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WHAT DOES WELL-MANAGED FAD USE LOOK LIKE WITHIN A TROPICAL PURSE SEINE FISHERY?

John Hampton, Gerry Leape, Amanda Nickson, Victor Restrepo, Josu Santiago, David Agnew, Justin Amande, Richard Banks, Maurice Brownjohn, Emmanuel Chassot, Ray Clarke, Tim Davies, David Die, Daniel Gaertner, Grantly Galland, Dave Gershman, Michel Goujon, Martin Hall, Miguel Herrera, Kim Holland, Dave Itano, Taro Kawamoto, Brian Kumasi, Alexandra Maufroy, Gala Moreno, Hilario Murua, Jefferson Murua, Graham Pilling, Kurt Schaefer, Joe Scutt Phillips, Marc Taquet[1]

ABSTRACT

The authors participated in the Global FAD Science Symposium, March 20-23, 2017, in Santa Monica, California and are presented without affiliation. This paper is one of several from the Symposium and does not represent an exhaustive discussion of the issue but includes points agreed by participants. The participants recognized that impacts of FADs and FAD management cannot be considered entirely independently of harvest strategies, issues related to fishing capacity, ecosystem structure, or management of all other fishing gears in tropical tuna fisheries. None of these points alone will address the management challenges associated with FAD use. The effectiveness of any of these points will depend on the levels of implementation and compliance and need to be connected to processes at the RFMOs. Participants underlined the need for data harmonization, standardization, and availability and stressed the need to develop standardized language and definitions to support consistent interpretation of what conservation and management measures intend to achieve across ocean basins. In response, participants offer a glossary (**Appendix 1**) as a "straw man" for consideration and/or development, and underline the clear need for this standardization. Participants noted that "best practices" are not necessarily "most practical" and will need to be assessed to determine which are most appropriate to apply in any particular management setting or geographic area. Finally, participants stressed the need for ongoing and close collaboration among scientists, managers, and industry in driving innovative solutions within and across RFMOs. The points presented here are not in an order of priority; priorities and solutions may change on a regional basis.

Introduction

The topic of "FAD management" in tropical tuna purse seine fisheries has been the subject of considerable attention in recent years. However, with very few exceptions, there are no purse seine fleets that fish all year round on FADs only or on free schools of tuna only. Furthermore, the species of tuna targeted by purse seine fisheries (primarily skipjack, yellowfin and bigeye) are also targeted by other fisheries such as longline, pole-and-line, gillnet and troll. For these reasons, the impacts of FADs and FAD management cannot be considered entirely independently of harvest strategies, fishing capacity, ecosystem structure, or management of all other fishing gears in tropical tuna fisheries.

In this paper, we consider the issue of managing FAD use within tropical tuna purse seine fisheries. These considerations are separated into three general categories: (1) Managing impacts on target species; (2) managing impacts on non-target species, coastal habitats, and the pelagic marine ecosystem; and, (3) the management framework, including monitoring, compliance and surveillance (MCS).

1 Managing impacts on target tunas

A well-managed purse seine fishery has the following attributes regarding target species:

- Target stocks are maintained around the target levels and away from biological limits that could severely impact the stocks;
- Where a target stock is overfished, a rebuilding program is in place with a clear timetable and milestones to rebuild the stock to around the target level;
- Assessments of the target stocks are conducted regularly to inform decision makers.

Clearly, these cannot be achieved by managing FAD use alone. They require agreement on a number of elements such as management objectives for each stock (targets, limits, etc.) and decisions about allocation, both among gears and within the purse seine fishery. Nevertheless, there are a number of management actions for FAD use that are high priority and consistent with the above principles. These are actions that will mitigate the impact of FAD use on overfished target tuna stocks, including bigeye in the Atlantic and Pacific oceans and yellowfin in the Indian and (to a lesser extent) Atlantic oceans.

Examples of best practices for target species include:

- Setting catch limits specifically for juvenile tunas caught by purse seine operations, particularly of overfished stocks;
- Shifting some purse seine fishing effort from FAD sets to sets on unassociated tuna schools (free schools), either voluntarily or through annual FAD set limits;
- Avoiding setting on FADs with large concentrations of juvenile or overfished tunas, including by:
  - Avoiding hotspots, where overfished species are relatively abundant or vulnerable (this could include time-area closures);
  - Developing techniques to use FAD acoustic technology to avoid sets that are likely to contain high numbers of overfished species, recognizing that this practice will require technological and methodological advances;
- Avoiding purse seine setting techniques or equipment that are more likely to select overfished species (if such things can be identified);
- Using improved datasets to develop science-based, FAD deployment limits.

Some of these practices (e.g., avoiding hotspots or use of acoustic technology to inform purse seine captains) require market- or policy-based incentives to encourage or require operators to make good choices when setting their purse seine gear.

2 Managing impacts on non-target species, coastal habitats, and the pelagic marine ecosystem

A well-managed purse seine fishery has the following attributes regarding non-target species and marine ecosystems:

- Non-target stocks are maintained above biological limits that could severely impact the stocks. For endangered, threatened, and protected (ETP) species, measures are in place to minimize mortality;
- Where a non-target stock is overfished, the fishery will not hinder its recovery and there are timetables and milestones in place to rebuild the stock to around the target level;
- Operators collect and report data on interactions with non-target species and their fate (discarded, kept), at the species level;
- Waste is minimized;
- The fishery is operated so that it is unlikely to reduce the structure or function of habitats and the pelagic ecosystem.

Tropical purse seine tuna fisheries have relatively low bycatch rates compared to other industrial fisheries. However, impacts vary by set type and region, with FAD sets generally catching higher diversity, numbers, and biomass of non-target species (e.g., sharks, small tuna species, etc.). Though bycatch rates are relatively low, the large scale of the global purse seine fishery may lead to measurable impacts on non-target species, via entanglement in the FAD itself or encirclement by the purse seine vessel during a set.

Examples of best practices for non-target species include:

- Shifting some purse seine fishing effort from FAD sets to sets on unassociated tuna schools (free schools), either voluntarily or through annual FAD set limits;
- Avoiding interactions before a purse seine set by:
  - Using FADs that are not likely to entangle sharks, sea turtles, or other species;
  - Avoiding sets on small FAD-associated schools that generally have a higher bycatch rate than large schools;
  - Identifying and avoiding “hotspots” where the risk of catching non-target species is high;

- If encircled by a purse seine net, actively releasing sharks (via other fishing gear) and turtles (via manual capture);
- If brought on deck, practicing safe-handling techniques for sharks and resuscitation/revival techniques for sea turtles, to reduce mortality after release;
- Reducing dead discards and promoting increased utilization of non-target bony fishes, accounting for impacts on local markets and artisanal fisheries.

In addition to the impacts of FADs and FAD fishing on non-target species, there is some concern about the contribution of FADs to marine debris and direct impacts on sensitive habitats, such as coral reefs.

Examples of best practices for ecosystem impacts include:

- Using biodegradable FADs;
- Improving monitoring of FAD deployments and locations of drifting FADs for use in evaluating FAD density impacts on the pelagic ecosystem, including tuna aggregation dynamics;
- Using improved datasets to develop science-based, FAD deployment limits;
- Developing FAD recovery plans with provisions to minimize loss, abandonment, or interaction with sensitive habitats, including by partnering with coastal groups to use FAD location information to assist in recovery of FADs before they encounter sensitive areas.

3 Management framework, including MCS

A well-managed fishery has the following attributes regarding management:

- Short and long-term objectives are clearly stated and explicitly defined;
- The management system exerts effective cooperation with other fisheries for the management of shared stocks;
- Overall capacity of the fishery is limited, either directly or through effort or catch limits, in order to be commensurate with management objectives;
- An effective MCS system is in place to ensure compliance with management measures and collection of data necessary to inform management.

The effectiveness of any of the practices identified in (1) and (2) above will be dependent on implementation by management bodies and compliance by stakeholders and as such will need to be connected to those processes at the tuna RFMOs.

Examples of best practices for MCS include:

- Requiring 100% observer coverage (human or electronic) of purse seine vessels, in order to record FAD deployment, retrieval, set types, and catch numbers;
- Requiring 100% observer coverage (human or electronic) of supply vessels, in order to record FAD deployment and retrieval;
- Requiring 100% vessel monitoring system(VMS) coverage, with a reporting resolution sufficient to detect fishing;
- Implementing full tuna catch retention and effectively monitoring catch numbers during unloading;
- Using FAD positional data in combination with VMS data to identify FAD sets;
- Effectively and comprehensively addressing suspected non-compliance at the licensing authority, flag state, or RFMO, as appropriate.

FAD GLOSSARY

NOTES:

(1) The purpose of this Glossary is to provide definitions of different terms that are used in the context of FAD use in tuna purse seine fisheries. In some cases, certain terms do not have a universally agreed definition, and their meaning may depend on the context in which they are used. The terms in this glossary are grouped by topic.

(2) Often, RFMOs adopt binding measures that contain terms which are not precisely defined, and this can lead to ambiguity and subjectivity in interpretation. One example is for "non-entangling FAD (NEFAD) designs" which are mentioned in measures for three RFMOs. However, the key attributes for the construction of NEFADs are not defined in the measures. Ideally, definitions of such terms would span management, scientific as well as industry interests. This would allow clarity for fishers, fishery managers, and compliance professionals.

Bycatch

There is no universally-agreed definition, although the connotation is usually one of undesired catch. Generally speaking, bycatch refers to the catch of anything that is not the main reason for which the skipper is fishing, whether retained or discarded.

Some of the terms related to bycatch are the following:

Target species: The tropical tuna purse seine fisheries, depending on their fishing strategy, target skipjack, yellowfin and/or bigeye tuna. Considerations such as size also matter, as tunas that are undesirably-small for processing are also sometimes called bycatch.

Non-Target species: These generally include minor tuna species (bullet and frigate tunas, Pacific black skipjack, little tunny), other bony fishes (mahi-mahi, rainbow runner, billfishes), sharks, rays, turtles, etc. Some of these species can be targeted opportunistically during a fishing trip.

Discarded/Retained: Any catch, whether target or non-target, can be either discarded or retained on board. Many scientific studies equate the term "bycatch" with discards.

Byproduct: This term is often used for catch of non-target species that is retained and utilized (e.g. consumed onboard, processed on board or given to the crew in port).

Efficiency

A vessel's or a fleet's fishing efficiency can change over time, resulting in greater amounts of fishing mortality. There are many factors that contribute to the efficiency of tuna purse seine vessels. If their adoption and resulting impact on catch rates cannot be quantified adequately, this results in "**effort creep**" (an unquantified increase in efficiency over time).

The following are some of the main factors that contribute to efficiency, with a focus on FAD fishing.

Beacon (also GPS Buoy): Drifting FADs can be fitted with transmitter beacons so that they can be located. In order to monitor the number of FADs used by a vessel or a fleet, the following terms are being proposed for use in RFMOs:

Operational beacon: a beacon that, after leaving the factory and passing through transit, has been registered and has the ability to transmit.

Active beacon: operational beacon located at sea and transmitting position reports.

Deactivation: Action of de-registering a beacon by the buoy supplier company after the request by the ship owner due to loss, theft or other cause.

Reactivation: action of re-registering a beacon previously deactivated by the buoy supplier company after the request by vessel owner.

Fleet size: If the number of vessels in a fleet increases, the fleet's capacity will increase.

FADs: The deployment and use of FADs allows skippers to fish in remote areas where tuna schools were not very abundant or easily accessible before, to plan trips with greater certainty and efficiency, to make fewer "skunk sets" (sets where the school of tuna escapes) and to catch more skipjack tuna (a very productive and abundant tuna). FADs are equipped with some type of location device, ranging from simple radio beacons to sophisticated GPS, enabling the skipper or fleet manager to locate them remotely. The number of FADs deployed by a vessel or company increases their capacity because of increased options for "cherry picking" the FADs with more biomass underneath. But, there may come a point where high FAD density in an area is counter-productive because of a saturation effect that reduces aggregation size.

Echosounder buoys: Many FADs (100% for some fleets) are being equipped with echosounder buoys that estimate the amount of fish biomass present underneath. This allows the skipper or manager to make decisions about what areas to visit in order to have access to FADs with high tuna biomass.

Supply (support) vessels: Some fleets use supply vessels to plant and check FADs and to maintain them. A supply vessel can work with one purse seiner or be shared by a group. Such activity allows a fishing vessel to access a larger number of FADs than it would otherwise be able to maintain.

Helicopters and radars: Helicopters and bird radars have traditionally been used to search for tuna schools. They are now also being used to search for FADs that are not controlled by the vessel.

Fishing Strategy

A fishing strategy is a plan followed by a vessel designed to achieve certain results in terms of catch. The strategy may be that of a skipper, a vessel owner, group of vessels, or a fleet. Fishing strategies can change seasonally or over time.

There are three main fishing strategies in tropical tuna purse seine fisheries:

Dolphin strategy (dolphin fishing): Vessels that primarily target schools of yellowfin tuna associated with dolphins. These tuna-dolphin associations are most common in the eastern Pacific Ocean.

FAD strategy (FAD fishing or Floating object fishing): Vessels that largely rely on FADs (floating objects) to catch tunas, primarily skipjack.

Free-school strategy (school fishing): Vessels that largely rely on free-school sets to catch yellowfin and/or skipjack.

Note: Most tuna purse seine vessels do not adhere to one of these strategies all of the time; for instance, a vessel typically makes both sets on floating objects and on free schools during a fishing trip. Thus, even if a vessel is following a strategy, it will deviate from it opportunistically or seasonally.

Floating Object (FOB)

An object floating at sea that attracts tuna underneath. A floating object can be natural, natural but altered by fishers, or man-made.

The following broad categories of floating objects are defined (adapted from CECOFAD):

FAD (fish aggregating device): A man-made FOB specifically designed to encourage fish aggregation at the device.

dFAD (Drifting FAD): A dFAD typically has a floating structure (such as a bamboo or metal raft with buoyancy provided by corks, etc.) and a submerged structure (made of old netting, canvass, ropes, etc.).

aFAD (Anchored FAD): Anchored FADs usually consist of a very large buoy, anchored to the bottom with a chain. aFADs are called '**payaos**' in some regions.

LOG: A natural (branches, carcasses, etc.) or artificial (wreckage, nets, washing machines, etc.).

FALOG (Artificial log resulting from human fishing activity): These artificial logs are usually abandoned or lost materials related to fishing activity (nets, wreck, ropes, vessels that act as FADs, etc.).

HALOG (Artificial log resulting from human non-fishing activity): Other artificial logs (e.g. a washing machine, oil tank, etc.).

ANLOG (Natural log of animal origin): A natural log such as a whale carcass or a living whale shark. Note: In some regions, sets on whale sharks are seen as being similar to FAD sets, whereas in other regions they are seen as more similar to free-school sets.

VNLOG (Natural log of plant origin): A natural log such as a branch, trunk, palm leaf, etc.

According to their design characteristics, the following categories of FADs are often used:

NEFAD (non-entangling FAD): FAD designed to minimize ghost fishing (entanglement of fauna, primarily sharks and turtles). For a FAD to be completely non-entangling, it must use no netting materials either in the surface structure (raft) or the submerged structure. Some organizations also consider NEFADs to be those using netting but built to minimize entanglement such as using netting tied in bundles or using small size netting (<7 cm stretched mesh); these are sometimes called **LERFADs** (Lower Entanglement Risk FADs).

Biodegradable FADS: FADs constructed with natural or biodegradable materials that reduce the impact of beaching and debris. The term biodegradable is applied to a material or substance that is subject to a chemical process during which microorganisms that are available in the environment convert materials into natural substances such as water, carbon dioxide, and decompose organic matter. The time required for biodegradation of different materials varies. Some fishers believe that a FAD should last up to one year before degrading.

Set types

A purse seine is a large wall of netting deployed around an entire area or school of tuna. The net is then "pursed" by closing the bottom, and the catch is harvested by hauling the net aboard.

There are three main set types in tropical tuna purse seine fisheries:

Free school (FS) set: The net is deployed around a free-swimming school of tuna, i.e. a school that is not associated with any floating object or a pod of dolphins.

Floating object set (Associated set): The net is deployed around a school of tuna that has aggregated under a floating object. The characteristics of the catch made in the presence of a floating object, whether a log or a FAD, tend to be similar and scientists tend to group the data resulting from these into the category "**Floating object set**." In recent years, the term "**FAD set**" has also been used interchangeably.

Dolphin set: The net is deployed around a tuna-dolphin association.

Attributing the catch to a set type is not always straightforward. For example, a floating object may be present in or near the set, but not visible. Or, a floating object may be at a distance beyond an RFMO's legal definition (e.g. 1 nautical mile in one RFMO), but the tuna school may still be under the object's attraction. Furthermore, the push by some markets to source "FAD-free tuna" (i.e. catch from anything other than floating object sets) can be a driver for misreporting of set type in logsheets or observer reports.

Hampton J., Leape G., Nickson A., Chassot Emmanuel, Gaertner Daniel, Taquet Marc, et al. (2017)

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