

Beaching of drifting FADs in the WCPO: Recent science, management advice and in-country data collection programmes

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Fishers have long known that pelagic fish species aggregate around floating objects such as natural logs and debris, and have intentionally deployed bamboo rafts with the express intention of attracting species such as tunas. This has been done for decades in coastal areas throughout the Pacific, where anchored fish aggregating devices (FADs) are used by artisanal and recreational fishers to increase food security through higher catch rates and reduced fishing costs (Itano et al. 2004). Anchored FADs have also been used by industrial fisheries (pole-and-line and purse-seine vessels) for several decades, mostly in the western part of the western and central Pacific Ocean (WCPO), to attract and catch tunas. More recently (in the late 1990s), the WCPO purse-seine fisheries began deploying their own drifting fish aggregating devices (dFADs), typically consisting of a bamboo raft with numerous 30- to 80-m appendages of old ropes or nets hanging below. Their use expanded rapidly, given the higher catch rates and fewer chances of unsuccessful sets on dFADs compared with free school sets, and dFADs have become a key component of the purse-seine fishery and responsible for 40% of the total purse-seine catch in recent years (Williams and Reid 2019). This has been facilitated by technological developments, such as the use of satellite buoys. These high-tech buoys packed with solar-powered electronics provide fishers with the position of their dFADs and can indicate the amount of tuna aggregated underneath each one of them.

Purse-seine fisheries represent a very important source of financial income and employment for Pacific Island countries and territories (PICTs), with up to 98% of the national government revenue generated by fishing access agreements in some cases (FFA 2017). While dFADs help stabilise catch rates and make fishing fleets more profitable, and hence generate revenue for PICTs, the now extensive use of dFADs also leads to several issues. dFAD sets present higher rates of catch for juvenile tuna, especially bigeye, potentially affecting the status of tuna stocks; dFADs are also responsible for higher bycatch rates.

The scale of dFAD use in the WCPO is the highest of all oceans, as it has been estimated that between 30,000 and 65,000 satellite buoy-equipped dFADs are now deployed in the WCPO each year (Escalle et al. 2018). This extensive use of dFADs, therefore, also raises concerns about ecosystem impacts, such as the entanglement of sensitive species, and marine pollution, with a high proportion of dFADs being lost at sea. Ultimately, they may reach coastal areas, where they become beached (i.e. wash up on shore) and potentially damage reefs and related ecosystems.

In this paper, we present results from recent scientific research estimating the number of dFAD beaching events in the WCPO, their spatial distribution, and the factors influencing high rates of beaching. We also describe the potential management options that may mitigate marine pollution and beaching events. Finally, we present opportunistic data from dFADs found beached in various areas around

the WCPO and highlight the need for more systematic record, with the help of local communities, of information on dFAD and satellite buoys found beached or drifting in coastal areas. The paper concludes with a call for the submission of any information regarding dFADs or satellite buoys found beached or at sea in coastal areas around the Pacific.

Results from scientific research

A large number of dFAD trajectories were recently provided by fishing companies to the Parties to the Nauru Agreement (PNA) through a dFAD tracking programme that aimed to improve the understanding of dFAD use; provide better scientific information on the impacts of dFADs and fishing on them; have a better understanding of the economics of dFAD use; and inform dFAD management. The availability of these data to the Pacific Community (SPC) for scientific studies that help guide dFAD management has, in particular, allowed investigation into the patterns of dFAD beaching events. Using this regional database of dFAD trajectories during the 2016–2017 period, Lauriane Escalle and fisheries scientists from SPC's Oceanic Fisheries Programme identified 1320 beaching events (7% of the dFADs in the database) in the WCPO (Fig. 1; Escalle et al. 2019a) over 30,000 drifting fish aggregating devices (dFADs). The exclusive economic zones (EEZs) presenting the highest number of beaching events were Papua New Guinea (483), Solomon Islands (379), Kiribati (155) and Tuvalu (117). The drivers of beaching events, however, varied between these different areas, as highlighted

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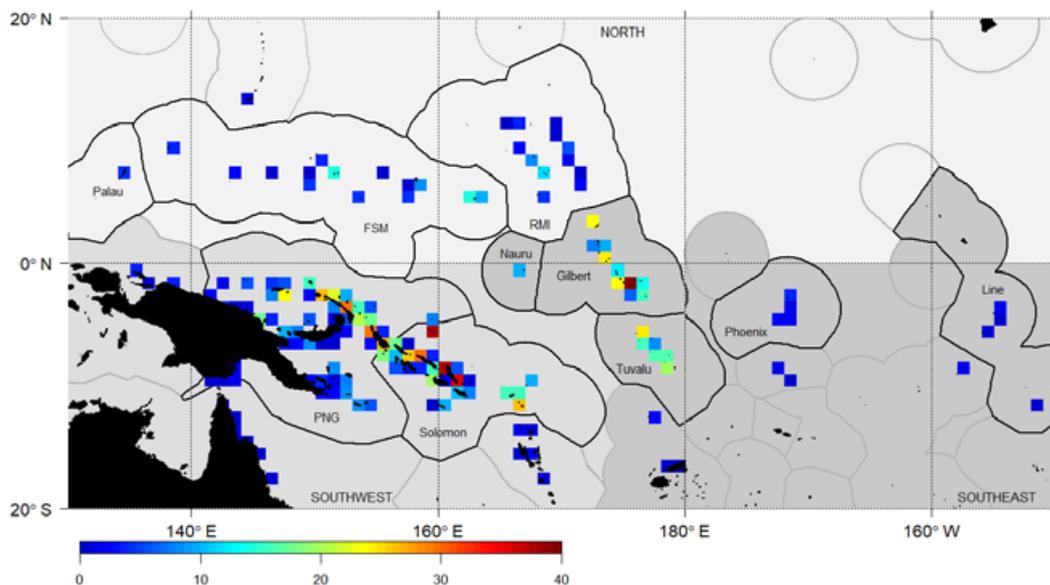


Figure 1. Number of beaching events (1320 in total) per 1° grid cell across 2016 and 2017. Countries that form the Parties to the Nauru Agreement (Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu) where most dFAD trajectories in the regional dataset occur, are indicated on the map.

using a combination of real dFAD trajectories and of simulations based on ocean currents (Escalle et al. 2019b).

The study found the following.

- Islands within the EEZs of Papua New Guinea and Solomon Islands experienced the highest number of beaching events. Beaching here was mostly driven by oceanographic processes, principally due to the dominant westward current along the equator, but was also due in part to local currents that drive floating objects onto coastlines.
- Kiribati's EEZ, located along the equator, experienced a high number of dFADs drifting through its waters alongside significant levels of beaching, simply caused by its proximity to where fishers appear to deploy dFADs.
- Tuvalu's EEZ is influenced by large-scale ocean circulation and is the area with the highest dFAD density in the WCPO, which explains the relatively high beaching rate of dFADs observed in this area.
- One main limitation in the current assessment of beaching events in the WCPO is the fact that most records come from within the waters of PNA members, as very few data from other countries or outside of EEZs within high seas pockets have been made available by fishing companies to the PNA regional dFAD tracking dataset. In addition, the satellite buoy attached to dFADs is generally deactivated when the dFAD drifts outside of the main fishing area (which means fishers do not receive positional or echo-sounder information for their dFAD). Subsequently, information on these dFADs arriving in coastal areas, including beaching events, is often lacking, meaning our calculation of beaching rates is likely under-estimated.

For more information on dFAD beaching in the WCPO based on data from the PNA FAD tracking programme and cutting edge simulation methods, see <https://www.nature.com/articles/s41598-019-50364-0>

Potential management options

Management of the dFAD purse-seine fishery by the Western and Central Pacific Fisheries Commission (WCPFC) includes prohibiting all dFAD-related activities (deploying, setting and servicing) during a three- to four-month period (i.e. FAD closure), as well as limiting the number of active satellite buoys that each vessel can follow at any given time to 350 (WCPFC 2018). These measures mostly aim to reduce the impact of dFAD use on tuna stocks.

Specifically, for objectives that aim to reduce dFAD-induced marine and coastal pollution, additional management measures could include:

- limiting the total number of dFAD deployments in the WCPO;
- limiting the number and/or the spatial location of deployments in areas where beaching is linked to deployment strategies (i.e. beaching events in Kiribati's Gilbert Islands);
- using biodegradable materials for dFADs (currently encouraged by WCPFC, with several ongoing trials by fishing companies in the WCPO);
- retrieving dFADs at sea before they reach areas identified as sensitive to beaching; and
- initiating shoreline cleaning programmes, potentially through a financial contribution by fishing companies.

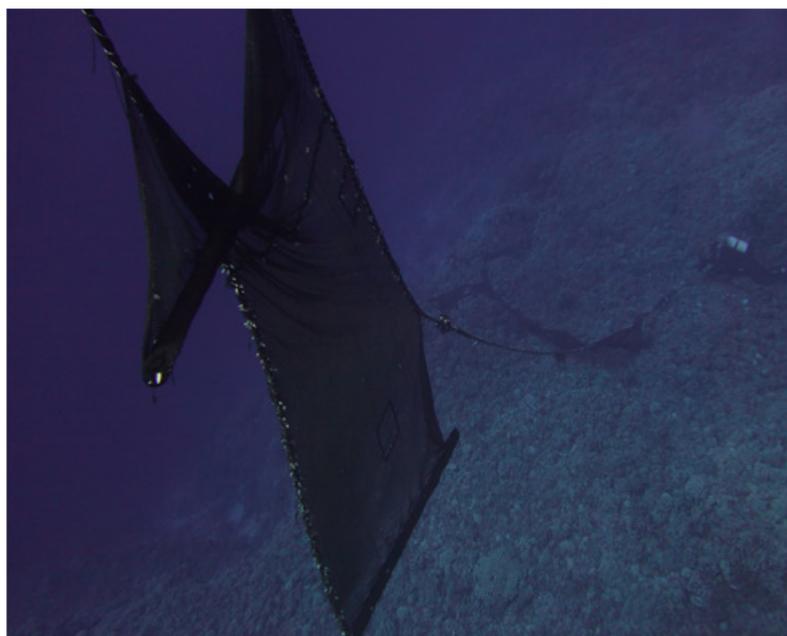


Figure 2. dFADs found beached or entangled in coral reefs in Touho, New Caledonia (top-left, A. Durbano, Association Hô-üt'), New South Wales, Australia (top-right, G. Holmes, The Pew Charitable Trusts) and Pitcairn (bottom photos, Jon Slayer - Protect Blue).

Opportunistic data collection

In addition to the beaching events effectively recorded through the analysis of dFAD trajectories, it has been estimated that around 50% of dFADs are lost at sea (i.e. drifting outside the fishing grounds of fishing companies that own them) (Escalle et al. 2019a). Although some of these dFADs may be retrieved at sea by other vessels, most of them will likely end up as marine pollution and will ultimately disintegrate at sea, sink or beach on coastal areas, potentially quite far from purse-seine fishing areas. Given that the satellite buoy attached to the dFAD is no longer transmitting, these beaching events will remain unnoticed until found by someone.

Hence, to complement the analyses already performed and the data currently available to scientists and managers, the *in situ* record of dFADs reaching coastal areas and their impacts is necessary. In this way, opportunistic communication regarding dFADs found beached in different areas around the WCPO have begun to be reported to SPC in recent years (see Fig. 2). When a satellite buoy is still attached to the dFAD or just by itself, it is possible to

check the presence of the buoy in the PNA dFAD tracking database. This could help a) determine whether the dFAD has been used in the WCPO, and b) give access to all or part of its trajectory.

During the fifth western Pacific (WP5) tagging cruise in September 2019 in the Federated States of Micronesia, visits to Yap State's outer islands allowed discussions with local communities regarding beached dFADs and satellite buoys, which are often taken apart so that the batteries and solar panels can be re-used (Fig. 3). On every island visited, local communities claimed to have found dFADs and/or satellite buoys. The data collected during this tagging cruise was purely opportunistic, and unlikely to be systematically repeated in the future. While local communities were interested in collaborating with scientists, the remote nature of these islands precludes any data transmission programme.

Similarly, during a two-week visit in the northern Cook Islands (Manihiki and Rakahanga) to assist the Cook Islands Ministry of Marine Resources gather views to develop a new strategic plan for the pearl industry, 36 satellite buoys and/or dFADs were found on beaches or



Figure 3. dFADs found beached by locals in Ulithi and Lamotreck islands in Yap State within the Federated States of Micronesia. (images: Joe Scutt Phillips, SPC)

in people’s garden (Fig. 4). This is a striking number, but while a certain number of satellite buoys and/or dFADs certainly arrived recently on beaches, others may have been collected a long time ago.

This highlights the need for data collection of buoys already gathered by local communities, but more importantly to develop a programme to collect precise information on dFADs and buoys newly beached and/or drifting through coastal areas, as well as their impacts, in the WCPO.

Launching an in-country data collection programme

In-country data collection programmes for beached dFADs and lost dFADs drifting near shore are essential to complement existing databases and assess the actual beaching rates and the consequences of these on coastal ecosystems and local fisheries.



Figure 4. dFADs found beached on Rakahanga, Cook Islands. (images: Ian Bertram and Jeff Kinch, SPC)

Following the arrival of a large number of dFADs in coastal areas, including in PICTs where purse-seine fishing does not occur (e.g. Wallis and Futuna, and French Polynesia), some countries have started programmes to collect such information. This involves distributing posters to inform local communities of what dFADs are, why collecting such data is important, and how to record the appropriate information on them (Fig. 5). For the moment, programmes have been launched or are in the development stage in Cook Islands, Wallis and Futuna, and French Polynesia.

Please send any information regarding dFADs that are beached or in nearshore areas to: rar@mmr.gov.ck ; service.peche@agripeche.wf and drm@drm.gov.pf). Such a programme, accompanied by community awareness, will be expanded to several other PICTs over the next few months.

Acknowledgments

We are grateful to members of the Parties to the Nauru Agreement for access to their dFAD tracking data. We would also like to thank Ian Bertram, Jeff Kinch and the Cook Islands Ministry of Marine Resources for beached dFADs data collection in Rakahanga and Manihiki, local communities in Yap State (FSM), and Boris Colas (SPC) for his work on the communication poster.

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FISH AGGREGATING DEVICE (FAD) DRIFTING FAD FOUND BEACHED OR AT SEA ?

Where is the buoy ID number ?

WHAT IS A DRIFTING FAD?
It is a raft, generally made of bamboo, with a tail of net, cords and/or canvas and a satellite buoy, deployed by tuna purse seiners to aggregate and catch tuna.

WHY ARE WE COLLECTING THIS DATA?
To quantify the number of beached or lost FADs, and to note their impact on coastal areas, which will help improve the management of FAD fishing.

WHAT TO DO WITH THE FAD?
If possible, tow the drifting FAD back to shore then contact the MMR office.

RECORD ANY OF THESE DETAILS:

- What did you find ?
 - a FAD by itself
 - a FAD with a buoy
 - a buoy by itself
- Buoy ID number and any mark painted on the buoy
- Date found
- Location (Lat/Lon or name of beach, village, island...)

IF POSSIBLE, NOTE:

- Environment: at-sea, coral reef, beach, lagoon
- Materials: bamboo, net, cord, floats
- Tail length (if possible)
- What did you do with the FAD/buoy? (e.g. removed from water or land, left drifting, sunk, fished)
- Any additional comments? (e.g. environmental damage, entangled animals or aggregated tuna or other animals)

TAKE PICTURES:

- General picture of what you found
- A close-up of the buoy with the ID number visible

SEND AN EMAIL TO: rar@mmr.gov.ck
OR CALL **28721**

For more information, or to notify the finding of a beached FAD or satellite buoy in coastal areas around the Pacific, contact your local fisheries office and/or send an email to laurianee@spc.int

Figure 5. A poster on dFADs developed for the Cook Islands.

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