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STAKEHOLDER PERSPECTIVES AND ECONOMIC AND FEASIBILITY ANALYSIS OF OPTIONS TO MITIGATE DRIFTING FISHAGGREGATING DEVICES (DFAD) LOSS AND ABANDONMENT

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Submitted by

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Executive Summary

Drifting Fish Aggregating Devices (dFADs) are widely used in tropical tuna purse-seine fisheries and play a critical role in maintaining catch efficiency in the Western and Central Pacific Ocean (WCPO). However, the large number of devices deployed each year results in substantial levels of loss, abandonment, and stranding, with associated environmental, economic, and social impacts. Despite increasing regional and international attention to the issue, there remains limited information on the practical feasibility and economic implications of different mitigation and retrieval strategies under realistic operational conditions.

This study evaluates the feasibility and potential cost-effectiveness of five mitigation options aimed at reducing dFAD loss and abandonment in the Pacific region:

1. Modifying deployment and retrieval patterns to reduce the likelihood of loss and stranding;
2. Increased purse-seine responsibility for retrieval prior to abandonment, loss or stranding;
3. Chartering or purchasing dedicated “cleaning” vessels to retrieve dFADs in identified hotspots at the edge of the purse-seine fishing grounds;
4. Recovery by existing vessels operating outside the purse-seine fishing grounds (such as longliners); and
5. Shore-based recovery programmes designed to intercept dFADs before stranding occur.

To evaluate these options, a multi-component analytical framework was applied combining stakeholder consultation, case study review, and economic modelling. Stakeholder perspectives were collected through both general and stakeholder-specific surveys. Case studies of existing retrieval initiatives were reviewed to provide real-world context on operational constraints and implementation requirements. An economic modelling framework was then developed to estimate the potential costs associated with different retrieval strategies using WCPO dFAD tracking data, vessel behaviour, and operational assumptions. Information from stakeholder consultations and case studies were used to inform key modelling parameters and ensure that cost estimates reflected realistic conditions. Two main assumptions were considered in the study. First, options 2 to 5 rely on the assumption that positions of dFADs considered lost by owner fishing companies would be shared with retrieval programmes / regional coordination initiatives. Second, options 3, 4 and 5 rely on the assumption that retrieval would be carried out based on receiving a financial incentive.

Survey responses indicated broad agreement that dFAD loss represents a shared regional problem, although opinions differed regarding responsibility for retrieval and the practicality of different mitigation options. Perceptions of the feasibility and cost-effectiveness of different mitigation options varied across stakeholder groups, and no single option was consistently identified as the most favourable. Economic modelling demonstrated that the cost of dFAD retrieval varies substantially depending on the retrieval option considered, the spatial distribution of lost and abandoned dFADs, and operational assumptions, such as the additional distance required to deviate from the planned vessel route. Across all mitigation options considered, levels of retrieval/mitigation of loss or stranding per option varied from less than a thousand dFADs (minimum in options 2 and 4) to several 10,000s (maximum in options 3 and 5), corresponding to up to a third of dFADs deployed in the WCPO per year. Cost per dFAD also varied from 51–264 USD (shore-based retrieval programme; option 5); 204–279 (opportunistic retrieval by longliners; option 4); 178–555 (dFAD cleaning vessel; option 3); to 668–893 USD (opportunistic retrieval by purse-seiners; option 2).

Taken together, results suggest that the most realistic approach to reducing dFAD loss in the Pacific will involve a combination of complementary mitigation options. Spatial management measures regulating location of dFADs deployment (option 1) may help reduce the likelihood of dFADs loss and stranding, although the economic consequences are hard to evaluate. Opportunistic retrieval by purse-seine or longline vessels (options 2 and 4) may be feasible in some situations, with priority given to hotspots with the highest densities of lost/abandoned dFADs (northwest and southwest WCPO), to increase recovery likelihood during routine operations. Dedicated or chartered vessels (option 3) could recover large numbers of dFADs in high-density hotspots but would require significant and sustained financial support. The northwest and southwest hotspots could be serviced by vessels based in geographically proximate ports (such as the Philippines, Fiji or American Samoa). Finally, shore-based recovery programmes (option 5) appear to be relatively low-cost in nearshore areas, but would require extensive coordination. They could focus in and around Marine Protected Areas; specific Pacific Islands countries and territories (PICTs) that have the resources and willingness to sustain such programmes (e.g. Palmyra atoll; French Polynesia; Hawaii) or located within the fishing grounds and experiencing high levels of dFAD strandings (e.g. Papau New Guinea, Solomon Islands, Tuvalu).

The overall cost associated with meaningful results in terms of retrieval (above 5,000 dFADs; options 3 and 5) are between 0.2 and 3.4 million USD per year per option considered. For instance, cleaning vessel(s) retrieving 75% of dFADs in the four main abandonment hotspots (option 3; 7,175 dFADs) would represent 1,400,000 to 3,400,000 USD / year, plus additional fixed and other costs of 300,000 to 480,000 / year per vessel. Similarly, recovering 75% of dFADs within 6 nm of ports through a shore-based retrieval programme (option 5; 5,381 dFADs) would cost 400,000 USD / year. However, this includes operational costs but excludes the ones associated with coordination of such a programme.

Additional work is needed to further refine the analyses reported herein. These include refining analytical methods and expanding the amount of data used in the model, such as improved dFAD tracking data to include the EPO; vessel-tracking data; alternative scenarios of dFAD cleaning vessels and implementing pilot projects to test mitigation strategies under real operating conditions. Given the transboundary nature of the issue, effective mitigation will require coordination among fleets and industry partners, PICTs, and regional organisations. This study is a first step in evaluating potential mechanisms to reduce dFAD loss, abandonment and stranding in the WCPO and could guide the management of the dFAD fishery, as recommended in the workplan of the WCPFC FAD-MO IWG.

We invite WCPFC-SC22 to:

- Note this integrated assessment combining existing knowledge with stakeholder input, case study data, real regional dFAD data, and economic considerations to evaluate feasibility and cost associated with five dFAD loss and abandonment mitigation options.
- Note that across all mitigation options considered, levels of retrieval/mitigation of loss or stranding per option varied from less than a thousand dFADs to several 10,000s per year.
- Note that estimates of the cost per dFAD also varied from 51–264 USD (shore-based retrieval programme; option 5); 204–279 (opportunistic retrieval by longliners; option 4); 178–555 (dFAD cleaning vessel; option 3); to 668–893 USD (opportunistic retrieval by purse-seiners; option 2).
- Recommend additional work to be carried out to better refine the analysis and support implementation of pilot projects in the WCPO.

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1. Introduction

Drifting Fish Aggregating Devices (dFADs) are widely used in tropical tuna purse-seine fisheries to increase catch efficiency by aggregating tuna schools in the open ocean. More than half of the global tropical tuna purse-seine catch is now taken in association with dFADs (Capello et al., 2023; Pons et al., 2023). In the Pacific, 40,000–65,000 dFADs equipped with satellite buoys with echosounders are deployed annually, allowing fleets to monitor dFAD location and estimate associated biomass beneath the device (Escalle et al., 2021; Lopez et al., 2024). When they drift outside fishing areas, dFADs are generally abandoned by fishers, who deactivate the satellite buoy. In the Western and Central Pacific Ocean (WCPO), it is estimated that only 9.6% of dFADs are retrieved, 65.4% are deactivated and considered abandoned, left to drift at sea and contribute to the broader problem of marine pollution from lost and abandoned fishing gear (Escalle et al., 2023; Gilman et al., 2021).

While dFADs improve fishing efficiency, stabilise catch rates and contribute to government revenues for many Pacific Island countries and territories (PICTs), their loss or deliberate abandonment can generate social, environmental and ecological impacts. In the Pacific region, they can drift long distances, interacting with artisanal fisheries, creating navigational hazards and contributing to marine debris before stranding. Stranded dFADs damage coral reefs and coastal habitats (Davies et al., 2017; Mourot et al., 2025).

DFAD loss and abandonment has received increasing attention from tuna Regional Fisheries Management Organizations (RFMOs), the purse-seine industry, local communities and environmental organizations (Escalle et al., 2026a; Moreno et al., 2025). Current measures to reduce the impacts of dFAD structures include active dFAD limits per vessel across all tuna RFMOs, as well as the requirement to transit towards non-entangling and biodegradable dFADs in all tuna RFMOs, with the exception of WCPFC. In addition, the Western and Central Pacific Fisheries Commission (WCPFC); the Inter-American Tropical Tuna Commission (IATTC); the Indian Ocean Tuna Commission (IOTC); and the International Commission for the Conservation of Atlantic Tuna (ICCAT), have all considered how dFAD loss and abandonment issues could be reduced or the impacts mitigated. Options considered include improving fisher accountability for deployed gear, practical approaches for dFAD recovery (Banks and Zaharia, 2020; Escalle et al., 2026a; Murua et al., 2023), and finance mechanisms to increase dFAD recovery (Ferraro et al., 2025). These discussions highlight the scale and complexity of the issues making recovery operations logistically challenging and potentially costly. They nevertheless also highlight the increasing attention that this topic receives, and the need to continue exploring and developing options. Effective mitigation will likely require a combination of regulatory measures, technological improvements, and cooperative initiatives involving industry, governments, and coastal communities.

Previous studies and RFMO discussions generally group dFAD mitigation and retrieval options into several broad categories:

1. Modifying deployment and retrieval patterns to reduce the likelihood of loss and stranding;
2. Increased purse-seine responsibility for retrieval prior to abandonment, loss or stranding, which could include higher collaboration between fishing companies and fleets;
3. Chartering or purchasing of dedicated “cleaning” vessels to retrieve dFADs in identified hotspots at the edge of the purse-seine fishing grounds;

4. Recovery by existing vessels operating outside the purse-seine fishing grounds (such as longliners); and
5. Shore-based recovery programmes designed to intercept dFADs before stranding events occur.

Although frequently discussed in both the literature and in RFMO working groups, there has been relatively little evaluation of their effectiveness in practice. Few studies have examined how different retrieval or mitigation strategies could be implemented under realistic operational conditions, or how costs, logistical constraints, and stakeholder participation may influence their effectiveness (Ferraro et al., 2025; Murua et al., 2026). More comprehensive assessments that combine existing knowledge with stakeholder input, case study data, real dFAD regional data, and economic considerations could determine which options are both operationally feasible and cost-effective.

This study addresses these knowledge gaps by evaluating a range of dFAD mitigation and retrieval options. This report compares the five options within the context of the WCPO, to identify options that might realistically be implemented through industry, governments, regional organisations, and coastal community collaborations. In particular, the WCPFC FAD-MO IWG work plan includes the assessment of mechanisms and strategies for practical, effective and economically viable dFAD recovery that could be considered in the WCPO. This study provides guidelines and informed assessment for the development of evidence-based pilot initiatives and conservation and management measures aimed at reducing dFAD loss and abandonment and its associated impacts.

2. Methods

Five options for mitigating dFAD loss and abandonment and increasing their recovery were considered:

1. Modifying deployment and retrieval patterns to reduce the likelihood of loss and stranding;
2. Increased purse-seine responsibility for retrieval prior to abandonment, loss or stranding, which could include higher collaboration between fishing companies and fleets;
3. Chartering or purchasing of dedicated “cleaning” vessels to retrieve dFADs in identified hotspots at the edge of the purse-seine fishing grounds;
4. Recovery by existing vessels operating outside the purse-seine fishing grounds (such as longliners); and
5. Shore-based recovery programmes designed to intercept dFADs before stranding events occur.

The analysis is based on two key assumptions.

First, options 2 to 5 rely on the assumption that positions of dFADs considered lost (i.e., outside their operational fishing grounds) by the owner fishing company would be shared with retrieval programmes or third-party organisations. Retrieval operations are therefore assumed to be coordinated using known dFAD positions rather than relying on opportunistic encounters. Implementing such an approach in practice would require the development of a regional coordination framework, which is beyond the scope of the present study.

Second, options 3, 4 and 5 assume that retrieval would be incentivised through a financial reward. The economic analysis estimates retrieval cost per dFAD, which provides a basis for estimating the relevant reward that could be considered. Option 4 estimates the potential financial incentive that would be paid to longline (or another vessel type) undertaking retrieval operations; while option 5 estimates the financial incentive to be provided to government or local partners / communities. Finally, option 3 estimates the overall financial contribution required to retrieve dFADs with a cleaning vessel, which would be used to finance the operational and fixed costs of such vessel.

A multi-component analytical approach was applied in this study (Figure 1):

1. **A literature review** was compiled, with all known information regarding the five mitigation options which guided the structure of this study. Available economic data on purse-seine and longline vessels and potential dFAD cleaning vessels were reviewed.
2. **Stakeholder consultations**, conducted through both general and stakeholder-specific surveys were used to capture perspectives on the feasibility, operational considerations, and potential barriers associated with different mitigation options.
3. **Case study investigations**, that examined existing initiatives for mitigating dFAD loss or facilitating their retrieval revealed practical examples, implementation challenges, and lessons learned.
4. **Analyses of WCPO dFAD tracking data** revealed dFAD presence, drift, loss and stranding on the WCPO.
5. **Economic modelling** was developed to estimate the potential costs and logistical feasibility associated with implementing selected mitigation options.

Figure 1. Conceptual framework illustrating the analytical approach used to investigate and assess dFAD mitigation options.

Stakeholder consultations and case study investigations provided independent insights into operational feasibility and existing practices. They also informed key assumptions within the economic modelling component (Figure 1). The multi-component methodology enabled two approaches for estimating dFAD recovery programme costs: i) willingness to pay; and ii) cost of production. In the first, stakeholder consultations collated participant views regarding how much they would accept to retrieve a dFAD (reward in case of options 3 to 5; overall cost incurred in terms of option 2). Secondly, a "bottom-up" economic production cost approach for recovering dFADs was used.

2.1.Literature review

Available economic data on purse-seine and longline vessels and potential dFAD cleaning vessels (converted fishing and supply boats) were reviewed as part of the literature review and preliminary data analysis phase. Data were sought from key regional organisations including FFA, PNA, WCPFC, and SPC, alongside published literature and technical reports to understand the population of potential dFAD cleaning vessels, existing vessels used as dFAD cleaning vessels (Figures S1 to S3) as well as the distribution of sizes of purse-seiners and longliners (IATTC, 2026; PNA, 2026; WCPFC, 2026). While some published information exists on dFAD deployments, trajectories and fates (Escalle et al., 2023), publicly available economic data on vessel operations in the WCPO are limited.

2.2. Stakeholder Consultation

A stakeholder consultation was conducted to gather perspectives on the operational feasibility, potential costs and implementation challenges associated with the five mitigation options considered. A tiered survey approach was used to capture both broad perspectives across the dFAD fishing and broader purse-seine industry and more detailed operational insights from stakeholders directly involved in dFAD deployment, use, and retrieval activities. This approach included a general stakeholder survey followed by stakeholder-specific surveys, with questionnaires tailored to particular groups corresponding to the five different mitigation options.

The general stakeholder survey was designed to capture high-level perspectives on the drivers of dFAD loss and abandonment, perceived feasibility and cost-effectiveness of mitigation options, and potential regulatory, logistical, or economic barriers to implementation. This survey was distributed electronically and remained open for responses for approximately 6 months between May to October 2025 (Escalle et al., 2025). During this time numerous communications were sent to stakeholder groups asking for their participation and for them to forward the survey to colleagues and members of their respective teams.

Stakeholder-specific surveys were administered to gather more detailed operational insights from groups with direct experience relevant to particular mitigation options. These surveys targeted four stakeholder groups:

- Purse-seine company managers and skippers, who provided insights on retrieval of dFADs by purse-seine vessels prior to dFAD loss or abandonment.
- Longline company managers and skippers, who provided insights on at-sea collection by non-purse-seine vessels already present at-sea.
- Local partners, who provided perspectives on shore-based dFAD retrieval initiatives such as dFAD watch programmes, including those implemented or potentially of interest.
- Artisanal fishers, who provided practical insights into community-level engagement and the feasibility of nearshore dFAD retrieval efforts.

Responses to the stakeholder-specific survey were collected from across the Pacific to capture perspectives from a range of operational and geographic contexts within the region[1]. In many cases, these surveys were conducted during in-country workshops, where SPC project staff worked through the survey questions with stakeholders. This approach helped facilitate participation, clarify questions where needed, and ensure consistent interpretation of survey responses. Some stakeholder-specific survey instruments were adapted from earlier surveys previously developed and distributed by SPC. Where minor differences existed between earlier and more recent survey versions, questions were harmonized during analysis to ensure responses could be compared across the different survey efforts.

Survey responses were compiled and analysed to examine stakeholder perspectives on the mitigation options, including perceptions of feasibility, cost-effectiveness, and potential implementation challenges. Where relevant, responses were compared across stakeholder groups to identify patterns of interest across stakeholder perspectives.

2.3. Case Studies

Existing and emerging dFAD retrieval programmes were reviewed to provide real-world context on implementation approaches, operational constraints, lessons learned, and associated costs. These case studies provided insights into how retrieval initiatives had been designed and implemented in practice and in some cases offered empirical reference points for interpreting the feasibility and economic implications of the strategies assessed in this study.

The case studies selected represented a range of geographic regions, programme structures, and retrieval mechanisms, including industry-led initiatives, community-based programmes, and government-supported recovery schemes. The following case studies were summarised following discussions with partners involved in each case:

- dFAD retrieval and marine debris management in Australia - Tangaroa Blue Foundation
- Palmyra Atoll FAD Watch Program[2] - The Nature Conservancy (TNC)
- The Hawai'i's integrated derelict fishing gear retrieval and recycling programme - The Hawaiian Center for Marine Debris Research (CMDR)
- Seychelles FAD Watch[2] as a prevention and retrieval system - Seychelles Fisheries Authority (SFA) and the purse-seine industry
- Galápagos Islands industry-led interception and recovery of dFADs – TUNACONS
- French Polynesia community-based dFAD monitoring as a foundation for FAD Watch - Direction des Resources Marines (DRM)
- Solomon Islands industry-led recovery planning for dFADs - National Fisheries Development Ltd (NFD).

Information for each case study was compiled through a combination of published literature, programme documentation and discussion with case study partners. Particular attention was given to

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[1] Six surveys were carried out during the study period with purse-seiners in Ghana. These were undertaken opportunistically during related consultations and were included to increase the number of responses from purse-seine.

[2] A FAD Watch program is a collaborative initiative in which participating fishing companies share the positions of their dFADs with the programme. When a dFAD enters a predefined geofenced area, an alert is triggered so that recovery can be coordinated before the dFAD reaches sensitive coastal habitats, such as reefs, islands, or beaches.

operational design, retrieval logistics, and, where possible, the economic structure of each programme. Existing initiatives reported economic outcomes using different approaches; therefore, collating a harmonized, standardized set of core economic metrics across all cases was not possible.

In addition, since May 2023, SPC has been leading a project, in collaboration with purse-seine companies (the American Tunaboat Association, Caroline Fisheries Corporation and Trimarine) and local organisations, to monitor buoys outside fishing grounds and trial pilot dFAD watch projects wherever possible (Escalle et al., 2026c). Four pilot dFAD watch projects have been implemented in the following areas: Hawaii (with the support from TNC and the CMDR); French Polynesia (Direction des Ressources Marines); Australia (Tangaroa Blue Foundation) and Aitutaki in the Cook Islands (Aitutaki FAD watch, respectively). Economic information was collected, where possible, for the 23 successful dFAD recoveries to date (9% of all the buoys monitored). Operational costs were considered based on parameters and costs from real dFAD recoveries (see section 2.5.5).

2.4. Spatial analysis of dFAD loss, abandonment and stranding

A key spatial component of the analysis involved identifying areas where dFAD loss, abandonment and stranding are most likely to occur. The most recent complete years of dFAD tracking data available at SPC (2023 and 2024) were used to estimate the total number of dFADs transiting or with a final position (last received position before deactivation) in specific spatial areas (options 2 to 4) and country-specific buffers (option 5).

Patterns of dFAD loss and abandonment (i.e. last position outside the fishing grounds; Figure 2) were identified based on the last recorded positions of dFADs before deactivation located outside the WCPO purse-seine fishing grounds (defined as 10°N–10°S) in 2023 and 2024. These patterns were used to delineate spatial “hotspots” representing areas of concentrated loss and abandonment, which in turn informed the definition of operational zones where offshore vessels (e.g., purse-seiners, longliners, or dedicated cleaning vessels) could potentially undertake retrieval activities.

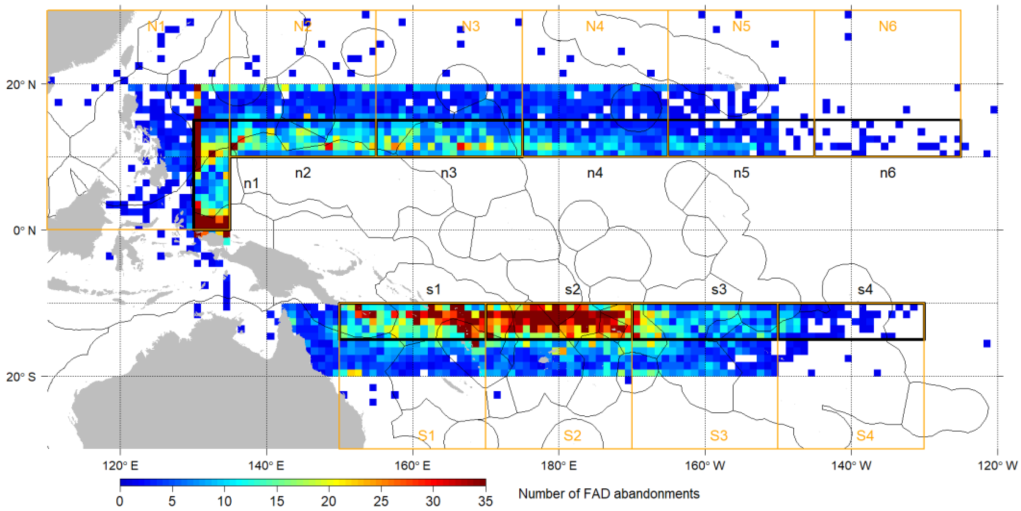

Figure 2. Location of last position of dFADs outside the main WCPO purse-seine fishing grounds using 2023 and 2024 dFAD tracking data. Restricted hotspots (black boxes) were used in option 3, while larger hotspots areas (orange boxes) were used for options 2 and 4.

DFAD tracking data were analysed to estimate the number of dFADs transiting within each abandonment hotspot in 2024, providing the basis for the economic analysis (Table 1 and Figure 3). To avoid double counting potential recoveries, when a dFAD first reached a hotspot, it was then considered as retrieved and did not count in a further hotspot that it might have reached in its following trajectory.

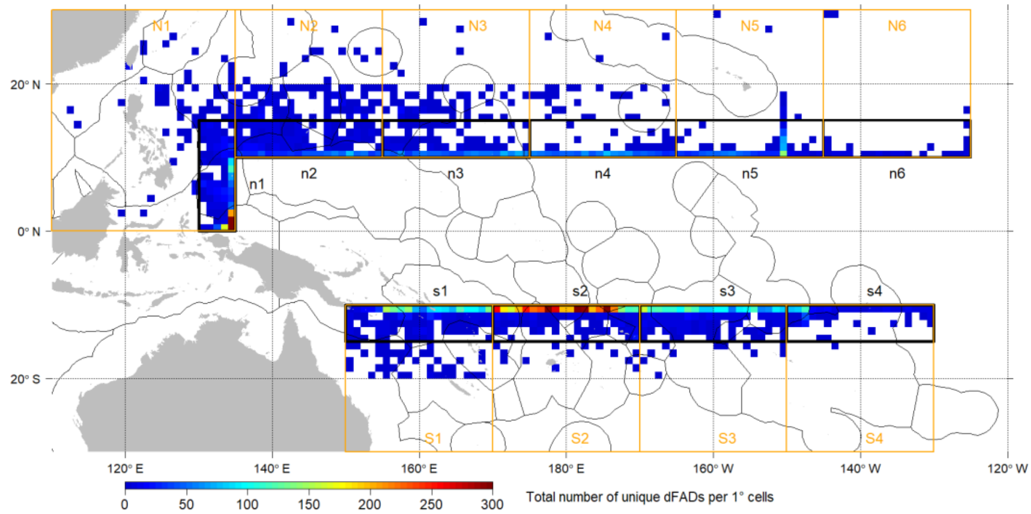

Figure 3. Number of unique dFADs transits outside the main WCPO purse-seine fishing grounds, using 2024 dFAD tracking data. Hotspot areas used for the cleaning vessel scenario (black line; n1 to s4) and extended hotspot areas used for the purse-seine and longline dFAD recovery scenarios (orange line; N1 to S4).

Table 1. Total number of unique dFAD transits by hotspot in 2024 based on dFAD tracking data available at SPC (total unique number of dFADs in 2024 of 42,072).

Extended hotspot areas	Total number of dFADs	Minimum inter-FAD distance /day (nm)	Hotspot areas	Total number of dFADs
n1	2,331	13.1	N1	2,364
n2	1,029	19.7	N2	1,153
n3	1,063	18.1	N3	1,098
n4	925	20.4	N4	957
n5	832	24.2	N5	850
n6	50	183.9	N6	59
s1	1,741	11.6	S1	1,775
s2	4,466	9.68	S2	4,479
s3	2,089	12.2	S3	2,095
s4	460	29.1	S4	461

The number of dFADs present within 6nm and 12nm of PICT coastlines or ports was also evaluated using the 2024 dFAD tracking data to account for potential recovery in the shored-based dFAD retrieval programme scenario (Figure 4).

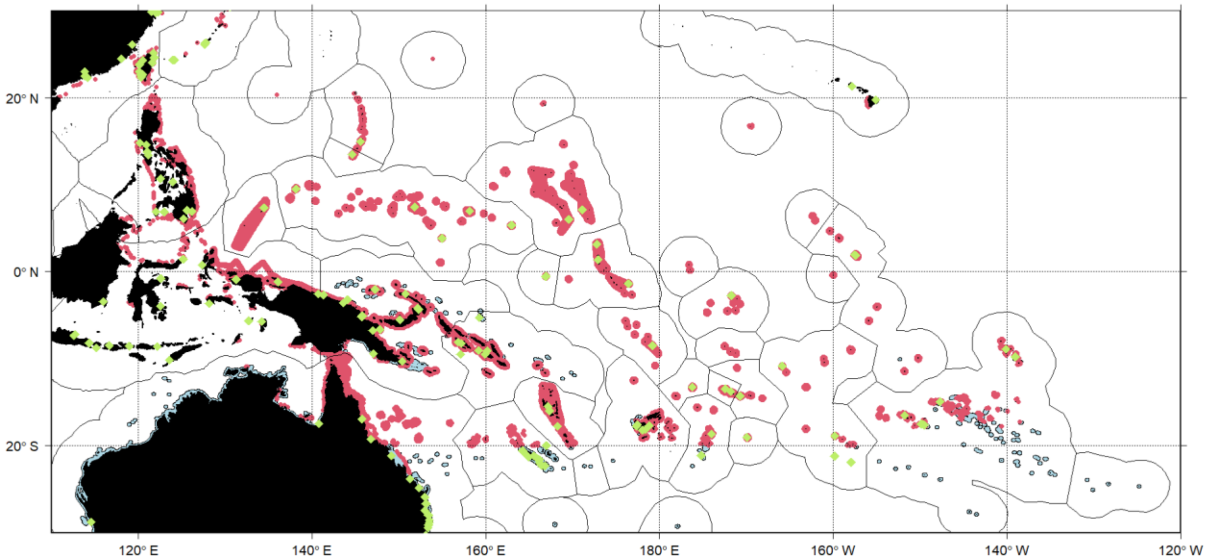

Figure 4. Location of dFADs within 12nm from shore using 2024 dFAD tracking data (red) and ports considered in the shored-based dFAD retrieval programme scenario (green diamond).

2.5. Economic modelling

An economic modelling framework was developed to estimate the costs of the dFAD retrieval options. The framework considered retrieval-based mitigation options only (options 2 to 5), while the first option to modify dFAD deployment and retrieval patterns simply considered numbers of loss, abandonment and stranding that could be avoided. Operational costs were estimated using assumptions regarding each option's total costs to recover all or a certain % of dFADs present; and the cost per dFAD recovered[3].

The costs that could be considered included:

- Fixed costs (capital and/or refit costs, insurance, coms, berthing, repairs and maintenance).
- Variable costs, which are mostly fuel, crew costs, and provisions.
- Transaction costs (costs of negotiation and organising different solutions; monitoring and enforcing compliance) – these are not considered in our study but would be important to account in the development of regional mechanisms for dFAD recovery programmes.

Depending on the option considered some or all of these costs were considered. Across most mitigation options, fuel consumption (and lubricants and auxiliary systems) represented the primary cost component. Cost estimates are likely to be conservative operational cost estimates. For the dedicated /chartered vessel(s) option, crew hire and berthing costs were included to capture the vessel's full operations[4].

Fuel and petrol cost data for major ports across the Pacific Ocean were collected from publicly available sources, including technical reports and industry references (Wainibalagi, 2018) and online cost data accessed on November 2025 (Bunker Index, 2026; Rhino Car Hire, 2026; Ship & Bunker, 2026). This data was used to establish port-specific fuel costs across the Pacific (Table S1). Expert

[3] For the dedicated / chartered vessel(s) for at-sea collection option additional outputs were generated, including number of dFADs collected by a single vessel in a year and number vessels needed to recover a certain % of dFADs in each hotspot.

[4] See Dedicated or chartered cleaning vessel(s) for at-sea collection.

stakeholders reviewed the cost estimates (industry stakeholders, personal communication). Fuel price estimates were inferred for ports lacking publicly available information based on their level of industrial development and complexity.

Berthing costs were similarly estimated from each port's level of industrial development, from A (developed industrial ports) to C (least developed ports). Representative berthing cost ranges were sourced from selected reference port's tariff schedules and from stakeholder consultation. These ranges were subsequently applied across all ports based on their assigned development tier.

2.5.1. Modification of dFAD deployment and retrieval patterns to limit dFAD stranding and loss from fishing grounds

This option investigated the potential dFAD loss, abandonment and stranding linked to dFAD activities occurring at the edge of the purse-seine fishing grounds or close to shore. While difficult to predict in terms of economic aspects and consequences, such an option could be easily implemented (in complement to other options considered) and potentially decrease the level of loss and stranding directly at the source.

DFAD activities recorded by observer data in the most recent years (2023 and 2024) were used to identify deployments and other dFAD activities (set, visit, retrieval) close to shore and at the edge of fishing grounds. The number of deployments within 50 or 100 nm from shore was investigated. Then the number of dFAD activities (set, visits, deployments) occurring at the edge of fishing grounds (defined as below 8°S; above 6°N and west of 145°W) were investigated. These would correspond to activities, in terms of visits and sets, that would still occur but where the dFAD may not be put back in the water afterwards given the likelihood of it getting lost.

2.5.2. A greater emphasis on retrieval by purse-seine vessels

Opportunistic purse-seine vessel dFAD retrieval costs were estimated by combining vessel tracking data with dFAD trajectory data to identify when vessels transited within dFAD hotspots areas for potential recovery. Given the opportunistic nature of retrieval from purse-seine transiting, larger areas of dFAD abandonment hotspots were considered (Table 1). Due to time and data processing constraints, the analysis was conducted using a subset of vessels. For each hotspot, the five vessels with the highest transit activity were identified using Vessel Monitoring System (VMS) data and their tracks from 2024 were downloaded from Global Fishing Watch (GFW). To maximize the amount of data available for analysis, vessel tracks from all selected vessels across hotspots were pooled and used in the subsequent analysis.

Vessel tracks were filtered to include only transit periods when opportunistic retrieval could occur, specifically movements from the last fishing event to port, and from port to the first fishing event. These segments represent periods when vessels are not actively fishing and may have operational flexibility to recover dFADs (Figure 3). Based on stakeholder consultations, in particular industry representatives, a 20 nm buffer was applied around vessel tracks to represent the maximum distance purse-seiners are typically willing to deviate from their usual transit route to recover a dFAD.

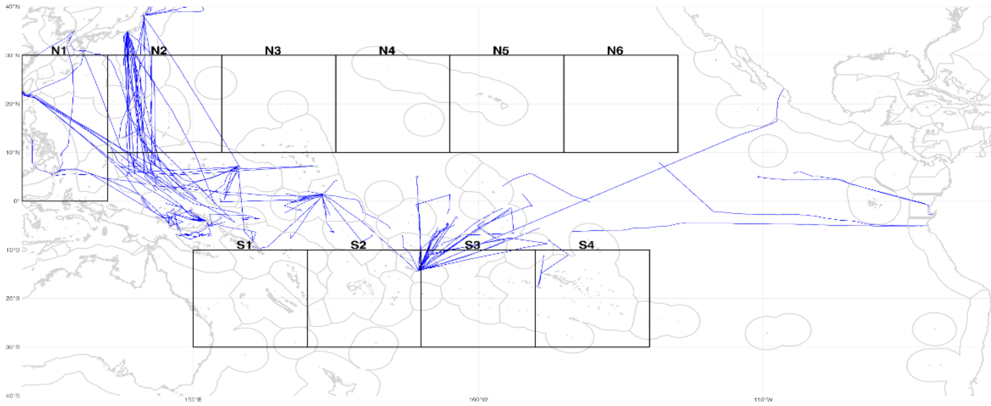

Figure 3. Map of vessel tracks from the subset of 5 purse-seine vessels identified to have the highest transit activity within each of the hotspots (N1–N6, S1–S4). Vessel tracks include only transit periods when opportunistic retrieval could occur by purse-seiners, specifically movements from the last fishing event to port and from port to the first fishing event.

Buffered vessel tracks were then tallied within each hotspot by date and 1° spatial grid cell and matched with dFAD tracking data by date and grid cell. This process identified the number of dFADs present in cells on days when at least one purse-seine transit track occurred. Once a dFAD was matched, it was removed from subsequent analysis to avoid double counting.

Purse-seine vessels are limited in the number of dFADs they can recover during a given transit period[5]; therefore, two retrieval scenarios were evaluated at the day-by-cell level:

- Minimum retrieval scenario: a vessel can recover **one** dFAD per day per grid cell
- Maximum retrieval scenario: a vessel can recover **three** dFADs per day per grid cell

These retrieval estimates were subsequently aggregated across cells and dates within each hotspot, allowing comparisons between the potential number of dFADs that could be opportunistically recovered and the total number of dFADs present in cells and days with at least one vessel transit track (Figure 4, Table 2).

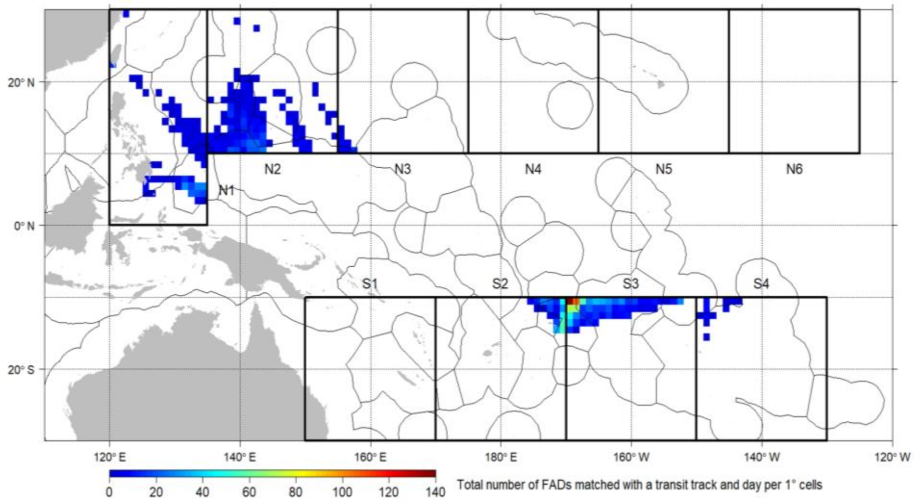

Figure 4. Map of total number of abandoned dFADs that match with purse-seine vessel tracks by day and 1° grid cell in each hotspot (N1-N6 and S1-S4).

[5] Model assumption not informed by industry or other stakeholders.

Table 2. Minimum and maximum dFAD retrieval by purse-seine vessels (based on the top 5 vessels per hotspot only), and the total number of dFADs present in cells and days with at least one vessel track, summarized by hotspot.

Hotspot	Minimum dFADs picked up	Maximum dFADs picked up	Total dFADs present in a cell and day with at least one track
N1	115	186	272
N2	257	424	491
N3	7	18	34
N4	0	0	0
N5	0	0	0
S1	0	0	0
S2	0	0	0
S3	82	172	352
S4	219	513	980
S5	11	20	29
Total	**312**	**705**	**1,361**

Operational costs were estimated using representative purse-seine vessel operating expenditure parameters based around fuel costs (to cover the distance outside of their route to recover a dFAD) for different vessel size-to-engine sizes. Fuel costs were evaluated using low and high marine fuel price scenarios of approximately USD 750 per tonne and USD 1,400 per tonne, respectively (Table S1). Additional lubrication and auxiliary (generator) fuel consumption was incorporated as an uplift of 15–20% of total fuel costs. This is consistent with published estimates indicating that auxiliary engines and onboard energy demands can account for approximately 10–30% of total fuel consumption in fishing vessels, with lubrication oil contributing a smaller but non-negligible additional cost (Chassot et al., 2021; Prado, 1990).

Fuel consumption for purse-seine vessels was assumed to be approximately 32 litres per nautical mile (L/nm). This estimate was derived through triangulation of published fuel consumption data for tuna purse-seine fisheries (Basurko et al., 2016, 2022; Chassot et al., 2021; Hospido and Tyedmers, 2005), combined with typical transit speeds of 10–15 knots (J. Muir, personal communication) and reported daily fuel use of approximately 7,000 - 10,000 litres (J. Muir, personal communication). These values correspond to a literature-supported range of approximately 20–40 L/nm (Basurko et al., 2016, 2022; Chassot et al., 2021; Hospido and Tyedmers, 2005), placing the adopted assumption (32 L/nm) within a realistic mid-to-upper range. This approach reflects the absence of a single standardized fuel consumption metric expressed in L/nm in the literature and instead applies a conversion from established fuel-use and vessel performance data. The distance associated with recovering a dFAD was approximated as 20 nautical miles and used as a standardized estimate of the additional travel required to reach and recover a dFAD within a cell. This does not factor in human intelligence and decision making, sea state and weather which will impact the fuel cost estimates.

2.5.3. Dedicated or chartered cleaning vessel(s) for at-sea collection

To estimate the costs associated with dFAD retrieval using dedicated or chartered cleaning vessel(s), recovery operations originating from 26 ports distributed across the Pacific (Figure 5 and Table S1) were modelled. These ports were assumed to serve as potential base-ports for cleaning vessels targeting the different identified dFAD hotspot areas. The selection of ports was based on their established role within regional tuna fisheries and broader maritime operations, drawing on a combination of:

- known longline and purse-seine landing and transhipment locations across FFA member countries (i.e., to align with locations identified in operational practice as primary or secondary nodes in tuna fishing supply chains);
- operational logistics hubs commonly used for provisioning, refuelling, and crew changes;
- geographic distribution to ensure coverage across key subregions of the WCPO; and
- practical experience and industry knowledge of active fishing ports and anchor points for offshore operations.

The resulting set of 26 ports therefore represent a realistic and operationally relevant network of home-port options for potential dFAD cleaning vessel(s). This approach allows the analysis to capture the spatial variability in response distances, fuel costs, and logistical feasibility associated with dFAD retrieval operations across the Pacific.

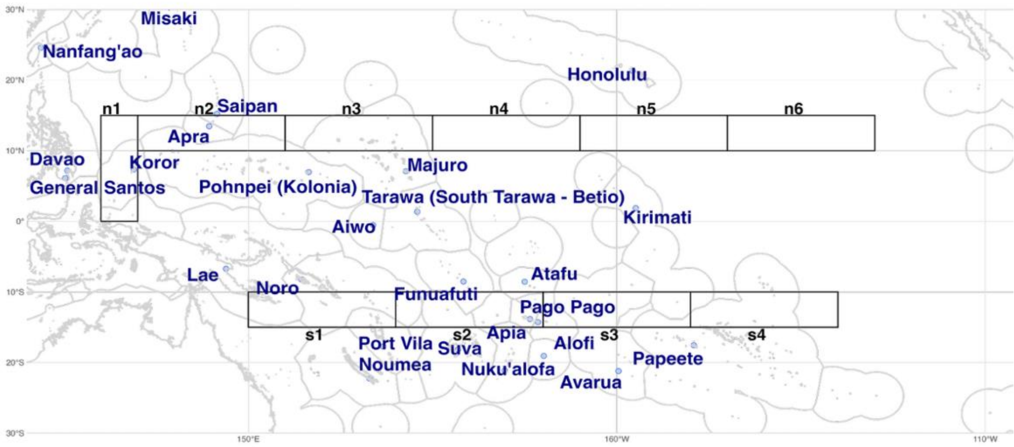

Figure 5. Major ports across the Pacific assumed as potential base-ports for cleaning vessels dedicated to dFAD retrieval operations servicing identified hotspots across the region. Ports are labelled in blue. Boxes depict the hotspots considered for the dedicated vessel for at-sea collection economic analysis (n1–n6 and s1–s4).

The number of abandoned dFADs occurring within each hotspot was calculated using the SPC dFAD tracking data. It provided the basis for the economic analysis under this retrieval scenario (Table 1).

For each port–hotspot combination, transit distance was calculated as the distance between the port and the centroid of each hotspot. Table 3 separately lists the closest port(s) and closest port(s) with purse-seine transhipment for each hotspot considered. In addition to transit distance, a search distance was applied to each dFAD recovered using the average inter-FAD distance per day per hotspot calculated using the 2024 dFAD tracking data (Table 1). Each search distance was informed by the density of dFADs within each hotspot. Therefore, cells with more dFADs present had a shorter search distance compared to those with fewer dFADs.

Table 3. Distance between each hotspot centroid and any closest port or purse-seine (PS) port.

Hotspot	Closest port(s)	Distance (nm) port - centroid	Closest PS port(s)	Distance (nm) port - centroid
n1	Koror (Palau) Davao (PH)	118 420	General Santos (PH)	444
n2	Apra (GU) Saipan (MP)	50 158	Pohnpei (FM)	853
n3	Majuro (MH) Pohnpei (FM)	505 528	Majuro (MH) Pohnpei (FM)	505 528
n4	Majuro (MH) Tarawa (KI)	872 989	Majuro (MH) Tarawa (KI)	872 989
n5	Honolulu (HW)	543	Kiritimati (KI)	665
n6	Honolulu (HW)	1,409	Kiritimati (KI)	1,483
s1	Noro (SB) Port Vila (VU) Noumea (NC)	314 569 684	Noro (SB) Lae (PG)	314 849
s2	Funafuti (TV) Suva (FJ) Apia (WS)	254 339 486	Funafuti (TV) Pago Pago (AS)	254 551
s3	Avarua (CK) Pago Pago (AS) Papeete (FP)	512 632 672	Pago Pago (AS)	632
s4	Papeete (FP)	626	Kiritimati (KI)	1357

Three vessel scenarios (Table 4 and S3) were simulated to represent a range of operational capacities:

- the Solomon Searcher, which is a renovated pole and line and now FAD support, recovery and tuna tagging and research vessel operating in the Pacific Ocean;
- an Atlantic Ocean supply vessel used to support a purse-seine vessel; and
- the Saya de Malha, an ex-longliner now coast guard auxiliary vessel also operating as a dFAD collecting platform in the Indian Ocean.

These scenarios differed in retrieval capacity and maximum daily travel and fuel consumption (Table **4**4 and S3). In the simulation, once a vessel reached a hotspot, it was assumed to recover dFADs until onboard storage capacity was reached (minimum or maximum scenario), after which the vessel returned to port to unload before beginning a new retrieval trip until all dFADs in a given hotspot are retrieved.

Operational costs were estimated using vessel specific operational parameters (Tables 4 and S3), and incorporating fuel, berthing, and crew costs (Equation *1*). Fuel costs were calculated using port-specific marine gas oil (MGO) prices accessed in November 2025 (Bunker Index, 2026; Rhino Car Hire, 2026; Ship & Bunker, 2026; Wainibalagi, 2018), with low and high price scenarios ranging from approximately USD 750–1,400 per tonne (Table S1). Lubrication and generator fuel consumption were incorporated as an additional 15–20% increase in fuel costs (as suggested by several skippers both during the stakeholder consultation and in post-survey interview follow-ups). Additional operating costs included port-specific berthing fees ranging from 0 to 900 USD per day (Table S1), reflecting tiered pricing structures across ports. Finally, crew salary costs were assumed to be of USD 650 to

1,167 per day (from cost associated with each vessel, Tables 4 and S2). Alternatively, a crew structure with a skipper, first mate, engineer and 5 crew could be considered with crew cost of USD 1,570 per day (following D. Boulle; M. Herrera; J. Lynch; and A. Read, personal communication). These cost components were applied within the simulation framework (Equation 1) to estimate total operational costs and derive key economic metrics, including the total cost required to retrieve all dFADs within each hotspot, cost per dFAD recovered, the number of dFADs collected by a single vessel per year, and the number of vessels required to recover all dFADs in a year.

$$\boldsymbol{Operating\ costs\ =\ Fuel\ +\ Lubrication\ +\ Berthing\ +Crew\ Salary\ +Provisions}$$

Equation 1. Operating costs considered to estimate total costs associated with dFAD retrieval using dedicated or chartered vessels.

Table 4. Three dedicated vessels for at-sea collection and their operational parameters used in the economic modelling, including minimum and maximum dFAD storage capacity, maximum distance travelled per day (in nm) and daily fuel burn (in L/day). These represent the variables used to derive cost estimates in this dFAD cleaning vessel scenario (see more details in Table S2).

	Atlantic Ocean supply vessel	**Saya de Malha**	**Solomon Searcher**	**Type of cost in Equation 1**
Size (LOA)	31m	41m	38m	
Number of crew onboard	7–9 core	30 core & science	8–12 core 6–10 science	
dFAD storage onboard minimum	70	150	50	*Storage*
dFAD storage onboard maximum	200	300	200	*Storage*
Cruising speed (knots)	8	13	11	
Maximum distance travelled per day (nm)	192	312	240	
Fuel burn per day (L/day)	2,240	3,920	2,000	
Fuel cost per day minimum - port specific (USD)	875	819	1,500	*Fuel*
Fuel cost per day maximum - port specific (USD)	1,634	1,529	2,800	*Fuel*
Lubrication (surcharge)	15–20%	15–20%	15–20%	*Lubrication*
Berthing - port specific (USD / day)	0–900	0–900	0–900	*Berthing*
Crew salary - vessel specific (USD / day)	1,167	650	740	*Crew salary*
Crew salary alternative - standard industrial vessel crew structure (USD / day)	1,570	1,570	1,570	
Provisions (USD / day)	~500 / day	720 / day	~530 / day	*Provisions*

Estimates for vessel specifications were provided via personal communication: Solomon Searcher (J. Muir and R. Dunham), Atlantic Ocean tuna supply vessel (M. Herrera), and Saya de Malha (D. Boulle). All values reflect best estimates at the time of writing.

Each operating costs were calculated for the following scenarios:

- low fuel and low berthing; and minimum dFAD onboard storage
- low fuel and low berthing; and maximum dFAD onboard storage
- high fuel and high berthing; and minimum dFAD onboard storage
- high fuel and high berthing; and maximum dFAD onboard storage

In addition to operating costs, this scenario would require the charter, purchase and/or refurbishment of vessels specifically for dFAD retrieval, unlike other scenarios that rely on existing vessels. As a result, additional costs would need to be considered, which vary significantly depending on whether a new vessel is commissioned, an existing hull is refurbished, or a vessel is chartered. These costs would also include ongoing expenses associated with vessel management such as insurance, port fees, and routine maintenance (Tables 5 and S2). For the 3 vessels considered these additional fixed and other costs ranged from 300,000 USD to 480,000 USD per year (Table S3), but general estimates are also provided in Table 5, as a comparison.

Table 5. Estimated cost ranges associated with the acquisition, refurbishment, chartering, and annual operation of vessels that could potentially be used for dFAD retrieval operations across broad level vessel size classes. See Table S3 for indicative vessel size class definitions.

Cost category	Indicative estimate (USD)	Caveats / considerations
Purchase / acquisition		
A- Small/local vessel	Not consistently available / context-specific	Likely to involve locally available vessels rather than purpose-built dFAD recovery vessels.
B- Mid-size vessel	~ 4,700,000–10,000,000 (used[6]) 3,700,000-21,000,000 (new)	Used vessel market; price varies heavily by age, condition, gear, freezing capacity, flag/class, and location. Estimates from new mid-size vessel based on French Polynesia longliners (Hare, 2023)
C- Large industrial tuna fishing or support vessel	~ 5,000,000–15,000,000 (used[6]) ~ 15,000,000–35,000,000+ (new)	Large purse-seine/support vessels; used price varies heavily by age, condition, gear, freezing capacity, flag/class, and location. New-build or very modern vessels will be at the higher end of this range.
Major refurbishment / conversion		
A- Small/local vessel	Not consistently available / context-specific	Scope-dependent; may include dry dock, engine work, deck modifications, crane/winch, safety upgrades, storage, and dFAD handling equipment.
B- Mid-size offshore-capable vessel	~ 1,600,000–3,000,000+	Scope-dependent; may include dry dock, engine work, deck modifications, crane/winch, safety upgrades, storage, and dFAD handling equipment.
C- Large industrial tuna fishing or support vessel	~ 3,000,000–6,000,000+	Scope-dependent; may include dry dock, engine work, deck modifications, crane/winch, safety upgrades, storage, and dFAD handling equipment.
Dedicated charter / service contract (per campaign of 1-3 months)[7]		
A- Small/local vessel	~ 50,000–200,000 per campaign	Costs depend heavily on whether the vessel is already operating locally, number of sea days, fuel, crew, safety equipment, mobilisation, and whether payment is on a day-rate, retainer, or task-based basis.
B- Mid-size offshore-capable vessel	~250,000–900,000 per campaign	Costs depend on vessel days, fuel, crew, mobilisation, insurance, port fees, steaming distance, and whether the

[6] As an indicative planning assumption, second-hand acquisition costs may be treated as approximately 40-60% of equivalent new build costs for a modern, operational vessel in good condition. Older vessels, vessels requiring major refit, or vessels with limited class/survey validity may fall well below this range, while near new or highly specialised vessels may sit above it.

[7] Charter/service-contract estimates are indicative planning-level ranges. A "campaign" is assumed here to mean approximately 1–3 months of retrieval activity, or roughly 20–60 active sea days, depending on mobilisation, weather, port calls, steaming distance, and the number/location of dFADs targeted. Actual costs may vary substantially depending on vessel class, fuel prices, crew requirements, insurance, port fees, mobilisation distance, standby days, and whether the vessel is locally available or must be brought in from outside the operating area.

		vessel is chartered full-time or used opportunistically between other operations.
C- Large offshore-capable vessel	~ 750,000–1,500,000 per campaign	Reflects a chartered workboat, supply vessel, patrol/research vessel, tuna support vessel, or similar offshore-capable platform. Costs are likely to be dominated by fuel, crew, mobilisation, insurance, port fees, vessel availability, and operating distance. Best treated as an order-of-magnitude planning estimate rather than a fixed market rate.
Annual operating costs		
A- Small/local vessel	~ 120,000–300,000+	Appropriate for limited local or nearshore operations. Best modelled by vessel days, fuel use, steaming distance, crew, maintenance, and utilisation.
B- Mid-size offshore-capable vessel	~ 500,000–1,500,000+ 3,000,000-5,000,000	Best modelled by vessel days, fuel use, steaming distance, crew, maintenance, and utilisation. Estimates of the new SPC research vessel (48m) (SPC-OFP, 2025)
C- Large industrial tuna fishing or support vessel	~ 1,000,000–3,000,000+	Best modelled by vessel days, fuel use, steaming distance, crew, maintenance, and utilisation.

Costs in Table 5 are indicative planning-level estimates rather than vessel-specific quotations. The figures are derived through triangulation across multiple sources, including available vessel-sale listings, market notes, and literature (Atlantic Shipping Ship Brokers, 2026; Basurko et al., 2022; Dan Sea, 2022; Gillett and Fong, 2023; Godfrey, 2020; Martin Associates, 2014), previous industry examples, and consultation/industry knowledge. Where broad published ranges have been split into small, mid-size, and large vessel categories, the resulting bands should be treated as approximate order-of-magnitude estimates rather than directly quoted values from a single source. Costs will vary substantially depending on vessel age, condition, flag/class, shipyard location, equipment specification, freezing/storage capacity, deck layout, lifting gear, crew requirements, fuel use, port fees, insurance, mobilisation, and operating distance.

2.5.4. At-sea collection from non-purse-seine vessels (i.e., longliners) already present at-sea

To provide an initial assessment of the feasibility of at-sea dFAD collection by non-purse-seine vessels, an exploratory screening of longline vessels operating in the Pacific Ocean was undertaken. Vessel registries from the IATTC and the WCPFC were reviewed to characterize and identify vessels with attributes potentially suitable for retrieval operations. Particular attention was given to vessels already engaged in, or closely aligned with, retrieval-related activities. This included support vessels listed in the WCPFC registry (e.g., support vessels, fishery research, and training vessels), as well as vessels within the Hawaii longline fleet known to conduct dFAD recovery among other derelict fishing gear (see Case study of Hawai'i's integrated derelict fishing gear retrieval & recycling programme). These vessels were used to establish a reference profile of operational characteristics associated with retrieval capacity (Figures S1 to S3).

A set of key vessel attributes was compiled, including beam (m), vessel length (m), depth (m), engine power (hp), fish hold capacity (metric tonnes), and gross tonnage (metric tonnes)[8]. These characteristics were then used as a benchmark to screen the broader longline fleet across both registries and identify candidate vessels with similar profiles.

Visual inspection of vessel characteristics suggests that longline vessels flagged to the United States, Costa Rica, and Mexico within the IATTC registry; and to Taiwan, Japan, and China within the WCPFC registry (Figures S2 and S3), show the closest alignment with the profiles of support vessels and the Hawaiʻi longline fleet. These fleets therefore represent the most likely candidates for participation in at-sea dFAD retrieval based on the attributes assessed. In contrast, fishery research and training vessels were generally substantially larger than both support vessels and the Hawaiʻi longline fleet. While these vessels overlapped with the upper range of vessel characteristics observed across the registries, they were considered less representative of typical operational conditions and were therefore visualized for context but not included in direct comparative screening.

Due to time constraints, the analysis at this stage was limited to longline vessels. However, the results provide an initial basis for identifying priority vessel groups that could be further evaluated for participation in dFAD recovery programmes. Future analyses could expand this approach to additional vessel types, such as support vessels and fishery research vessels; focus on longline vessels with characteristics most similar to the Hawaiian longline fleet; and incorporation of more detailed operational and spatial data to refine candidate selection and assess practical feasibility.

The method used to estimate costs associated with retrieval by longliners followed the same analytical framework used for the purse-seine retrieval analysis, as both strategies rely on matching vessel transit tracks with dFAD tracking data to identify potential recovery opportunities. Two modifications were made to reflect the operational characteristics of longline vessels. First, vessel tracks were filtered to include only transit segments from the last fishing event to port, representing periods when longline vessels are returning to port and may have opportunity to deviate from their route to recover drifting dFADs (Figure 6). This differs from the purse-seine analysis, which included both port-to-first fishing event and last fishing event-to-port transit segments. Applying the same analytical framework used for purse-seine vessels, with modifications to reflect longline operational context, the total number of abandoned dFADs matching longline vessel tracks by day and cell in 2024, along with minimum and maximum potential retrieval scenarios were estimated (Figure *7*, Table). Similar to the purse-seine vessel retrieval option, the larger areas of dFADs loss and abandonment hotspots were considered (Table 1). Second, fuel consumption was adjusted to reflect the lower fuel burn typically associated with longline vessels. Fuel consumption was therefore assumed to be 10 L/nm, compared with 32 L/nm used for purse-seine vessels in the previous analysis. This combined typical transit speeds of 8-10 knots and reported daily fuel use of approximately 900 litres (Beverly, 1996; Tyedmers and Parker, 2012; M. Herrera; J. Muir; and A. Reed, personal communication). All other aspects of the analytical approach were the same as the purse-seine retrieval analysis.

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[8] Vessel attributes were compiled from both WCPFC and IATTC registries. While several key characteristics (e.g., beam, vessel, length, depth, engine power, and gross tonnage) were consistently reported across both registries, other attributes (e.g., fish hold capacity) were not uniformly available and were reported only where data were provided.

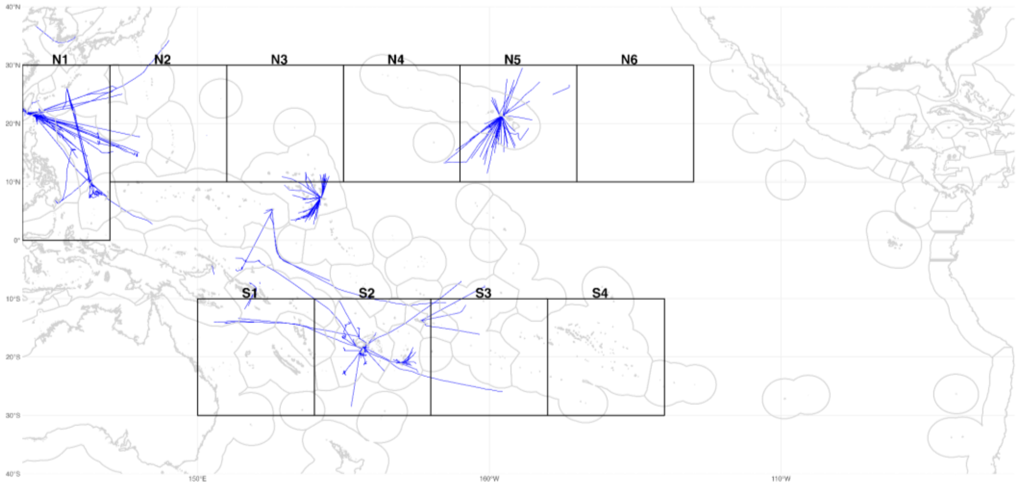

Figure 6. Map of vessel tracks from the subset of longline vessels identified to have the highest transit activity within each of the hotspots (N1-N6, S1-S4). Vessel tracks include only transit periods when opportunistic retrieval could occur by longliners, specifically movements from the last fishing event to port in 2024.

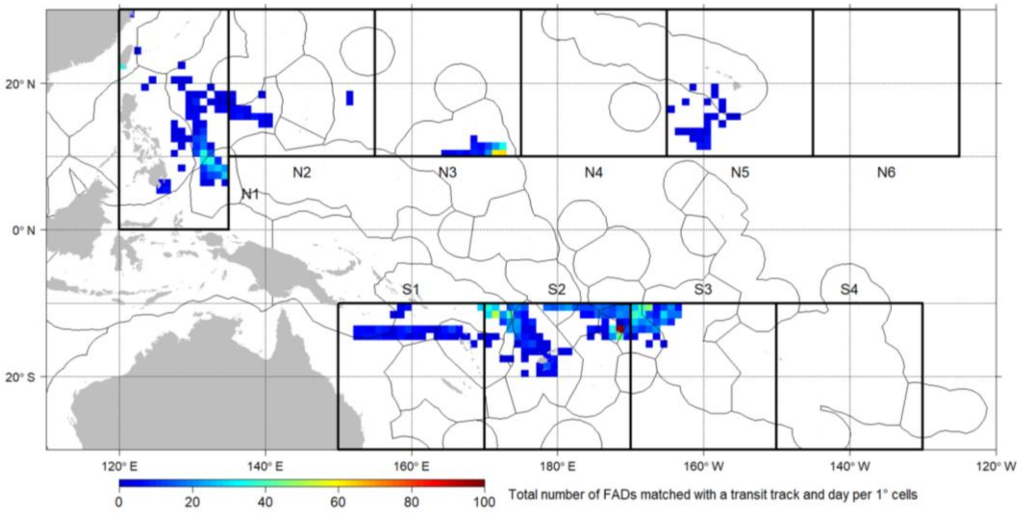

Figure 7. Map of total number abandoned dFADs that match with longline vessel tracks by day and 1° grid cell in each hotspot (N1-N6 and S1-S4) in 2024.

Table 6. Minimum and maximum dFAD retrieval by longline vessels (based on the top 5 vessels per each hotspot only), and the total number of dFADs present in cells and days with at least one vessel track, summarized by hotspot.

Hotspot	Minimum dFADs picked up	Maximum dFADs picked up	Total dFADs present in a cell and day with at least one track
N1	180	306	383
N2	27	43	43
N3	50	126	175
N4	0	0	0
N5	27	44	52
S1	0	0	0
S2	62	114	152

S3	173	365	819
S4	44	120	389
S5	0	0	0
Total	**563**	**1,118**	**2,013**

2.5.5. Shore-based dFAD retrieval programmes

To estimate the potential costs associated with a shore-based dFAD retrieval programme, a spatial and operational cost model was applied. For each PICT, the number of dFADs was aggregated within 6 and 12 nm buffers surrounding ports (including both the major purse-seine ports (Table S1, Figure 5; and local minor ports (Figure 4)) and the national coastline (Table 7). These buffers represent the likely operational range of small community vessels that could be engaged in nearshore dFAD retrieval (corroborated by expert knowledge in the case studies, see section 2.3). For the 12nm buffer scenarios, dFADs located within the purse-seine fishing area (defined as waters between 10°N and 10°S) were excluded. In the purse-seine fishing grounds, shore-based retrieval programmes would focus on intercepting only dFADs posing a direct threat of stranding (hence within 6nm from shore); while outside fishing grounds, removing dFADs would reduce marine pollution, navigation hazard and stranding risk (extending the buffer to 12 nm).

Table 7. Total number of dFADs by country within 6 nm and 12 nm* buffers around corresponding ports and PICT coastlines in 2024, based on dFAD tracking data available at SPC (total unique number of dFADs in 2024 of 42,072). Dashes correspond to the full EEZs or ports within the purse-seine fishing grounds and therefore without retrieval simulated.

Spatial Area	Total number of dFADs			
	6nm		12nm*	
	Port	Coastline	Port	Coastline
American Samoa	62	262	102	399
Australia	0	250	3	281
Cook Islands	81	398	160*	511*
Fiji	6	334	15	464
French Polynesia	0	85	13*	133*
Hawaii	6	8	-*	8
Kiribati Gilbert	2,010	3,767	-*	-*
Kiribati Line	165	601	-*	176*
Kiribati Phoenix	50	1,162	-*	-*
Marshall Islands	127	3,768	-*	767*
Micronesia	2,205	4,063	-*	51*
Nauru	77	1,839	-*	-*
New Caledonia	1	10	1	9
Niue	0	13	10	21
Palau	9	219	40	453
Papua New Guinea	1,149	7,013	4*	108*
Samoa	55	159	124	193
Solomon Islands	654	3,898	-*	1,594*
Tokelau	0	296	-	-
Tonga	1	117	10	84
Tuvalu	467	1,807	-*	154*

Vanuatu	7	464	19	285
Wallis and Futuna	42	164	117	212

**In the 12nm scenario, dFADs located in the purse-seine fishing grounds (defined as waters between 10°N and 10°S) were not accounted for.*

Operational costs were considered based on parameters and costs from real dFAD recoveries as part of pilot dFAD watch projects in Hawaii, French Polynesia, Australia and the Cook Islands in 2025–2026 for vessels of 5–30 m (Table 8). Retrieval distance associated with each recovered dFAD was considered as 31.7 nm for dFADs within a 12nm buffer, which corresponds to the average of the total distance covered during real retrieval activities, and of 16.0 nm for dFADs within a 6nm buffer. This represents the average round-trip travel required for a vessel to reach and recover a dFAD and return to port. Fuel prices were applied using country-specific costs, which ranged from approximately 1.10–2.20 USD per litre across PICTs (Table S1). To account for the higher fuel cost in remote areas, a multiplying factor of 1.5 was applied (see Table 9 for example of fuel per area in Solomon Islands). Fuel consumption was assumed to be 2.0 litres per nautical mile (L/nm) for vessels with smaller engines (HP <200) and 3.0 L/nm for larger engines (HP >200), based on estimates from the trial FAD watch programmes (Table 8). Cost per dFAD recovered were estimated per PICT and assuming the fuel consumption of small and large engines. Total fuel costs were estimated for each scenario, using engine <200HP for within 6nm buffers and engine >200HP for within 12nm, and applied to the number of dFADs within each buffer to generate estimates of total retrieval costs.

Table 8. Economic information linked to dFAD retrieval operation in pilot dFAD watch programmes in Hawaii, French Polynesia, Australia and the Cook Islands in 2025–2026 for vessels of 5–30 m. HP= vessel engine horsepower.

	HP <200	HP >200
Closest distance from shore (straight line) (nm)	6.0	9.6
Total distance covered by the boat for the recovery (way back included) (nm)	30.7	31.7
Fuel use (Gallon or L)	53.4	98.1
Fuel burn (L/nm)	2.0	3.0
Fuel cost for the retrieval (USD)	75.7	128.4

Table 9. Cost of fuel in different location of Solomon Islands in September 2025.

Location	**SBD / L**	**USD / L**	**Factor compared to Honiara**
Honiara	10	1.24	-
Noro	13	1.61	x1.3
Taro	16	1.98	x1.6
In communities (Choiseul)	18-20	2.23-2.48	x1.8–x1

3. Results

3.1. Stakeholder Surveys

Stakeholder perspectives were collected through a combination of a general survey and stakeholder-specific surveys. In total, 87 responses were obtained from the general survey (English and Spanish) and 68 responses from stakeholder-specific surveys conducted across the different stakeholder groups and four languages (English, French, Spanish, and Mandarin) (Table 10).

Table 10. Summary of stakeholder survey responses by survey and stakeholder type.

Survey Type	Stakeholder Type	Number of Responses
General	All	87
Stakeholder-specific	Purse-seine	20
	Longline	16
	Local Partner	29
	Artisanal Fisher	3

While respondents identified a range of actors that should be involved in, and contribute financially to, dFAD recovery programmes (**Error! Reference source not found.**), generally industry stakeholders were most commonly viewed as responsible. Fishing companies were most frequently identified as the primary stakeholders that should both be involved in and contribute to financing recovery efforts, followed by buoy companies and seafood processors (for financing). The local governments and communities, and the general public were the least frequently identified as stakeholders that should be directly involved in, or financing, dFAD recovery programmes.

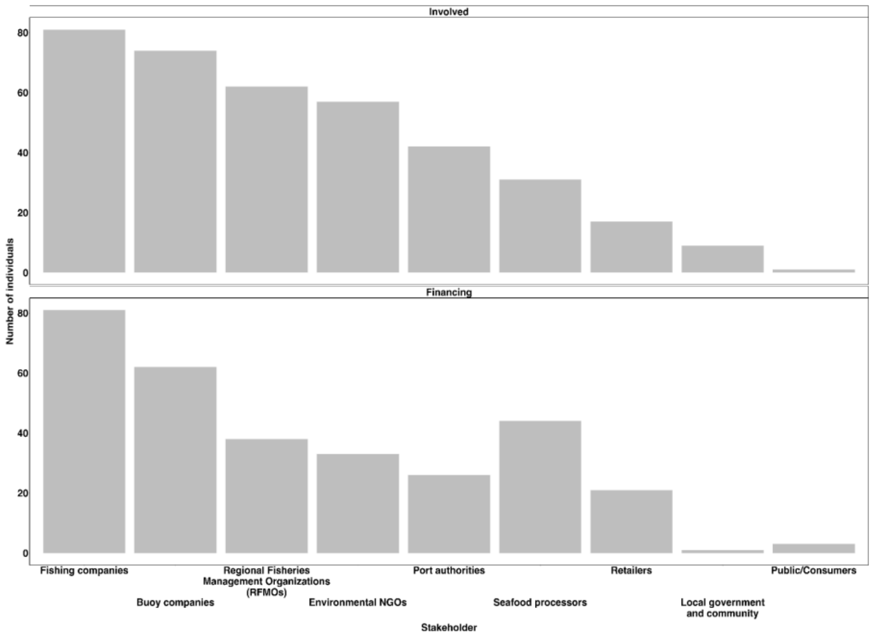

Figure 8. Survey responses indicating stakeholder perceptions of which actors should be involved in (n=83), and contribute financially to (n=82), dFAD recovery programmes. Bars represent the number of respondents selecting each stakeholder group for involvement (top) and financing (bottom).

Respondents were asked to rank the five mitigation options according to perceived feasibility (Figure 8 and S4) and cost-effectiveness (Figure 8 and S5). Rankings were assigned from 1 (least feasible or cost-effective) to 5 (most feasible or cost-effective) for each respondent, and total rank scores were summed across respondents within each stakeholder group. Higher total rank values therefore indicate that a mitigation option was considered more feasible or cost-effective overall for that stakeholder group.

Rankings of mitigation options varied substantially across stakeholder groups, and no single option was consistently identified as the most feasible (Figure S4). Government/RFMO representatives, scientists, and NGO respondents generally ranked increased retrieval by purse-seine vessels, modification of deployment areas, and shore-based recovery systems among the more feasible options, although the relative ordering differed between groups. In contrast, the use of dedicated or chartered vessels and at-sea collection by non-purse-seine vessels were ranked among the less feasible options within these stakeholder groups.

Responses from industry stakeholders showed a different pattern. Purse-seine and longline respondents ranked the shore-based recovery system, the use of dedicated or chartered vessels as the most feasible options, while modification of deployment areas was ranked as least feasible amongst both stakeholder groups. Overall, these results indicate that perceptions of feasibility differed between management, scientific, and industry stakeholders, with industry respondents showing greater preference for operational solutions such as shore-based recovery systems and dedicated cleaning vessels that do not involve or impact their operations.

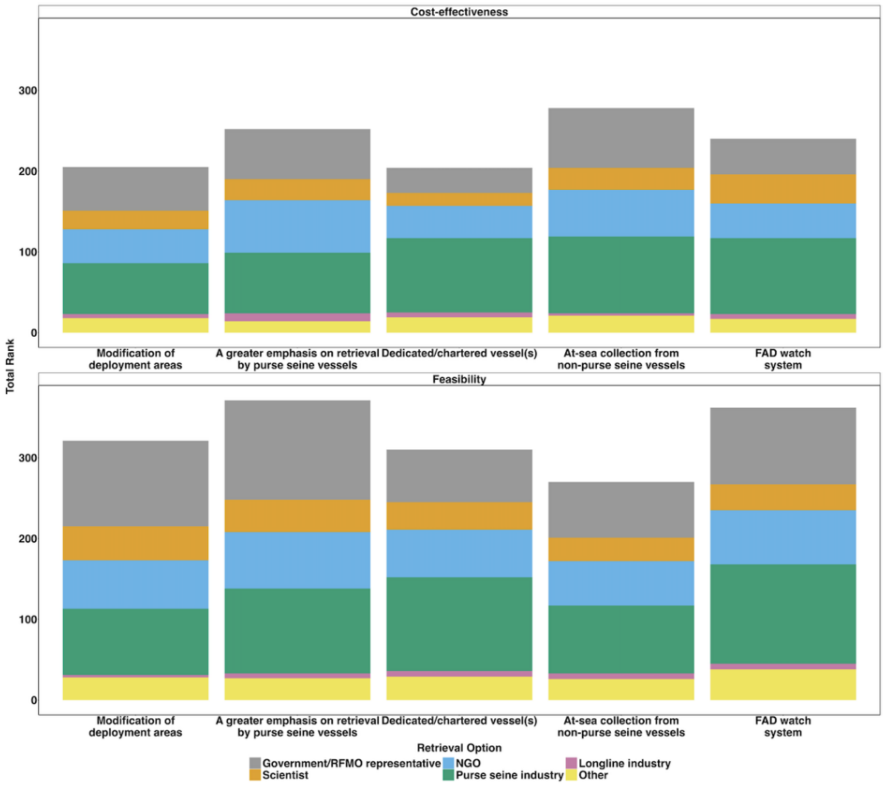

Figure 8. Ranking of mitigation options by perceived cost-effectiveness (top panel) and feasibility (bottom panel) across stakeholders (n=84). Respondents ranked each option from 1 (least cost-effective/feasible) to 5 (most cost-effective/feasible). Bars show the total rank score summed across respondents, with higher bars indicating greater overall perceived cost-effectiveness or feasibility.

Rankings of mitigation options based on perceived cost-effectiveness also varied substantially across stakeholder groups (Figure S5). Government/RFMO representatives, scientists, and NGO respondents generally ranked increased retrieval by purse-seine vessels, retrieval by non-purse-seiners, and shore-based recovery systems among the more cost-effective options, although the relative ordering differed between groups. In contrast, the use of dedicated or chartered vessels was ranked the least feasible option across these stakeholder groups.

Among fishing industry respondents, perceived cost-effectiveness differed depending on the stakeholder group affected by the mitigation option. Longline respondents ranked increased retrieval by purse-seine vessels as the most cost-effective option, while purse-seine respondents ranked at-sea collection from non-purse-seine vessels as the most cost-effective. Conversely, options that would require changes to a respondent's own operations tended to be ranked as less cost-effective. Longline respondents ranked at-sea collection from non-purse-seine vessels the least cost-effective option, while purse-seine respondents ranked modification of deployment areas and increased retrieval by purse-seine vessels among the least cost-effective.

3.1.1. Modification of dFAD deployment areas

Most respondents (n = 51, 59%) considered restricting dFAD deployment to certain areas or periods could reduce dFAD loss, while 15 (17%) respondents indicated that it would not, and 20 (23%) reported that they did not know (Figure 10). Similarly, for dFAD strandings, 46 (53%) respondents indicated that limiting deployment could reduce strandings, compared to 17 (20%) who responded negatively and 23 (27%) who indicated uncertainty (Figure 10). These responses suggest that most stakeholders consider spatial or temporal deployment restrictions to have potential to reduce both loss and strandings, although uncertainty remains among a notable proportion of respondents. However, when considering responses from the purse-seine industry, most responded that they did not know or that restricting dFAD deployment to certain areas or periods would not reduce dFAD loss and dFAD strandings (Figure S6).

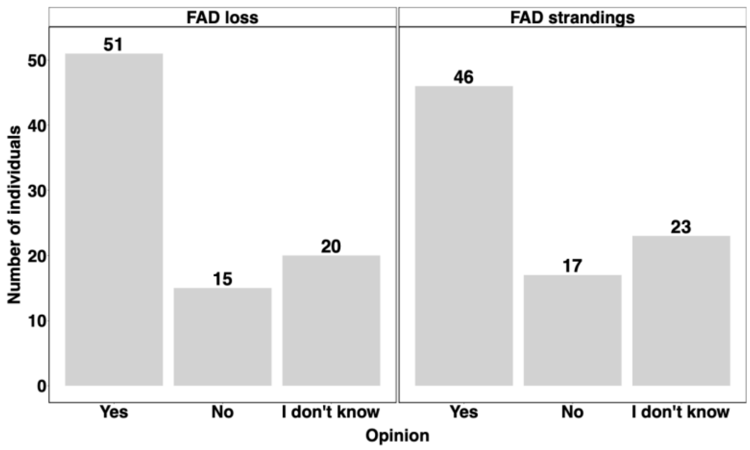

Figure 10. Stakeholder responses (n=86) indicating their opinion on whether restricting dFAD deployment to certain areas or periods could reduce dFAD loss (left panel) and dFAD strandings (right panel).

In regard to where dFAD deployment should be limited to reduce dFAD loss and strandings, responses indicated that areas of concern were concentrated primarily in the equatorial region of the WCPO, with the highest number of selections occurring in grid cells located in the central tropical Pacific (Figure 11).

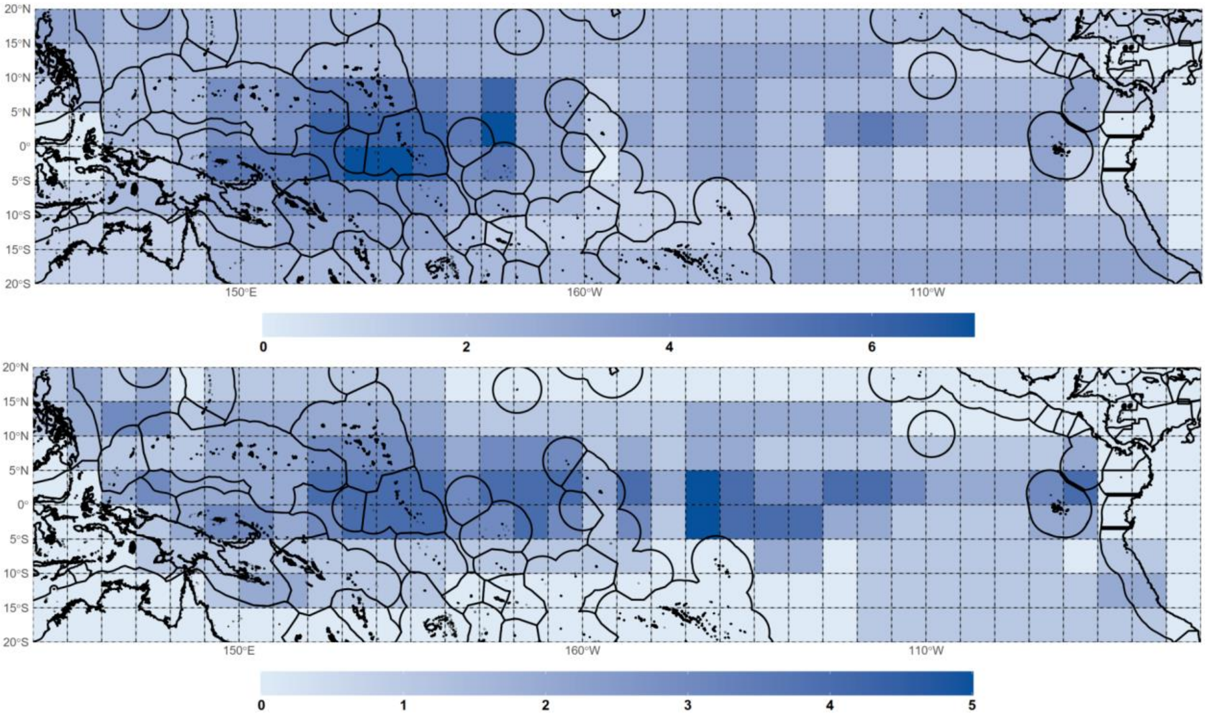

Figure 11. Areas identified by stakeholders where limiting dFAD deployment could reduce dFAD loss (top) (n=21) and dFAD strandings (bottom) (n=19). Shading indicates the number of respondents selecting each spatial grid cell.

3.1.2. A greater emphasis on retrieval by purse-seine vessels

Survey respondents were asked a series of questions related to the feasibility of recovering dFADs by purse-seine vessels, including perceived constraints, regulatory limitations, and potential measures that could promote recovery. Respondents identified several factors that may prevent purse-seine vessels from recovering dFADs (Figure 9). The most frequently cited constraints were logistical issues (n=64) and the high cost or lack of financial incentive (n=62). A lack of coordination or operational framework (n=42) and limited willingness within the industry to collaborate (n=37) were also commonly identified. Other factors included difficulties associated with current regulations (26 responses), sanitary issues onboard vessels (n=23), and a lack of regulatory mandates (n=4).

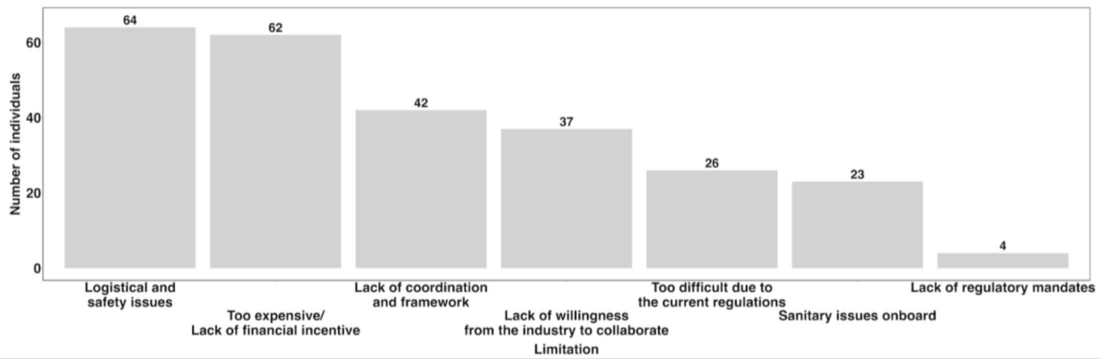

Figure 9. Survey responses (n=86) indicating factors that could be limiting the ability of purse-seine vessels to recover dFADs. Bars show the number of respondents selecting each constraint. Respondents were able to select more than one option.

Respondents were also asked whether purse-seine vessels could recover dFADs if they had access to buoy position information (Figure 13). Most respondents (n=48, 55%) indicated that recovery would be possible if they had the positions, while 13 (15%) respondents did not agree and 26 (30%) indicated that they did not know.

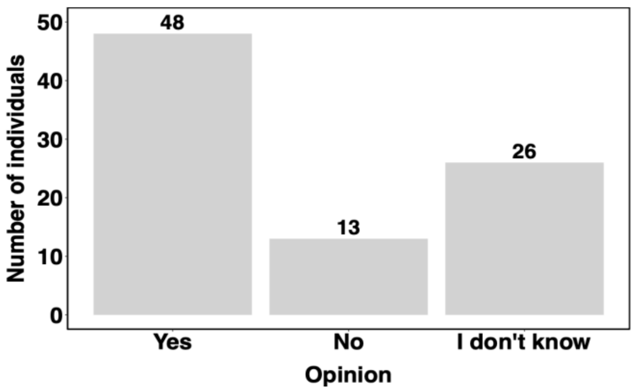

Figure 13. Stakeholder responses (n=86) indicating their opinion if purse-seine vessels could recover dFADs if they had access to buoy position information.

When asked what could promote recovery of dFADs by purse-seine vessels (Figure *10*), the most frequently identified measures were financial incentives (n=61) and additional regulatory requirements (n=59). Penalties or fines for non-recovery (n=41) were also commonly suggested. Other proposed measures included reduced port fees (n=16), logistical support or infrastructure to assist with deployment and recovery (n=8), revision of existing regulations (n=3), education or awareness-raising (n=1), and additional regulatory requirements (n=1). When purse-seiners were asked for a fair compensation to recover dFADs, respondents indicated 0–500 USD per dFAD recovered would be a fair compensation (Figure).

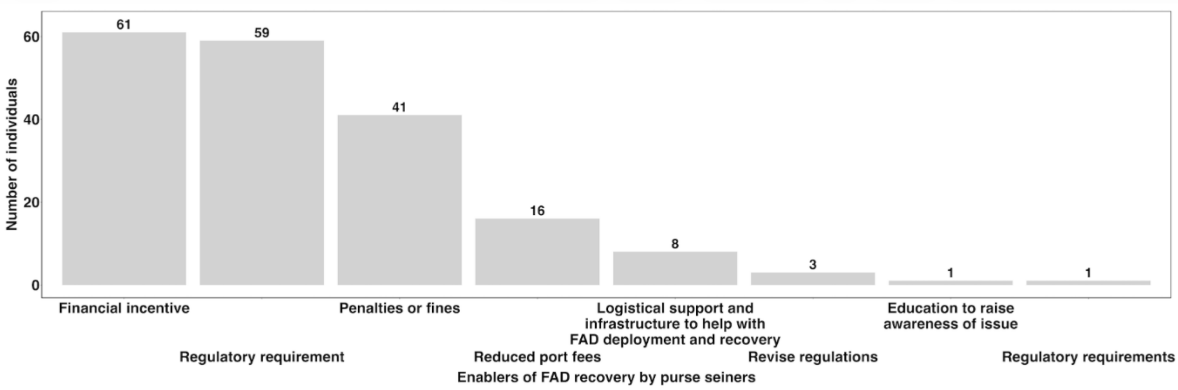

Figure 10. Stakeholder survey responses (n=78) indicating measures that could promote recovery of dFADs by purse-seine vessels. Bars show the number of respondents selecting each proposed measure. Respondents were able to select more than one option.

A majority of respondents (n=57, 67%) considered that RFMOs should require purse-seine vessels to recover dFADs, while 28 (33%) respondents disagreed (Figure S7). Among those respondents who considered RFMOs should require purse-seine vessels to recover dFADs, several potential RFMO-level measures were identified that could support recovery, including mandating target recovery rates, requiring reporting of dFAD tracking data, establishing dFAD design standards, and providing incentives for recovery.

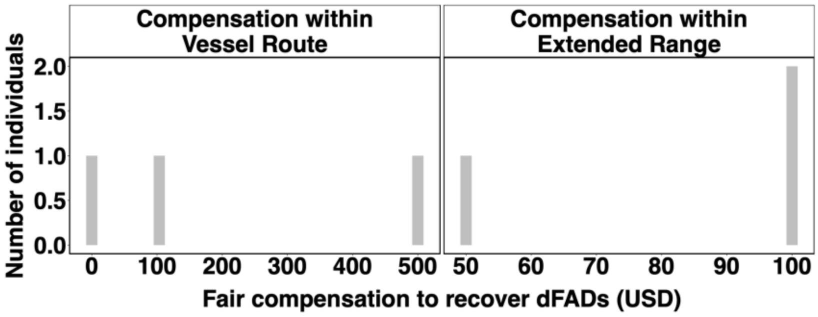

Figure 15. Purse-seiner responses indicating their opinion on the necessary compensation amount (USD) to recover dFADs within their typical (left panel, n=3) and extended vessel route (right panel, n=3).

3.1.3. Dedicated or chartered vessel(s) for at-sea collection

Stakeholders were asked about the feasibility of a dedicated vessel for at sea collection of dFADs. A majority of respondents (n=73, 86%) felt a dedicated cleaning vessel should be considered as a mitigation option to reduce dFAD loss and strandings, while 12 (14%) respondents felt the opposite (Figure 16). Respondents who indicated that a dedicated vessel should be considered were further asked to identify the areas where such a vessel should prioritise operations. Responses were concentrated in the western and central Pacific, particularly in waters around Papua New Guinea and French Polynesia (Figure 17), and were broadly consistent with SPC dFAD tracking data showing similar spatial patterns of abandoned dFADs (Figure 2).

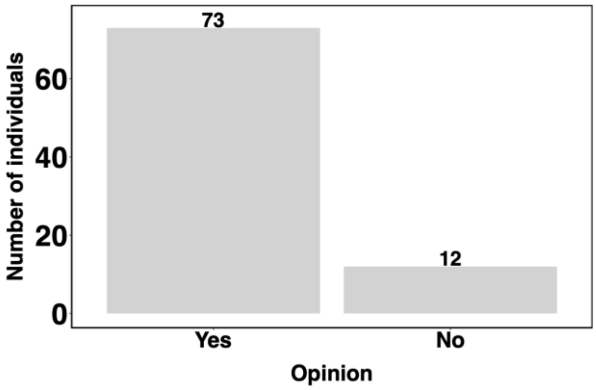

Figure 16. Stakeholder responses (n=85) indicating their opinion if a dedicated cleaning vessel should be considered as a mitigation option to reduce dFAD loss and strandings.

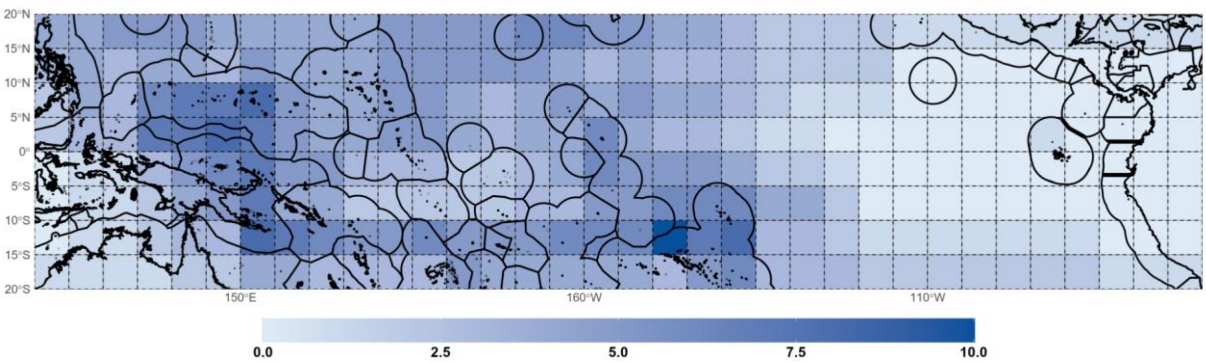

Figure 17. Areas identified by stakeholders (n=28) where a dedicated cleaning vessel should prioritise operations. Shading indicates the number of responses per grid cell.

Respondents were also asked to suggest the size of a dedicated cleaning vessel. Reported values varied widely, ranging from approximately 10 m to 100 m in length, with most responses falling between 20 m and 40 m (mean of 36 m and median of 30 m) (Figure 18). This suggests that respondents generally envisaged a medium-sized vessel capable of operating offshore while remaining smaller than large industrial fishing vessels.

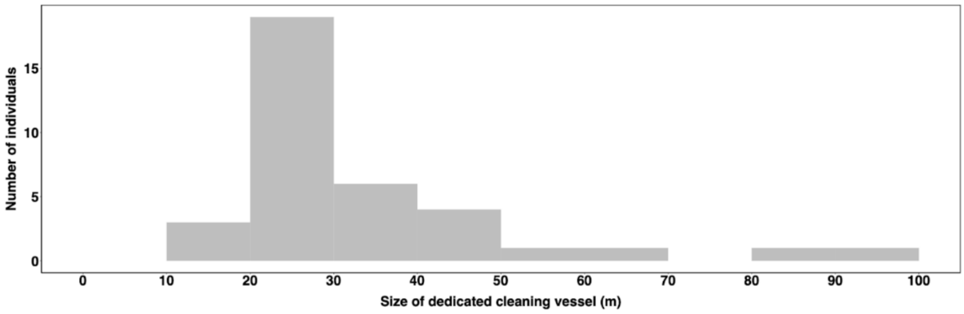

Figure 18. Suggested size of a dedicated cleaning vessel based on stakeholder survey responses (n=36). Bars show the number of responses for each vessel length class (m).

3.1.4. At-sea collection from non-purse-seine vessels (i.e., longliners) already present at-sea

Stakeholders were asked whether longline vessels could retrieve dFADs and responses were mixed, 30 (34%) respondents indicated that recovery by longliners could be feasible, 19 (22%) responded no, and 38 (44%) indicated that they did not know (Figure 19). The relatively large number of uncertain responses suggests that the potential role of longline vessels in dFAD recovery is less clearly defined compared to purse-seine vessels.

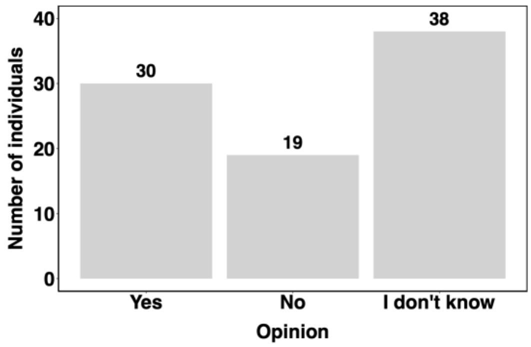

Figure 19. Stakeholder responses (n=87) indicating their opinion whether longline vessels could retrieve dFADs.

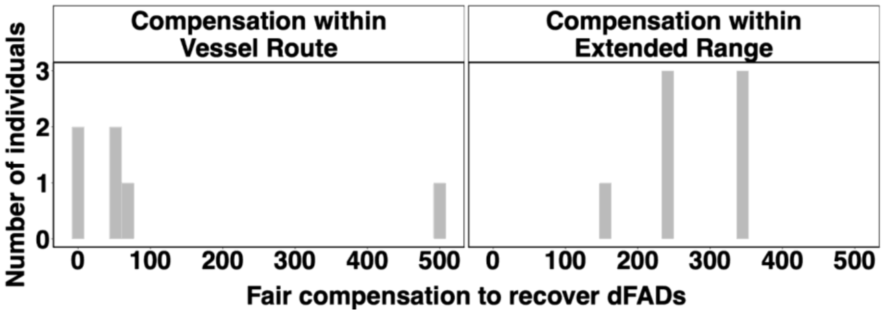

Figure 20. Longliner responses indicating their opinion on the necessary compensation amount (USD) to recover dFADs within their typical (left panel, n=6) and extended vessel route (right panel, n=7).

When longliners were asked to indicate what level of financial compensation would be considered fair for recovering dFADs, respondents indicated 0–500 USD per dFAD would be a fair compensation (Figure 20).

3.1.5. Shore-based recovery programmes

When stakeholders were asked about their awareness of dFAD recovery programmes a majority of respondents (n=57, 66%) were aware of such programmes, while 29 (34%) respondents were not (Figure S8). Among the respondents who were aware of such programmes, respondents were asked to note the programmes they were familiar with. This list helped inform the case studies that were highlighted in this report (Table S4 and section 2.3). When local partners were asked to indicate what level of financial compensation would be considered fair for recovering dFADs, respondents indicated 250–800 USD per dFAD would be a fair compensation or funds equivalent to the cost of fuel (Figure 21).

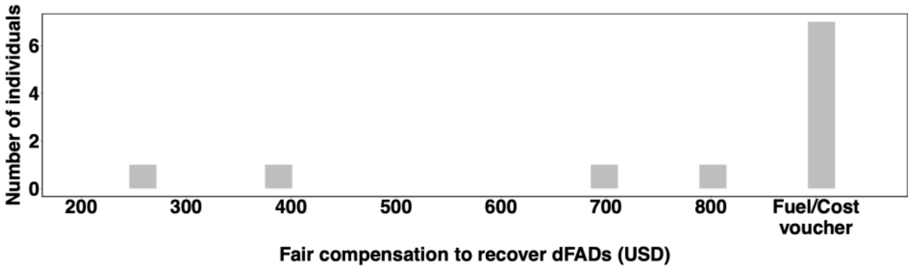

Figure 21. Local partner responses (n=11) indicating their opinion on the necessary compensation amount (USD) to recover dFADs.

3.2. Economic Modelling

Estimated costs associated with each mitigation option varied substantially depending on the operational assumptions applied and estimated dFAD abandonment across space (hotspots or country specific buffers). Because each mitigation option was modelled using different operational frameworks (e.g., opportunistic retrieval during fishing operations versus dedicated recovery missions), cost estimates across mitigation options should be interpreted as indicative rather than directly comparable across strategies. In practice, it is unlikely that a single mitigation option would be implemented in isolation, and a combination of approaches may be required depending on location, fleet behaviour, and logistical feasibility. For this reason, examining variation within each option helps identify the conditions under which retrieval can be conducted most cost-effectively, while broader comparisons across options provide an indication of the relative scale of costs associated with different types of retrieval strategies.

3.2.1. Modification of dFAD deployment and retrieval patterns

DFAD deployments occurring close to shore (50 and 100 nm from shore) and likely exhibiting higher probability of stranding were investigated (Table 11 and Figure 22). This corresponded to 3.1% (50 nm) and 24.2% (100 nm) of deployments in 2024 and 2025.

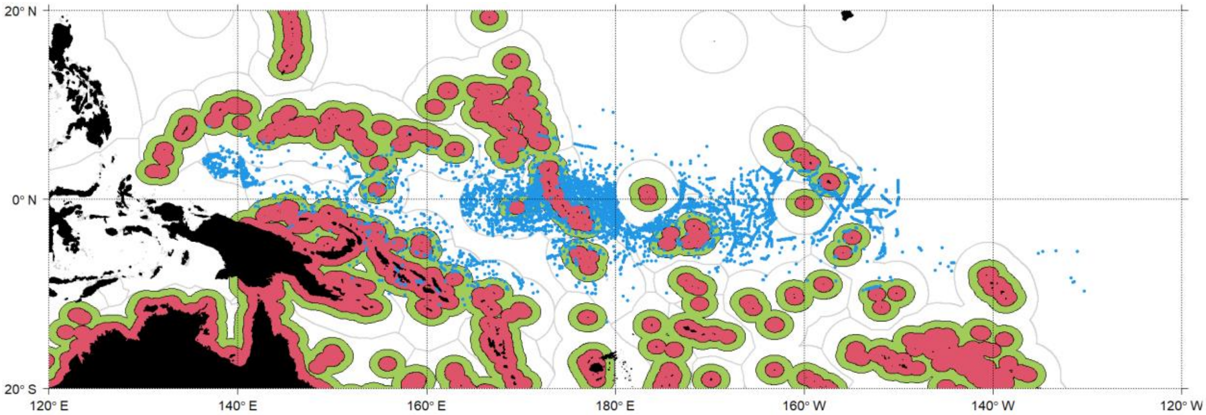

Figure 22. Buffers of 50 nm (red) and 100 nm (green) around shore and location of dFAD deployments recorded by observers in 2023 and 2024.

Table 11. Number and percentage of dFAD deployments in 2023 and 2024, occurring within 50 and 100 nm from shore, as recorded by observers.

	dFAD deployment		
	Total WCPO recorded	Within 100 nm	Within 50 nm
Number	5052	1223	158
%		24.2	3.1

Around 11.5% of dFAD deployments from 2023–2024 also occurred at the edge of the core purse-seine fishing grounds (Figure 23 and Table 12). Similar levels were detected for dFAD sets and visits, with 16.1% and 13.9%, respectively.

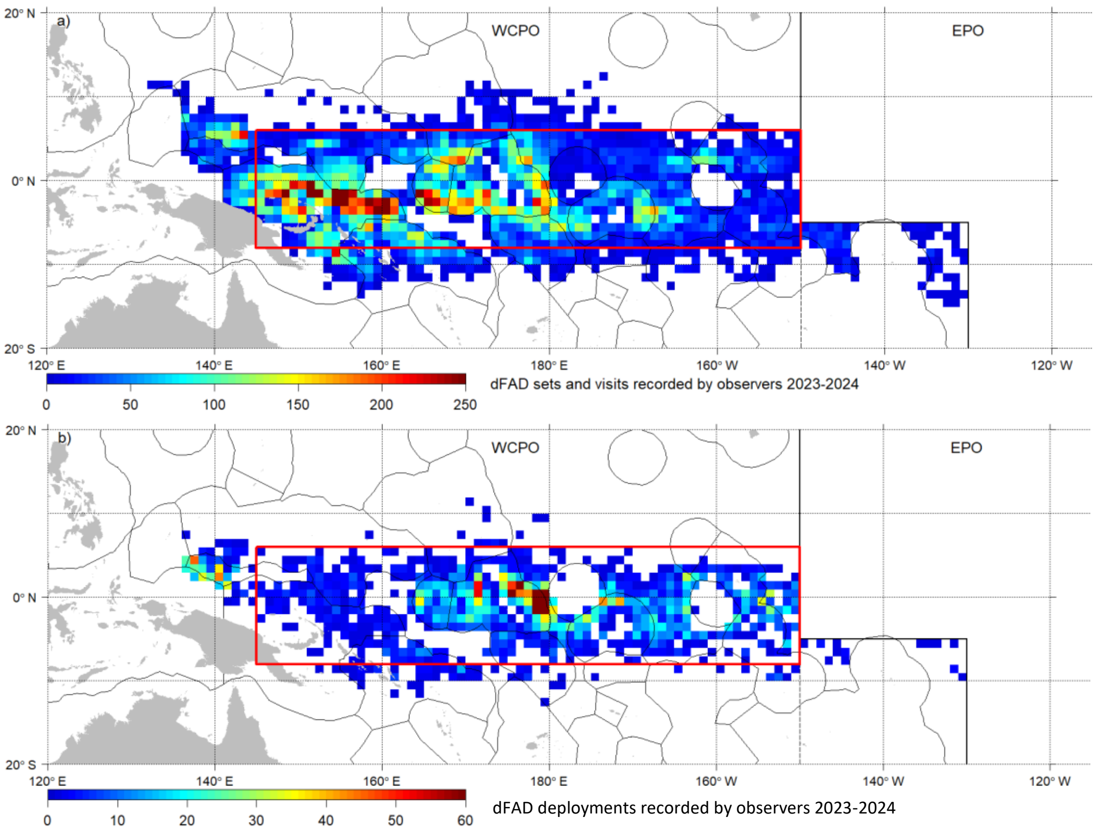

Figure 23. Density of a) dFAD sets and visits; and b) dFAD deployment in 2023 and 2024, recorded by observers. Red square represents the areas where most purse-seine activities occurred.

Table 12. Number and percentage of dFAD activities in 2023 and 2024, occurring within the core purse-seine fishing grounds ("PS grounds") (red square in Figure 23) or outside, as recorded by observers.

	Set	Visit	dFAD deployment	dFAD retrieval	Buoy retrieval	Buoy deployment
Total WCPO	28337	18826	5052	3295	5522	8676
Out of PS grounds	4562	2612	581	1300	707	620
% Out of PS grounds	16.1	13.9	11.5	39.5	12.8	7.1

Key uncertainties and questions

For simplicity, dFAD activities from observer data were used. Other sources, such as logsheet (dFAD sets), and FAD tracking data (deployment), could be used to enhance the analysis. In particular using dFAD tracking data could help better estimate the likelihood of stranding or loss and refine the analysis spatially.

The economic cost of changing deployment locations would be very difficult to assess, because it would include any additional cost associated with altering deployment and the potential change in fishing efficiency between ideal deployment areas and mandated restricted areas. In addition, successful implementation of this mitigation option would probably require a Conservation and Management Measure or other form of incentive.

Potential next steps

Refine the analyses using dFAD tracking and logsheet data to assess the probability of stranding/loss depending on deployment locations (Imzilen et al., 2021).

3.2.2. A greater emphasis on retrieval by purse-seine vessels

Under the option where purse-seine vessels retrieve dFADs opportunistically, the number of recovered dFADs that could be retrieved in a year by the top 5 vessels per hotspot ranged from 7 dFADs in N3 under the minimum dFAD retrieval scenario (1 dFAD per day per grid cell) and 513 dFADs in S4 under the maximum dFAD retrieval scenario (3 dFADs per day per grid cell) (Table *2* and Figure 24). When operational and economic parameters are applied to such dFAD scenarios, total costs of dFAD retrieval ranged from 4,573 USD corresponding to N3 (7 dFADs retrieved) and 458,082 USD corresponding to S4 (513 dFADs retrieved) (Figure 24). Given the way in which the modelling framework was developed, total estimated costs of dFAD retrieval exhibited a direct linear relationship with the number of dFADs retrieved per hotspot, therefore the more dFADs retrieved for a given hotspot, the higher the costs. Consequently, cost per dFAD is derived from this scaling relationship, calculated as total cost divided by the number of dFADs, and varies accordingly across hotspots.

Across all modelled scenarios, the estimated cost per dFAD retrieved ranged from 663 (low fuel) to 893 (high fuel) USD, which is above the required compensation indicated by purse-seine operators and skippers from the stakeholder survey results (0–500 USD based on 3 responses, Figure 15). While these results should be interpreted with caution given the low response rate, this discrepancy may highlight the extent to which the modelling framework oversimplifies real-world retrieval logistics, rather than representing true differences in estimated and perceived operational expenditure. The standardized assumptions (applying a maximum travel distance of 20 nm per retrieved dFAD) applied here do not capture the more opportunistic and potentially lower-cost retrieval strategies. As a result, estimated costs should be interpreted as indicative, representing an upper-bound estimate under simplified conditions.

Figure 24. Total cost (in USD) for purse-seiners to recover encountered dFADs under minimum (1 dFAD/day) and maximum (3 dFADs/day) retrieval and low and high fuel costs scenarios. The colour and number within each cell represent the total cost. The italic number on the bottom right of each cell corresponds to the number of dFADs encountered that could be retrieved per year in each hotspot under each retrieval scenario (based on assumption of 1 or 3 dFADs per day) (Table 2).

When considering all hotspots and dFADs that could be retrieved, a total cost of 451,459–1,190,298 USD was estimated for 691–1333 dFADs retrieved in a year (Table 13).

Table 13. Total number of dFADs that could be retrieved by the top 5 purse-seiners transiting and cost, based on different percentages of retrieval.

% of dFADs recovered	Number of dFADs that could be recovered by top 5 vessels		Cost of fuel			
			1 dFAD		3dFAD	
	1 dFAD	3 dFAD	Low	High	Low	High
100%	691	1,333	451,459	617,027	870,904	1,190,298
75%	518	1,000	338,594	462,770	653,178	892,724
50%	1,382	2,666	225,730	308,513	435,452	595,149
25%	173	333	112,865	154,257	217,726	297,575

Key uncertainties and limits

The estimated fuel consumption (L/nm) considered was representative of purse-seine operations. Further analysis could include varying fuel consumption based on potential vessel characteristics (e.g., size, engine power). Given the opportunistic nature of purse-seine retrieval modelled under this scenario, fuel and lubrication were the only costs considered, as retrieval would occur during a vessel transit and all other costs are already covered. Other additional operational costs (beyond fuel and lubrication) were therefore not incorporated into the analysis. The results are influenced by the assumptions of i) number dFAD retrieval per day per 1° cell (1–3 dFADs) and ii) a maximum search distance of 20nm. Feedback from real at-sea operations could help refine these assumptions. In addition, investigating overlap between VMS tracks and dFAD tracks using real data could better inform the model and provide more realistic and precise results. Finally, only purse-seine transits outside the purse-seine fishing grounds (10°S to 10°N) were considered. Vessel tracks at the edge of purse-seine fishing grounds could also potentially be included.

Potential next steps

- Expand the analysis to include all available vessel tracks, using VMS track available at SPC, rather than limiting to the top five vessels per hotspot[9]. This was not carried out due to limited time.
- Expand the analysis to vessel tracks at the edge of purse seine fishing grounds, not only outside the fishing grounds.
- Conduct finer-scale spatial analyses of VMS and dFAD trajectories to better identify potential retrieval opportunities under increased coordination.

3.2.3. Dedicated or chartered cleaning vessel(s) for at-sea collection

For the dedicated vessel option, three vessel types were modelled, based on characteristics and operational cost of real vessels (Table 4 and S3), under two retrieval capacity scenarios and two fuel cost scenarios. Due to the high number of outputs generated, only the results for the Atlantic Ocean tuna supply vessel operating under the maximum retrieval capacity (200 dFADs per trip) and low fuel cost scenarios are presented; additional outputs for other vessels are provided in the Appendix 4.

The cost per dFAD was between 278 and 4,525 USD in ports close to the hotspot and for the Atlantic Ocean tuna supply vessel; 200 dFADs storage capacity and low fuel cost scenario (Figure 25 and Tables Appendix 4). Across all scenarios and port-hotspot combinations considered it ranged from 178–4,525 USD (Figure 25 and Appendix 4). Lower densities, such as in hotspot n6, require longer search distances and greater fuel consumption, resulting in higher retrieval costs compared with hotspots where dFADs are more concentrated. Additionally, port–hotspot combinations that are farther apart require greater travel distances and, consequently, higher fuel consumption than those that are geographically closer. When considering only the realistic port–hotspot combinations (closest port), and focusing on the 4 hotspots with the highest abandoned dFAD density (n1; n2; s1 and s2), cost per dFAD was between 178 and 555 USD, which is lower than the estimated cost per dFAD for previous trips of Saya de Malha vessel in Seychelles (Table S3). For example, the best port to service a dedicated cleaning vessel focused on retrieving dFADs from n1 would be located in the Northwest, and more specifically in the Philippines and Palau, whereas retrieving dFADs from s2 would be located in the Southwest and Southeast, and more specifically Tuvalu, Fiji, and Samoa.

[9] A request was made to Global Fishing Watch (GFW) to access vessel tracks for all purse-seine vessels, but GFW was unable to fulfill this request.

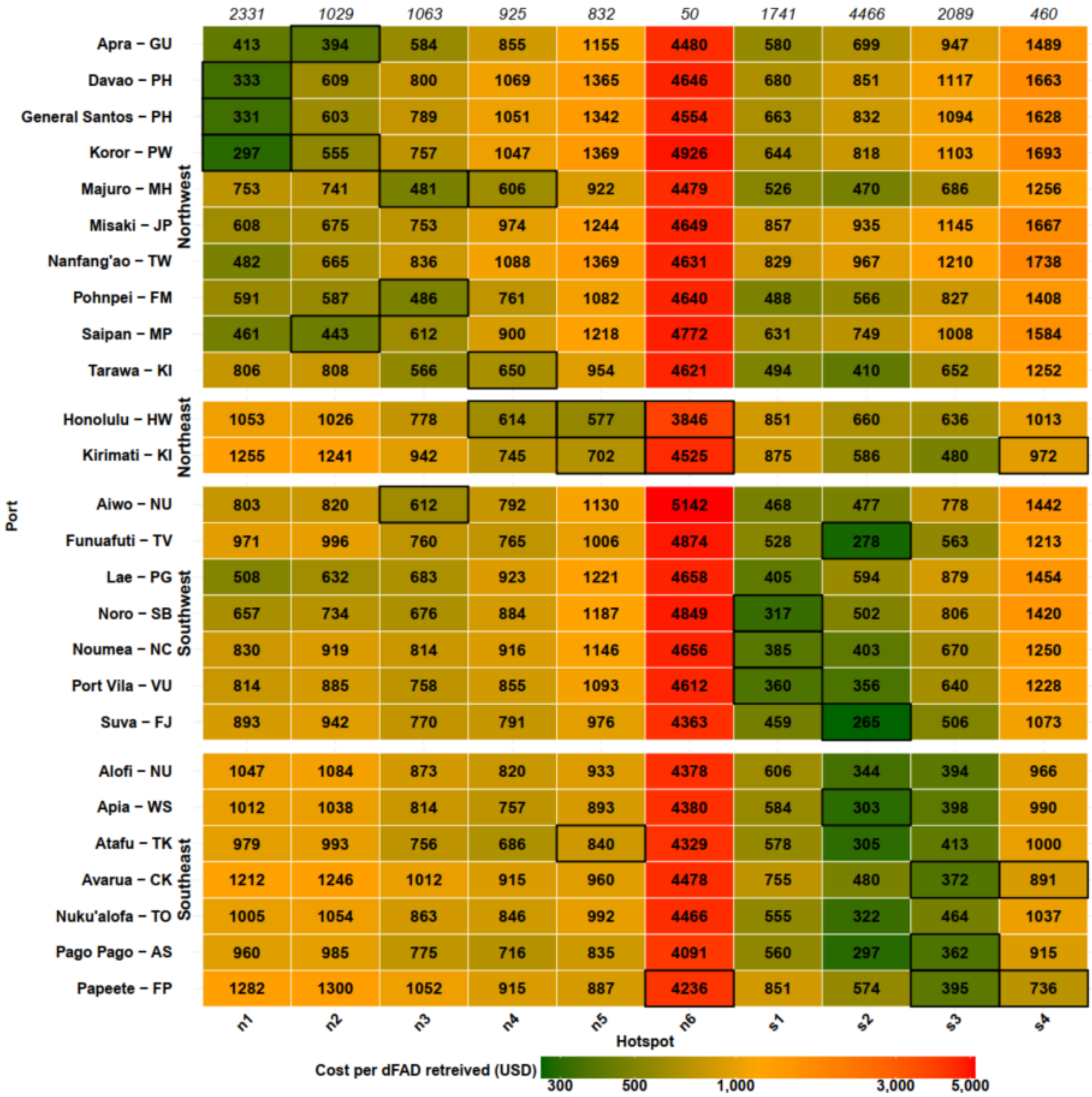

Figure 25. Cost per dFAD by port (rows) and hotspot (columns) combinations for the Atlantic Ocean supply vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour and number within each cell represent the cost per dFAD and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

Operational constraints limit the total number of dFADs that a single vessel could retrieve within a year. Across all modelled port-hotspot combinations, a single vessel could retrieve approximately 289 to 5,735 dFADs in a year, depending on steaming distance and density of dFADs for a given port-hotspot combination (Figure 26). Again, lower densities require longer search distances and greater fuel consumption, resulting in higher retrieval costs compared with hotspots where dFADs are more concentrated. Additionally, port–hotspot combinations that are farther apart require greater travel distances and, consequently, higher fuel consumption than those that are geographically closer. In all hotspots and the closest port to hotspot centroid, a single vessel with a 200 dFAD storage capacity would retrieve more dFADs than the number present in the hotspot. Interestingly, in hotspots n6 and s4, with very low dFAD density in our study - due to the unavailability of EPO dFAD tracking data and deactivation outside fishing grounds - the number of dFADs that could be retrieved was assessed at

350 and 1500–2000, respectively; which would likely be closer to the number of dFADs transiting in these hotspots.

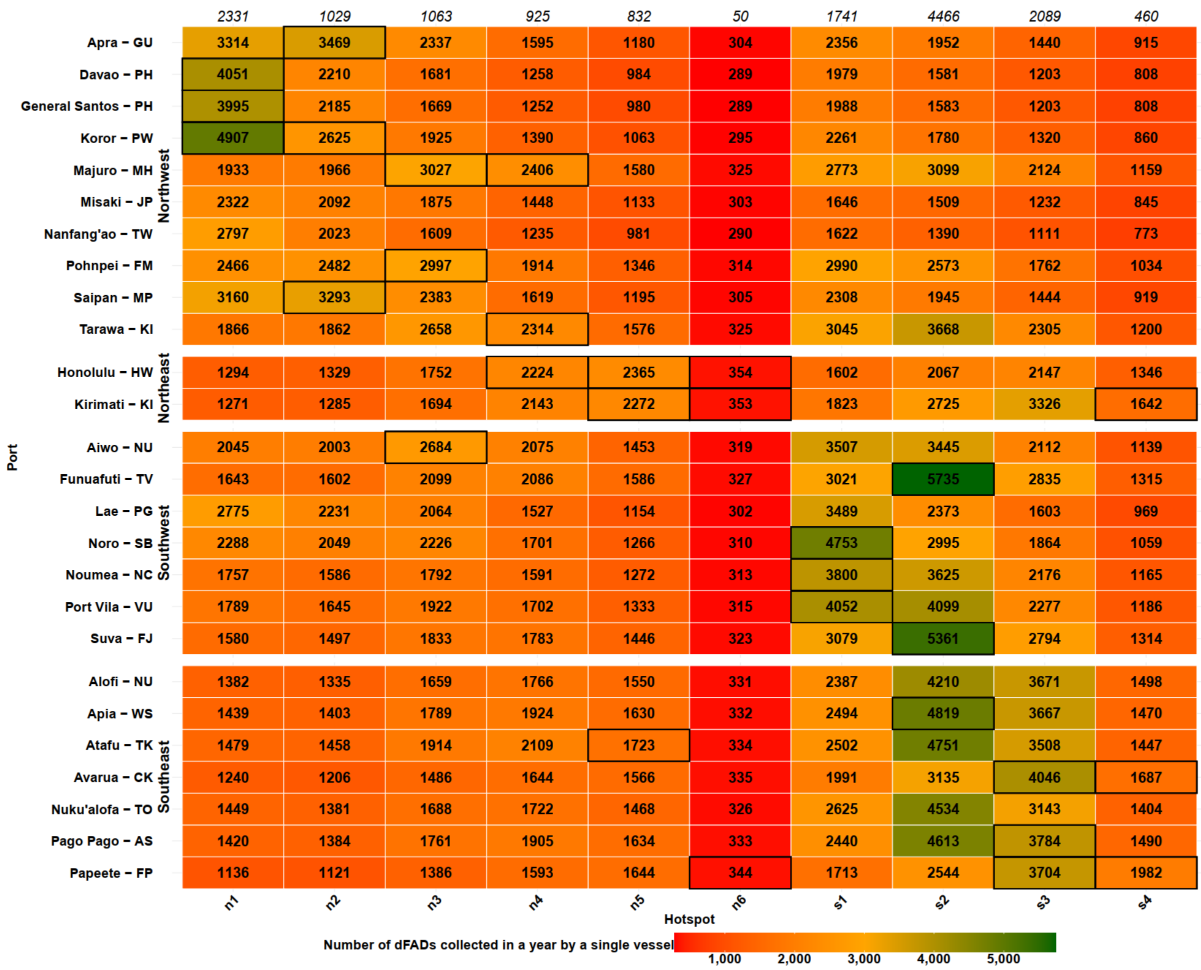

Figure 26. Number of dFADs collected in a year by a single vessel across port (rows) and hotspot (columns) combinations for the Atlantic Ocean supply vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour and number within each cell represent the number of dFADs retrieved in a year and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

These results indicate that a single dedicated vessel would be sufficient to retrieve all dFADs within all hotspots under the assumptions modelled. The estimated number of vessels required to retrieve all dFADs within each hotspot ranged from 0.1 to 0.9 (Figure 27), suggesting that a single vessel could operate across different hotspots.

Comparable outputs for the Atlantic Ocean supply vessel minimum capacity as well as Solomon Searcher and Saya de Malha vessels are presented in Appendix 4 (Figures S9 to S14 and Tables S5 to S7). While size of vessels, steaming speed, and thus fuel burn rate varies across the three cleaning vessels considered, the primary driver of cost variation is the spatial relationship between ports and hotspots, as well as the density of dFADs within those hotspots.

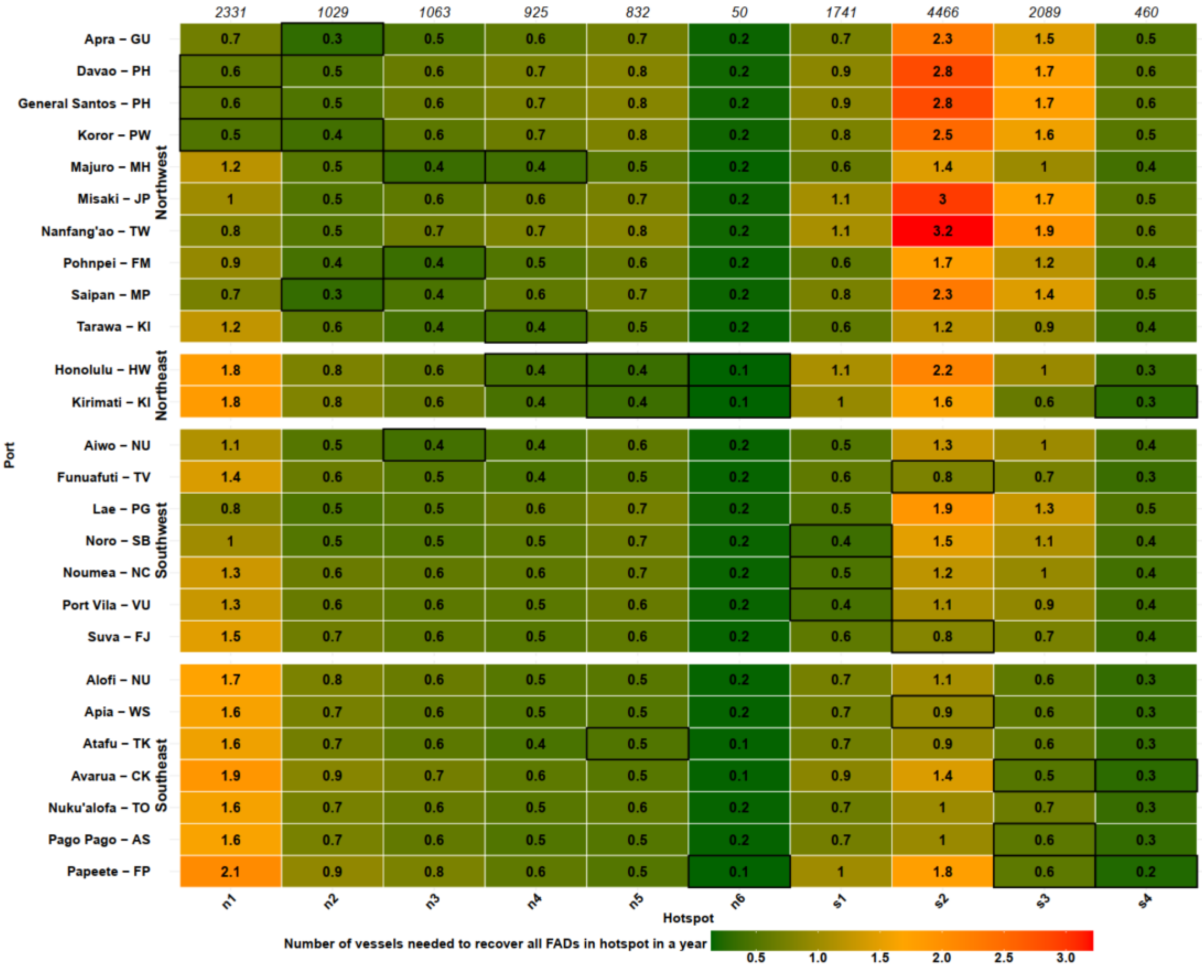

Figure 27. Number of vessels required to retrieve all dFADs in a given port (rows) and hotspot (columns) combinations in a cell for the Atlantic Ocean supply vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour and number within each cell represent the number of vessels required and on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

Across all scenarios considered, total costs to retrieve all dFADs (14,986) ranged between 3,865,500–9,625,449 USD (Table 14). While retrieving only 75% or 25% of all dFADs (11,240 and 3,747, respectively), costs ranged between 2,898,986–7,219,039; and 966,329–2,406,346, respectively. Similarly, if we consider focusing on hotspots with most dFAD abandonment (n1, n2, s1 and s2) retrieving 100% or 25% of all dFADs (9,567 and 2,392) ranged between 1,946,295–4,585,511 (100%); and 486,532–1,146,361 (25%) (Table 14). Given the result that 1 vessel would be largely sufficient to recover all dFADs within a particular hotspot (Figure 27), one vessel covering hotspots n1 and n2 in the north and one covering s1 and s2 in the south could be appropriate. Potential base ports are in Palau, Philippines and Pohnpei in the north; and Noro (Solomon Islands), Vanuatu, Fiji, Tuvalu or Pago Pago in the South.

As described in the Methods section, this analysis considers only the operational costs of running the dedicated cleaning vessel and excludes capital and maintenance costs, for which indicative estimates are provided separately (Table 5 and S2). Additional fixed and other costs of 300,000 to 480,000 per year per vessel should be added.

Table 14. Total operating costs (USD) to retrieve 100%; 75%; 50% and 25% of dFADs within a hotspot considering the closest port and the three cleaning vessel scenarios; a maximum capacity of 50 or 200 dFADs; and low or high fuel and berthing cost scenarios. Fixed and other costs per year (USD) based on information provided.

	Storage scenario	Number of dFAD transit 2024	Retrieval cost 100% of dFADs		Retrieval cost 75% of dFADs		Retrieval cost 50% of dFADs		Retrieval cost 25% of dFADs	
			Low fuel cost	High fuel cost	Low fuel cost	High fuel cost	Low fuel cost	High fuel cost	Low fuel cost	High fuel cost
Atlantic Ocean supply vessel										
TOTAL	70	14,986	7,843,751	9,625,449	5,882,886	7,219,039	3,921,924	4,812,693	1,960,962	2,406,346
	200	14,986	5,754,178	7,027,908	4,315,755	5,270,916	2,877,170	3,513,944	1,438,585	1,756,972
Total n1, n2, s1, s2	70	9,567	3,727,239	4,585,511	2,795,523	3,439,084	1,863,682	2,292,723	931,841	1,146,361
	200	9,567	2,893,484	3,537,569	2,170,189	2,653,233	1,446,792	1,768,822	723,396	884,411
Fixed and other costs / year			480,000							
Saya de Malha										
TOTAL	150	14,986	5,159,639	6,626,339	3,869,608	4,969,797	2,579,738	3,313,198	1,289,869	1,656,599
	300	14,986	4,525,514	5,797,437	3,394,205	4,348,265	2,262,803	2,898,843	1,131,402	1,449,421
Total n1, n2, s1, s2	150	9,567	2,577,253	3,310,269	1,932,831	2,482,702	1,288,554	1,655,135	644,277	827,568
	300	9,567	2,321,666	2,972,888	1,741,215	2,229,799	1,160,810	1,486,533	580,405	743,266
Fixed and other costs / year			Unknown							
Solomon Searcher										
TOTAL	50	14,986	6,144,731	7,676,263	4,608,284	5,757,309	3,072,189	3,838,206	1,536,095	1,919,103
	200	14,986	3,865,500	4,784,208	2,898,986	3,588,013	1,932,657	2,392,009	966,329	1,196,004
Total n1, n2, s1, s2	50	9,567	2,858,732	3,588,386	2,143,785	2,691,411	1,429,190	1,794,274	714,595	897,137
	200	9,567	1,946,295	2,411,970	1,459,596	1,808,786	973,064	1,205,857	486,532	602,929
Fixed and other costs / year			300,000							

Key uncertainties and limits

This dFAD retrieval option was based on economic data from a real vessel of similar characteristics and size to the ones suggested in the stakeholder consultation and suggest that similar vessel could be a good candidate for dFAD cleaning vessel. Uncertainties in results could be linked to the assumptions related to dFAD onboard storage; fuel consumption and cost; berthing; salary and distance. These covered the best knowledge at time of analysis and cost data from late 2025. Besides fuel cost per port and berthing, all other costs were fixed across the Pacific; better knowledge of variation in these between location could improve the analysis. Finally, the average minimum inter-FAD distance per day per hotspot (2024 dFAD tracking data) was used as the dFAD searching distance. Accounting for the variability in this inter-FAD distance could also improve the analysis.

Potential next steps

- Similar to other options considered, the number of dFAD that could be retrieved is based on dFAD tracking data available, which only includes WCPO data. Given that many dFADs from the EPO end up in the WCPO, the number of dFAD present in certain hotspots (eastern ones in particular; n5, n6 and s4), expanding the analysis to incorporate estimated dFAD loss from the EPO would provide a more comprehensive understanding of dFAD loss across the Pacific and enhance the economic modelling.

- Further develop spatial and operational simulations to better represent realistic vessel behaviour, search time, and coordination during retrieval operations (i.e. agent-based modelling).
- Consider potential other candidate cleaning vessels that differ significantly from the vessel specs investigated. For instance the 48 m SPC research vessel under development (SPC-OFP, 2025) or vessels similar to longliners (up to 21m) that could be constructed in French Polynesia and focus on the eastern hotspots not well modelled here.

3.2.4. At-sea collection from non-purse-seine vessels (i.e., longliners) already present at-sea

Under the option where longline vessels retrieve dFADs opportunistically, the number of recovered dFADs that could be retrieved by the top 5 vessels per hotspot ranged from 27 dFADs in N2 and N5 under the minimum dFAD retrieval scenario (1 dFAD per day per grid cell) and 365 dFADs in S3 under the maximum dFAD retrieval scenario (3 dFADs per day per grid cell) (Table *2* and Figure 28). When operational and economic parameters are applied to such dFAD scenarios, total costs of dFAD retrieval ranged from 5,513 USD corresponding to N2 and N5 (27 dFADs retrieved) to 101,852 USD corresponding to S3 (365 dFADs), depending on hotspot, fuel price and retrieval scenarios (Figure 28). Given the method used to estimate costs associated with retrieval by longliners followed the same analytical framework used for the purse-seine retrieval analysis, total estimated costs of dFAD retrieval similarly exhibit a direct linear relationship with the number of dFADs retrieved per hotspot by longliners. Therefore, the more dFADs retrieved for a given hotspot, the higher the costs. Consequently, cost per dFAD is derived from this scaling relationship, calculated as total cost divided by the number of dFADs, and varies accordingly across hotspots.

Across all modelled scenarios, the estimated cost per dFAD retrieved ranged from 204 (low fuel) to 279 (high fuel) USD corresponding to S3. This is within the range of required compensation suggested by purse-seine operators and skippers from the stakeholder survey results (0–500 USD, Figure 20). Similar to the purse-seine retrieval option, it should be noted that the current modelling framework oversimplifies real-world retrieval logistics. The standardized assumptions (applying a travel distance of 20 nm per retrieved dFAD) applied here do not capture the more opportunistic and potentially lower-cost retrieval strategies. As a result, estimated costs should be interpreted as indicative under simplified conditions. All that said, the difference in estimated costs between longliners and purse-seiners reflects the assumption that longline vessels are smaller and have a lower fuel burn rate than purse-seine vessels.

When considering all hotspots and dFADs that could be retrieved, a total cost of 114,947–228,261 USD was estimated for 563–1118 dFADs retrieved (Table 15).

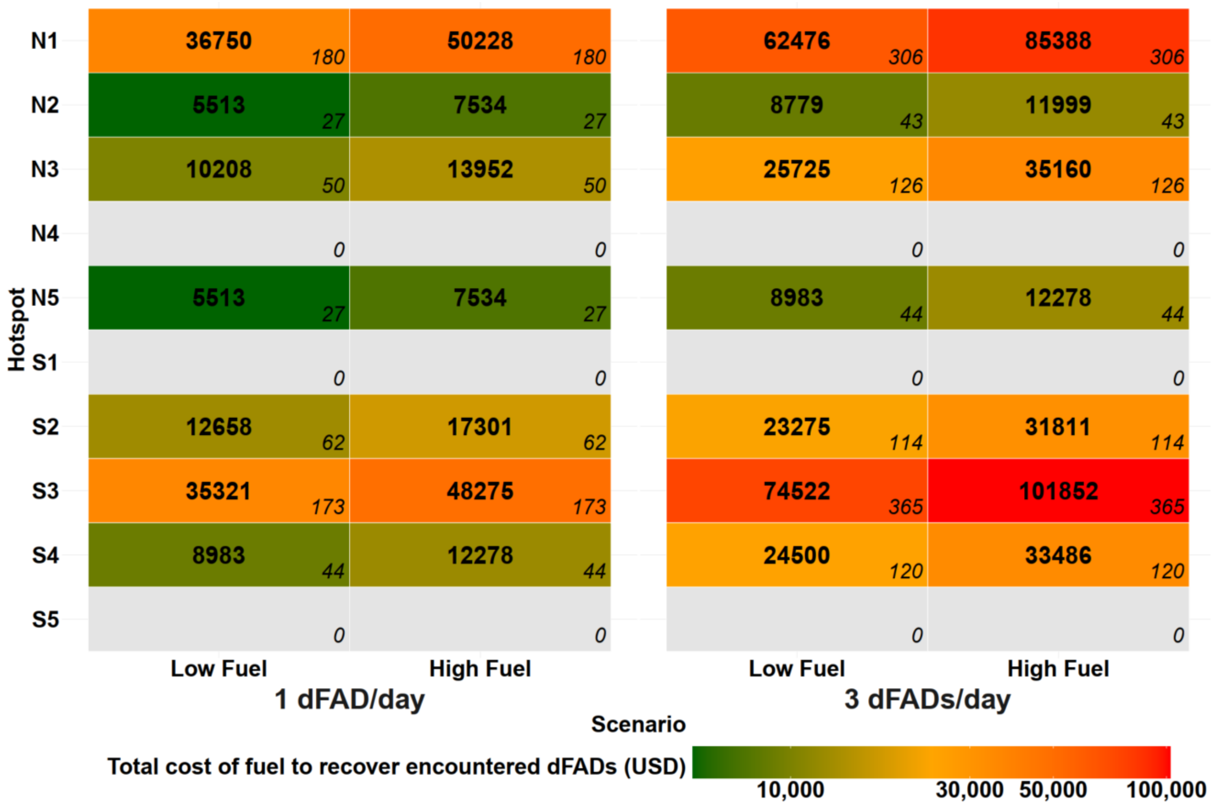

Figure 28. Total cost (in USD) for longliners to retrieve encountered dFADs by hotspot, fuel cost and retrieval scenario. The colour and number within each cell represent the total cost. The italic number on the bottom right of each cell corresponds to the number of dFADs encountered that could be retrieved in each hotspot under each retrieval scenario (based on assumption of 1 or 3 dFADs per day) (Table 6).

Table 15. Total number of dFADs that could be retrieved by the top 5 longliners transiting and cost, based on different percentages of retrieval.

% of dFADs recovered	Number of dFADs that could be recovered by top 5 vessels		Cost of fuel			
			1 dFAD		3dFAD	
	1 dFAD	3 dFAD	Low	High	Low	High
100%	563	1,118	114,947	157,103	228,261	311,974
75%	422	839	86,210	117,827	171,196	233,980
50%	282	559	57,474	78,551	114,131	155,987
25%	141	280	28,737	39,276	57,065	77,993

Key uncertainties and limits

Same uncertainties and limits to option 2, a greater emphasis on retrieval by purse-seine vessels (see section 3.2.2).

Potential next steps

- Expand the analysis to include all available vessel tracks, rather than limiting to the top five vessels per hotspot; or focus on key longline fleet identified through exploratory screening as potential candidates for dFAD retrieval and expand analysis to include other vessels such as support or research vessels (Figures S1 to S3).
- Expand the analysis to vessel tracks at the edge of purse seine fishing grounds, not only outside the fishing grounds.

- Future analyses could expand this approach to additional vessel types, such as support vessel and fishery research vessel; focus on longline vessels with characteristics most similar to the Hawaiian longline fleet; and incorporate more detailed operational and spatial data to refine candidate selection and assess practical feasibility.
- Conduct finer-scale spatial analyses of VMS and dFAD trajectories to better identify potential retrieval opportunities under increased coordination.

3.2.5. Shore-based dFAD retrieval programmes

Under the shore-based dFAD retrieval programmes option, cost of retrieval per dFAD is driven by distance covered to recover a dFAD, fuel consumption and PICT-specific petrol prices (Table S1). The estimated cost per dFAD for small vessels of engine power <200 HP ranged from 61–106 USD (within 6nm of the coastline) and 121–176 USD (within 12nm); and for vessels of engine >200 HP ranged from 92–158 USD (6nm coastline) and 181–264 USD (12nm coastline) (Figure **29*11***29).

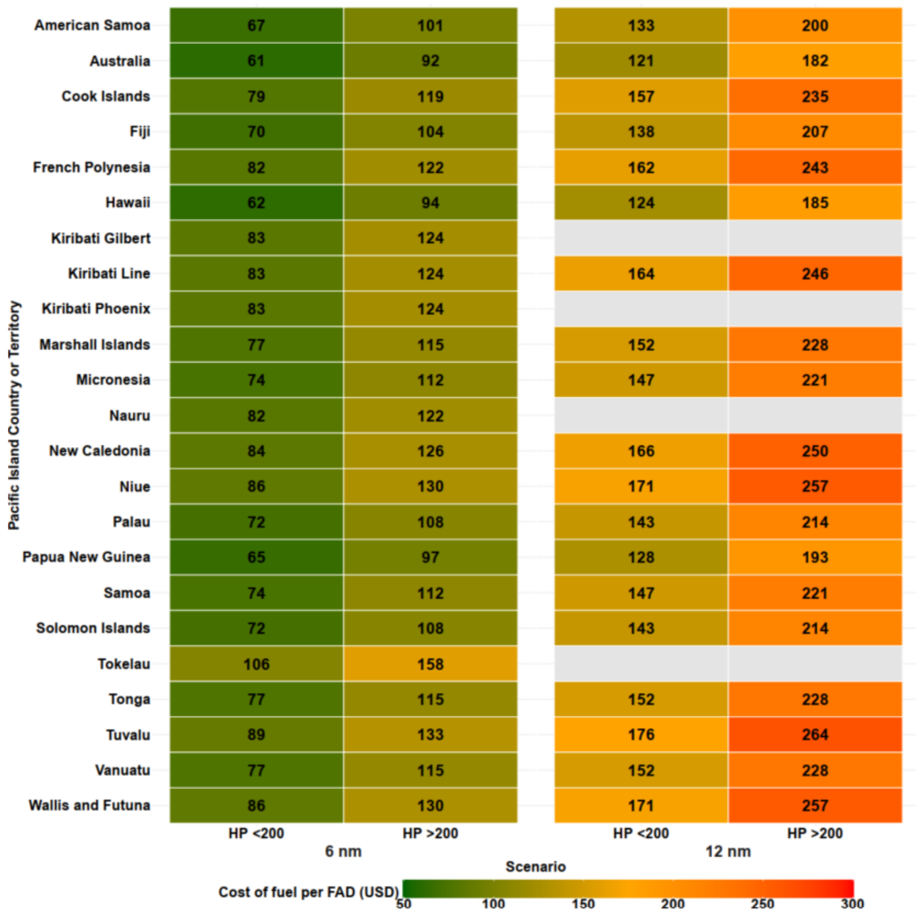

Figure 2911. Cost per dFAD by PICT (row), vessel engine size (column), and buffer size (panel) for dFAD Watch programmes. The colour and the numbers within each cell represent the cost per dFAD. Blank grey cells indicate scenarios where the PICT-specific buffer overlaps with purse-seine fishing grounds and cost estimates were therefore not calculated.

Such estimates are less than indicated by local partners in the stakeholder surveys (250–800 USD, Figure 21). The discrepancy between estimated cost per dFAD and stakeholder-reported values may reflect simplifications in the modelling approach, which focuses on fuel costs. Additional costs that could be accounted for include other vessel operational costs, salary (or missed fishing opportunities), food and consumables. It is likely that shore-based recovery programmes would instigate rewards per dFAD and/or buoy recovered that would cover fuel and other costs associated with the recovery.

Given the method used to estimate costs associated with retrieval by shore-based dFAD retrieval programmes, total estimated costs of dFAD retrieval exhibited a direct linear relationship with the number of dFADs retrieved per scenario, therefore the more dFADs retrieved for a given scenario, the higher the costs. The number of dFADs that could be retrieved within 6 nm ranged from 1 dFAD in New Caledonia to 7,013 dFADs in PNG waters; and within 12 nm (outside fishing grounds) from 1 in New Caledonia to 1594 in Solomon Islands (based on 2024 dFAD tracking data, Table 7). Costs of fuel for the retrieval of all dFADs within 6 nm and 12 nm buffers around ports and entire coastlines of each PICT were estimated (Figure 30). Retrieval costs for all dFADs detected in the buffers zones in 2024 were estimated at 0–166,430 USD within 6 nm around ports; 750–681,700 USD within 6 nm around entire coastlines; 166–25,100 USD within 12 nm around ports; 17,000–341,000 USD within 12 nm around entire coastlines (Figure 30). Noting that the 12 nm scenario only included areas outside the fishing grounds.

Figure 30. Total cost for shore-based dFAD retrieval programmes to retrieve dFADs by PICT (row) and origin point (column), and buffer size (panel) for shore-based retrieval programmes. The colour of each cell (log-scale) and the number at the centre represents the cost per dFAD; the numbers in the bottom right corner within each cell corresponds to the number of dFADs in each scenario, PICT, and buffer size (Table). Blank grey cells indicate scenarios where the PICT-specific buffer overlaps with purse-seine fishing grounds and cost estimates were therefore not calculated. Grey cells with a value of 0 indicate scenarios where no dFAD occurred in the buffer; these values are excluded from the colour scale to improve interpretability.

Total cost associated with the retrieval of 100% and 25% of dFADs transiting in different buffer zones were summarised in Table 16. This ranged from 547,772 (100%; 7,174 dFADs) and 136,943 (25%; 1,794 dFADs) USD for the recovery of dFADs within 6nm of ports; to 1,298,839 (100%; 5,903 dFADs) and 324,710 (25%; 1,476 dFADs) USD for the recovery of dFADs within 12nm of entire coastlines outside fishing grounds (Table 16).

Table 16. Total cost associated with different level of retrieval of dFADs present in each buffer.

% of dFADs in buffer recovered	Number of dFADs				Cost of fuel (USD)			
	6 nm		12 nm		6 nm		12 nm	
	Port	Coastline	Port	Coastline	Port	Coastline	Port	Coastline
100%	7,174	30,697	618	5,903	547,772	3,464,842	94,037	1,298,839
75%	5,381	23,023	464	4,427	410,829	2,598,631	70,528	974,129
50%	3,587	15,349	309	2,952	273,886	1,732,421	47,019	649,419
25%	1,794	7,674	155	1,476	136,943	866,210	23,509	324,710

Taken together, these results suggest that shore-based dFAD retrieval programmes should be prioritized in PICTs experiencing the highest levels of dFAD strandings or in areas of particular interest (Marine Protected Areas for instance). The relatively low cost per dFAD reflects the assumption that community vessels operate close to shore and require minimal travel distances to retrieve dFADs prior to stranding. However, the coordination, programme setup and effort required to retrieve the level of dFADs considered here would be very substantial. Future analyses should include costs associated with programme coordination and focus on selected areas where shore-based retrieval programmes would be most relevant.

Key uncertainties and limits

Main drivers of dFAD retrieval costs under this shore-based retrieval option are fuel costs; which were considered as of late 2025. In addition, fuel costs variability between main ports was considered, for simplicity, using a simple raising ratio based on real cost variation observed in Solomon Islands. However, this could be better modelled in the analysis. Second, while the analysis considered retrieval of all dFADs transiting in an area, future analyses could account for the fact that not all dFADs within a given area are likely to be recovered. Finally, additional cost components could be included (crew wages, food, and other direct operational expenses) or scenarios of potential rewards for dFADs and/or buoy recovery could be considered. Broader programme-level costs (coordination, training, equipment, and ongoing management of retrieval programmes) should also be incorporated.

Potential next steps

- Better incorporate remoteness into fuel cost assumptions. Develop an approach to account for spatial variation in fuel costs within PICTs, particularly between major ports and remote communities.
- Better account for different costs and/or potential rewards across the different PICTs considered.
- Consider programme-level costs and post-recovery pathways and associated costs, including: recycling and disposal options; potential logistical and financial burden on PICTs; and opportunities for circular economy approaches (e.g., repurposing materials).
- Prioritize areas for implementation of dFAD retrieval programs; and compare to the numbers in actual dFAD retrieval programs.

4. Conclusion and recommendations

4.1. General discussion of results

This study provides a structured assessment of the feasibility and potential economic implications of several mitigation options aimed at reducing dFAD loss and abandonment in the WCPO. By combining stakeholder consultation, case study review, and dFAD tracking data analysis, to inform economic modelling, this paper highlights both the opportunities and the constraints associated with different mitigation options.

Across all mitigation options considered, levels of retrieval/mitigation of loss or stranding per option per year varied from less than a thousand dFADs (minimum in options 2 and 4) to several 10,000s (maximum in options 3 and 5), corresponding to up to a third of dFADs deployed in the WCPO per year (Escalle et al., 2021). Cost per dFAD also varied from 51–264 USD (shore-based retrieval programme; option 5); 204–279 (opportunistic retrieval by longliners; option 4); 98–3,812 USD (dFAD cleaning vessel; option 3); to 668–893 (opportunistic retrieval by purse-seiners; option 4).

The overall cost associated with meaningful results in terms of retrieval (e.g., above 5,000 dFADs; options 3 and 5) are between 0.2 and 3.4 million USD per year per option considered. For instance, cleaning vessel(s) retrieving 75% of dFADs in the four main hotspots of dFAD abandonment (n1, n2, s1 and s2; 7,175 dFADs) would represent 1,400,000 to 3,400,000 USD per year, plus additional fixed and other costs of 300,000 to 480,000 per year per vessel (option 3). This is of similar level to i) a 50 USD tax per dFAD deployed in the WCPO, considering 40,000 deployments per year (2,000,000 USD / year) (e.g., Ferraro et al., 2025); or ii) a re-selling framework of second-hand buoys picked up by the recovery vessel at 200–300 USD /buoy. Similarly, recovering 75% of dFADs within 6 nm of ports from a shore-based retrieval framework (5,381 dFADs) would correspond to 400,000 USD / year (option 5). However, this excludes the costs associated with programme coordination.

The results indicate that if part of a coordinated recovery programme considering the two main assumptions of our study (knowledge of positions of lost / abandoned dFADs; and incentives for retrieval), several options could be considered. Taken together, these findings suggest that the most realistic option to reducing dFAD loss in the Pacific region will involve a combination of mitigation strategies tailored to different operational contexts, geographic areas, and stakeholder groups in order to meaningfully reduce dFAD loss and its associated environmental and social impacts.

Spatial management measures (option 1) that modify where and when dFADs are deployed and put back in the water may help reduce the likelihood of dFADs entering high-risk drift zones (Imzilen et al., 2021), although this option did not draw industry support in the stakeholder consultation. Furthermore, their economic consequences are hard to evaluate, and their effectiveness will depend on compliance and enforcement. Opportunistic retrieval by fishing vessels (purse-seine or non-purse-seine; options 2 and 4) may be cost-effective and contribute to recovery in some areas but likely require incentives or regulatory requirements. This could include, for purse-seiners, requiring a certain % of dFADs deployed to be retrieved (own dFADs and/or from other vessels). Priority should be given to hotspots with the highest densities of dFADs (hotspots S3, N1, and S4 in Table *1* and Figure *2*), as these increase the likelihood of recovery during routine operations. These options were considered as the most cost-effective by longline and purse-seine industry representatives, but not the most feasible. Dedicated or chartered vessel option (option 3) could recover substantial numbers of dFADs in high-density hotspots but would require significant and sustained financial support. Priority should be placed on port–hotspot combinations that both maximize the number of dFADs recovered and minimize transit distances. This includes targeting high-density hotspots (e.g., s1; s2; n1 and n2) while basing vessels in geographically proximate ports, such as those in the northwest Pacific (e.g., the Philippines) or the south Pacific (e.g., Fiji or American Samoa), thereby improving operational efficiency and reducing overall retrieval costs. Finally, shore-based dFAD recovery programmes (option 5), ranked as most feasible along with option 3 by industry representatives, such as dFAD watch systems, appear to be relatively low-cost in nearshore areas, but would require extended coordination and high transaction cost to match the level of retrieval that could be reached by other options. Focusing shore-based retrieval programmes to MPAs or specific areas or PICTs (e.g. Palmyra atoll; French Polynesia; Hawaii) that have the resources and willingness to sustain such programmes would be most cost-effective and allow appropriate monitoring. In addition, PICTs located within the fishing grounds and experiencing higher levels of dFAD strandings, such as Papua New Guinea, Federated States of Micronesia, Solomon Islands, Republic of the Marshall Islands, and the Gilbert Islands of Kiribati could also be considered.

Although the issue of dFAD loss and abandonment has been discussed for almost a decade (Moreno et al., 2018) and is receiving increasing attention, the development and operational testing of practical solutions remain relatively recent. Some of the options assessed in this study would require changes to fishing practices, including where dFADs are deployed, how long buoys remain active, and whether dFAD positions can be shared to facilitate retrieval. These changes are not straightforward and will require time, incentives, and coordination among all relevant stakeholders. However, the shift to non-entangling dFADs and ongoing transition to biodegradable dFADs (Escalle et al., 2026b) demonstrates that purse seine fleets are able to respond to new sustainability challenges by progressively adapting their practices, making operational changes, and investing time and resources. Building on this progress, and on the efforts already being made by fleets and other stakeholders, effective dFAD retrieval options should be considered as the next step towards more sustainable dFAD fisheries in the WCPO.

The analyses presented in this study provide an initial assessment of the feasibility and potential costs of several dFAD mitigation options. Future work should focus on refining the analytical framework where needed, while placing greater emphasis on testing mitigation strategies under real operating conditions and developing the institutional and financial mechanisms required to support implementation. Given the transboundary nature of dFAD deployment and drift, progress will also require coordination across fleets, countries, and RFMOs.

4.2. Improving the analytical framework and future work

- Incorporate additional trajectory datasets, including data from the EPO, to better evaluate dFAD hotspots at the Pacific-wide scale and improve economic modelling of all mitigation options.
- Further develop spatial and operational simulations to better represent realistic vessel behaviour, search time, and coordination during retrieval operations (i.e. agent-based modelling) for all mitigation options.
- Expand economic modelling analysis of mitigation option 2 (increased retrieval by purse-seine vessels) and 4 (retrieval by non-purse-seine vessels already operating at sea, such as longliners),

which include vessel-tracking data, to include a larger number of vessels and additional years of data.

- In mitigation option 1, better investigate the implications of temporal and spatial modifications of dFAD deployment and other activities on likelihood of dFAD loss and strandings.
- Further investigation of potential candidate vessels for mitigation option 3 focused on dedicated offshore dFAD cleaning vessels.
- Further develop cost of coordination of recovery programme (in particular option 5); and investigate costs and feasibility associated with recycling, storage, re-use of dFAD and buoys recovered; as well as feasibility in developing a circular economy framework.
- Comparison of estimated costs associated with environmental damages from dFAD loss and strandings with estimated costs of dFAD recovery.
- Pilot studies should be designed and implemented for each mitigation option in selected hotspots to evaluate realistic recovery rates, operational costs, and logistical requirements. Pilot study results could be used to refine operational assumptions and support future decision-making at national and regional levels. These studies could also allow testing of different funding and cost-sharing approaches during pilot programmes, including industry contributions, government support, or levy-based systems.
- Provide guidance on which options are likely to be more realistic or practical for different PICTs (e.g. high-stranding countries vs others), including possible prioritisation and sequencing. This could be informed by the pilot studies.
- In terms of governance, funding, and regional coordination, mechanisms to support long-term financing of retrieval programmes should be explored, including industry levies, cost-sharing arrangements, or dedicated funding schemes. This could be promoted by strengthened coordination among regional organisations to support consistent approaches to implementation, monitoring, data sharing, and mitigation.

We invite WCPFC-SC22 to:

- Note this integrated assessment combining existing knowledge with stakeholder input, case study data, real regional dFAD data, and economic considerations to evaluate feasibility and cost associated with five dFAD loss and abandonment mitigation options.
- Note that across all mitigation options considered, levels of retrieval/mitigation of loss or stranding per option varied from less than a thousand dFADs to several 10,000s per year.
- Note that estimates of the cost per dFAD also varied from 51–264 USD (shore-based retrieval programme; option 5); 204–279 (opportunistic retrieval by longliners; option 4); 178–555 (dFAD cleaning vessel; option 3); to 668–893 USD (opportunistic retrieval by purse-seiners; option 2).
- Recommend additional work to be carried out to better refine the analysis and support implementation of pilot projects in the WCPO.

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Declaration of generative AI and AI-assisted technologies in the SC paper preparation process

The generative AI tool Copilot was used to assist with code optimisation. All analytical choices, model specifications, diagnostic interpretations, and conclusions are those of the authors, who reviewed and verified all AI-assisted output. The methodology, model implementation, and the scientific conclusions are the responsibility of the authors.

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Appendix 1. Additional economic data and vessel profiles of dedicated vessels for at-sea collection used in the economic analysis

Table S1. Fuel and berthing costs by port. For fuel and berthing, costs are provided as a low and high estimate.

Country/Territory	Port	Low Fuel Price (MGO) (USD/tonne)	High Fuel Price (MGO) (USD/tonne)	Berth Cost Tier	Low Berth Cost (USD/day)	High Berth Cost (USD/day)	Estimated petrol price (USD/L)
Tokelau	Atafu	NA	NA	Tier C	0	400	2.2
Hawaii	Honolulu*	800	1,050	Tier A	400	900	1.3
FSM	Pohnpei (Kolonia)*	900	1,200	Tier B	200	600	1.55
American Samoa	Pago Pago	800	1,050	Tier A	400	900	1.4
French Polynesia	Papeete	900	1,150	Tier A	400	900	1.7
PNG	Lae	850	1,100	Tier B	200	600	1.35
RMI	Majuro	900	1,200	Tier B	200	600	1.6
Fiji	Suva*	850	1,100	Tier A	400	900	1.45
New Caledonia	Noumea	900	1,150	Tier A	400	900	1.75
Solomon Islands	Noro	950	1,250	Tier B	200	600	1.5
Samoa	Apia	900	1,200	Tier B	200	600	1.55
Kiribati	Tarawa (South Tarawa - Betio)	950	1,250	Tier B (low-end)	200	600	1.65
Vanuatu	Port Vila	900	1,200	Tier B	200	600	1.6
Tonga	Nuku'alofa	900	1,200	Tier B	200	600	1.6
Cook Islands	Avarua	950	1,250	Tier B (low-end)	200	600	1.65
Kiribati	Kirimati	1,050	1,350	Tier C (effectively "by arrangement")	0	400	1.8
Palau	Koror	900	1,200	Tier B (low-end)	200	600	1.5
Guam	Apra	800	1,050	Tier A	400	900	1.25
Northern Mariana Islands	Saipan	900	1,150	Tier B	200	600	1.3
Nauru	Aiwo	1,100	1,400	Tier C	0	400	1.7
Tuvalu	Funuafuti*	1,050	1,350	Tier C	0	400	1.85
Niue	Alofi	NA	NA	Tier C	0	400	1.8
Philippines	General Santos*	750	1,000	Tier A (industrial hub)	400	900	1.1
Philippines	Davao	780	1,020	Tier A (industrial hub)	400	900	1.1
Taiwan	Nanfang'ao	780	1,050	Tier A	400	900	1.5

Japan	Misaki	850	1,110	Tier A	400	900	1.3
Australia	Brisbane*	820	1,050	Tier A	400	900	1.25
Australia	Cairns	850	1,150	Tier B	200	600	1.3
Wallis and Futuna	Mata Utu	NA	NA	Tier C	0	400	1.8

Tier A= Developed industrial ports, Tier B= semi-developed industrial ports, Tier C=least developed ports. Marine Gas Oil (MGO) is a clean, low-viscosity distillate fuel designed for marine diesel engines, while petrol (gasoline) is a light, highly volatile fuel for spark-ignition engines. MGO is used for inboard engines (in this context larger boats) whilst petrol is used in outboard engines (i.e. small vessels). Fuel prices were derived and triangulated using several sources including technical reports and industry references (Wainibalagi 2018) as well as online cost data accessed on November 2025 (Rhino Car Hire 2026; Ship & Bunker 2026; Bunker Index 2026), and were further corroborated using discussions with contacts in the PICs. For ports where fuel price information could not be identified directly from these sources, estimates were inferred based on the relative level of port development. Berthing costs (per day) were estimated using a standard vessel size of 30m and provided as a range as often prices even within the same port may vary depending on the activity of the vessel - e.g. offloading versus anchored - and may also include additional entry / exit charges that are not always listed on published price lists. Ports marked with an asterisk (*) indicate locations where port-specific information was directly by a combination of direct consultation with selected ports and stakeholders or published tariff schedules from representative ports across tiers (Port of Tuvalu 2015; Port of Brisbane 2025; Hawaii Department of Transportation 2017; Micronesia Port of Pohnpei 2026). For all other ports, estimates were assigned based on port development status, using ranges derived from these reference ports.

Table S2. Indicative vessel classes and sizes potentially relevant to dFAD retrieval operations. Vessel classes are defined using approximate length overall (LOA) ranges and are intended as broad planning categories rather than fixed operational definitions.

Vessel class	Indicative size range	Examples / interpretation
A- Small/local vessel	**~ 8–20 m LOA**	Small coastal vessels, skiffs, launches, small workboats, artisanal/coastal tuna vessels, or small local longliners. Suitable mainly for nearshore, inter-island, or opportunistic retrieval.
B- Mid-size offshore-capable vessel	**~ 20–50 m LOA**	Medium longliners, larger workboats, patrol/research vessels, pole-and-line vessels, small purse-seiners, or repurposed fishing/support vessels. Suitable for multi-day operations, depending on range and safety certification.
C- Large industrial tuna fishing or support vessel	**~ 50–90 m+ LOA**	Large purse-seiners, carrier/support vessels, ex-industrial tuna vessels, or large offshore service vessels. This includes the upper end of the industrial tuna fleet, with some purse-seiners around 78–89 m LOA.

Table *S3*. Vessel profile for *i)* an Atlantic Ocean purse-seine supply vessel, information provided by M. Herrera (OPAGAC); ii) an Indian Ocean ex-purse-seine supply vessel *Saya de Malha*, information provided by D. Boulle (Seychelles Fisheries Authorities); and iii) a renovated pole-and-line vessel used as tagging vessel in the Pacific Ocean *Solomon Searcher*, information provided by J. Muir (SPC) and R. Dunham (National Fisheries Developments (NFD). *Indicative cost estimates correspond to 2025.

Vessel name	Unknown *"Atlantic Ocean Supply vessel"*	Saya de Malha	Solomon Searcher *Former name: Soltai No. 105*
Vessel type	Tuna purse-seine supply vessel	Indian Ocean goverment vessel Ex Tuna purse-seine supply vessel	Renovated pole-and-line vessel Now as aFAD support; dFAD recovery and tuna tagging vessel
Owner	*Not provided*	Seychelles Coast Guard (SCG)	National Fisheries Developments (NFD)
Home port	Abidjan (Ivory Coast) /Dakar (Senegal)	Port Victoria (Seychelles)	Noro, Solomon Islands
Flag	*Not provided*	Seychelles	Solomon Islands
Length overall (LOA)	30.60 meters	41.00 metres	37.65 metres
GRT or MT	168 GT	500 tonnes	199 GT
Beam (width)	7.22 meters	9.00 metres	6.40 metres
Draft	2.84 meters	5.00 metres	2.53 metres
Deck space available	90 m2	*Not provided*	*Not provided*
Hold space (for FADs)	*Not provided* Considered as 70–200	Max of 50–70 dFADs retrieved /trip Considered as 150–300	~50–200 depending on configuration
Lifting equipment	Toimil crane Capacity 1.5 tns / 8 m	1 big deck crane	Heavy-duty deck crane/davit system (~6 tonne lifting capability planned)
Safety equipment	Yes	Yes	Yes
Engine type	Cummins	*Anglo Belgian Corp. (ABC)*	Yanmar
Engine power	675 HP	*750 HP*	887 HP
Cruising speed	8 knots	15 knots	11 knots
Fuel capacity	125,000 L	≥ 180,000 L	~ 64,000 L
Operational range	Gulf of Guinea	≥ 3000 nm	~30 days operational autonomy
Maximum distance travelled /day	*Not provided* *Calculated as 192 nm/day*	*Not provided* *Calculated as 312 nm/day*	~ 240 nm/day
Crew Size	7 – 8 persons	20 persons (max 30)	~ 8–12 operational crew 6–10 science staff
Crew nationality	Spanish / African / Indonesian	Seychelles	Solomon Islands nationals

Crew accommodation (# of bunks)	9	26	26
Additional Support Vessels	None specified	2 tenders	None specified
Waste Management Capabilities	*Not provided*	On deck storage prior to unloading	On deck storage prior to unloading
Any special notes/ additional capabilities	*Not provided*	Dive operational	Scouting, dFAD retrieval, aFAD deployment, tuna tagging, and fisheries research activities
Capital and refit costs			
Capital cost (purchase price) new	USD 2,000,000 – 5,000,000	*Not provided*	*Not provided*
Capital cost (purchase price) used / refit	USD 1,000,000 – 2,000,000	Donation	~ USD 2,000,000 refit cost for full research/tagging configuration
Refit cost (estimated lower-cost conversion scenario)	NA	NA	~ USD 1,000,000 refit cost for simplified dFAD retrieval-only
Operating costs (fuel, crew salary and provisions)			
Fuel consumption rate	3.5 tns (sea) / 1.2 tns (port) = 22 L per nm	~ 35 L per nm	*Unknown*
Average fuel burn day steaming	Considered as 2,240 L/day	Considered as 3,920 L/day	~ 2,000 L /day steaming
Average daily fuel cost	USD 800 /day*	~ USD 1,400 /day*	~ USD 738 /day*
Total crew costs (daily or monthly)	USD 35,000 /month ~ USD 1,167 /day	~ USD 19,500 /month ~ USD 650 /day	USD 22,130 /month ~ USD 740 / day
Provisions / supplies	*Not specified*	USD 24 /person /day = 720 / day	~USD 530 /day
Fixed costs and other operating costs			
Maintenance and repair costs	USD 220,000 /year	*Unavailable*	USD 135,000 / year
Insurance costs	USD 24,000 /year	*Unavailable*	USD 40,000/ year
Port/harbor fees	USD 1,500 – 3,000 /month	Coast guard berth, no cost	*Not provided*
Other operating costs	USD 200,000 /year	*Unkown*	USD 90,000 /year
Depreciation	*Not provided*	*Unavailable*	USD 41,173 /year
Additional cost notes	*Not provided*	~ 600 USD per dFAD retrieved, based on 2026 streamlined mission	dFAD retrieval operations integrated with scouting and operational vessel movements
Total fixed and other costs (besides fuel, crew wages, provisions) / year	USD 480,000 /year	*Not provided*	USD 300,000 /year

Appendix 2. Investigation of candidate vessels operating in the WCPFC and IATTC convention areas and capable of retrieving dFADs.

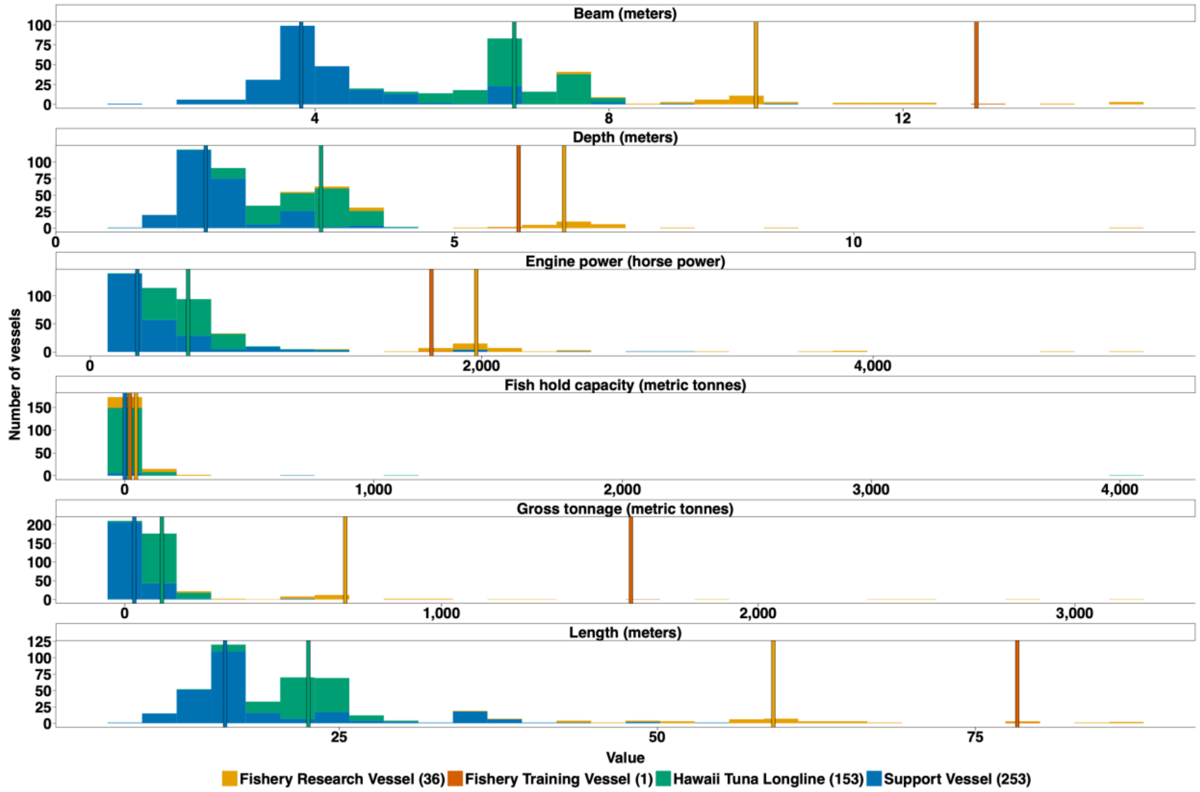

Figure S1. Distribution of identified reference support vessels (by colour) from the WCPFC vessel registry that are currently engaged in, or potentially capable of, dFAD retrieval, across key vessel characteristics (panels). Vertical lines show median values for each reference group, which are used to compare with longline fleets and identify vessels with similar characteristics suited to dFAD retrieval.

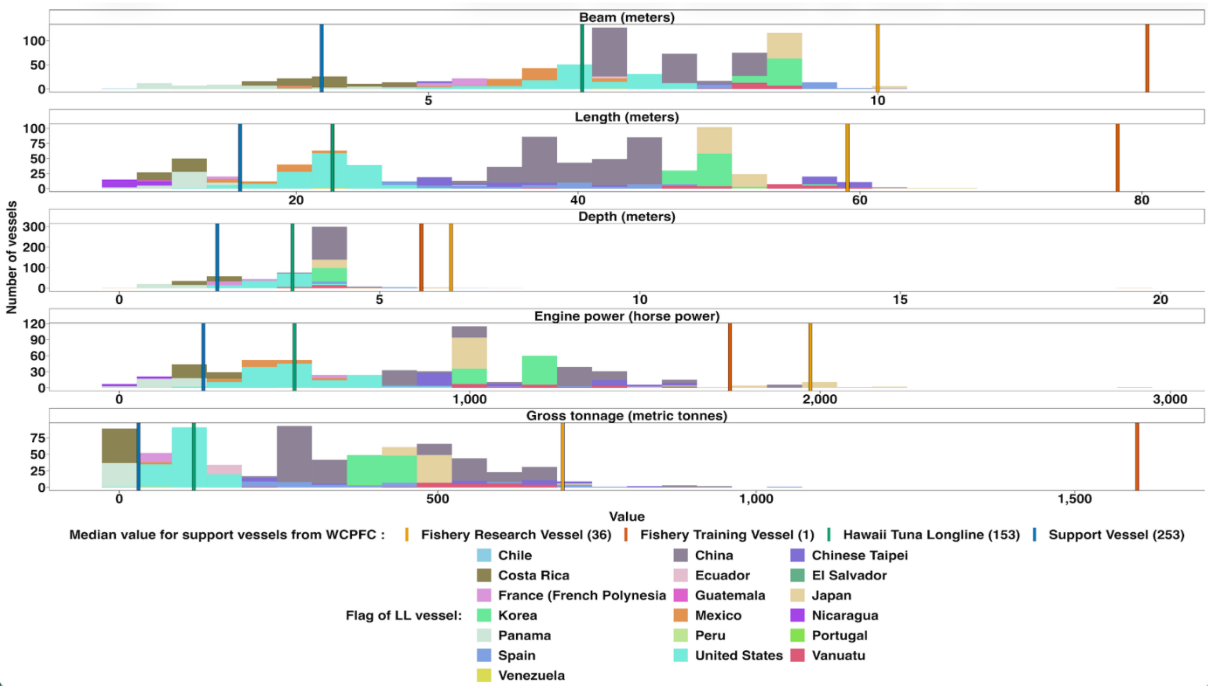

Figure S2. Distribution of longline vessel characteristics by flag state (colours), based on IATTC vessel registrar, compared to reference support vessels from the WCPFC registrar. Vertical lines indicate median values for selected reference groups, including support vessels, fishery research vessels, fishery training vessels, and the Hawai'i longline fleet. These comparisons are used to identify longline fleets with characteristics most closely aligned with vessels currently engaged in, or potentially capable of, dFAD retrieval.

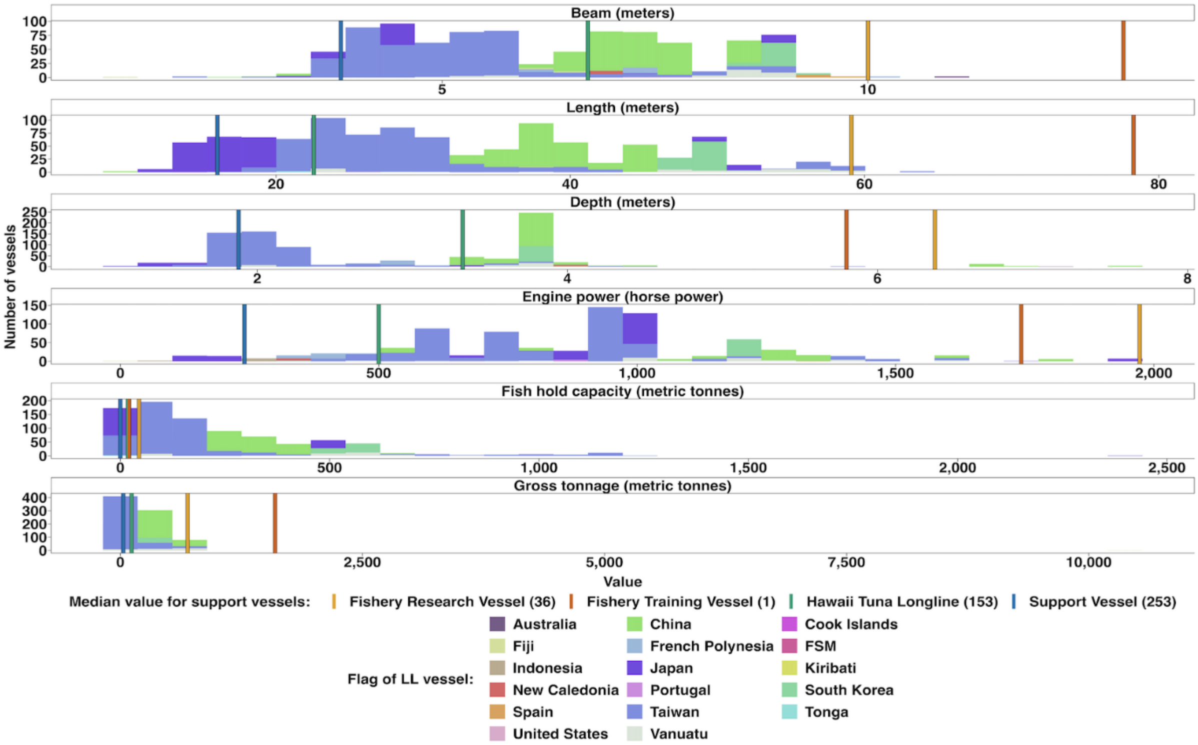

Figure S3. Distribution of longline vessel characteristics by flag state (colours), based on WCPFC vessel registrar, compared to reference support vessels from the WCPFC registrar. Vertical lines indicate median values for selected reference groups, including support vessels, fishery research vessels, fishery training vessels, and the Hawai'i longline fleet. These comparisons are used to identify longline fleets with characteristics most closely aligned with vessels currently engaged in, or potentially capable of dFAD retrieval.

Appendix 3. Additional figures for stakeholder survey

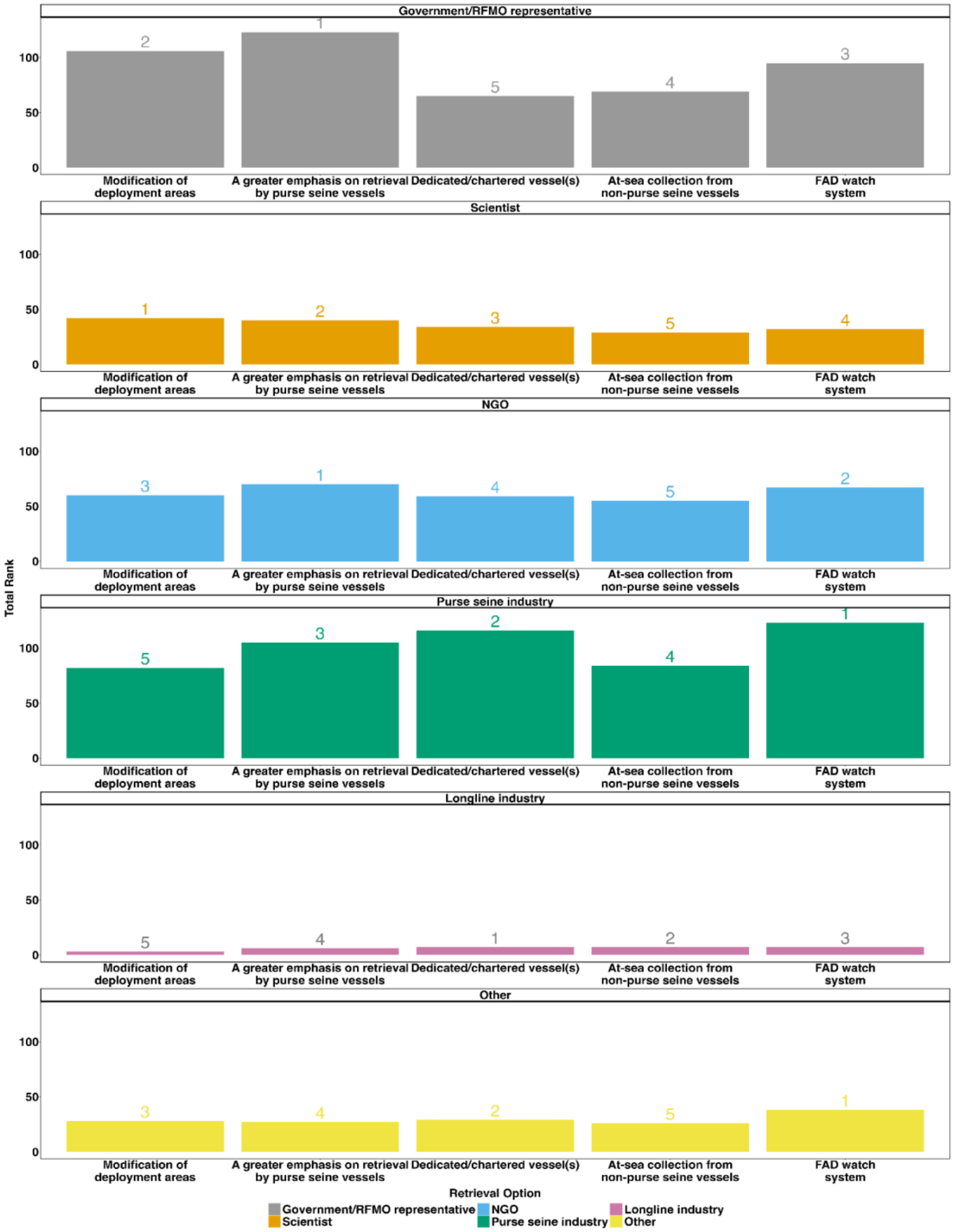

Figure S4. Ranking of mitigation options by perceived feasibility across stakeholders (n=84) by general stakeholder group. Respondents ranked each option from 1 (least feasible) to 5 (most feasible). Bars show the total rank score summed across respondents within each stakeholder group, with higher bars indicating greater overall perceived feasibility. Numbers above each bar show the relative ranking within each group, reordered so that 1 represents the most feasible option and 5 the least feasible.

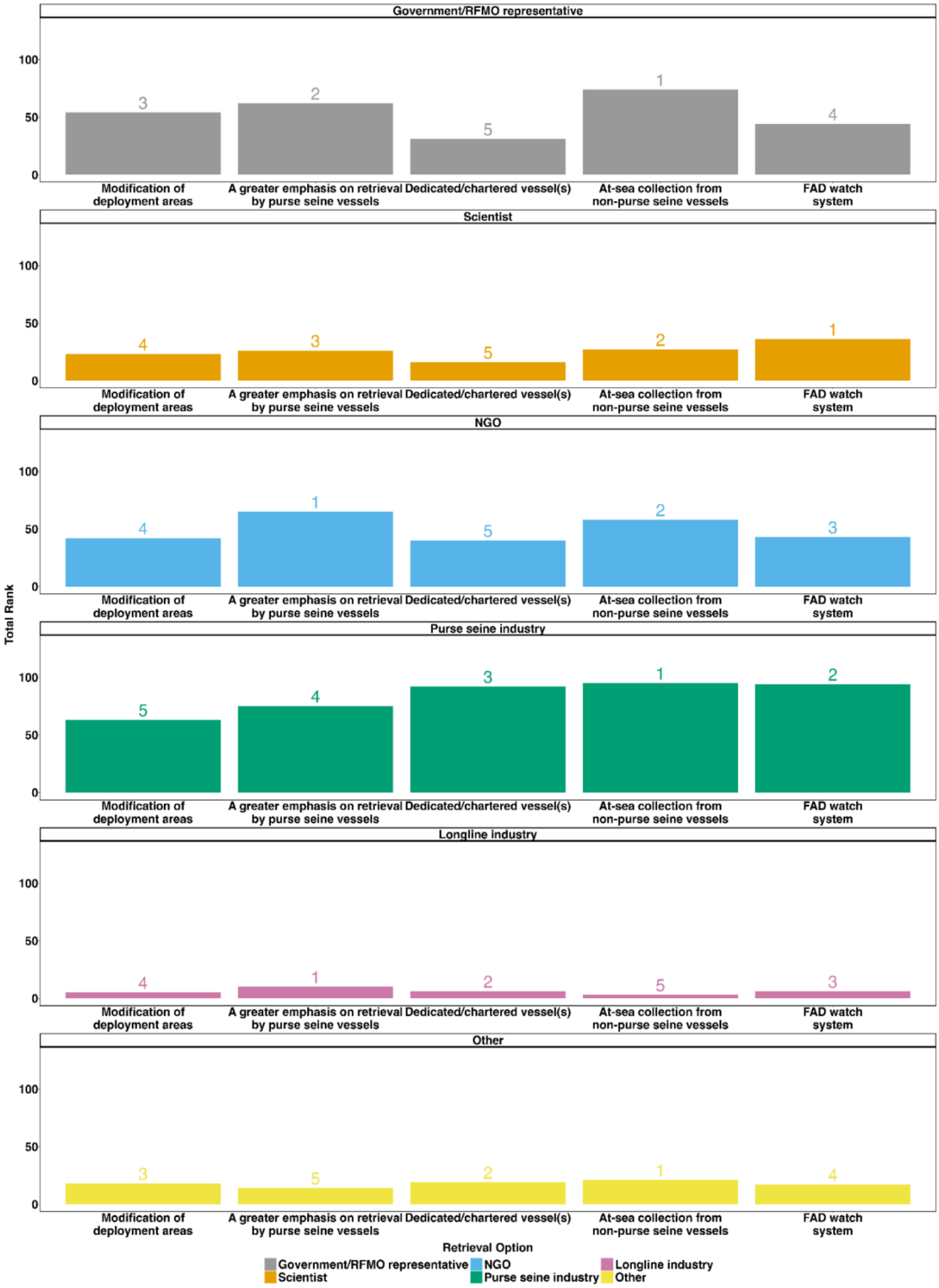

Figure S5. Ranking of mitigation options by perceived cost-effectiveness across stakeholders (n=84) by general stakeholder group. Respondents ranked each option from 1 (least cost-effective) to 5 (most cost-effective). Bars show the total rank score summed across respondents within each stakeholder group, with higher bars indicating greater overall perceived cost-effectiveness. Numbers above each bar show the relative ranking within each group, reordered so that 1 represents the most cost-effective option and 5 the least cost-effective.

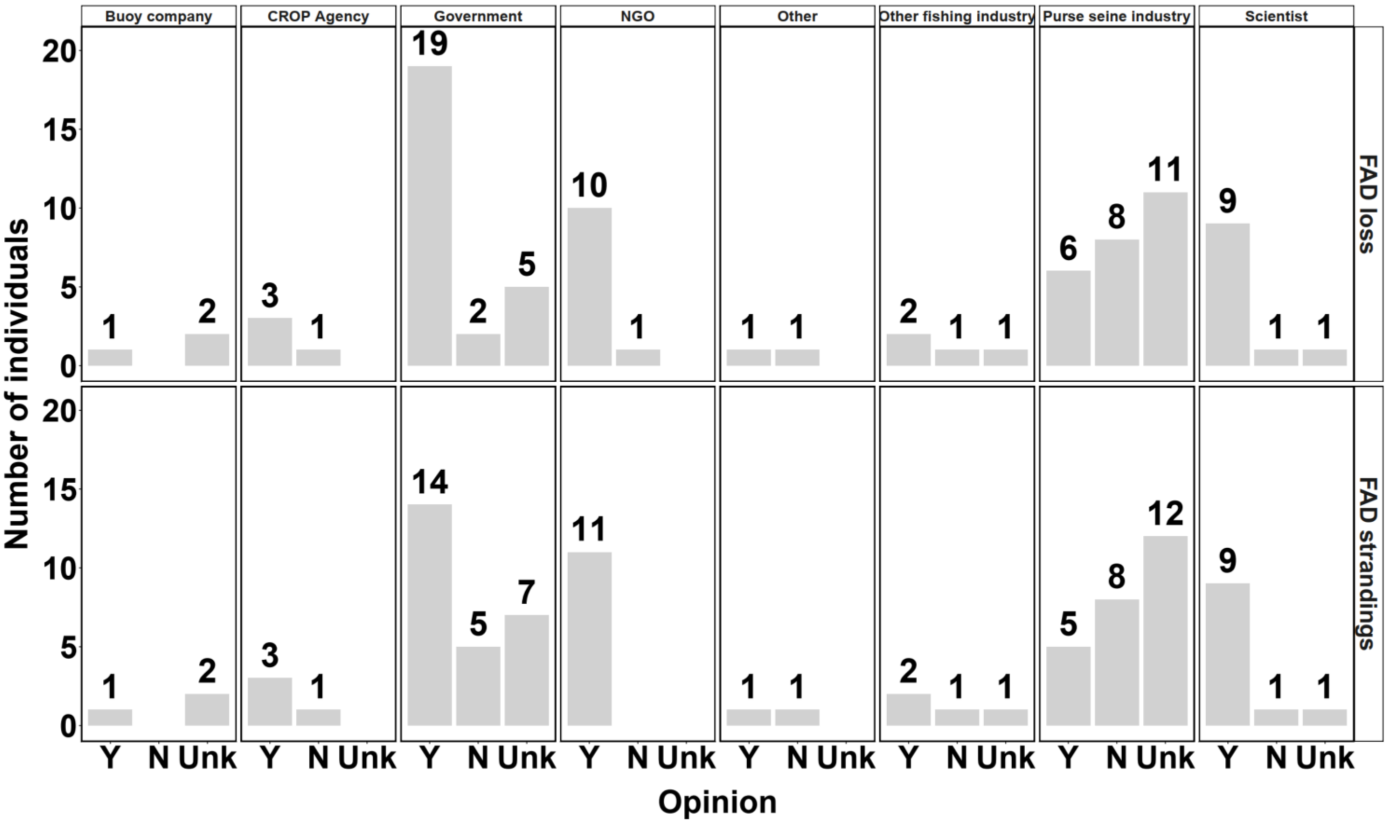

Figure S6. Stakeholder responses (n=86) indicating their opinion on whether restricting dFAD deployment to certain areas or periods could reduce dFAD loss (top) and dFAD strandings (bottom), by stakeholder type. Y= Yes; N= No; Unk= I don't know.

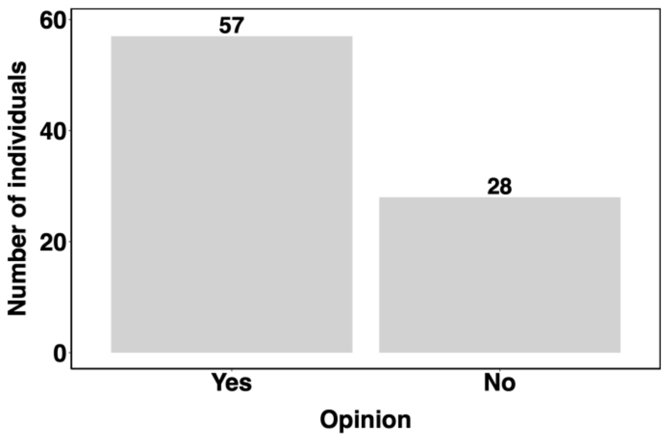

Figure S7. Stakeholder responses (n=85) indicating their opinion if RFMOs should require purse-seine vessels to recover dFADs.

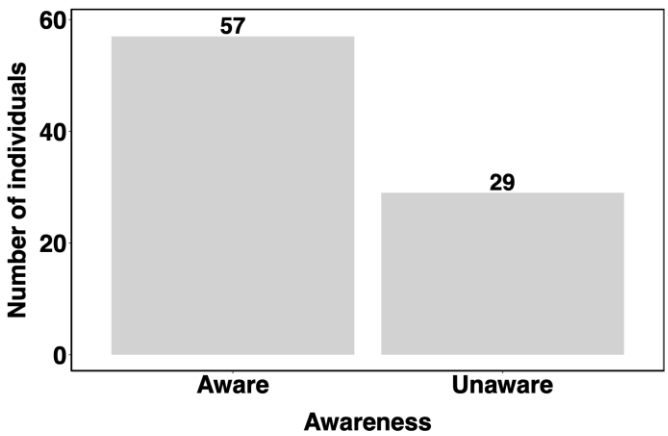

Figure S8. Stakeholder responses (n=86) indicating their awareness of dFAD recovery programmes.

Table S4. Examples of dFAD recovery programmes identified by stakeholders, including associated region, organizations, and country, based on stakeholder declarations.

Region	Organization / Initiative	Country / Location
Global	ISSF	Global
	The Ocean Cleanup	Global
	NGOs in collaboration with tuna companies	Global
Pacific	TNC	Palmyra
	DMWR	American Samoa
	TUNACONS and partners	Galápagos
	TriMarine / NFD	Solomon Islands
	SPC	Tonga
	HPU Center for Marine Debris	Hawai‘i
	DMR / Thibaut Thellier	French Polynesia
	Unknown	Guam
	Unknown (in development)	Cook Islands
Indian Ocean	TNC / SIOTI	Seychelles
	Oceanika / TNC	Indian Ocean (regional)

Appendix 4. Additional figures from the economic analysis

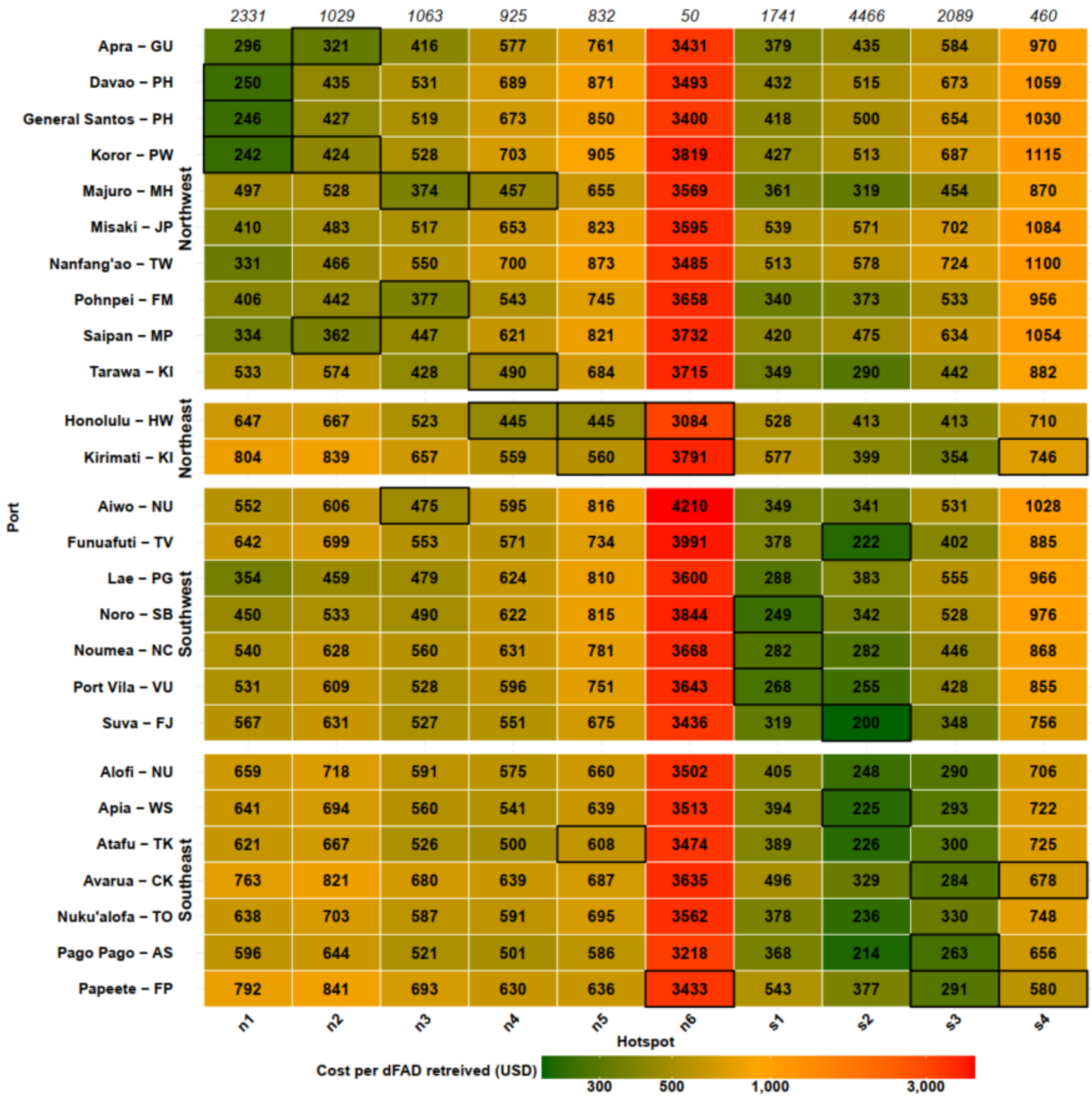

Figure S9. Cost per dFAD by port (rows) and hotspot (columns) combinations for the Saya de Malha vessel assuming a maximum capacity of 300 dFADs and low fuel cost scenarios. The colour and number within each cell represent the cost per dFAD and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

Figure S10. Number of dFADs collected in a year by a single vessel across port (rows) and hotspot (columns) combinations for the Saya de Malha vessel assuming a maximum capacity of 300 dFADs and low fuel cost scenarios. The colour of and number within each cell represent the number of dFADs retrieved in a year and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

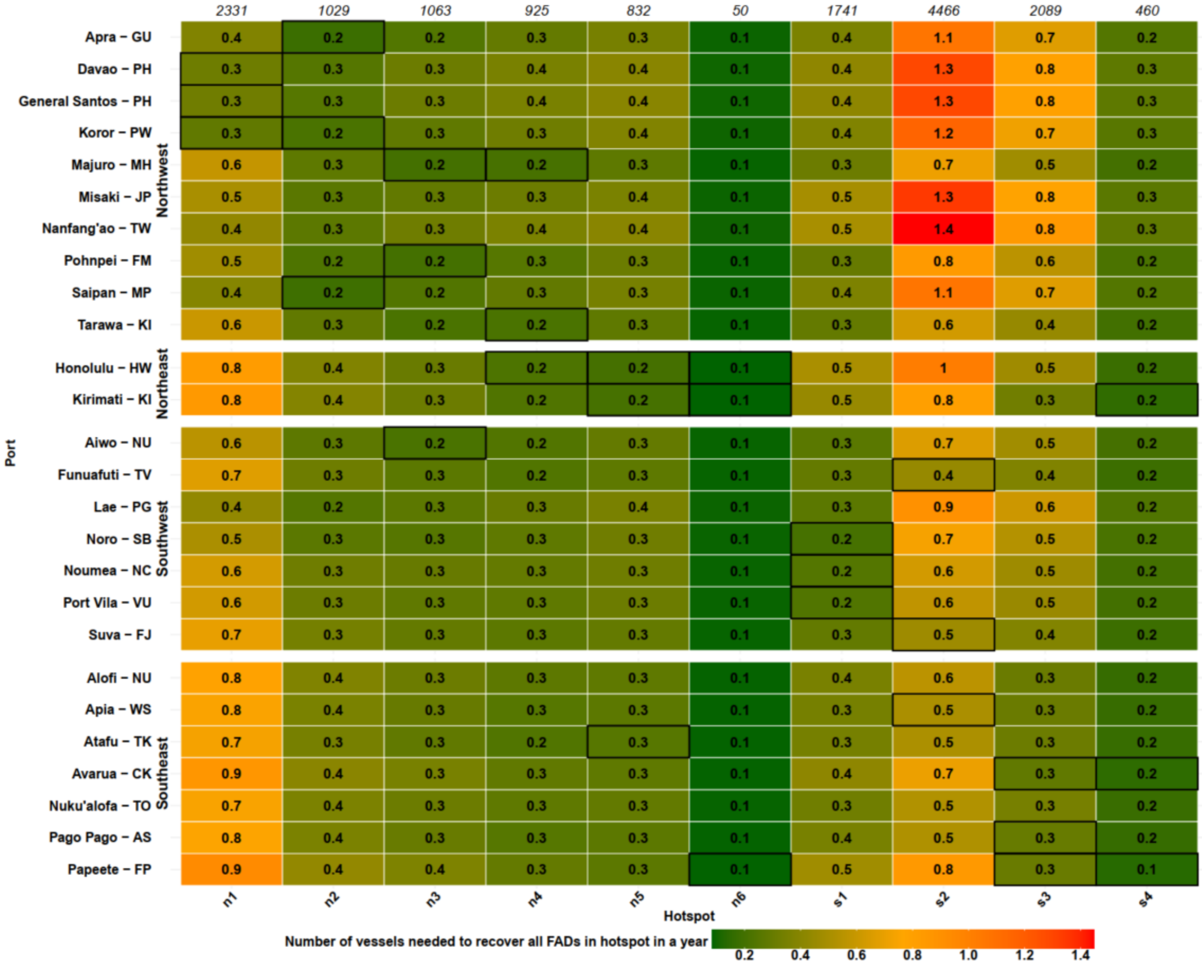

Figure S11. Number of vessels required to retrieve all dFADs in a given port (rows) and hotspot (columns) combinations in a for the Saya de Malha vessel assuming a maximum capacity of 300 dFADs and low fuel cost scenarios. The colour and number within each cell represent the number of vessels required and on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

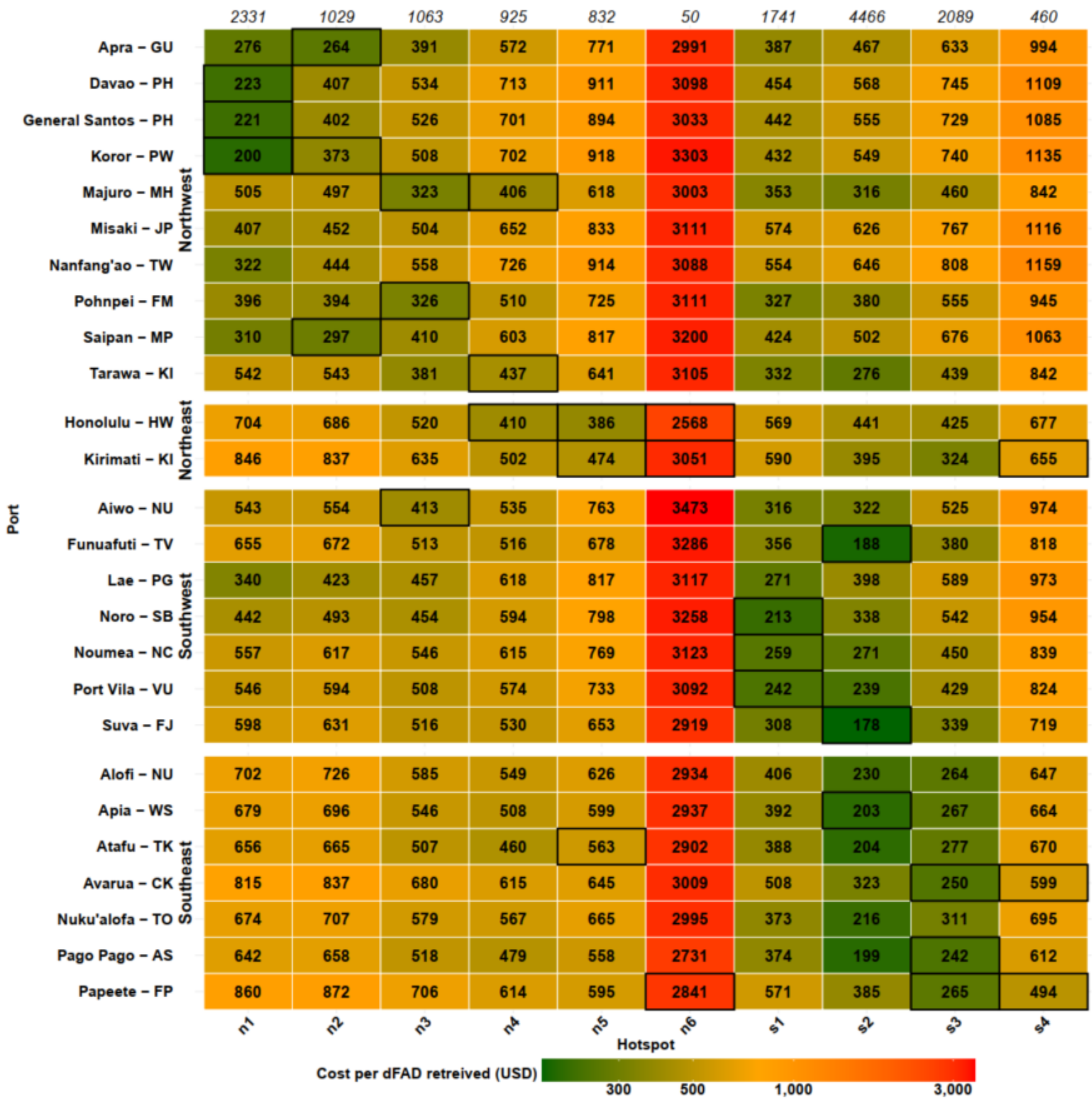

Figure S12. Cost per dFAD by port (rows) and hotspot (columns) combinations for the Solomon Searcher vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour and number within each cell represent the cost per dFAD and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

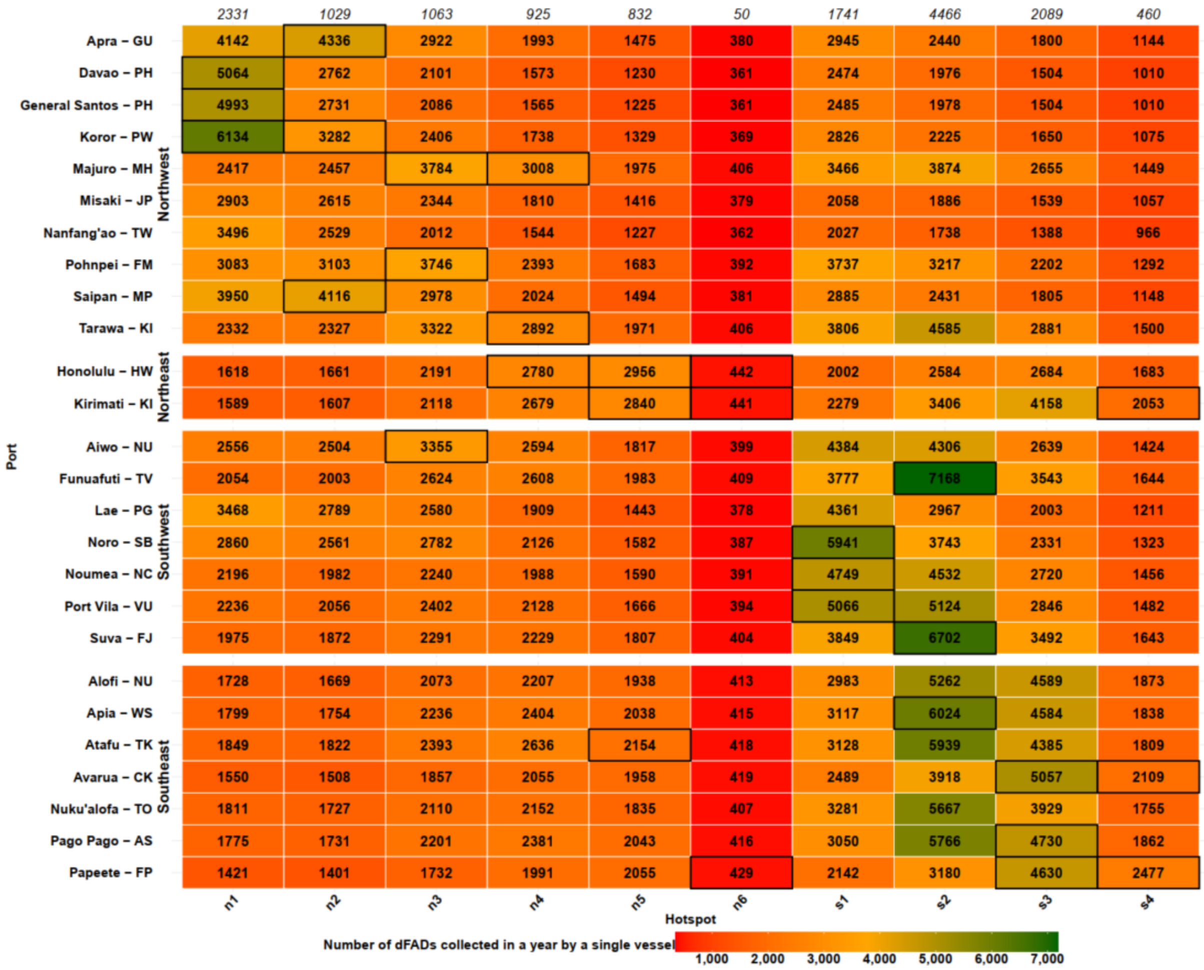

Figure S13. Number of dFADs collected in a year by a single vessel across port (rows) and hotspot (columns) combinations for the Solomon Searcher vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour of and number within each cell represent the number of dFADs retrieved in a year and the numbers on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

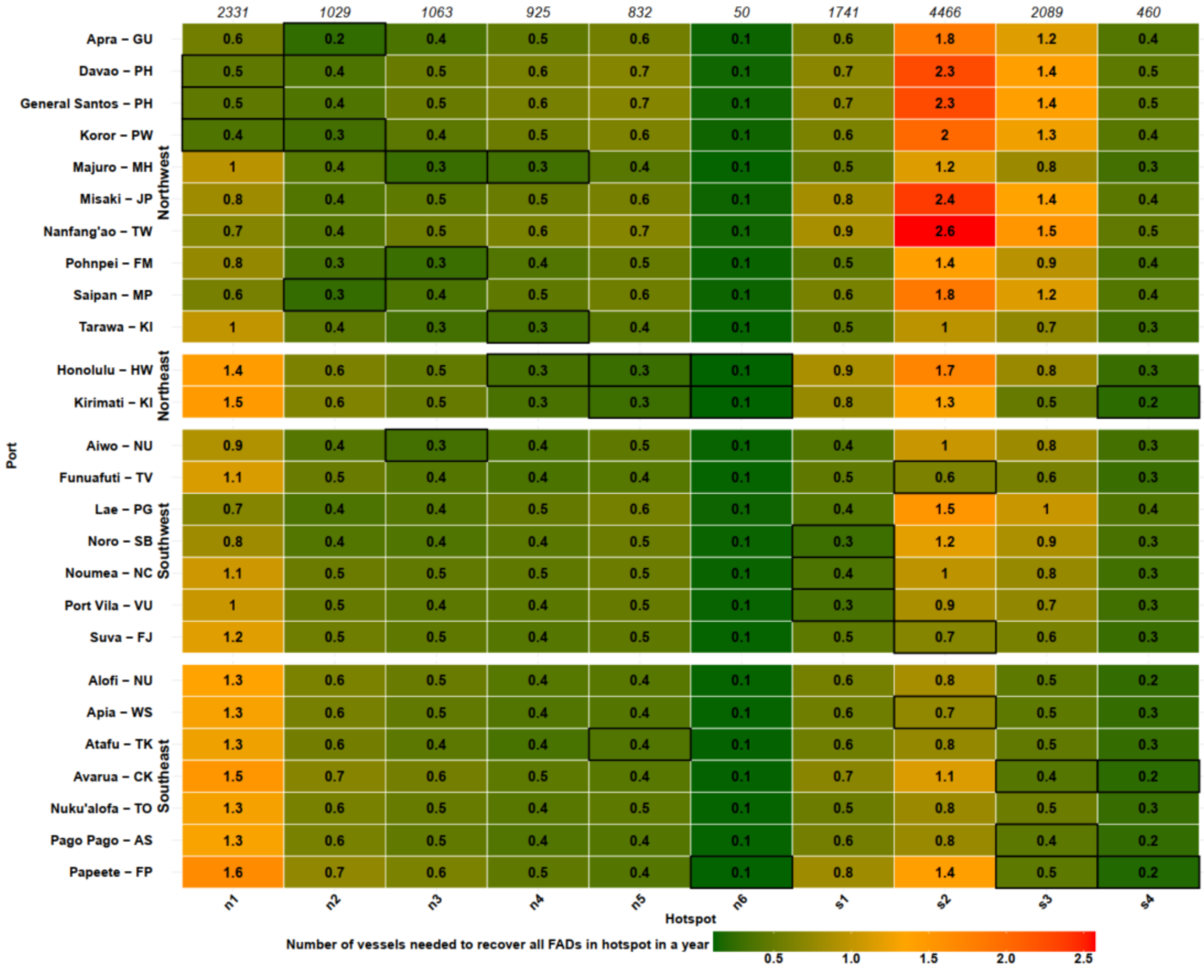

Figure S14. Number of vessels required to retrieve all dFADs in a given port (rows) and hotspot (columns) combinations in a for the Solomon Searcher vessel assuming a maximum capacity of 200 dFADs and low fuel cost scenarios. The colour and number within each cell represent the number of vessels required and on top of the column the number of dFADs estimated to occur in each hotspot (Table 1). Cells corresponding to the 3 closest ports to the centroid of each hotspot were highlighted with a black rectangle.

Table S5. Cost per dFAD (USD) and total operating costs (USD) to retrieve 100%; 75%; 50% and 25% of dFADs within a hotspot considering the closest port and for the Atlantic Ocean supply vessel assuming a maximum capacity of 70 or 200 dFADs and low or high fuel and berthing cost scenarios.

Storage scenario	Hotspot	Closest port	Number of dFAD transit 2024	Cost per dFAD (USD)		Cost retrieval 100% of dFADs		Cost retrieval 75% of dFADs		Cost retrieval 50% of dFADs		Cost retrieval 25% of dFADs	
				Low	High	Low	High	Low	High	Low	High	Low	High
70	n1	Koror - PW	2331	345	428	803,700	998,451	602,797	748,776	401,864	499,184	200,932	249,592
70	n2	Apra - GU	1029	416	507	428,235	521,873	321,202	391,432	214,135	260,954	107,067	130,477
70	n3	Majuro - MH	1063	678	837	720,681	890,113	540,536	667,617	360,357	445,078	180,179	222,539
70	n4	Majuro - MH	925	944	1164	872,863	1,076,238	654,623	807,178	436,415	538,119	218,208	269,059
70	n5	Honolulu - HW	832	777	942	646,479	783,529	484,848	587,621	323,232	391,747	161,616	195,874
70	n6	Honolulu - HW	50	4358	5254	217,890	262,704	163,418	197,029	108,945	131,353	54,473	65,676
70	s1	Noro - SB	1741	444	548	772,859	953,175	579,622	714,898	386,415	476,599	193,208	238,299
70	s2	Funuafuti - TV	4466	386	473	1,722,446	2,112,012	1,291,902	1,583,979	861,268	1,055,986	430,634	527,993
70	s3	Avarua - CK	2089	578	711	1,207,237	1,485,695	905,425	1,114,273	603,617	742,848	301,808	371,424
70	s4	Papeete - FP	460	981	1178	451,362	541,660	338,514	406,238	225,676	270,825	112,838	135,413
		TOTAL	14986			7,843,751	9,625,449	5,882,886	7,219,039	3,921,924	4,812,693	1,960,962	2,406,346
		Total n1, n2, s1, s2	9567			3,727,239	4,585,511	2,795,523	3,439,084	1,863,682	2,292,723	931,841	1,146,361
200	n1	Koror - PW	2331	297	367	693,295	855,242	519,930	641,433	346,620	427,622	173,310	213,811
200	n2	Apra - GU	1029	394	477	405,709	490,749	304,301	368,048	202,867	245,365	101,434	122,683
200	n3	Majuro - MH	1063	482	593	511,833	630,226	383,876	472,690	255,917	315,126	127,959	157,563
200	n4	Majuro - MH	925	606	745	560,101	689,236	420,066	516,913	280,044	344,609	140,022	172,304
200	n5	Honolulu - HW	832	577	697	480,367	580,248	360,298	435,178	240,198	290,118	120,099	145,059
200	n6	Honolulu - HW	50	3846	4634	192,304	231,697	144,229	173,771	96,153	115,848	48,076	57,924
200	s1	Noro - SB	1741	317	389	551,791	677,310	413,792	507,937	275,861	338,625	137,931	169,312
200	s2	Funuafuti - TV	4466	278	339	1,242,689	1,514,269	932,166	1,135,816	621,444	757,210	310,722	378,605
200	s3	Avarua - CK	2089	372	457	777,507	953,723	583,144	715,221	388,763	476,814	194,381	238,407
200	s4	Papeete - FP	460	736	881	338,584	405,209	253,955	303,911	169,303	202,607	84,652	101,304
		TOTAL	14986			5,754,178	7,027,908	4,315,755	5,270,916	2,877,170	3,513,944	1,438,585	1,756,972
		Total n1, n2, s1, s2	9567			2,893,484	3,537,569	2,170,189	2,653,233	1,446,792	1,768,822	723,396	884,411

Table S6. Cost per dFAD (USD) and total operating costs (USD) to retrieve 100%; 75%; 50% and 25% of dFADs within a hotspot considering the closest port and for the Saya de Malha vessel assuming a maximum capacity of 150 or 300 dFADs and low or high fuel and berthing cost scenarios.

Storage scenario	Hotspot	Closest port	Number of dFAD transit 2024	Cost per dFAD (USD)		Cost retrieval 100% of dFADs		Cost retrieval 75% of dFADs		Cost retrieval 50% of dFADs		Cost retrieval 25% of dFADs	
				Low	High	Low	High	Low	High	Low	High	Low	High
150	n1	Koror - PW	2331	257	334	598,100	778,367	448,601	583,741	299,067	389,160	149,534	194,580
150	n2	Apra - GU	1029	328	418	337,103	430,082	252,825	322,592	168,550	215,061	84,275	107,531
150	n3	Majuro - MH	1063	433	562	460,565	597,713	345,448	448,294	230,299	298,862	115,150	149,431
150	n4	Majuro - MH	925	559	724	516,615	669,844	387,459	502,414	258,306	334,943	129,153	167,471
150	n5	Honolulu - HW	832	504	642	419,512	534,047	314,621	400,546	209,747	267,030	104,874	133,515
150	n6	Honolulu - HW	50	3,236	4,105	161,775	205,233	121,331	153,926	80,888	102,618	40,444	51,309
150	s1	Noro - SB	1741	287	371	500,441	645,851	375,273	484,433	250,182	322,956	125,091	161,478
150	s2	Funuafuti - TV	4466	256	326	1,141,609	1,455,970	856,132	1,091,937	570,755	727,958	285,377	363,979
150	s3	Avarua - CK	2089	346	446	723,020	932,125	542,252	699,084	361,501	466,056	180,751	233,028
150	s4	Papeete - FP	460	654	820	300,899	377,108	225,665	282,831	150,443	188,554	75,222	94,277
		TOTAL	14986			5,159,639	6,626,339	3,869,608	4,969,797	2,579,738	3,313,198	1,289,869	1,656,599
		Total n1, n2, s1, s2	9567			2,577,253	3,310,269	1,932,831	2,482,702	1,288,554	1,655,135	644,277	827,568
300	n1	Koror - PW	2331	242	314	564,636	732,460	423,426	549,300	282,284	366,200	141,142	183,100
300	n2	Apra - GU	1029	321	408	330,215	420,002	247,655	315,028	165,103	210,019	82,552	105,009
300	n3	Majuro - MH	1063	374	485	397,624	515,150	298,251	386,347	198,834	257,565	99,417	128,783
300	n4	Majuro - MH	925	457	591	422,428	547,052	316,836	410,284	211,224	273,523	105,612	136,761
300	n5	Honolulu - HW	832	445	566	370,328	470,600	277,742	352,934	185,162	235,290	92,581	117,645
300	n6	Honolulu - HW	50	3,084	3,912	154,218	195,586	115,661	146,689	77,108	97,793	38,554	48,896
300	s1	Noro - SB	1741	249	320	433,166	557,570	324,871	418,232	216,580	278,821	108,290	139,411
300	s2	Funuafuti - TV	4466	223	283	993,650	1,262,856	745,264	947,239	496,843	631,492	248,421	315,746
300	s3	Avarua - CK	2089	284	365	592,377	762,172	444,330	571,707	296,220	381,138	148,110	190,569
300	s4	Papeete - FP	460	580	726	266,874	333,989	200,169	250,505	133,446	167,003	66,723	83,502
		TOTAL	14986			4,525,514	5,797,437	3,394,205	4,348,265	2,262,803	2,898,843	1,131,402	1,449,421
		Total n1, n2, s1, s2	9567			2,321,666	2,972,888	1,741,215	2,229,799	1,160,810	1,486,533	580,405	743,266

Table S7. Cost per dFAD (USD) and total operating costs (USD) to retrieve 100%; 75%; 50% and 25% of dFADs within a hotspot considering the closest port and for the Solomon Searcher vessel assuming a maximum capacity of 50 or 200 dFADs and low or high fuel and berthing cost scenarios.

Storage scenario	Hotspot	Closest port	Number of dFAD transit 2024	Cost per dFAD (USD)		Cost retrieval 100% of dFADs		Cost retrieval 75% of dFADs		Cost retrieval 50% of dFADs		Cost retrieval 25% of dFADs	
				Low	High	Low	High	Low	High	Low	High	Low	High
50	n1	Koror - PW	2331	252	320	587,462	746,317	440,559	559,790	293,706	373,193	146,853	186,597
50	n2	Apra - GU	1029	289	361	297,801	371,405	223,344	278,525	148,896	185,683	74,448	92,842
50	n3	Majuro - MH	1063	537	674	570,747	716,634	428,044	537,506	285,362	358,337	142,681	179,169
50	n4	Majuro - MH	925	774	968	715,468	895,483	536,616	671,619	357,744	447,746	178,872	223,873
50	n5	Honolulu - HW	832	603	743	501,911	618,518	376,459	463,882	250,973	309,254	125,486	154,627
50	n6	Honolulu - HW	50	3,121	3,812	156,065	190,602	117,049	142,950	78,033	95,300	39,016	47,650
50	s1	Noro - SB	1741	352	442	612,903	769,766	459,624	577,272	306,416	384,848	153,208	192,424
50	s2	Funuafuti - TV	4466	305	381	1,360,566	1,700,898	1,020,258	1,275,825	680,172	850,550	340,086	425,275
50	s3	Avarua - CK	2089	475	594	991,451	1,240,065	743,580	930,023	495,720	620,015	247,860	310,008
50	s4	Papeete - FP	460	762	927	350,357	426,576	262,752	319,919	175,168	213,279	87,584	106,640
		TOTAL	14986			6,144,731	7,676,263	4,608,284	5,757,309	3,072,189	3,838,206	1,536,095	1,919,103
		Total n1, n2, s1, s2	9567			2,858,732	3,588,386	2,143,785	2,691,411	1,429,190	1,794,274	714,595	897,137
200	n1	Koror - PW	2331	200	250	465,586	582,594	349,126	436,888	232,750	291,258	116,375	145,629
200	n2	Apra - GU	1029	264	324	271,462	332,939	203,588	249,738	135,725	166,492	67,863	83,246
200	n3	Majuro - MH	1063	323	403	343,507	428,681	257,592	321,531	171,728	214,354	85,864	107,177
200	n4	Majuro - MH	925	406	507	375,823	468,591	281,871	351,454	187,914	234,303	93,957	117,151
200	n5	Honolulu - HW	832	386	473	321,159	393,096	240,864	294,840	160,576	196,560	80,288	98,280
200	n6	Honolulu - HW	50	2,568	3,131	128,380	156,554	96,285	117,416	64,190	78,278	32,095	39,139
200	s1	Noro - SB	1741	213	265	371,275	461,927	278,517	346,416	185,678	230,944	92,839	115,472
200	s2	Funuafuti - TV	4466	188	232	837,972	1,034,510	628,366	775,744	418,911	517,163	209,455	258,581
200	s3	Avarua - CK	2089	250	311	523,030	650,092	392,314	487,573	261,543	325,048	130,771	162,524
200	s4	Papeete - FP	460	494	598	227,306	275,224	170,465	206,414	113,643	137,609	56,822	68,805
		TOTAL	14986			3,865,500	4,784,208	2,898,986	3,588,013	1,932,657	2,392,009	966,329	1,196,004
		Total n1, n2, s1, s2	9567			1,946,295	2,411,970	1,459,596	1,808,786	973,064	1,205,857	486,532	602,929