocks damage for both net mesh size and design).

TABLE 12. 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 damage	22.6% (7)	9.7% (3)	6.5% (2)	35.5% (11)
Rocks damage	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 damage	29.0% (9)	6.5% (2)	3.2% (1)	35.5% (11)
Rocks damage	6.5% (2)	6.5% (2)	3.2% (1)	9.7% (3)

f) Origin – Matching with observer and FAD tracking data

Two approaches were used to determine the origin of the FADs and buoys found stranded in the Pacific Ocean. 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.
A painted mark was found on 66% of the 1,175 satellite buoys found. 16% of the buoys did not have any marks and the presence of any marking was unknown for 18% of the buoys. However, markings on the buoy did not always result in the identification of a vessel or a flag. Among all the satellite buoys, it 24.1% had information for the flag identification and 25.3% for the convention area (CA) identification. A large variability in the origin of vessels monitoring satellite buoys found stranded (and attached to a dFAD or not) was detected (Figure 13). 33.6% of buoys were from Ecuadorian vessels; 21.9% from United States of America (US) vessels; 11.7% from Korean vessels and the rest from 16 other flags (Figure 13). Most buoys found stranded were from vessels fishing in the IATTC (47.0%), followed by WCPFC (43.2%) and both CAs (9.8%) (Figure 14).

In terms of country of stranding events, 96.3% of the marks on buoys found in French Polynesia were from the IATTC-CA (Ecuador, US and, Colombia) (Figure 13). The buoys found in the Federated States of Micronesia were almost exclusively from the WCPFC-CA (90.2%), although from a wide range of fleets (Japan, Korea, Chinese Taipei, US, Papua New Guinea, Ecuador as examples). The buoys found in Wallis and Futuna were mainly from the WCPFC-CA (> 65%) and from vessels flagged US, Korea, Kiribati and Ecuador (Figure 13 and Figure 14). More than half of the buoys found in the Cook Islands were monitored by US vessels (57.7%) (Figure 13). In Hawai'i, a large range of vessel flags from the IATTC-CA were detected, mostly from US, Colombian, and Ecuadorian vessels (33.3, 22.2%, and 11.1%, respectively). Finally, stranding events in Australia, located in the western part of the Pacific Ocean, consisted mostly of buoys from US (33.3%), Korea (26.7%) and Ecuador (10.0%).

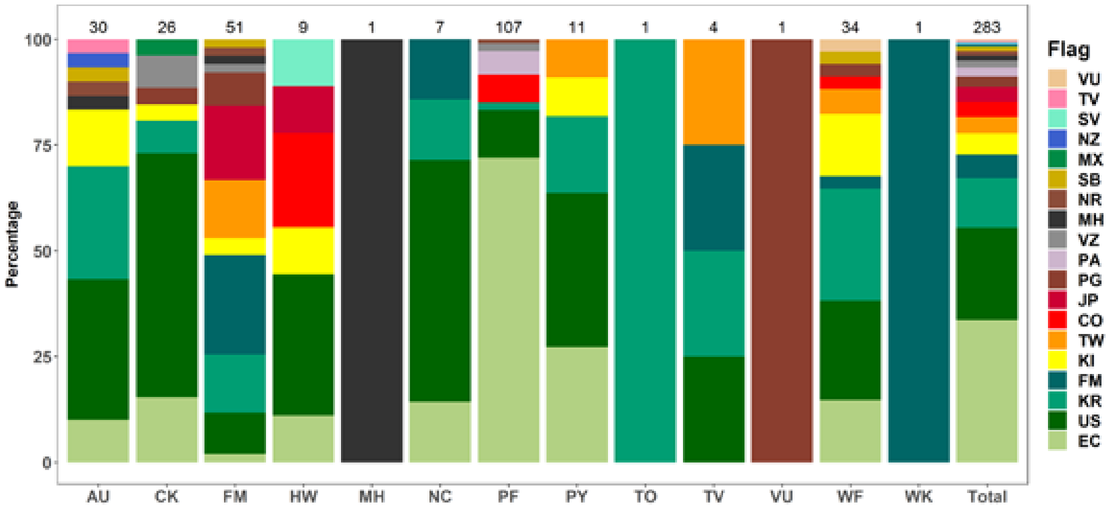

FIGURE 13. The identified vessel's flag of each satellite buoy's owner based on marks painted on the buoy by stranding location. Numbers on the top of the figure correspond to the number of buoys stranded per country. AU = Australia; CK = Cook Islands; CO = Columbia; EC = Ecuador; ES = Spain; FM = Federated 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; WS = Samoa.

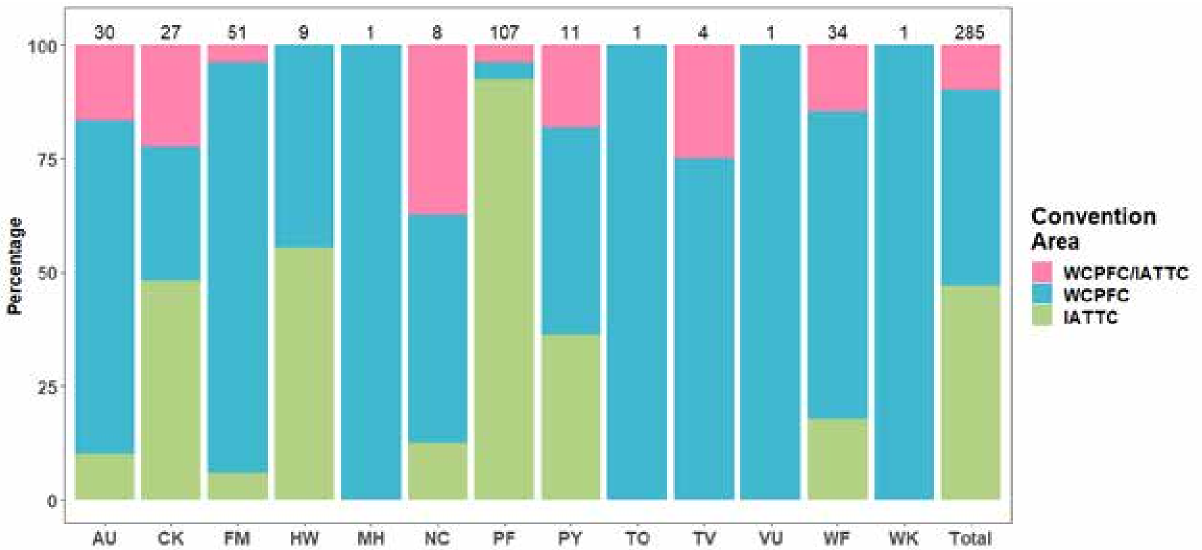

FIGURE 14. Convention Area of owner vessel identified using marks painted on the satellite buoys by stranded location. Numbers on the top of the figure correspond to the number of buoys stranded per country. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; MH = Marshall Islands; NC = New Caledonia; PF = French Polynesia; PY = Palmyra; TO = Tonga; TV = Tuvalu; VU = Vanuatu; WF = Wallis and Futuna; WK = Wake Atoll.

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 PNA FAD tracking database; ii) the WCPFC observer database; and iii) the IATTC observer 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.

As previously identified, certain PICTs received satellite buoys mostly from one CA only (Figure 17). For instance, French Polynesia, Hawai'i, and Palmyra Atoll have stranded buoys mostly from vessels fishing in the IATTC-CA and few from the WCPFC-CA (Figure 17). It was also found that buoys were mainly drifting and stranded between one year and more than two years before being found stranded. Australia received buoys coming from WCPFC-CA, which could be linked to geographical proximity, but there are also buoys coming from the IATTC-CA, one and two years after the last recorded activity (Figure 16).

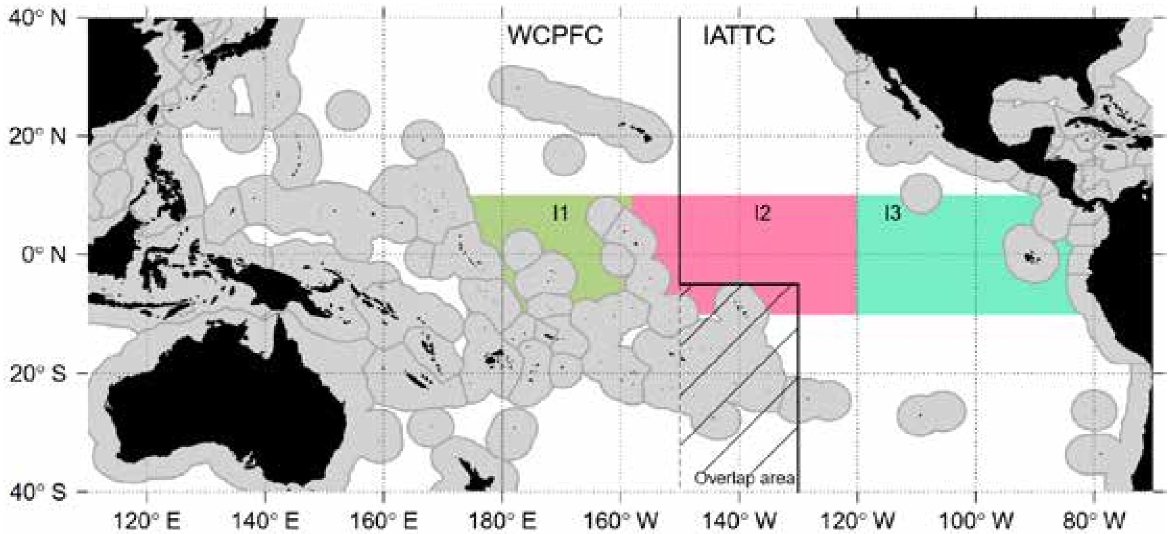

FIGURE 15. Map of the WCPFC and IATTC Convention Areas, including the overlap area. Areas of international waters I1, I2, and I3, as used in Figure 18 are indicated in green, pink and light green.

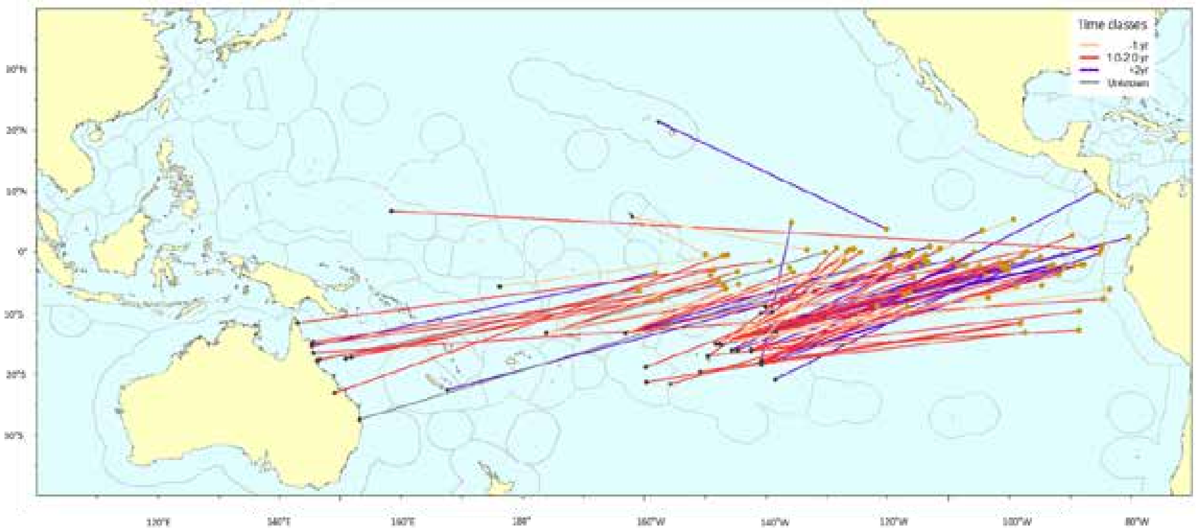

FIGURE 16. Map with all recorded buoy stranding positions (black dots) and last known positions (orange dots) of buoys from the IATTC observer data only. The color of the lines indicates the time between last known position and the date found stranded.

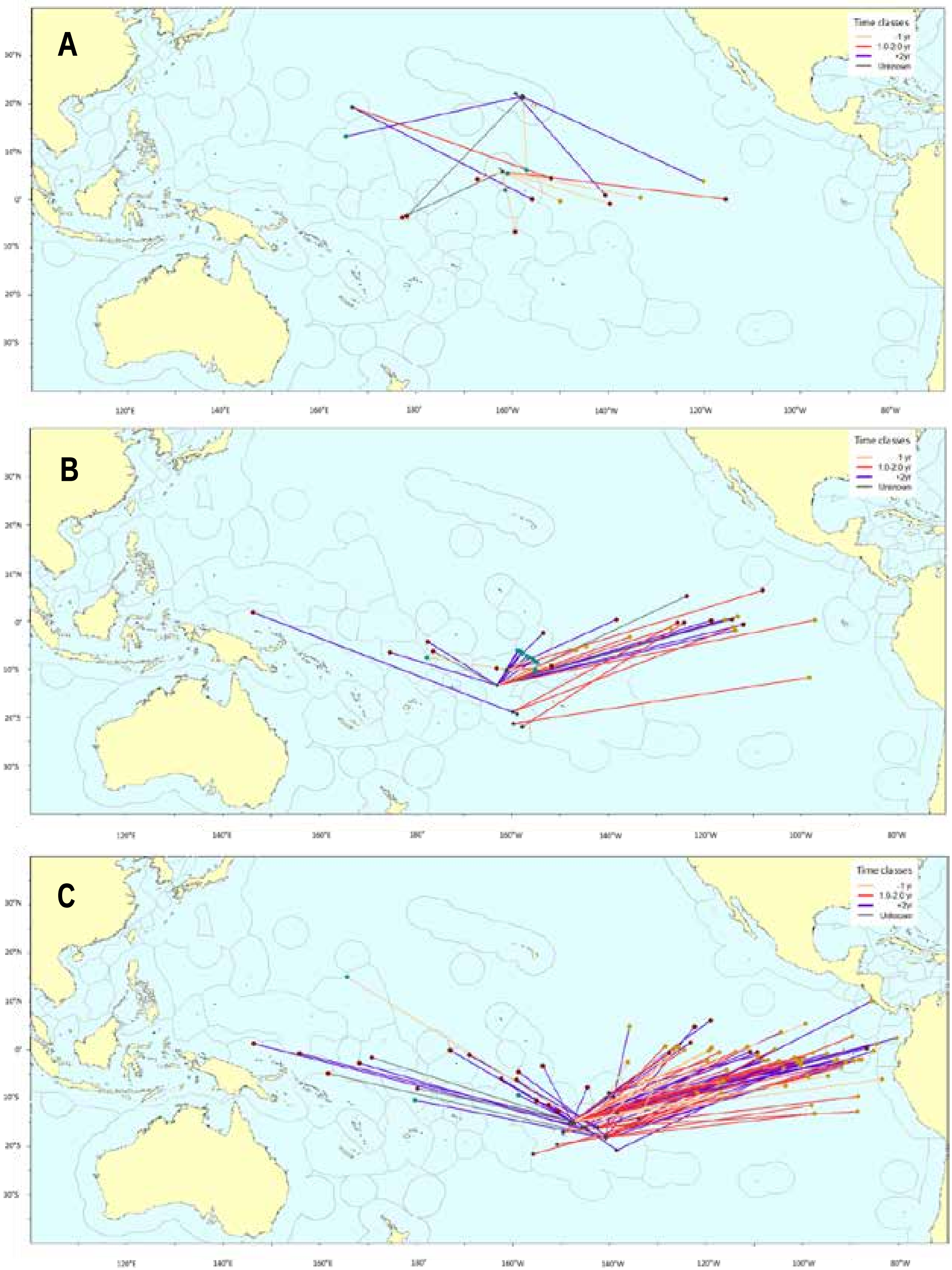

FIGURE 17. Maps of Hawai'i, Palmyra Atoll, and Wake Atoll (A), Cook Islands (B) and French Polynesia (C) with buoy stranding positions (black dots) and the last known position of buoys from three fishery databases: the
PNA FAD tracking data (blue dots); the WCPFC observer data (red dots) and the IATTC observer data (orange dots). The color of the lines indicates the time between the last known position and the date found stranded.

The exclusive economic zone (EEZ) of the last known position of buoys was investigated to detect potential patterns of origin by stranding areas (Figure 18). In the following paragraph, a focus is made on the countries located in the western part of the Pacific Ocean. In the Cook Islands, most stranded FADs were last detected in the Kiribati Line Islands (27.3%), the high seas in the central Pacific Ocean (I2; 27.3%), Tuvalu (4.5%), and the Cook Islands (2.3%) (Figure 18). 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 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 Galapagos EEZ (16.7% and 11.1%, for both EEZs, respectively). 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%).

Stranding areas								WCPFC CA									Origin areas		IATTC CA		
	AU	PG	FM	SB	MH	WK	VU	GL	LN	PX	I1	TV	FJ	WF	TK	PY	CK	I2	I3	GP	PU	CR
AU	2.3	9.2	0	19.5	0	0	2.3	4.6	10.3	4.6	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	27.3	6.8	0	4.5	0	0	0	0	2.3	27.3	29.5	0	0	0
FM	0	9.5	54.8	0	2.4	0	0	16.7	2.4	2.4	4.8	0	0	0	0	0	0	4.8	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	28.6	0	0	7.1	0	21.4	7.1	0	14.3	0	0	0	0	0	14.3	7.1	0	0	0
PG	0	0	0	0	0	0	0	100	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 18. 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; 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 15.

The time difference between the date buoys and FADs were found stranded and their last known position was investigated. 18.8% of all buoys were found less than one year after the time of their last known position and 27.6% were within two years of their last known position.

The time difference between the date buoys and FADs were found stranded and the last known position was investigated by PICT (Figure 19). In most PICTs, the data collection programs started recently but may have included FADs and buoys found 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, higher time differences were detected for matches with the WCPFC observer's database, which recorded the last activity in the observer data; and smaller time differences for matchings with the PNA FAD tracking data, which is closer to the real date of last transmission. In FM, 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 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 19).

Data from WCPFC and IATTC observer programs correspond to the last activity on the buoy that was recorded by observers, not the very last position recorded from a satellite buoy. Thus, it can overestimate the time difference between the actual last transmission and the stranding position, while fishers could potentially still have used the buoy and associated FAD, with this information not available to the observer. In addition, a floating object could have been stranded for a long period before being found by local communities. Consequently, the time difference can, again, be overestimated. Another point to note is that the PNA FAD tracking program started in 2016. No matching could therefore be found with buoys found stranded before 2016. Moreover, the PNA tracking database does not include the full trajectories of buoys, with some buoy trajectories having been "geo-fenced" (Escalle *et al.*, 2021) with the part of trajectories outside PNA country EEZs removed. Complete trajectories from both the WCPFC, and the IATTC would therefore be needed to identify more accurately the origin of buoys and the time buoys were drifting before reaching coastal areas. Note that high-resolution buoy data is not available for the IATTC until 2022 but is now mandatory for the whole fleet under Resolution C-21-04.

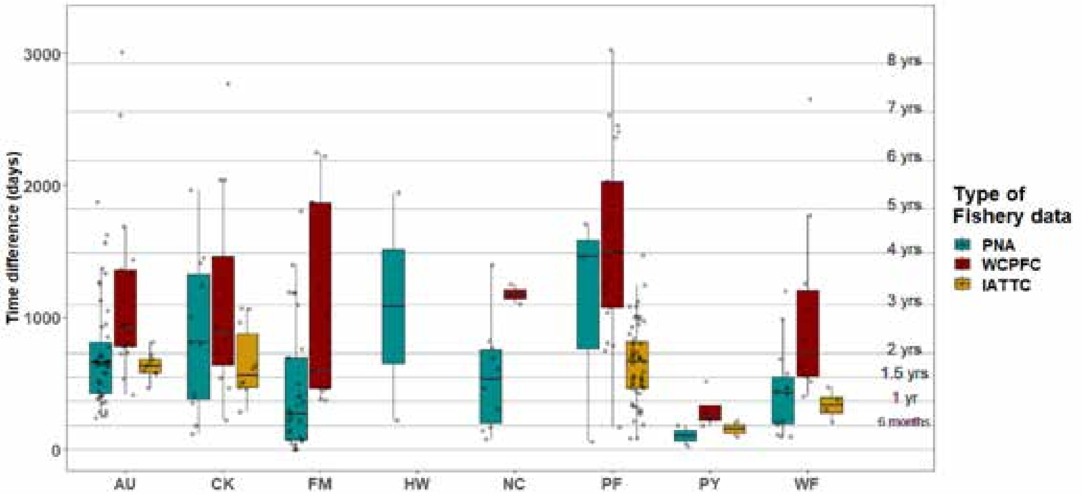

FIGURE 19. Boxplots of time difference between the date found stranded and the last known position in the fishery databases: the PNA FAD tracking data, the WCPFC observer data and the IATTC observer data; by PICT of stranding event. Grey dots indicate an individual stranding event. The lower and upper box boundaries indicate the 25th and 75th percentiles, respectively, the black line indicates the median, and the lower and up-per error lines indicate the 10^{th} and 90^{th} percentiles, respectively. AU = Australia; CK = Cook Islands; FM = Federated States of Micronesia; HW = Hawai'i; NC = New Caledonia; PF = French Polynesia; PY = Palmyra; WF = Wallis and Futuna.

4. DISCUSSION AND NEXT STEPS

This paper presents the in-country data collection programmes related to dFADs found in coastal waters and on coastlines, as well as the development of a regional database. Data collection is now in place in 10 PICTs: Australia, Cook Islands, Federated States of Micronesia, French Polynesia, Hawai'i, Marshall Islands, New Caledonia, Palmyra, Tuvalu and Wallis and Futuna, and is being explored in Solomon Islands, Samoa, Papua New Guinea and Galapagos. More than 2,100 stranding events have been identified, with data collected as far back as 2006. When compiling data from all the different programmes, considerable work in processing, and cleaning the data was necessary to standardise the data collected, while the database also includes links to supplied pictures that were sometimes used to complement the data entered. We also note that the data collection effort is spatially and temporally variable throughout the region, as most programs are based on voluntary reports from communities, while others used dedicated surveys (e.g., French Polynesia). In addition, in many places, the first step in the data collection effort was an inventory of all the buoys and FADs that had been stranded on the coastline. Future data collection will allow the identification of the rates of stranding events in a given time.

Data collection and transfer are currently made via a paper form and Google Drive spreadsheets. With the anticipated increase in reporting and PICT involvement in the project, the use of an app could be considered (potentially through Tails[2], and/or through the PNA FAD logsheet application with a specific section related to data collected in the coastal environment). In the future, specific dFAD stranding officers or coordinators may be needed to deal with the amount of data received.

As mentioned previously, some of the data collection programmes are independent initiatives in specific PICTs. Other independent initiatives may also be occurring throughout the Pacific Ocean. In addition, in oceanic waters, some fishing companies likely sell or collect lost or abandoned dFADs from their own and other fleets and store them in port storage areas to be returned or traded back to company owners.

In this paper, we present preliminary results on the data collected in the stranded FAD regional database. This highlighted the extent of FAD and buoy stranding events in the WCPO and some locations of the EPO. The type of stranding events, materials of the FADs found stranded, as well as the habitats impacted and the environmental damage detected were studied. Information collected through the data collection programmes and analysed here could also help prioritize and explore potential FAD retrieval programs in the future, as a measure to mitigate the impacts of lost FADs in the environment.

A comparison with existing dFAD-related databases in the Pacific Ocean (e.g., WCPFC and IATTC observer data and PNA dFAD tracking data) was implemented and helped identify the origin (monitoring vessel, the flag and CA) and life history of the dFADs in many cases (area and date of last known position, drift patterns). Some buoys found stranded could not be matched with the fishery data investigated. This could be because; i) we did not have access to all the buoy trajectories in the Pacific Ocean (incomplete and modified trajectories from the PNA FAD tracking program in the WCPO and no trajectory data for the IATTC-CA); ii) observers cannot always record the buoy ID (or not the full ID or accurately) from dFADs set on or visited by vessel; and iii) not all dFADs are set on or visited during their lifetime. Under-estimation is likely with in-situ data as well, with not all the records or events being reported. However, dissemination, communication and involvement of a large portion of the public, including fishermen and other stakeholders, could help increase data collection and reporting.

Additional countries and territories should consider implementing similar data collection programs and participating in this regional initiative. More reliable and relevant quantification of dFAD stranding or drifting nearshore, as well as assessment of ecosystem impacts will be possible through data collection over several years and covering the largest area possible, including countries and territories with low or no purse-seine effort. Although the WCPFC and IATTC are currently moving forward in terms of non-entangling and biodegradable dFADs, such designs can still have an impact on the environment, making this programme relevant and timely. This could ultimately help inform dFAD management options in the Pacific Ocean.

Recommendations

- Highlight the need for and support to in-situ data collection and reporting to better quantify dFAD stranding events and the impacts of dFADs on marine and coastal ecosystems.
- PICTs note and consider joining the development and progress of the in-country data collection programs on stranded and lost dFADs and of a regional database in the Pacific

[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.

Ocean;

- Note the preliminary results from analyses of the regional database presented in this paper;
- Note the need for FAD-buoy trajectory data, including for historical periods, from both the IATTC and WCPFC convention areas to better determine the origin of FADs and buoys found stranded and explore spatial management options to reduce stranding events;
- Consider the need for in-situ data to be collected to better quantify dFAD stranding events and the impacts of dFADs on marine and coastal ecosystems;
- Encourage the expansion of the in-country data collection programs to other members of IATTC;
- Highlight the need to explore potential FAD retrieval programs, before dFADs reach coastal areas, as a measure to mitigate the impacts of lost FADs, and encourage collaboration between companies and management bodies (with or without fees upon retrieval);
- Consider ways to mitigate impacts of dFADs, develop solutions to process/recycle FAD materials in ports, and provide scientific-based advice to guide the management of dFADs in the Pacific Ocean.

ACKNOWLEDGMENTS

World Wildlife Fund (WWF) provided funding to print and ship posters in the Cook Islands and Wallis and Futuna; activities are organised by Tiare-Renee Nicholas and Chloé Faure. The New Zealand Aid Program provided funding for the awareness and data collection program in the Federated States of Micronesia and the Marshall Islands, with James Wichman and Beau Bigler organising the awareness and data collection activities. The Fond Pacifique provided funding for the awareness and data collection program in Tuvalu, New Caledonia, and Wallis and Futuna and allowed the scientific analyses of the database performed by Jennyfer Mourot. Mainui Tanetoa, Margot Boval, Jean-Claude Gaertner, Charles Daxboeck, Marie Soehnlen, Anne-Marie Trinh are part of the data collection projects in French Polynesia, that are funded by the Direction des Ressources Marines, the University of French Polynesia/ Institut de Recherche pour le Développement (IRD) and The Nature Conservancy (TNC). Palmyra Atoll data collection is part of a larger dFAD Watch Program currently being developed and is funded by TNC and led by Kydd Pollock. Sarah-Jeanne Royer and Jennifer Lynch from the Center for Marine Debris Research at Hawai'i Pacific University are organising the data collection in Hawai'i. Tangaroa Blue Foundation would like to thank all of the Australian Marine Debris Initiative partners and volunteers involved in the collection and provision of data used in this report. For a list of AMDI partners who have contributed to the AMDI Database, please visit https://www.tangaroablue.org. The authors are grateful for the assistance provided by the fisheries department and officers in the field in each of the PICTs involved. The authors would also like to thank the local communities, fishermen, and general public involved in data collection in the PICTs. The authors are also grateful for any opportunistic report provided, including findings in Australia; Cook Islands (Te Ipukarea Society); New Caledonia (Association Hô-üt); Pitcairn Islands (The Pew Charitable Trusts); Samoa; Tuvalu; and Vanuatu. The authors would like to thank the members of the Parties to the Nauru Agreement, the Pacific Islands Regional Fisheries Observer Programme, and the Inter-American Tropical Tuna Commission for giving us access to their data for this analysis; as well as observers involved in the collection of observer data.

REFERENCES

Balderson, S. D., and 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. IOTC Technical Report IOTC-2015-WPEB11-39 15pp.

Banks, R., and 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. Report produced by Poseidon Aquatic Resources Management Ltd for The Pew Charitable Trusts.

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

Escalle, L., Scutt Phillips, J., Brownjohn, M., Brouwer, S., Sen Gupta, A., Van Sebille, E., Hampton, J., *et al.* 2019b. Environmental versus operational drivers of drifting FAD beaching in the Western and Central Pacific Ocean. Scientific Reports, 9: 14005. Nature Publishing Group. http://www.nature.com/articles/s41598-019-50364-0 (Accessed 1 October 2019).

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

WCPFC. 2018. CMM-2018-01 Conservation and management measure for bigeye, yellowfin and skipjack tuna in the Western and Central Pacific Ocean.

WCPFC. 2021. CMM-2021-01 Conservation and management measure for bigeye, yellowfin and skipjack tuna in the Western and Central Pacific Ocean.

Zudaire, I., Santiago, J., Grande, M., Murua, H., Adam, P.-A., Nogués, P., Collier, T., *et al.* 2018. FAD Watch: a collaborative initiative to minimize the impact of FADs in coastal ecosystems. IOTC Technical Report IOTC-2018-WPEB14-12 21pp.

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 1: SUPPLEMENTARY FIGURES

FIGURE S1. Pictures of some dFAD rafts, submerged appendages and satellite buoys found in French Polynesia since 2019.

FIGURE S2. Pictures of some dFAD rafts, submerged appendages and satellite buoys found in Wallis and Futuna since March 2020.

FIGURE S3. Pictures of some dFAD rafts, submerged appendages and satellite buoys found at Palmyra Atoll since 2009.

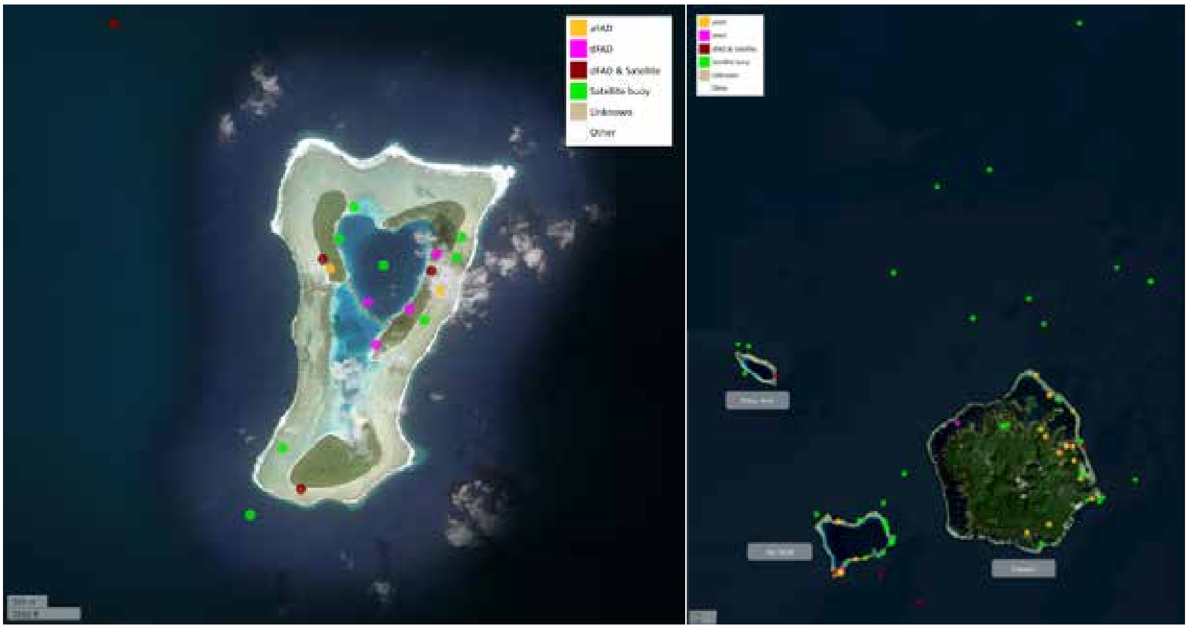

FIGURE S3.1. Map of stranding events in Mokil Atoll (left), and Pohnpei, Ant Atoll and Pakin Atoll (right) (Federated States of Micronesia).

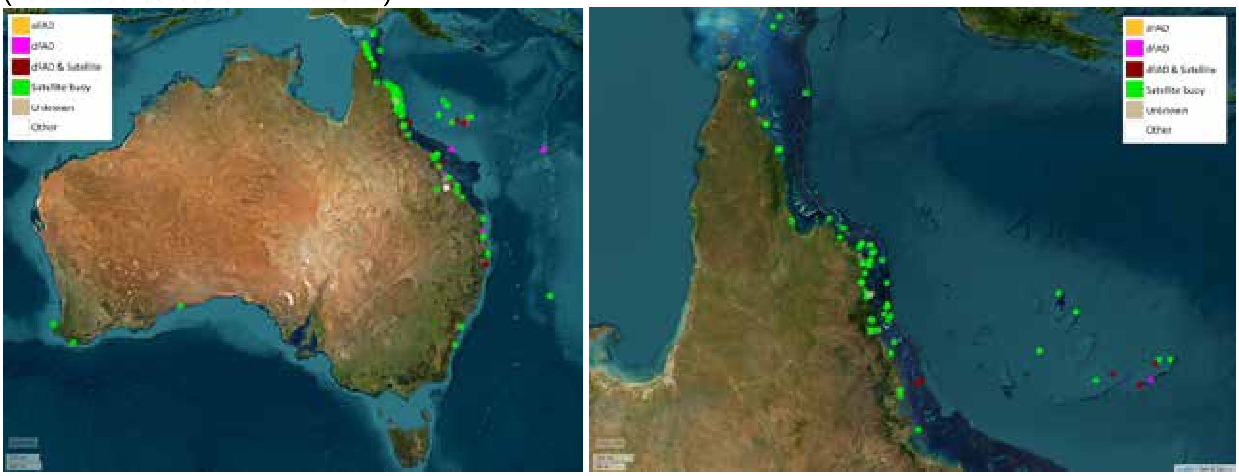

Figure S3.2. Map of stranding events in Australia (left) and in the North-east coast of Australia (right).

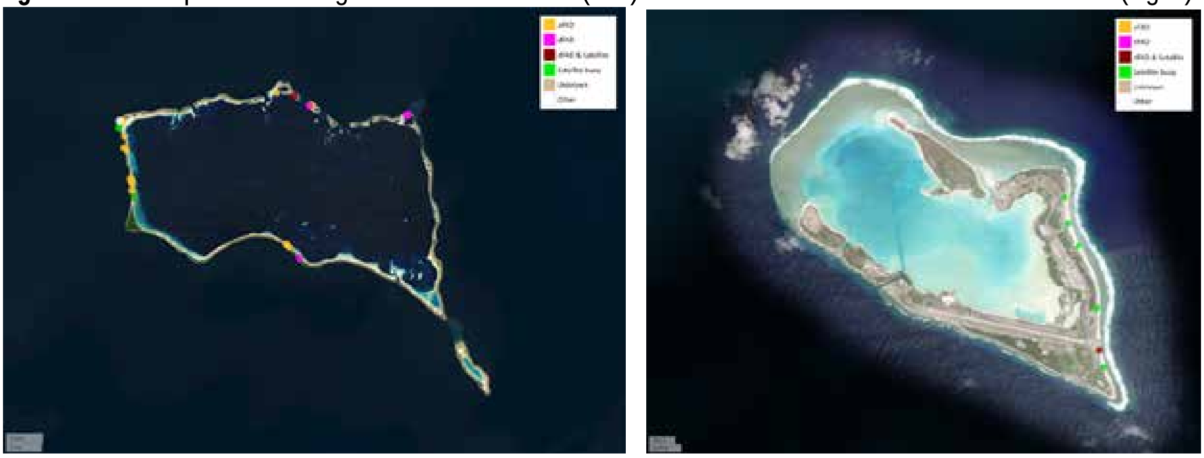

FIGURE S3.3. Map of stranding events in Mili Atoll (Republic of the Marshall Islands, left) and in Wake Atoll (US, right).

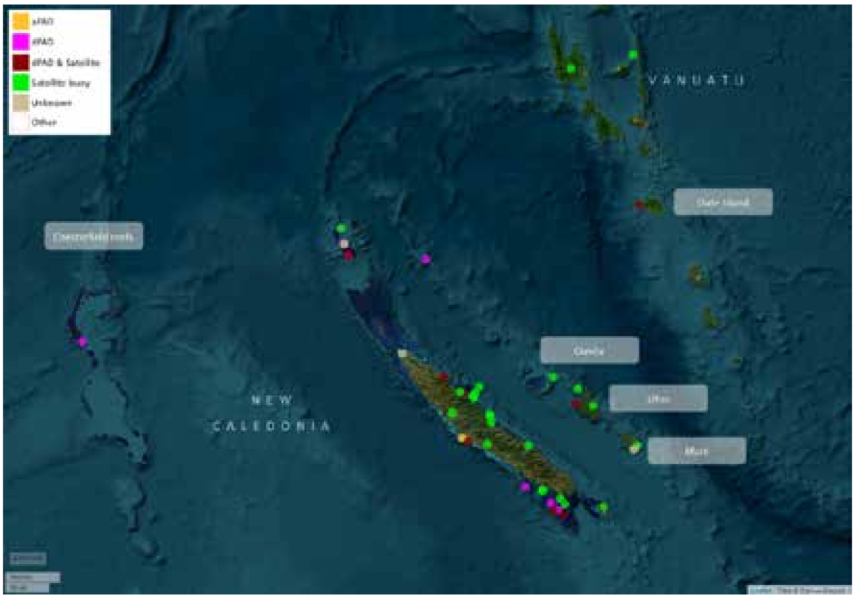

FIGURE S3.5. Map of stranding events in New Caledonia and Vanuatu (Southwest Pacific example).

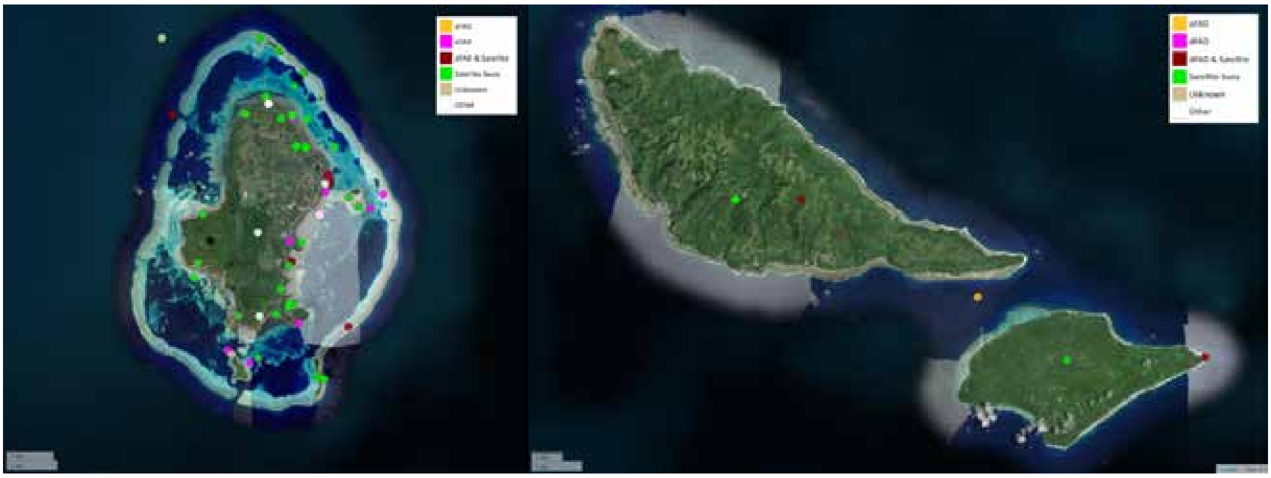

FIGURE S3.6. Map of stranding events in Wallis (left) and Futuna (right).

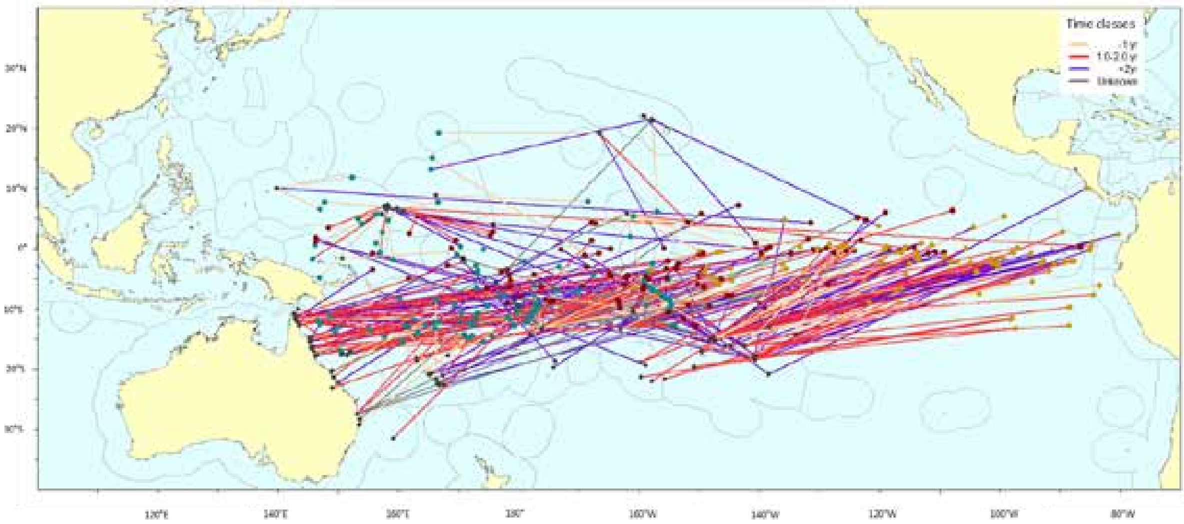

FIGURE S4. Map with all recorded buoys stranding position (black dots) and the last known position of buoys from the three fishery databases: the PNA FAD tracking data (blue dots); the WCPFC observer data (red dots) and the IATTC observer data (orange dots). The color of the lines indicates the time between last known position and date found stranded.

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