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Estimating The Use of FADs Around the World

An updated analysis of the number of fish aggregating devices deployed in the ocean

Contents

Authors

Dave Gershman, *senior associate, global tuna conservation, The Pew Charitable Trusts*
Amanda Nickson, *director, global tuna conservation, The Pew Charitable Trusts*
Megan O'Toole, *senior associate, global shark conservation, The Pew Charitable Trusts*

Pew's environmental initiative

Joshua S. Reichert, *executive vice president*
Tom Wathen, *vice president*

Global tuna conservation

Amanda Nickson, *director*
Rachel Hopkins, *officer*
Michael Crispino, *manager, communications*
Henry DeBey, *senior associate*
Grantly Galland, *senior associate*
Dave Gershman, *senior associate*
James Gibbon, *senior associate*

Contact: Michael Crispino, communications manager
Email: mcrispino@pewtrusts.org
Project website: pewtrusts.org/tuna

Overview

Many fish species naturally congregate near objects floating in the ocean, a fact that has been carefully and systematically exploited to catch schools of commercially valuable tuna for decades. Fish aggregating devices (FADs) are artificial floating objects, specifically constructed to attract these fish. Typically, these FADs consist of a floating raft, submerged synthetic netting, and a satellite buoy that allows a fishing vessel to return to a specific location to gather the catch. Synthetic rope or webbing often secures the components to the raft, and the webbing beneath the device can extend to depths of 80 meters.

Unlike anchored FADs, drifting FADs float freely on the ocean surface. The purse seine industry has become increasingly dependent on drifting FADs, which regional fisheries management organizations (RFMOs) have struggled to effectively regulate as the gear evolves.

This report deals only with drifting FADs because of their prominence in industrial tuna fisheries. Some management measures are in place, but they are generally ineffective and fail to limit the overall number or use of these devices. Meanwhile, the proliferation of FADs continues unchecked. Observed FAD deployments have more than doubled since 2006 in the eastern Pacific Ocean alone.[1] Still, across the world's oceans there are few regulations for fishermen or vessel owners to follow, and no penalties for deliberately abandoning FADs at sea when they are no longer deemed useful or productive. Some RFMOs have measures intended to improve the monitoring of drifting FADs, but the overall lack of regulation makes counting these objects difficult.

Information on FAD deployments remains hard to find. Much of the data that would be needed to develop a precise estimate of their numbers exist but are confidential. The fishing industry considers this information proprietary and does not share it with regional fisheries management organizations.

In 2012, The Pew Charitable Trusts published an educated estimate of how many drifting FADs were deployed globally.[2] The analysis concluded that the total number deployed in 2011 ranged from 47,500 to 105,000, depending on the calculation method. Using data on fishing obtained since then, along with new scientific research and an examination of recent trends in FAD use and technology, **Pew has produced updated estimates indicating that the total number of drifting FADs deployed in 2013 ranged from 81,000 to 121,000. The upper estimate has increased by 14 percent since the calculations for 2011.**

For this report, Pew again conducted an analysis using a patchwork of information collected and reported by RFMOs, combined with insights from confidential interviews with people in the fishing, processing, and buoy industries.

These methodologies are a best-effort attempt to characterize the scale of use of a fishing gear widely employed by the global purse seine fleet. This fleet accounts for 60 percent of the world's catches of tropical tuna. Pew welcomes the participation of industry and fishing states in providing the data needed to develop a better estimation.

Despite the difficulties, the methodologies have been peer reviewed by external scientists. Other analyses have come to similar conclusions. For instance, the European Commission released a report in 2014 estimating that 91,000 drifting FADs are deployed annually.[3]

Meanwhile, new initiatives are underway to better track and understand FAD use. For example, three French purse seine companies, operating in the Atlantic and Indian oceans, provided researchers with detailed tracking data of FAD movements to create the most extensive analysis yet of how FADs move in those ocean areas. Next year, the Parties to the Nauru Agreement, a group of eight Pacific island states that have the world's largest skipjack fishery within their waters, plans to implement an electronic tracking system that will allow monitoring of FAD numbers and locations in near real time to better understand the impact on the tropical tuna fishery. This will provide useful data to fisheries scientists and managers on the use of tens of thousands of drifting FADs in the western and central Pacific Ocean. Starting in 2017, the Inter-American Tropical Tuna Commission (IATTC) will require vessels to provide additional FAD data and physically mark their FADs with unique identification codes.

Given the practical and feasible steps available to improve FAD management, Pew calls on RFMOs and fishing entities to:

- Harness the data collected by drifting FADs to develop science-based regulatory measures for use of the devices to minimize bycatch and catches of vulnerable species, including juvenile bigeye tuna. This would help create more sustainable fisheries.
- Establish comprehensive monitoring and tracking systems to accurately quantify and monitor FAD use, improve tuna stock assessments, and ascertain the contribution of FADs to marine debris.
- Set up licensing and registration systems to hold vessels accountable for the FADs they deploy.

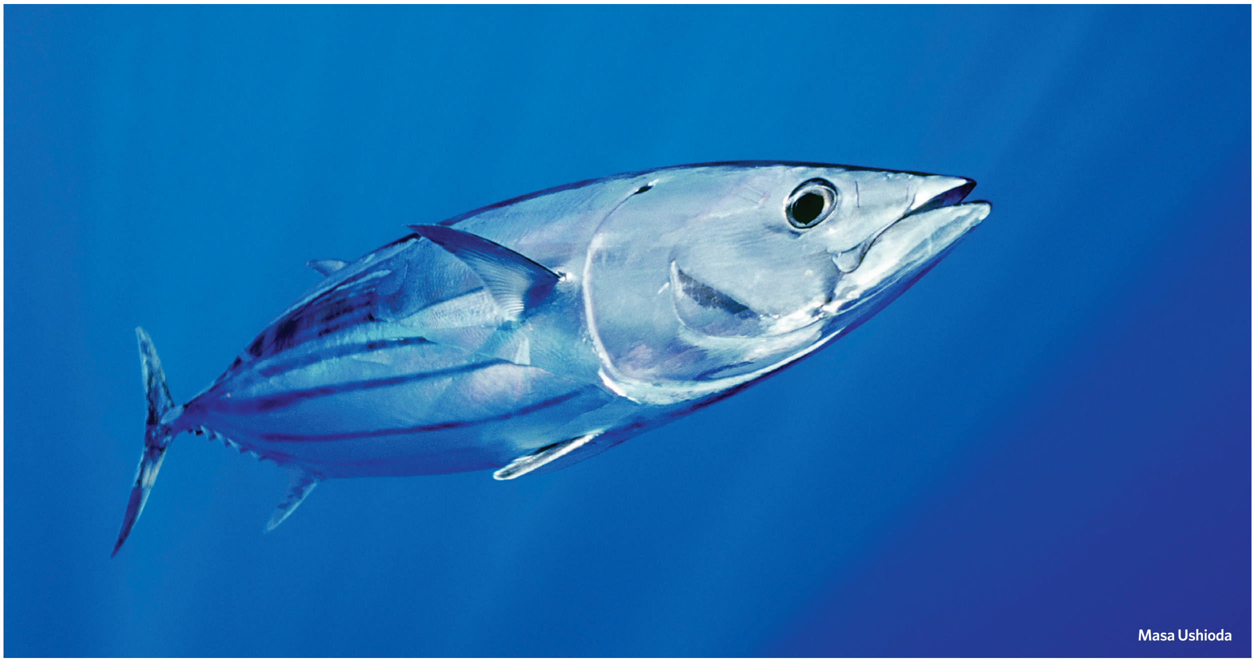
The bottom line: FAD use continues to grow, the technology is evolving rapidly, and the lack of regulation threatens ocean ecosystems, undermines sustainable fisheries efforts, and jeopardizes the livelihoods and well-being of fishermen. While Pew does not advocate for an outright ban on FADs, fishing nations must properly manage this fishing gear. That begins with an understanding of just how many are used, how often, and where.

An estimated 121,000 FADs let loose in 2013

The use of drifting FADs has a significant environmental impact and is closely linked to issues of long-term tuna sustainability. These objects contribute to marine litter, jeopardize the survival of vulnerable species, and have already contributed to bigeye tuna in the Pacific and Atlantic becoming overfished. FADs that are not recovered drift freely, entangling and killing marine life. For instance, an estimated 480,000 to 960,000 silky sharks are killed each year in the Indian Ocean when caught in drifting FADs.[4]

Fishing on FADs was the primary factor driving purse seine catches of bigeye tuna to a record high in the western and central Pacific in 2013. While purse seine vessels generally target schools of skipjack tuna, juvenile bigeye tuna often gather under FADs and are caught before they have a chance to reproduce. In 2013, for example, more than 85 percent of bigeye tuna landed in the western and central Pacific were small, mostly immature fish caught on these devices.[5] The overall tonnage of small bigeye caught on FADs that year actually exceeded the tonnage caught by longline vessels that target bigeye tuna.[6] Scientists also believe that FADs play a role in the significant changes in the migratory patterns of skipjack tuna during El Nino events.[7] An overabundance of FADs, meanwhile, may be linked to changes in observed behavior and size of skipjack tuna caught in several oceans.[8, 9]

In 2012, Pew developed the first global estimate of drifting FAD deployments. Three methodologies yielded wide-ranging estimates indicating that at least 47,500, 61,900, or 105,000 drifting FADs had been deployed in 2011. This update is intended to illuminate trends in FAD fisheries and the impact of technological advances. To revise the report, Pew used two of the same methodologies, yielding estimates of 81,000 and 121,000 drifting FADs deployed in 2013. Each methodology has limitations, but the trend is clear: The total number of FADs being



Skipjack tuna.

deployed in the world's oceans is rising. With dozens of new purse seine vessels scheduled to enter the tropical tuna fishery in the coming years, this trend is likely to continue—unless management measures limiting drifting FAD use are adopted and enforced.

Other changes to the FAD fishery also raise concern about the lack of effective regulation. The use of echo sounders, a new technology spreading through the purse seine fleets, allows vessels to discern the biomass under each device and to fish only on the most productive FADs. This technology could increase incentives to deploy even more FADs. Because many FADs never attract large schools of tuna, fishermen may deploy more to increase the chances of having one that draws many fish. In addition, data show that vessels are removing a smaller percentage of their FADs from the ocean than in past years, adding to the problem of marine debris.[10] Unrecovered FADs break up and sink in the ocean, or they wash up on beaches and coral reefs.

Recognition of the urgent need for FAD management has been increasing. At an international FAD symposium in 2011, scientists and fisheries managers from around the world agreed that the proliferation of drifting FADs was having negative impacts on tuna and other bycatch species. They called on countries and the RFMOs to take steps to make sure that sufficient information is available to effectively regulate the devices. Among the proposed steps, they recommended:

- Sharing basic technical data on the number of drifting FADs deployed, the number actively monitored by fishing vessels and companies, and the movement and range of FADs throughout an ocean area.
- Developing management plans to record the number and status (e.g., lost, stolen, retrieved) of deployed FADs, and outlining procedures to clarify ownership of and responsibility for lost or abandoned gear.

In developing these estimates a second time, Pew continued to face difficulties in obtaining much of the information necessary to determine a full and transparent estimate of the numbers of drifting FADs being deployed. This hindrance points to the need for clear and straightforward regulation and management of this fishing gear by policymakers, the fishing industry, and the RFMOs.

Methodology

The two methods used to estimate the number of drifting FADs deployed in 2013 mirror those used in the previous analysis.

- The first approach analyzed publicly available scientific studies and RFMO reports in an effort to estimate deployments in the major tuna fisheries. This resulted in an estimate of 80,535 FADs deployed per year, which probably is low.
- The second approach estimated annual FAD use by combining the reported number of tropical tuna purse seine vessels with information on drifting FADs from industry experts and informal discussions with stakeholders in the tuna purse seine industry. Because we could not obtain information on every fleet or vessel, the methodology required a number of assumptions and extrapolations. These match those used in the first report, allowing the estimates to be compared directly. This method resulted in an estimate of 120,679 drifting FADs deployed per year, which also is probably low.

Because of difficulties in obtaining data, the third method used in the previous analysis—which incorporated information on market share, recent production, and increases in demand from companies that produce satellite buoys—was not repeated.

Method 1: Published scientific and RFMO literature

To estimate the number of drifting FADs deployed in each of the major tuna fishing zones each year, Pew reviewed the latest literature from the scientific community as well as documents submitted to tuna RFMOs about fishing activity taking place during 2012 and 2013.

Eastern Pacific Ocean

The Inter-American Tropical Tuna Commission gathers information from onboard observers on the number of FAD deployments from purse seine vessels larger than 363 gross tons. The total number in 2012 was 14,110. The total number in 2013 was 13,820, a 7 percent increase from 2011 and a 73 percent jump in annual deployments from 2006. (See Figure 1.)

As was the case with the 2011 estimate, these data reflect only "observed" deployments. Because smaller vessels in the eastern Pacific are not required to carry observers, these figures must be considered an underestimate.

Figure 1

Drifting FADs Deployed in the Eastern Pacific Ocean by Large Vessels

2006	2007	2008	2009	2010	2011	2012	2013
8,006	8,403	9,724	10,768	11,090	12,864	14,110	13,820

Source: Inter-American Tropical Tuna Commission

Purse seine tuna vessel in the Indian Ocean.

To estimate the number of drifting FADs deployed by smaller vessels, Pew again extrapolated from the data at hand but had to assume that smaller vessels operated similarly to larger vessels. (For the second methodology in this report, Pew was able to account for operational differences by using a rough sorting of sizes of vessels but could not do so for this analysis.) The IATTC records both the number of sets on natural objects, such as logs, and on FADs, defined by the commission as artificial objects that fishermen deploy specifically to attract tuna.

In 2013, large purse seiners with observers set their nets around FADs 8,038 times. That represented 96.5 percent of the sets made on floating objects of all types (including natural objects and what are called "unknown" sets).[11]

The data show that smaller vessels set on floating objects of all types 3,034 times in 2013. Unlike larger vessels, published records on smaller ones do not distinguish between setting the nets on natural objects or FADs. But if 96.5 percent of sets by smaller vessels also were made on FADs, then smaller vessels set on these devices 2,928 times.

To calculate the number of drifting FADs that smaller vessels actually deployed, Pew created a "FAD set to FAD deployment" ratio. Assuming smaller vessels exhibit a ratio similar to the larger ones may result in an imperfect analysis because smaller vessels may not deploy as many FADs as larger vessels. However, it provides the best available option for estimating the number of FADs deployed by smaller purse seiners.

Using that formula, the ratio for large vessels in 2013 amounts to 13,820 FAD deployments divided by 7,759 FAD sets, equaling a ratio of 1.78. Multiplying that same ratio by 2,928, the estimated number of FAD sets by smaller vessels in 2013, results in an estimate of 5,215 FAD deployments.

Based on this calculation, the estimated number of drifting FADs deployed in the eastern Pacific Ocean in 2013 totaled 19,035, a nearly 12 percent increase from the 2011 estimate.

Indian Ocean

In producing the earlier analysis, Pew relied on data from a study submitted to the Indian Ocean Tuna Commission (IOTC) in 2010 that reported on the practices of purse seine supply vessels. Those vessels supported only Spanish- and Seychelles-flagged purse seiners, which represented about one-third of the total IOTC purse seine fleet. Supply vessels deploy, monitor, and repair drifting FADs,[12] among other supporting tasks. The study showed that these supply vessels registered about 3,800 FAD tracking buoys in 2009.[13] To generate an IOTC-wide estimate of the number of FADs deployed, Pew then doubled that number to 7,600.

Though the estimate was uncertain, it appeared to be conservative. All purse seine vessels, whether or not they used supply vessels, deploy FADs. But Pew lacked firm data on their behaviors. Still, reports indicate that some purse seiners deployed hundreds of drifting FADs each year.[14]

Since then, new information submitted to the IOTC by Spanish- and French-flagged purse seiners has allowed scientists to model annual FAD deployments. A 2014 paper submitted to the commission estimated that European Union-flagged vessels deployed 10,500 to 14,500 FADs in these waters in 2013. That number does not represent the total number deployed in the Indian Ocean because other fleets, not included in the estimate because of a lack of data on their operations, also deploy FADs.[15]

Western and Central Pacific Ocean

The Western and Central Pacific Fisheries Commission (WCPFC) manages the world's largest tuna purse seine fleet, which numbered 297 vessels in 2013, up from 283 vessels in 2011.[16] No literature is available documenting the total number of drifting FADs deployed in the area. However, the Secretariat of the Pacific Community, the body responsible for providing stock assessments and collating observer data for the WCPFC, estimates that

Tuna fishing vessel transships its catch to another vessel in the Pacific purse seiners operating in the region typically deploy 100 or more FADs with satellite transmitters each year.[17] If each of the 297 vessels deployed 100 FADs, there would be an estimated 29,700 deployed in the western and central Pacific in 2013, a 5 percent increase in two years attributable to the larger fleet.

This projected increase is conservative. The WCPFC Secretariat estimated in 2014 the number of drifting FADs deployed annually at around 30,000, but a lack of data meant that the tally did not include FADs used in Philippine and Indonesian waters.[18] Those nations may use a considerable number of anchored and drifting FADs. Together, the domestic fisheries in both account for 8 to 20 percent of the annual total purse seine catch of the WCPFC area.[19] Separately, a study that examined skipjack caught on drifting FADs in the 2000s in the world's tropical tuna fisheries identified these two nations' fisheries as producing some of the smallest skipjack, another indication of FAD use.[20]

Atlantic Ocean

In producing the earlier FAD analysis, Pew relied on a report on fishing activity for 2010 that was submitted to the International Commission for the Conservation of Atlantic Tunas (ICCAT). The report estimated that the total number of FADs drifting in the waters of the Atlantic varied from 2,500 to 9,000, depending on the season.[21] The authors used information provided by the French fleet but had to make certain assumptions about other nations' fishing practices. With a lack of data on other fleets, the report assumed that Spanish purse seiners in the Atlantic operated as they do in the Indian Ocean, where data are available on the average deployment of FADs by each Spanish purse seiner. The analysis also included assumptions on the mean number of FADs from Ghanaian purse seiners.

Since then, a team of scientists completed a new analysis for ICCAT using a different methodology. Although the results are not directly comparable to the previous report, the numbers show a large increase in FAD deployments over 10 years ago. Instead of looking at the number of FADs in the water at a given time, this analysis sought to provide a sense of how many were deployed in a specific year. It estimated that 17,300 FADs were deployed within the Convention Area in 2013.[22] As with the earlier attempt to quantify FAD deployments in ICCAT waters, the authors had to account for a lack of data on the behavior of fleets other than the French fishers.

To do this, they hypothesized that a vessel's FAD catches would be proportional to the number of FADs deployed. Using data on FADs from the French fleet, they extrapolated to estimate the FADs deployed by the Spanish and other fleets. The authors then used this method to model such deployments a decade ago. They found that annual deployments had increased 2.6 times from 10 years earlier.

The commission has tried to improve data gathering, but results have been mixed. Although a measure approved in 2011 requires flag States to provide the commission's Standing Committee on Research and Statistics with information in their FAD management plans, only six complied in 2012. Of those, only three included the complete suite of required information, including numbers of FADs deployed.

In 2011, ICCAT reported that over 90 percent of sets from purse seiners had been on FADs, suggesting that FADs are a critical gear for all fleets fishing in the area. The largest purse seine fleets for tropical tuna in the Atlantic by number of vessels are those of France, Spain, and Ghana. In addition, a number of vessels are known to have moved from the Indian Ocean to the Atlantic Ocean in recent years to avoid piracy, so the number of purse seine vessels operating in this area has increased.

A conservative estimate

The total estimate of 80,535 drifting FADs deployed in 2013 is likely to be conservative, particularly because it does not account for changes in waters monitored by ICCAT. There is no way to confirm the total number of FADs being deployed in a given time without cooperation from the industry.

Other factors, when taken into consideration, lend credence to the likelihood that the total is an underestimate. For example:

- Not all FAD deployments are observed. In the case of the IATTC, observers are carried only on large purse seine vessels. The IOTC requires that only 5 percent of the operations and sets of purse seiners be observed. ICCAT requires a minimum 5 percent observer coverage of sets or trips by purse seiners and bait boats with one caveat: 100 percent coverage is required during a two-month annual prohibition on fishing using floating objects in an area off West Africa.
- Not all FADs are deployed by purse seine vessels. Bait boats also regularly deploy and use FADs,[23] but little information is available on their practices. Other vessels also can, and do, deploy FADs in cooperation with purse seine vessels. Supply vessels are allowed to assist with FAD fishing activities in the Indian Ocean, and other vessel types (without observers), such as longliners, may work in cooperation with purse seine vessels in certain ocean areas.
- Not all deployed FADs are monitored. The devices are regularly lost or abandoned, or they drift out of fishing areas and must be replaced. A report that says 20 FADs are monitored at a given time does not mean that only 20 FADs are deployed, as many more may have been deployed but are not being monitored.
- Levels of FAD use have not been constant over recent years. Based on data from the IATTC, deployments are on the rise. Given that the FAD fishery is very dynamic and that technologies are constantly changing, basing current estimates on historical data is likely to yield underestimates. (See Figure 2.)

Figure 2
The Growing Use of FADs
Number deployed per year by the tropical tuna purse seine fleet

RFMO	2011	2013	Percent change
IOTC	7,600	14,500	90%*
IATTC	17,000	19,035	12%
WCPFC	28,300	29,700	5%
ICCAT	9,000	17,300	92%**
TOTAL	**61,900**	**80,535**	**31%**

* The 2013 estimate reflects the development of a new accounting of the IOTC fishery.
** The 2013 estimate reflects the development of a new accounting of the ICCAT fishery.

Source: Regional fisheries management organizations

Method 2: Extrapolation based on the number of vessels and information from stakeholders

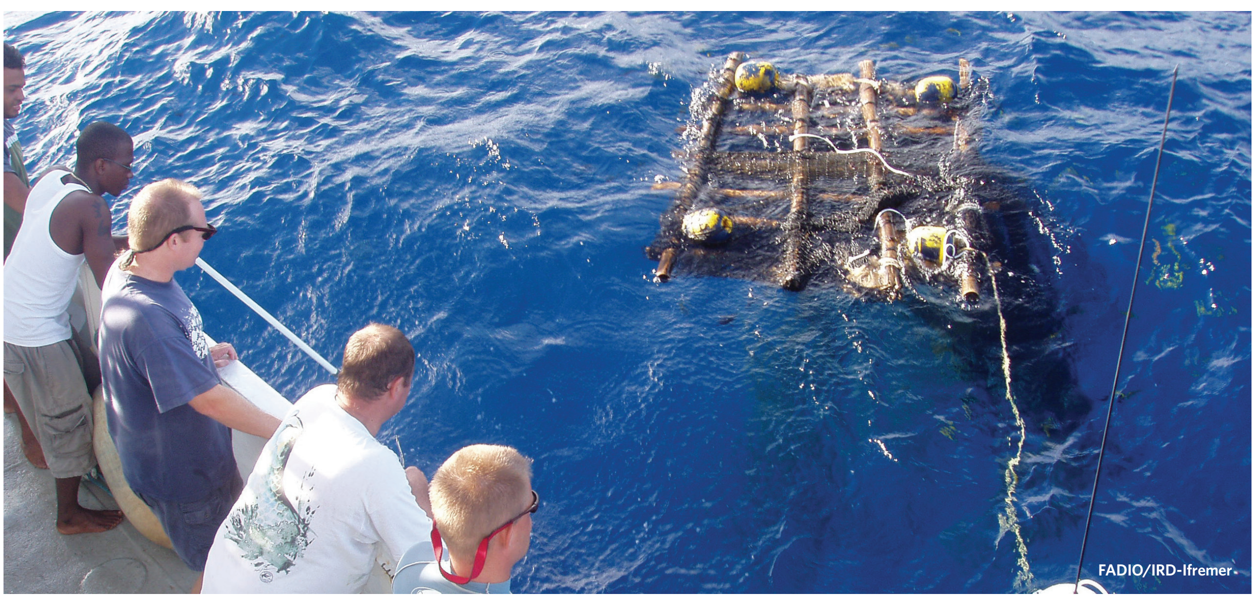
With this method, Pew arrived at a total estimate on global FAD use by combining two types of information. Data on the number and size of purse seine vessels fishing in the four ocean areas were combined with estimates of the number of FADs deployed—broken down by size of vessels—from each fleet. The estimates were based on information obtained from stakeholders with knowledge about drifting FAD use.

Data type 1: Number of purse seine vessels worldwide

The estimate of the number of tuna purse seine vessels around the globe was calculated from vessel registries published by regional fisheries management organizations. This number was limited to active vessels registered as weighing at least 400 gross registered tons (GRT). Following exchanges with the secretariats of regional fisheries management organizations, inactive and duplicate vessels were removed to ensure that only active vessels were counted. Vessels that fished in more than one ocean area were counted only once in the tally.

When Pew produced the first global estimate of FAD use, this process produced a list of 529 active purse seine vessels. Reflecting the growth in the global purse seine fleet, the updated analysis generated a list of 560 purse seine vessels active in 2013. That number may include some vessels that were added to the registries in early 2014. Because of time lags in updating the registries, vessels may operate within some of the RFMOs' convention areas before they appear on the registries.

To ease the next part of the analysis, the list of purse seine vessels was broken down into four size categories: smaller vessels (400–799 GRT), medium vessels (800–1,399 GRT), large vessels (1,400–2,399 GRT), and extra large vessels (greater than 2,400 GRT). This breakdown helped account for fleet size distribution and differences in operating practices, though the use of gross registered tons to segment the vessels by size has some limitations. It does not necessarily represent the best measure of fishing effort or fish hold capacity. Nevertheless, fish hold capacity data were not publicly available for every listed vessel, making gross registered tons the best available proxy to account for the fact that larger vessels deploy more FADs.



Purse seine tuna fishing in the Indian Ocean.

Data type 2: Deployments per size class of vessel per fleet

Informal conversations with members of the fishing industry, vessel operators, fleet managers, and representatives of tuna processing and buoy companies provided information by each size class of vessel from each flag State to inform Pew's 2011 estimate of FAD use. In all, 32 individuals from multiple countries provided data.

These people had direct information about the operations of only a portion of the global purse seine fleet—roughly 25 percent of the vessels—and partial information about approximately another 35 percent. That constraint meant that their knowledge had to be combined with other data sources to derive estimates for the other fleets. For instance, some companies operate vessels under more than one flag. If direct information was available for a company's operation under one flag, this analysis assumed that the company's vessels deployed FADs similarly under a different flag—if other vessel and fishing characteristics were similar. For those fleets for which no direct information was available, data from similar fleets, operating in the same ocean area and having similar fishing characteristics, were used to create FAD deployment assumptions. Whenever possible, information was cross-checked through multiple sources.

Deployment estimates for each size class of vessels in each fleet were not updated for this report and are the same as in the 2011 analysis. Despite the lack of new data, the estimates represent a conservative, best-effort attempt to quantify FAD use when more comprehensive information is not being required from the world's purse seine fleets.

For some fleets, more information has emerged since the estimates were derived, but it is not available in a format that allows it to be incorporated into this methodology. For instance, the French and Spanish fleets were assumed to operate identically for the purposes of the earlier analysis. In practice, that is not the case today. The French fleet has limited itself to 200 buoys per vessel per year in the Atlantic and Indian oceans.

Spanish vessels, some of which deploy more than 800 FADs per year, agreed in 2015 to a limit of 550 that can be monitored at any one time—but only in the Indian Ocean. It is not clear how such a limit will affect actual deployments. For example, a vessel can decide at any time to cease monitoring a FAD that has drifted out of the fishing grounds or is simply unproductive. Its fishermen then could deploy a new FAD.

The bottom line: Combining the information on vessel numbers and FAD usage produced an updated estimate of approximately 121,000 drifting FADs deployed by the world's tuna fishing fleet in 2013. **This is 14 percent higher than our 2011 estimate.** Analysts also were able to break down the information by the RFMOs and to determine which fleets deploy the most drifting FADs. (See Figures 3, 4, and 5.)

Figure 3

FAD Deployments by Flag State

Ecuador and Spain surpass all other states in number of devices released into the ocean

Country	FAD deployment assumptions per size class vessels				Number of vessels per size class				Total number of drifting FADs
	Small	Medium	Large	Extra large	Small	Medium	Large	Extra large	
Belize	0	0	0	360	0	0	0	1	360
Cape Verde	0	0	200	0	0	0	2	0	400
China	0	150	250	0	0	11	1	0	1,900
Colombia	90	150	240	0	1	7	5	0	2,340
Curacao	0	0	350	0	0	0	3	0	1,050
Ecuador	150	240	300	360	31	29	17	2	17,430
El Salvador	0	0	350	560	0	0	3	1	1,610
Federated States of Micronesia	150	240	300	0	1	2	1	0	930
France	175	280	350	560	2	6	13	6	9,940
Ghana	100	200	0	0	7	9	0	0	2,500
Guatemala	0	0	350	560	0	0	6	1	2,660
Guinea	75	0	0	0	3	0	0	0	225
Indonesia	60	80	0	0	7	2	0	0	580
Iran	0	180	300	0	0	2	2	0	960
Ivory Coast	0	150	0	0	0	1	0	0	150
Japan	0	280	350	0	0	27	4	0	8,960
Kiribati	0	180	300	480	0	5	6	1	3,180
Marshall Islands	0	150	0	0	0	5	0	0	750
Mauritius	0	0	0	560	0	0	0	2	1,120
Mexico	30	60	100	0	4	30	7	0	2,620
New Zealand	0	150	250	0	0	1	1	0	400
Nicaragua	0	180	300	0	0	5	2	0	1,500
Panama	175	280	350	560	1	5	8	1	4,935
Papua New Guinea	90	180	0	0	3	4	0	0	990

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Country	FAD deployment assumptions per size class vessels				Number of vessels per size class				Total number of drifting FADs
	Small	Medium	Large	Extra large	Small	Medium	Large	Extra large	
Peru	75	0	0	0	2	0	0	0	150
Philippines	90	180	300	0	32	23	1	0	7,320
Russia	0	150	0	0	0	5	0	0	750
Seychelles	0	0	350	560	0	0	3	5	3,850
Solomon Islands	125	0	0	0	5	0	0	0	625
South Korea	150	180	300	0	10	9	5	0	4,620
Spain	175	280	350	560	3	7	12	12	13,405
Sri Lanka	60	0	0	0	8	0	0	0	480
Taiwan, Province of China	0	150	250	0	0	23	11	0	6,200
Tuvalu	0	0	300	0	0	0	1	0	300
United States	0	180	240	360	0	9	30	1	9,180
Vanuatu	0	180	240	0	0	7	5	0	2,460
Venezuela	150	150	250	0	6	13	4	1	3,850
Estimated total number of drifting FADs									**120,680**

Source: Data come from informal conversations with 32 individuals representing the fishing industry, vessel operators, fleet managers, and representatives of tuna processing and buoy companies. Additional methodology details on Page 10.

Figure 4
Number of FADs by RFMOs

Regional fisheries management organization	FADs deployed in 2013
IOTC	14,787
WCPFC	49,710
IATTC	36,232
ICCAT	19,950
Total	**120,679**

Source: Data come from informal conversations with 32 individuals representing the fishing industry, vessel operators, fleet managers, and representatives of tuna processing and buoy companies. Additional methodology details on Page 10.

Figure 5
Top 8 Users of Drifting FADs by Country

Country	2011	Country	2013
Ecuador	14,130	**Ecuador**	17,430
Spain	9,625	**Spain**	13,405
Japan	9,450	**France**	9,940
France	7,910	**United States**	9,180
United States	7,140	**Japan**	8,960
Philippines	6,390	**Philippines**	7,320
South Korea	5,700	**Taiwan, Province of China**	6,200
Taiwan, Province of China	5,460	**Panama**	4,935

Source: Data come from informal conversations with 32 individuals representing the fishing industry, vessel operators, fleet managers, and representatives of tuna processing and buoy companies. Additional methodology details on Page 10.

Trends

Notable Trends

In addition to the general increase in deployment of fish aggregating devices, Pew was able to identify several other trends:

- Vessels are beginning to use more technologically advanced FADs utilizing echo sounders.
- The number of FADs deployed annually per vessel is increasing.
- The number of purse seine vessels continues to grow.
- Though deployments continue to increase, operators are setting on lower percentages of their FADs, leading to a rise in the number intentionally left or abandoned at sea each year.

Increased use of echo sounders

Purse seine vessels are beginning to use more advanced buoys equipped with echo sounders. This type of sonar can enable fishermen to estimate the amount—and sometimes determine the species—of fish gathered underneath FADs.[24] Such information allows for significant savings in the time spent searching for tuna schools because vessels return only to the most productive FADs. Experts see the industry moving toward exclusive use of this type of buoy.[25] Already, two of the main manufacturers, Satlink and Marine Instruments, are limiting production of buoys without echo sounders, and according to one source, Satlink is now producing only those with echo sounders. Although many vessel owners continue to use both types, echo sounders are expected to become standard practice over the next few years.

Greater number of FADs per vessel

Vessels are deploying more of these devices than previously. The number of drifting FADs deployed at sea is growing faster than the number of large purse seiners entering the fisheries. For instance, the RFMOs noted a 5 percent increase in the number of large purse seine vessels between 2011 and 2013 but recorded a 14 percent increase in the number of FADs deployed each year.[26] Unless RFMOs take the steps needed to rein in the overuse of this fishing gear, the numbers of FADs will continue to grow. The unchecked proliferation could make them less effective over the long term if fishing grounds become oversaturated with these devices.[27]

Continued growth in capacity of the world's purse seine fleets

The growth in fleet size is cause for concern and could contribute to declines in tuna stocks.[28] In the western and central Pacific, 10 new purse seine vessels were added between 2012 and 2013. As of February 2014, shipyards were building 17 more.[29] Using the average number of buoys per vessel from the calculations in Methodology 2, the additional vessels would collectively release at least 3,655 additional FADs each year.

Purse seine tuna fleet sizes are increasing in other regions, too, and the RFMOs have yet to create effective plans to control the growing capacity. Unless actions are taken soon, the growth in fishing capacity will exacerbate the challenges created by the undermanaged FAD fisheries.

Increasing numbers of FADs left at sea

Despite the general increase in deployments over the past two years, the number of drifting FADs retrieved from the oceans is decreasing. The Scientific Advisory Committee of the IATTC has noted that, starting in 2011, the FAD fishery has retrieved a smaller percentage of the overall number of the devices deployed each year[30]—leaving a higher percentage abandoned in the ocean. This trend continued through 2013. Data collected by the commission indicate that about 33 percent of FADs deployed in the eastern Pacific in 2013 may not have been removed. In contrast, data from 2005 suggest that only 9 percent were not recovered from that area.[31]

The increased number of deployed FADs, coupled with their relatively cheap cost and the emergence of new technologies, gives vessel captains less incentive to retrieve devices that can drift far from the fishing grounds. A satellite tracking buoy costs from $800 to $1,200, less than the cost of fuel to recover a FAD with few tuna gathered underneath. Abandoned or discarded devices become another source of marine debris and ghost fishing gear. Neglected FADs can eventually wash up on coral reefs or beaches, sometimes damaging these ecosystems and leaving cleanup costs to coastal communities. A first-of-its kind study of the FAD movements in the Atlantic and Indian oceans using electronic tracking data shared by French purse seiners estimated that 10 percent of FADs run aground.[32]

Purse seine tuna fishing in the Indian Ocean.

Increasing attention at the RFMOs

Regional fisheries management organizations are beginning to take notice of the ecological effects of the unchecked number of FADs deployed each year. They have adopted some initial measures that include requirements to collect data on FADs, to use nonentangling FADs to minimize harm to vulnerable species, and to prohibit FAD use based on area and time to minimize the catch of juvenile bigeye tuna. (See Figure 6.) However, compliance with these measures cannot be assumed or accurately assessed in most RFMOs, and not all measures are applied in all cases. This leads to a patchwork of inconsistent approaches. As a result, measures to date are insufficient and have not diminished the devices' negative impacts, nor have they curbed the growing dispersal of FADs into the marine environment.

Figure 6

Improving FAD Management

The RFMOs implement new measures

RFMO	Current and planned FAD-related management measures
Western and Central Pacific Fisheries Commission	The WCPFC imposes a 3-month prohibition on FAD sets plus either an additional month's prohibition or adoption of a FAD set limit for the fleet. Members fishing on the high seas must submit FAD management plans that specify strategies for limiting catches of juvenile bigeye and yellowfin tuna.
Inter-American Tropical Tuna Commission	Beginning in 2017, vessel operators must collect and report FAD deployment and activity data and have identification codes for all FADs deployed. The IATTC encourages designs that reduce entanglement with sharks, marine turtles, and other species.
International Commission for the Conservation of Atlantic Tunas	Vessel operators must report annually to the commission deployment of each FAD and each visit on a FAD, whether followed by a set or not, as well as each loss of a FAD. ICCAT also closes limited areas to FAD use in January and February. All FADs should be non-entangling by 2016.
Indian Ocean Tuna Commission	The IOTC limits each purse seine vessel to a maximum of 550 instrumented FAD buoys that can be monitored at any one time. The commission capped the number that each vessel can acquire annually at 1,100 buoys. Countries must submit FAD management plans that specify the number deployed as well as any initiatives to minimize capture of small bigeye and yellowfin tuna and non-target species. Use of non-entangling materials is recommended. Starting in 2016, each FAD must be marked with a unique number.

Conclusion

Because of the paucity of available information, estimating the number of drifting FADs in the world's oceans continues to be a challenging task with imperfect results. Pew's analysis using two methodologies results in separate conservative estimates of between 81,000 and 121,000 FADs set adrift in 2013. Those figures are consistent with data contained in other reports and reflect the continued growth of the global purse seine fleet.

These estimates indicate that the magnitude of the problem has increased. While FADs are highly effective fishing gear, their impact on ecosystems and their contribution to marine debris are of concern. The RFMOs, however, have not taken sufficient action to effectively manage their use and impact.

To address these concerns, Pew urges RFMOs and other fishing entities to:

- Use the data collected from drifting FADs to develop science-based limits for deployment and use of FADs to minimize catches of vulnerable species and juvenile bigeye tuna. This practice will help create sustainable fisheries.
- Establish comprehensive systems to accurately quantify and monitor FAD use, improve tuna stock assessments, and ascertain the contribution of FADs to marine debris.
- Establish and require licensing and registration systems to hold vessels accountable for the FADs they deploy.

Fishing masters, fleet managers, and satellite buoy companies know how many FADs are deployed, where they are, and whether they are retrieved. To date, there have been no requirements to share this information, and there are no limits on the numbers of FADs that can be deployed. This situation must change.

It is clear that it is time for those who rely on drifting FADs to take responsibility and share information on how, when, and in what numbers they are used. It is also necessary for fisheries managers to ensure that FAD use is appropriate to the fishery, minimizing bycatch and collateral damage. Doing so is the responsibility of all involved in tuna fishing and will safeguard the health and sustainability of these fisheries and the greater marine ecosystem for generations to come.

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