Pacific Islands Regional Office
NOAA FISHERIES
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Pacific Islands Region FAD Issues and Priorities Workshop

Introduction

In many areas of the Pacific Islands, coastal fish aggregation devices (FADs) have been used to divert fishing effort away from slow-growing coral reef and bottomfish species, towards faster-growing and more abundant pelagic species such as mahimahi, wahoo, skipjack tuna and yellowfin tuna. SPC's Coastal Fisheries Programme led the way in developing FAD mooring systems and has been investigating ways to reduce costs and improve the efficiency of FAD programs.

To take advantage of these studies and to learn from other FAD programs, the Pacific Islands Regional Office of the National Oceanic and Atmospheric Administration (NOAA) has worked with the Western Pacific Fishery Management Council (WPFMC) to host the Pacific Islands Region FAD Issues and Priorities Workshop earlier this year.

The meeting participants included FAD experts from American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Hawaii, and other areas of the central and western Pacific.

The meeting objectives included reviewing existing FAD programs in the Pacific Islands, discussing new developments and technology in anchored FAD designs, and examining ways to reduce program costs while increasing the length of time FADs remain on site. Participants also discussed issues relating to the collection of catch and effort data on FADs, associated FAD research, and community FAD programs.

Anchored FADs have been deployed in Hawaii, American Samoa, Guam and CNMI since 1979 to assist small-scale fishermen with reducing fuel costs and improving catch rates of popular pelagic fish. Several types of FADs are currently in use throughout the region. Fig. 1 illustrates the difference between drifting and anchored FADs used by

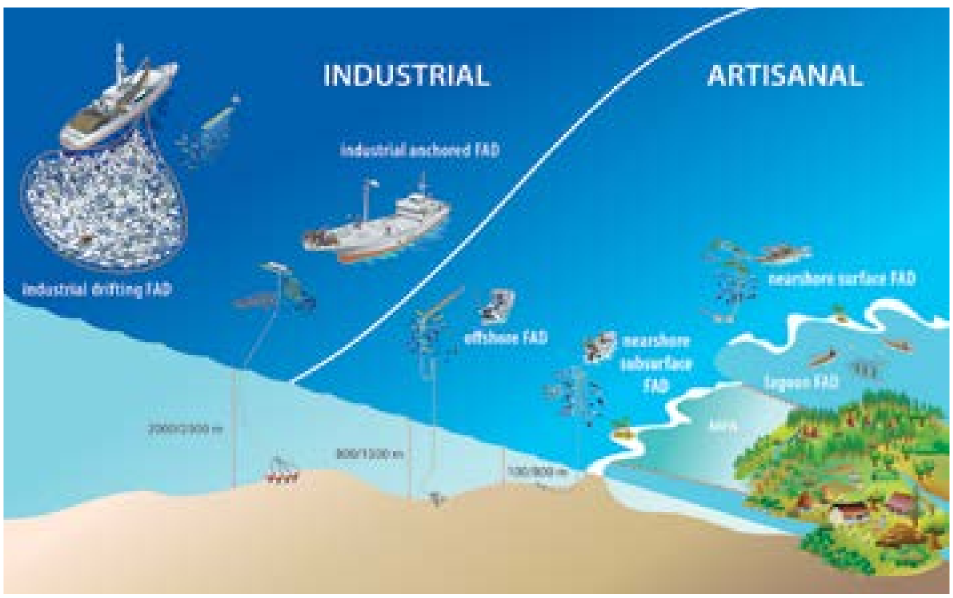

Figure 1. Types of fish aggregation devices (FADs) to support commercial, recreational and subsistence fisheries (illustration: Jipé Le-Bars, SPC).

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commercial fishing fleets, and anchored FADs used by small-scale fishermen near islands, and even inside bays and lagoons. The workshop centred on anchored offshore FADs used to assist small-scale fisheries.

FAD program managers from American Samoa, CNMI, Guam and Hawaii provided detailed descriptions of their domestic FAD programs, including historical overviews, current FAD sites and mooring systems, deployment procedures, data collection procedures, catch efficiency, expenses and significant issues and constraints that may impact the future of their programs. The workshop benefited greatly from the participation of William Sokimi, SPC Fisheries Development Officer, who provided an overview of artisanal FAD developments throughout the western Pacific. Mainui Tanetoa, FAD program manager for French Polynesia, also informed participants about innovative FAD technology and mooring systems used in his country.

Inverse catenary spar-style FAD

Figure 2 shows the FAD mooring system that has been used in Hawaii and the U.S. territories for over two decades. It consists of a concrete anchor (or anchors) with a length of chain shackled to a combination mooring system of floating polypropylene rope on the bottom spliced directly to nylon rope, and shackled to a surface chain that stabilizes a large steel or fiberglass float.

This is the original "inverse catenary" mooring design promoted by SPC, which uses poly line to float the anchor chain off the bottom and is spliced to a shorter section of sinking nylon line that stabilizes the FAD float. Not much has changed in this system over the years, although some regional FAD programs have adopted larger-diameter swivels and shackles in the upper system, and use more streamlined FAD floats.

Indian Ocean-style FAD

William Sokimi described two approaches for reducing FAD costs, while increasing the lifespan of anchored FADs. Both systems reduce surface drag and wear and tear on the mooring system at the sea surface where most FAD breakage and losses occur. The Indian Ocean FAD system replaces large steel or fiberglass spar buoys with a series of purse-seine floats strung directly on the mooring line. In many areas of the central and western Pacific, purse-seine floats can be found at little or no cost where net repairs are conducted. The low profile and visibility of this style FAD should be marked with the addition of a vertical flag buoy with a light and radar reflector. Fig. 3 shows an Indian Ocean-style FAD currently used in French Polynesia where they have completely replaced heavy steel spar buoys.

The SPC has been evaluating FAD and mooring designs for several years, and have identified some problem areas and solutions. Most problems that result in FAD loss occur in waters

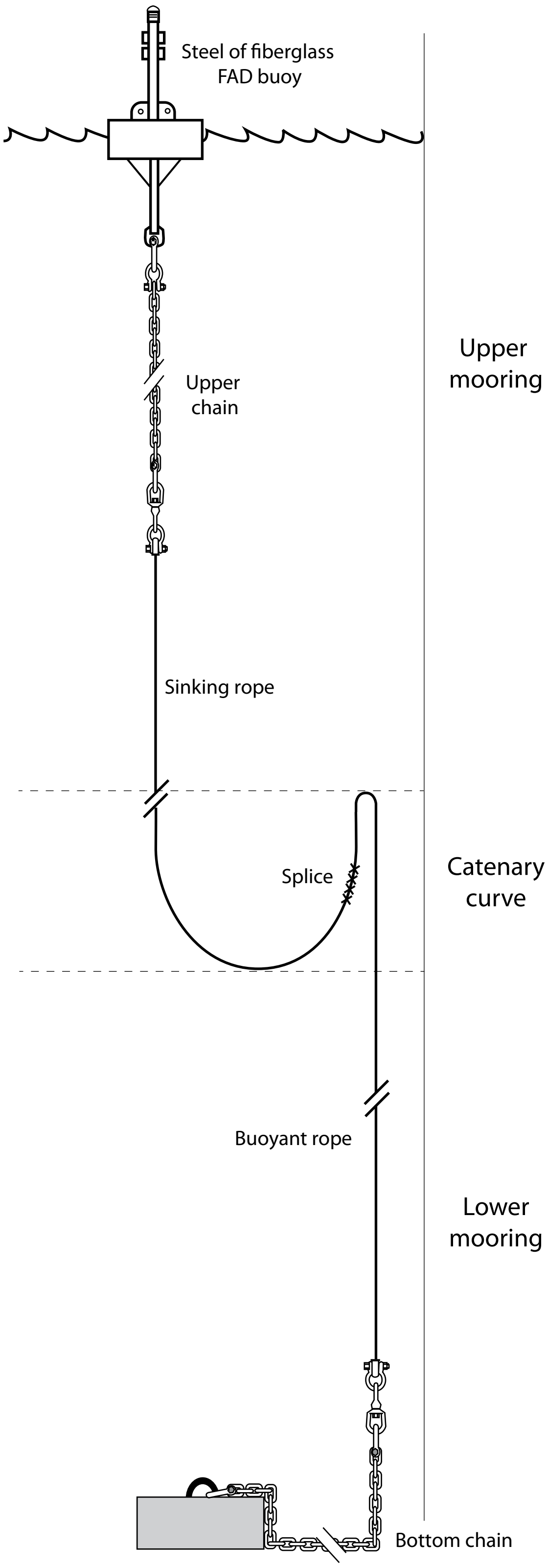

Figure 2. Inverse catenary SPC-style FAD spar buoy mooring system currently used in the Commonwealth of the Northern Mariana Islands.

Figure 3. Indian Ocean-type FAD set close to shore in French Polynesia. It uses purse-seine (soft) and pressure (hard) floats (image: Mainui Tanetoa).

within 150 m of the surface. Problems identified with spar buoy and Indian Ocean-style FADs and mooring systems include:

- Corrosion of surface hardware
- Breakage at flexing areas (Indian Ocean-style)
- Breakage due to chafing
- Breakage at upper splice
- Hooks and fishing gear in mooring line
- Shark damage
- Use of wire in some mooring designs
- Tangling and fouling of swivels

In order to address these problem areas, the Indian Ocean FAD has been redesigned with the following characteristics:

- Use of multi-strand plaited line for mooring system
- Removal of all metal hardware (shackles, chain, swivels) from upper system
- Nylon line put directly through the surface floats to eliminate multiple splices and connections
- Insulation hose used inside floats to minimise wear
- Use of insulation hose below floats to protect mooring line from hooking and shark damage

Subsurface FAD designs

Subsurface FADs tend to last longer because there is less impact on, and wear of, surface components resulting from wave action at the surface. They are also safe from boat strikes and vandalism. However, mooring line length, stretch or shrinkage of the rope in the mooring system, and the buoyancy ratio of the float-to-anchor weight must be calculated precisely for a successful deployment.

Subsurface FADs have proven to be very successful aggregators of pelagic and lagoon fish in many areas, particularly shallower than 500 m.

The participants recommended that subsurface FADs be deployed so that surface floats rest at around 20 m below the surface and constructed with pressure floats rated to 300 m. The SPC is promoting a combination surface and subsurface FAD that has flotation added to the mooring system below an Indian Ocean-style float that provides added buoyancy and security in the event that the surface floats lose buoyancy over time or are lost.

Subsurface FADs were trialled early on in Hawaii, but were not popular because fishermen found them difficult to locate. Now,

Figure 4: An experimental subsurface FAD flotation device modified from a Japanese design (image: Aymeric Desurmont).

however, they can be marked with a surface flag marker and are easily located using a GPS. The most common subsurface design currently in use resembles an Indian Ocean FAD that does not quite reach the surface. Fig. 4 shows a low-cost experimental subsurface FAD that was built in Vanuatu.

Aggregators beneath FADs

Suspending coconut fronds beneath anchored FADs has been standard practice in the Philippines where FADs (locally called payao) were first developed on a large scale to assist coastal and pelagic fisheries. Many different natural and synthetic materials have been used by FAD programs in the belief that they enhance the attraction of baitfish, tunas and other gamefish to FADs. There is little scientific proof that aggregators improve fishing on FADs, but many fishermen strongly support their use and they are routinely deployed in many FAD programs.

After much discussion at the workshop, there was some agreement that if aggregators are used, they should be: 1) designed to create low drag, 2) easy to deploy and replace, and 3) constructed of natural materials that will not contribute to plastic pollution of the oceans. Fig. 5 shows an aggregator line attached to a Philippine anchored payao that is constructed of biodegradable palm leaves in bundles attached to a weighted rope that can be added or removed from the surface.

Improvements to FAD deployment

Deployment costs account for one of the largest expenses for many FAD programs due to the need to contract large vessels to carry the anchors, FAD floats and volume of rope to the deployment site. The French Polynesian FAD program demonstrated how they are able to deploy FADs in remote, small island communities using a portable aluminium catamaran and Indian Ocean-style FADs. The catamaran float is transported to a remote area by the interisland ferry where two small boats are then used to carry the rope and floats and tow the catamaran that is loaded with the FAD anchor (Fig. 6). The FAD anchor is towed by one boat to the deployment site where the other vessel deploys all the mooring line attached to the concrete FAD anchor. A single person can then shift weight to the back of the catamaran

Figure 5. A Philippine-style aggregator line suspended from an anchored fish aggregation device (FAD) made of biodegradable materials (images: David Itano).

Figure 6. A small aluminium boat used to carry the FAD floats and mooring line (a) and the aluminiumcatamaran platform (b and c) used to carry the anchor block (images: Mainui Tanea).

that allows the anchor to slide off the back of the catamaran. Most of their deployments are conducted at little or no cost through the use of the anchor catamaran and volunteer services from fishing associations and clubs.

Community FAD programs

Hawaii may be unique in that individual commercial fishermen have self-funded their own anchored FADs and maintain their existence and position for proprietary use. These buoys are set in deep water farther offshore than the FADs deployed by the State of Hawaii. High catch rates on "private FADs" have contributed to some user conflicts.

The WPFMC has developed a community FAD program that assists with food security for isolated fishing communities, and mitigates user group conflicts over access to private FADs. The program was designed to supplement, rather than to compete with, the state FAD program by providing publicly accessible FADs in different areas, testing and developing new FAD designs and technology, and supporting FAD data collection efforts and cooperative research. Fig. 7 shows a WPFMC community FAD north of Maui that proved to be a highly productive fishing location for tuna and mahimahi. This FAD uses a foam-filled, boat- shaped float with a stabilizing keel, solar-powered light mast, and GPS positioning buoy. Workshop participants strongly supported the continuation of the WPFMC community FAD program.

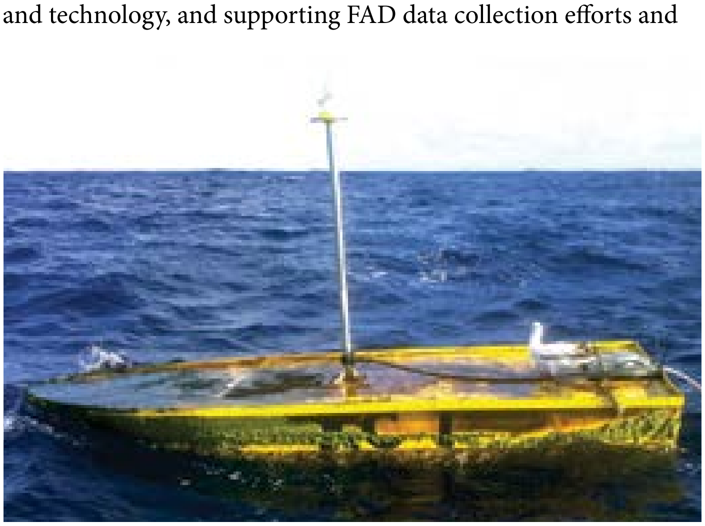

Figure 7. WPFMC community FAD float. Note the GPS buoy mounted in the stern of the foam-filled,boat-shaped float (image: Eric Kingma).

FAD maintenance programs

Workshop participants recommended FAD maintenance and inspection programs that would help increase the amount of time that FADs remain on site and that would make the most of each deployment. For example, the French Polynesia FAD program supports the regular and scheduled visual inspection, cleaning and repair of the upper portion of FAD mooring systems by fisheries personnel using scuba gear. Vertical longline gear is popular in French Polynesia, and large amounts of heavy monofilament line can become entangled in the mooring systems. Without regular maintenance, the build-up of entangled gear can cause significant drag and submerge Indian Ocean-style buoys, and contribute to FAD loss. Divers also inspect and install aggregators, reinforce damaged rope, and remove coral build-up on hardware and ropes. Damaged upper mooring systems can be replaced at sea by a support vessel and a team of divers using lift bags or lines to winch up the upper portion of the mooring system. A similar FAD maintenance system was in place in American Samoa during the 1980s.

Unfortunately, this type of system is not possible in Hawaii due to regulatory and liability issues that govern personnel and safety in accordance with state and federal regulations. For these and other pragmatic reasons (e.g, lack of trained divers, suitable support vessels), most FAD programs have adopted heavy-duty "maintenance-free" systems with high buoyancy and wear characteristics.

FAD research and scientific buoy programmes

The Hawaii State FAD Program deploys FADs to assist small-scale fishermen. The FADs are also used as a living laboratory to study the behavior of tunas and other species that gather around floating objects. The information gained is applicable to fisheries management at all scales. Dr. Kim Holland of the Hawaii Institute of Marine Biology administers the research side of the FAD program. Using funding from the University of Hawaii Pelagic Fisheries Research Program, Dr. Holland and colleagues have monitored the behavior of tagged tuna, sharks and billfish at FADs around the island of Oahu since 2002 using acoustic transmitter tags and FAD-mounted acoustic receivers. Results have demonstrated that FAD residence times for yellowfin and bigeye tunas can vary between a few hours to several months, with most residence times averaging about one week. Yellowfin and bigeye tunas associate closely with a FAD, seldom leaving it for more than 12 hours during a continuous FAD "stay," and appear to be capable of directed movement between neighboring FADs. In general, yellowfin tunas stay longer and feed more successfully at FADs than bigeye tunas, which apparently must venture away from FADs to feed. Schooling behavior and timing with regard to arrival and departure from a FAD has also been observed in both species, often linked to size-specific groups. FAD aggregations appear to be a mix of different species-specific schools that gather together at the FAD, but each having a different aggregation history that determines different residence times.

Depth-reporting acoustic tags have verified that FADs have a strong influence on the vertical movement of yellowfin and bigeye tunas, making them easier to target and catch. Although vertical behavior varies significantly by fish size, it is surprising how deep small tunas will swim, suggesting that predator avoidance as well as temperature may keep smaller tunas above the larger fish, and in shallow waters.

Recommendations

Workshop participants made several recommendations for improving FAD systems and ways to reduce FAD program costs. Recommendations for improving Indian Ocean-style FADs have already been mentioned. A summary of additional recommendations is included below. Some recommendations will apply only to certain areas, depending on local availability of materials and regulations.

- Develop and test locally constructed fibreglass floats (tapered) that reduce drag and shock load of wave action, are easier to transport and deploy using small vessels, and avoid time and expense of importing buoys.
- Use modular steel anchors that are more efficient than concrete, and allow the use of smaller deployment vessels.
- Consider the use of Indian Ocean-style or subsurface FADs, where appropriate.
- If aggregators are used, consider low-drag characteristics, ease of installation and removal, and construction with natural and/or biodegradable materials.
- Develop a maintenance program to visually inspect, clean, and repair FADs if compatible with local regulations and overall program structure.
- Increase the size or thickness of galvanized steel hardware in upper mooring system for spar buoys, especially if monitoring programs are implemented.
- Construct and use a portable anchor platform to allow low-cost FAD deployments in remote locations.
- Use volunteer labor, expertise and fishermen's cooperatives and fishing clubs to assist in FAD fabrication and deployments.
- Develop community FAD programs and encourage communities to raise funds to support their FAD(s), which will promote stewardship, maintenance, longevity and the respectful use of FADs.

Detailed information on FAD designs and technology used in the Pacific Islands Region can be found online at: http://www.spc.int/coastfish/en/publications/technical- manuals/fads.html

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