Report of the workshop on Biodegradable FADs in Zadar (Croatia) for the fleets operating in the western Pacific Ocean (Federated States of Micronesia)

5th September 2019

Gala Moreno and Jefferson Murua

1. Background

Following the series of workshops on biodegradable Fish Aggregating Devices (FADs) that ISSF has been conducting with the support of FAO, Common Oceans ABNJ Tuna project, in the western Pacific Ocean, a workshop in Zadar (Croatia) was organized. Zadar is homeport of the fleet (fishing masters and first officers), from Caroline Fisheries Corporation (CFC), a purse seine company based in Pohnpei (Federated States of Micronesia).

The fleet is also engaged in a trial to test 100 biodegradable FADs in the western Pacific Ocean, together with ISSF and the support of FAO, Common Oceans ABNJ Tuna project.

Previous to the workshop held in Zadar, 2 workshops were organized in Philippines (General Santos) and Marshall Islands (Majuro). The WCPFC has established a regulation for non-entangling FADs which will soon come into effect in 2020 and although the conservation measure in place (CMM 2018-01) does not refer to any specific materials, it states: "To reduce the amount of synthetic marine debris, the use of natural or biodegradable materials for FADs should be promoted. The use of non-plastic and biodegradable materials in the construction of FADs is encouraged." Further, this CMM provides that at its 2020 annual session, the Commission shall consider the adoption of measures on the implementation of non-entangling and/or biodegradable material on FADs.

2. Objectives of the workshop

The general objective of the workshop was to promote the use of non-entangling and biodegradable FADs in the fleet and set the protocol to test 100 biodegradable FADs with CFC fleet. The agenda of the workshop is in Appendix I. The workshop allowed ISSF scientists to present the latest results on biodegradable FAD initiatives in the Indian, Atlantic and eastern Pacific Oceans and gather feedback from CFC fleet in the Western Pacific on the type of FADs used, the difficulties that could be encountered when changing the structure of their FADs and how to best proceed with experimental

With the support from:

work to test and find non-entangling and biodegradable FADs that are productive for fishing in the WCPO.

3. Results of the workshop

The workshop in Zadar was held with 8 skippers (5 fishing masters and 3 first officers) belonging to the 6 vessels from CFC company. An oceanographer expert on oceanographic instrumentation and drifting buoys from the Institute de Ciències del Mar (CSIC) in Spain, was also invited to provide his expertise on the drift behavior of the Fish Aggregating Devices (FADs) related to the shape of the structure. The list of attendees is in Appendix II.

Pilot project to test 100 biodegradable FADs

Most of the fleets in the western Pacific Ocean and also the fleet from CFC are using for the FAD raft purse seine corks, draped with a net. The submerged part of the FAD is made of recycled purse seine net, palm leaves, nylon ropes and bamboo canes.

During the workshop, discussions were mainly focused on the technical features of FAD structures related to their drift behavior. From these discussions the protocol to test biodegradable FAD prototypes in the western Pacific Ocean was discussed. The following guide-line and protocol was set:

Biodegradable FAD structure design and materials

The most impacting part of the FAD structure is the submerged tail, this can be entangled in coral reefs and remain at sea for hundreds of years, if made with plastic components (nylon nets and ropes). Fleets have generally increased the depth of the submerged part of the FAD and nowadays these structures are very large (60 - 80 m). Thus, priority should be given to the replacement of the tail with biodegradable materials so that they degrade fast when FADs are lost or abandoned. The replacement of the tail would allow decreasing the impact of FADs while alternatives for the floatation are under research. Nowadays there has not been found any biodegradable alternative to plastic buoys or purse seine corks suitable for the floatation but some, as balsa wood, are under test.

a) Raft

Previous experiments have shown that the flotation of the FAD is a key factor for the effectiveness of a FAD and that if floatability is not well calculated the FAD could easily sink. In order to assure that biodegradable FADs under test remain afloat for the duration of the experiment and provide results on the performance of the tail, the raft of the prototype will remain the same as used in traditional FADs. Thus, for this project, the traditional raft made of purse seine corks draped with a non-entangling net (less than 2.5´´ mesh size) will be used. Because the most impacting part of the FAD is the tail, priority was given to find an alternative for the tail and in order to get results from the experiment, it was decided that floatation should remain the same so that experimental FADs remain alive without sinking.

b) Tail

- Experimental FAD´s tail should totally eliminate any plastic component.
- The materials used for the tail will be: bamboo, manila rope, jute canvas, palm leaves and stones or sand.
- 2 type of biodegradable FADs will be constructed (Design A and B, see appendix III). 50% of the experimental FADs to be tested will be a design that copies the traditional FAD (appendix III, Design A) but that uses biodegradable materials. The other 50% will be a biodegradable FAD designed during the workshop with fishers, oceanographer and ISSF scientists (Appendix III, Design B).

The construction of the FADs would be done in port to ensure that all the designs are constructed in the same way.

Biodegradable FADs deployment

- A total of 100 biodegradable FADs will be deployed. Each experimental FAD will be deployed close to a traditional FAD, so that the 2 type of FADs can be compared in terms of tuna aggregation and life spam.
- Number of FADs per vessel was set as follows: 20 biodegradable FADs deployed by each of the 4 large purse seiners of CFC company and 10 biodegradable FADs deployed by each of the 2 small purse seiners from CFC company (Appendix IV). Flexibility is allowed to improve this strategy if necessary, for instance if some vessels are in a better area and season to test biodegradable FADs, those vessels could deploy more biodegradable FADs and some others less. Always taking into account that a minimum of 100 biodegradable FADs have to be deployed to get results.
- The area and season of deployment will be decided once FADs are constructed and onboard purse seiners. The best area and season for the success of the experiment has to be determined related to the density of fleets in the area of deployment and the best conditions for fishing and this cannot be advanced during the workshop but closer to the deployment date/season.

Data collection of the FADs under test

- A data collection form in excel was designed an agreed during the workshop. This data form will be filled by fishers and observers both when deploying the biodegradable FADs as well as when visiting or encountering a biodegradable FAD.
- Data from the echo-sounder buoys used to track biodegradable FADs and their traditional pairs will be shared with scientist. This data will be delivered by Satlink buioy manufacturers directly to ISSF scientist with the agreement of the fishers and ship-owner. This data will be used with 1 month delay from the deployment of the FADs.
- National Oceanic Resource Management Authority, (NORMA) in Pohnpei, will help with the data collection through the observers onboard purse seiners,

especially when a vessel that is not from CFC company encounters a biodegradable FAD.

4. Conclusion

The workshop in Zadar was very productive. Fishers were participative and aware of the need to move towards a FAD that reduces the impact of the structure on the ecosystem, using non-entangling materials and reducing the plastic used. During the workshop, discussions among fishers, an oceanographer expert on drift behavior and ISSF scientists produced a new biodegradable FAD structure that will be tested by the fleet. Also, the protocol to successfully test those biodegradable FADs was set.

Upcoming Deliverables from the work conducted in the western Pacific Ocean:

- Scientific paper and/or technical report on the workshops conducted in the western Pacific Ocean and the test with CFC fleet.
- Visual documentation of the workshops and visit to port in the Western Pacific region.
- Video of the workshops held with the fleets in the western Pacific.

With the support from:

Appendix I –

ISSF Biodegradable FADs Workshop in Croatia for the fleet operating from Federated States of Micronesia (Pohnpei) 2019

Date: 5th September 2019 from 9:00 to 16:30
Place: Zadar (Croatia)
Venue: Kolovare Hotel
Presenters: Gala Moreno
Jefferson Murua

Workshop on Biodegradable FADs 09:00-12:30

09:00-10:30

Opening and welcoming

1. Presentation on the impacts of FAD structure on the ecosystem.
2. Presentation of potential solutions: non-entangling and biodegradable FADs and recovery of FADs
3. Ongoing experiences in other Oceans

10:30-11:00 Coffe break

Project to test biodegradable FADs in the western Pacific Ocean:

- What are the essential features of the structure of a productive FAD?
- Biodegradable FAD designs: different alternatives, challenges to be faced
- Biodegradable FAD deployments: best area and time of deployment to gather information.
- Biodegradable FAD monitoring and Data collection

With the support from:

12:30-13:30 Lunch Break

<u>Workshop on best sustainable practices with FADs 13:30-16:30</u>

1. Discussions on mitigating the undesired mortality of **bigeye and yellowfin tuna** through:

    - Acoustic discrimination
    - Modification of FAD structure: design of FADs, depth of FADs
    - Modification of the purse seine net: sorting grids, depth, others.

    14:30-15:00 Coffe break

2. Discussion on **Bycatch**:

    - Best on deck bycatch release practices
    - By-catch releasing from the net

3. Questionnaire for skippers
4. Summary and conclusion

With the support from:

Appendix II –
Participant Lists ISSF Skipper Workshop Zadar (Croatia)
2nd September 2019

Name	Profession	Vessel	Company
Neven Faricic	Fishing master	FV Nanmadol	Caroline Fisheries corporation (CFC)
Slavko Mislov	Fishing master	FV Caroline I	CFC
Marin Dunatov	First officer	FV Caroline I	CFC
Sendi Koncurat	Fishing master	FV Marelle	CFC
Zuonko Kurtin	Fishing master	FV Trinidad III	CFC
Marko Birkic	First officer	FV Queen Mary	CFC
Neven Kosovic	Fishing master	FV Nanmadol	CFC
Slavo Vitlov	First officer	FV Melissa	CFC
Joaquín Salvador	Ocenographer	-	ICM / CSIC
Jefferson Murua	Researcher	-	ISSF
Gala Moreno	Senior Researcher	-	AZTI

With the support from:

Appendix III –
A) Biodegradable FAD structure designed by fishers before the workshop

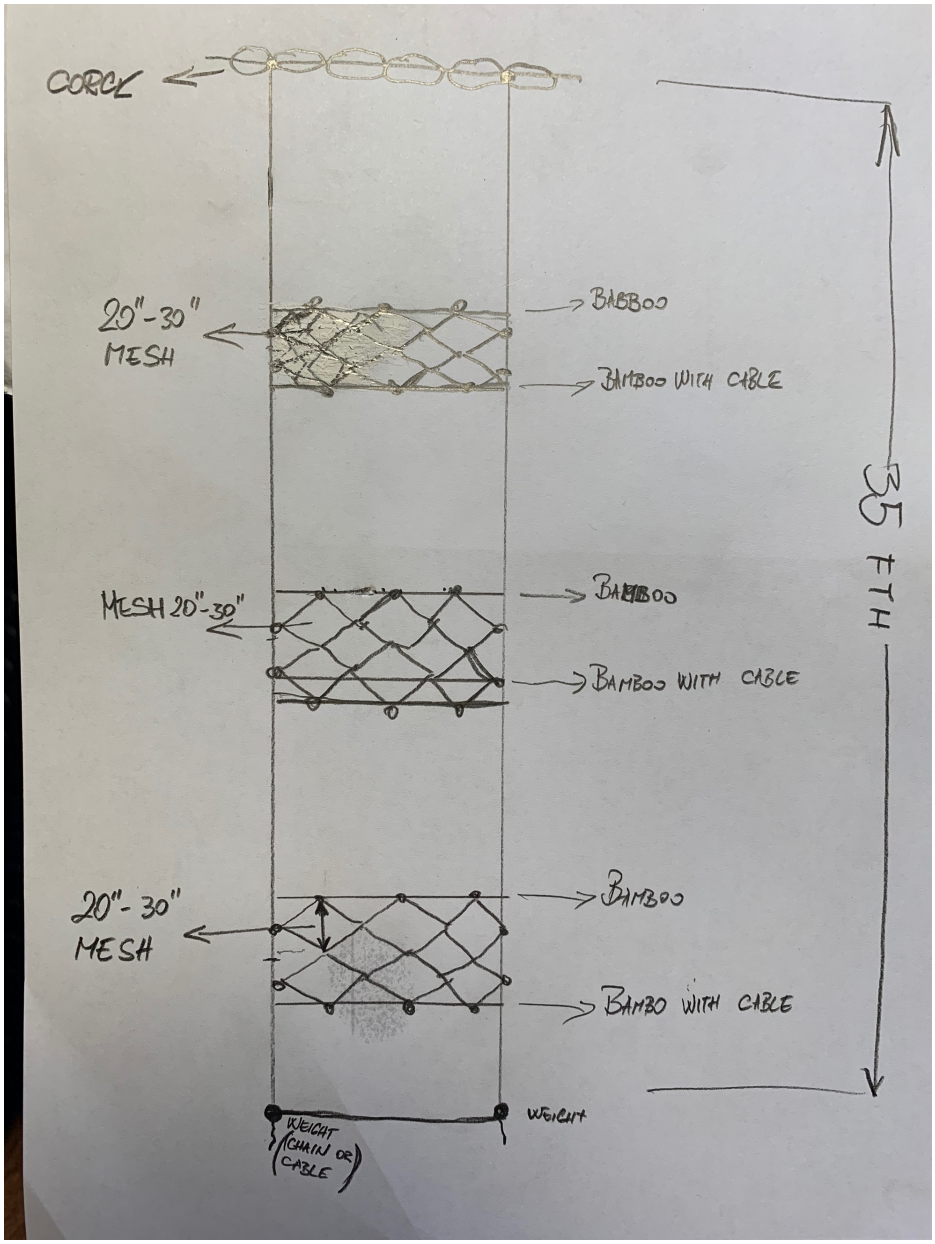


Fig 1. Design A: Simplified view of the biodegradable FAD (design A), designed by fishers before the workshop. This figure shows main components of the tail (submerged part) of the FAD. Two main ropes supporting a structure with "sails" made of jute canvas. The mesh was changed by canvas. Metal (chain and cable) is providing the weight. This prototype has the same design as the traditional ones used by the fleet but without plastic.

With the support from:

B) Biodegradable FAD structure designed during the workshop

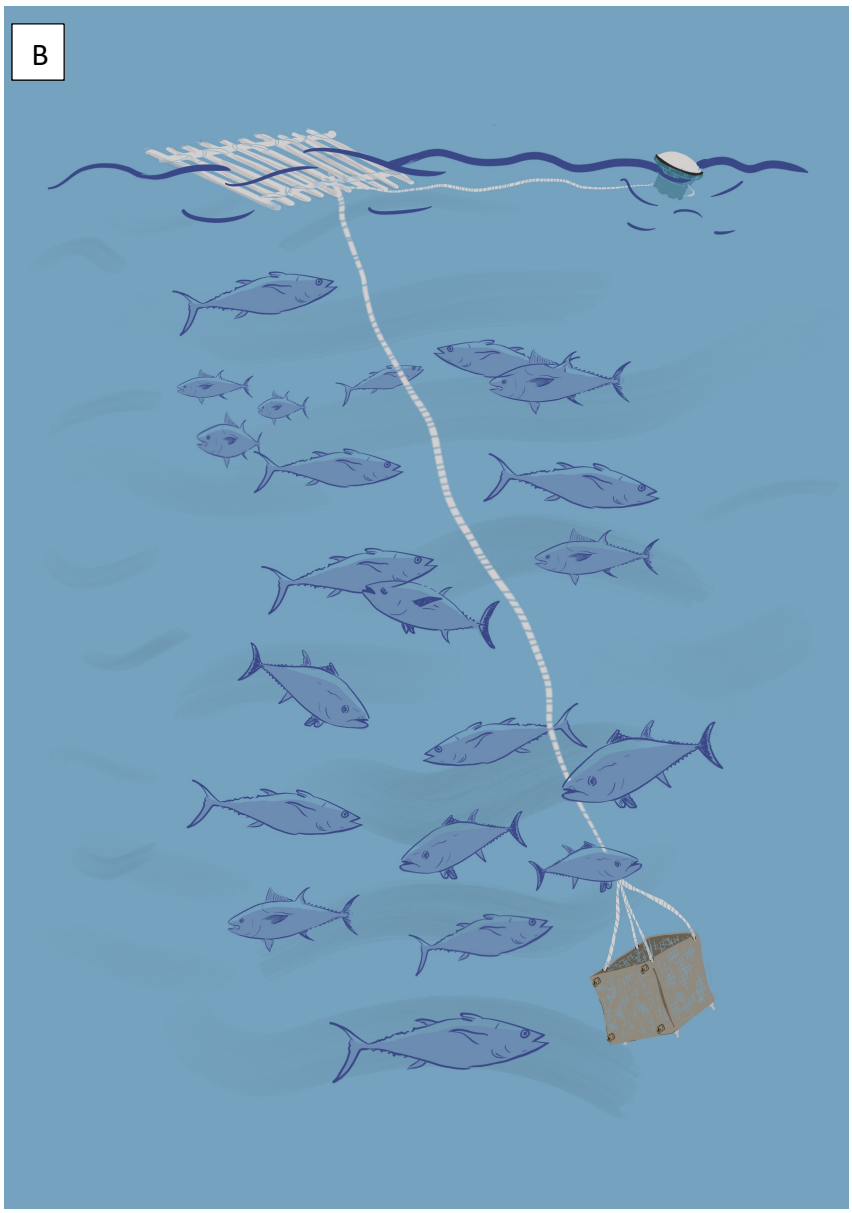


Fig 2. Design B: Simplified view of the biodegradable FAD (design B), designed during the workshop. This figure shows main components of the tail (submerged part) of the FAD. Palm leaves and biodegradable ropes can be attached to the main rope to provide "shadow" or more volume in the surface.

With the support from:

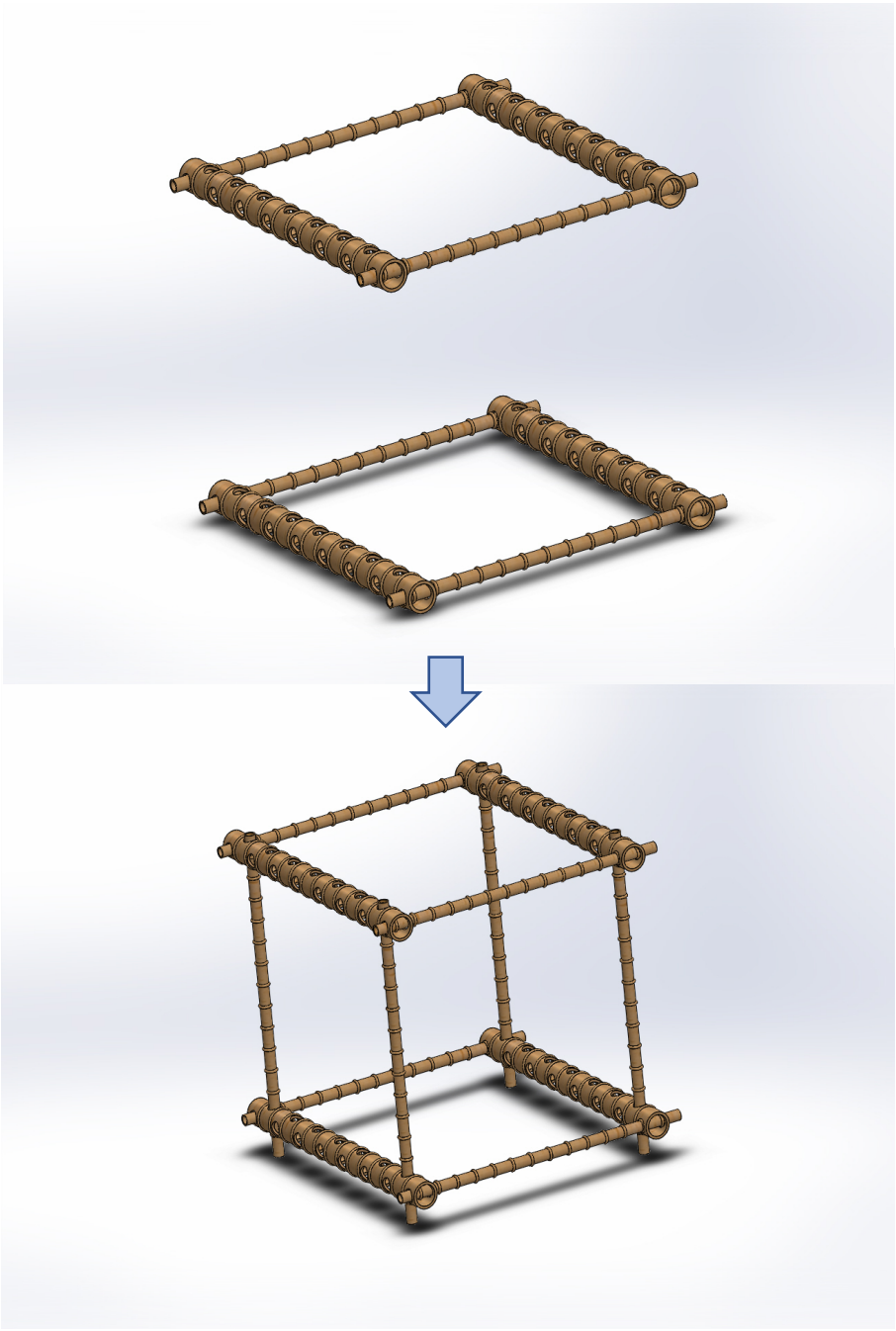


Fig 3. Design B: Detail of the square made of bamboo to create the underwater drag (4 thick and 4 thin bamboo canes). The 2 bamboo frames (top and bottom) can be either attached by bamboo canes or by the ropes that attach the drag to the main rope (see design below).

With the support from:

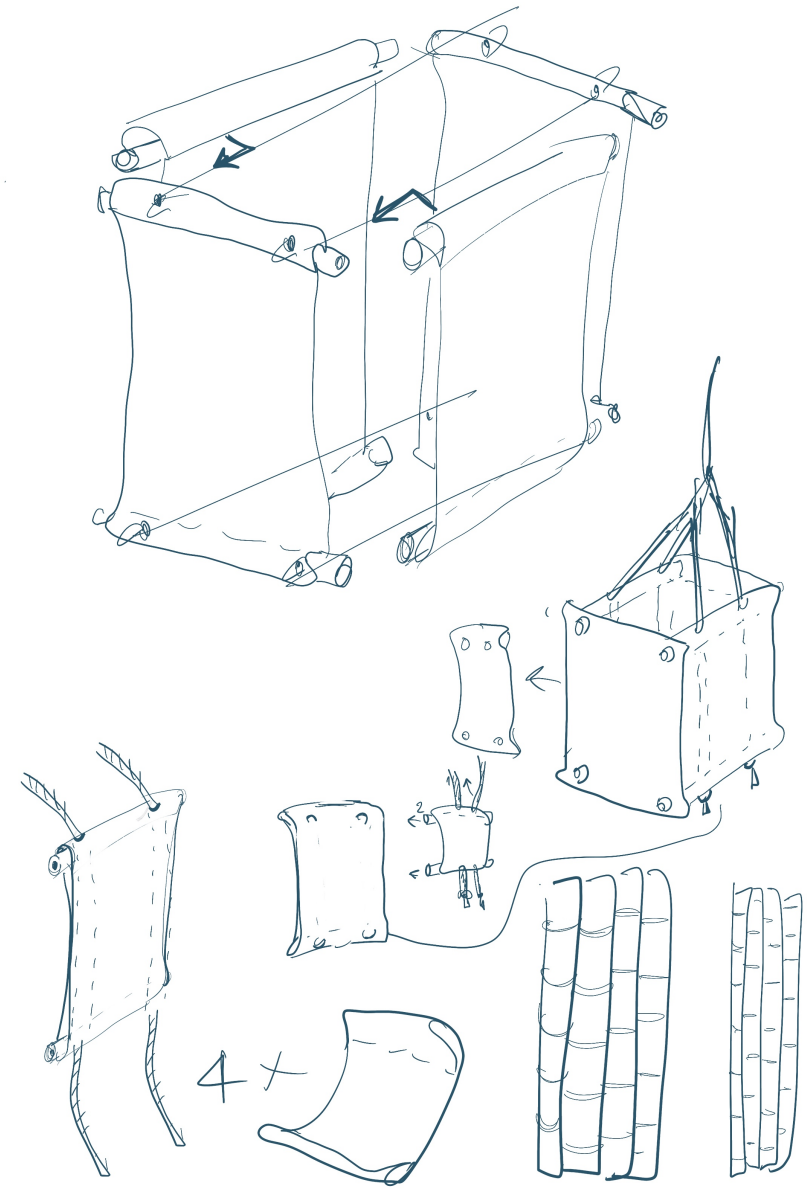
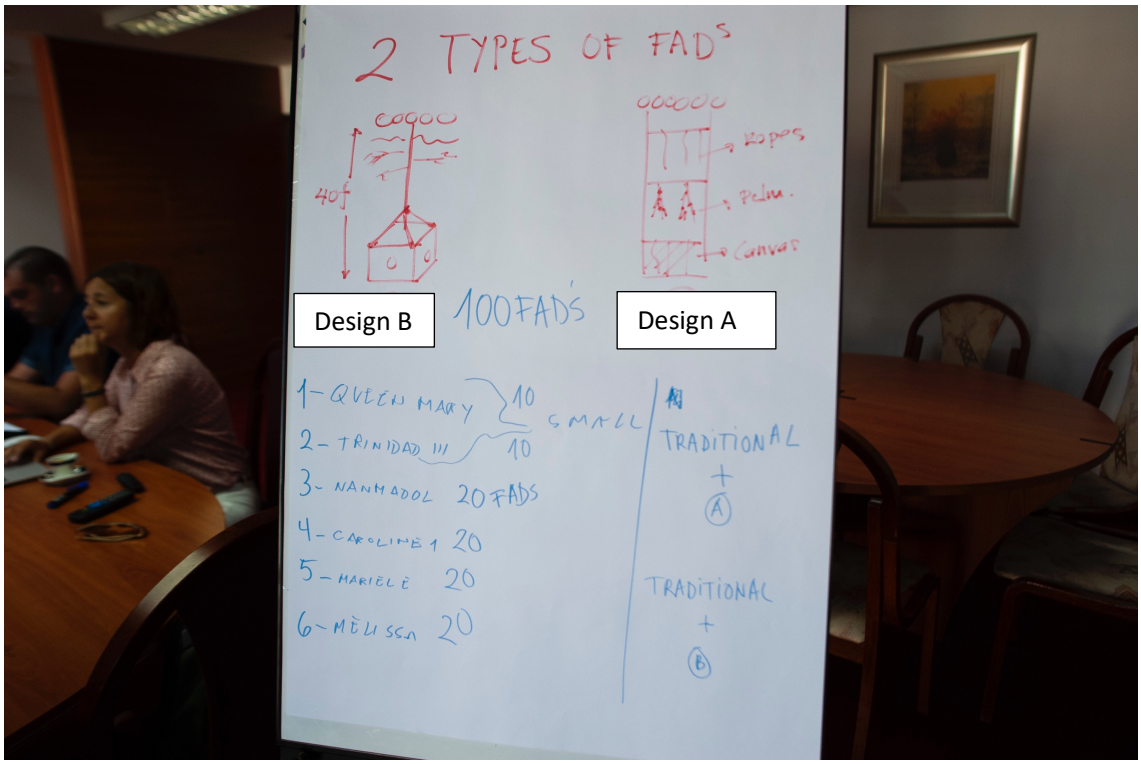


Fig 4. Detail of the drag with the canvas to cover the bamboo square. In this case the bamboo frames (top and bottom) are attached by the rope instead of using bamboo canes. The bamboo canes are wrapped with the canvas.

With the support from:

Appendix IV –
Deployment strategy with the involvement of the 6 purse seiners



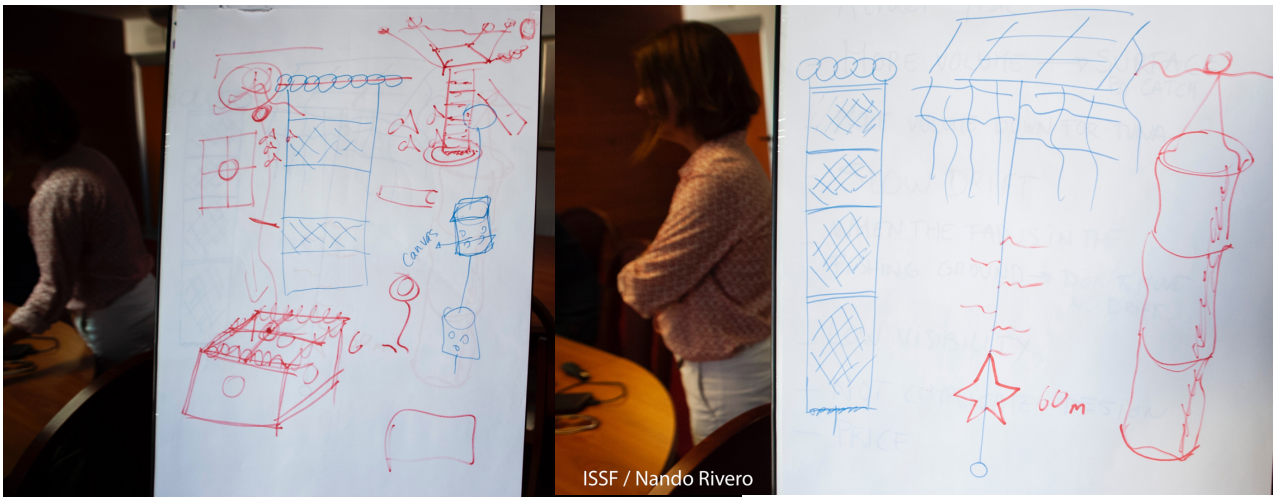
With the support from:

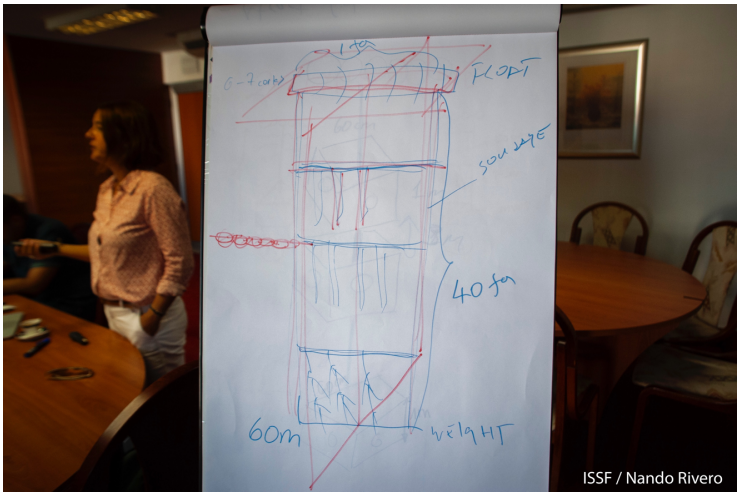
INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

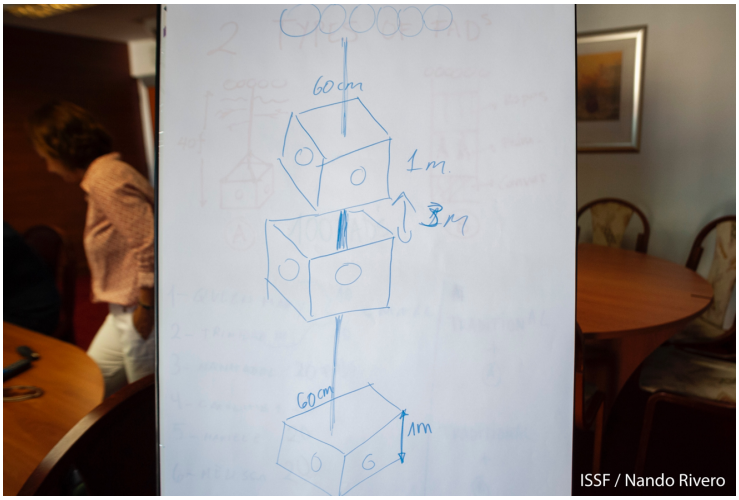
ISSF

Appendix V – Visual documentation of the ISSF Biodegradable FAD Workshop in Zadar.

With the support from: gef Food and Agriculture Organization of the United Nations COMMON OCEANS







With the support from:

Appendix VI –

Power point presentation of the biodegradable FAD workshop in Zadar, Croatia

With the support from:

Workshop on Biodegradable FADs

4 September 2019 / Zadar, Croatia

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

gef

Food and Agriculture Organization of the United Nations

COMMON OCEANS

Workshop Outline

09:00-10:30

Opening and welcoming

1. Presentation on the impacts of FAD structure on the ecosystem.
2. Presentation of potential solutions: non-entangling and biodegradable FADs
3. Ongoing experiences in other Oceans

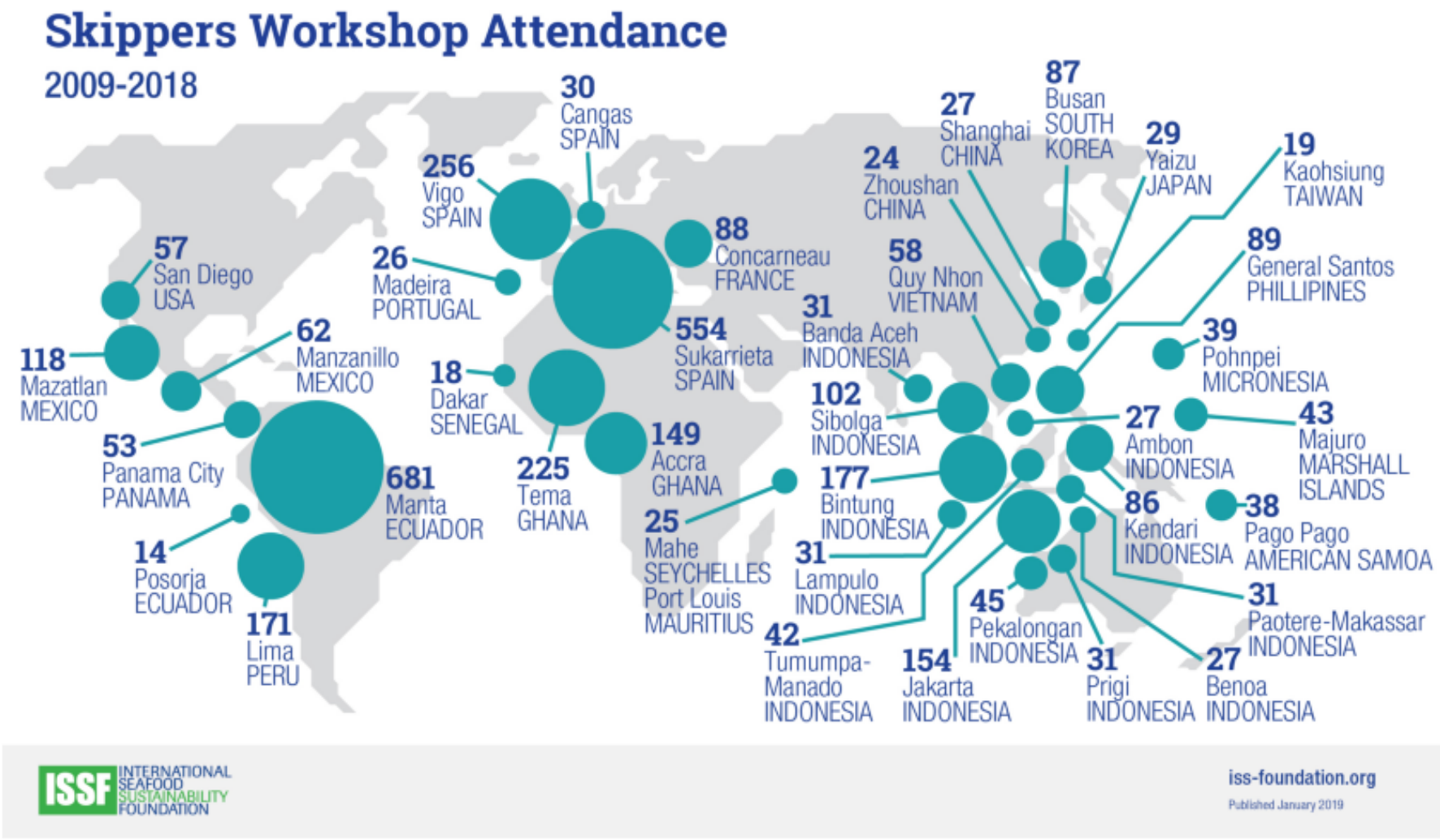
10:30-11:00 Coffe break

Project to test biodegradable FADs in the Western Pacific Ocean:

1. What are the essential features of the structure of a productive FAD?
2. Biodegradable FAD designs: different alternatives, challenges to be faced
3. Biodegradable FAD deployments: best area and time of deployment to gather information.
4. Biodegradable FAD monitoring and Data collection

12:30-13:30 Lunch Break

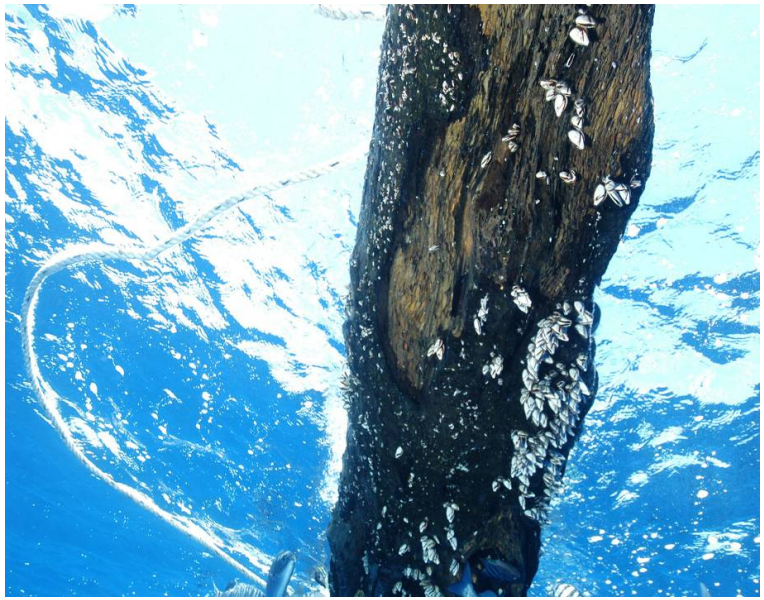
SKIPPERS WORKSHOPS MAP



Floating Objects

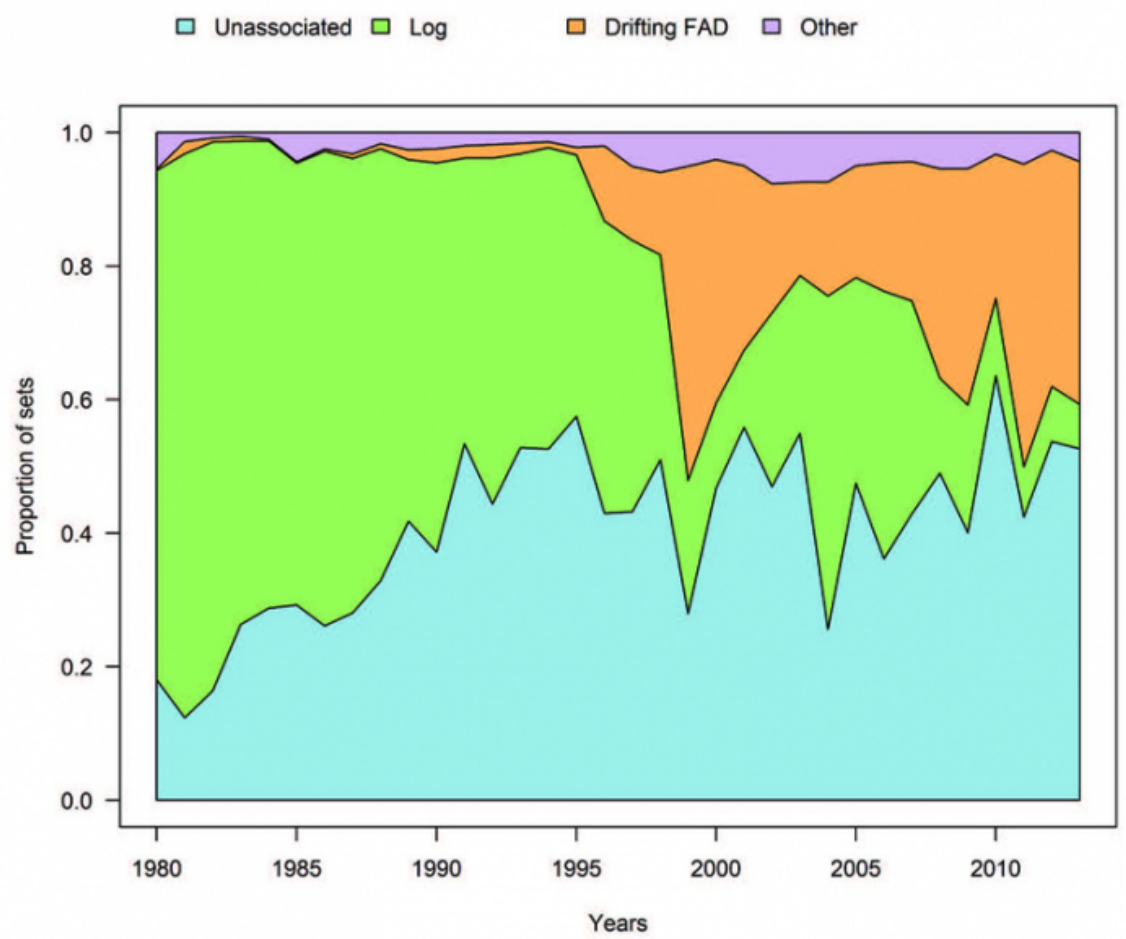
ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Naturally ocurring components of the pelagic ecosystem



Percentage of FAD Sets vs. Natural Logs

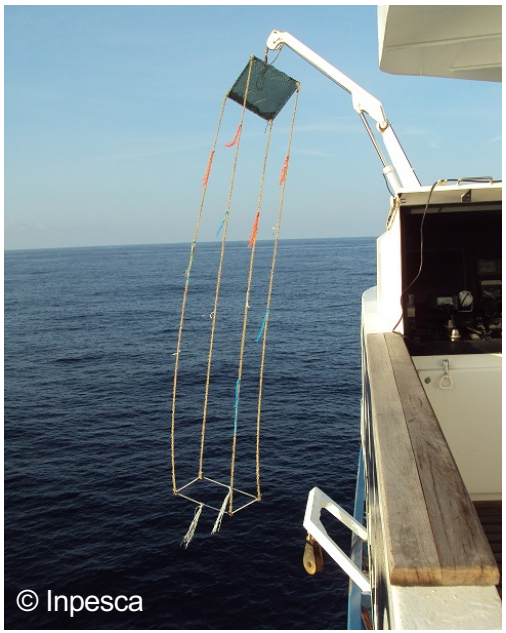
WCPO — Percentage of total sets by school type for the major PS fleets



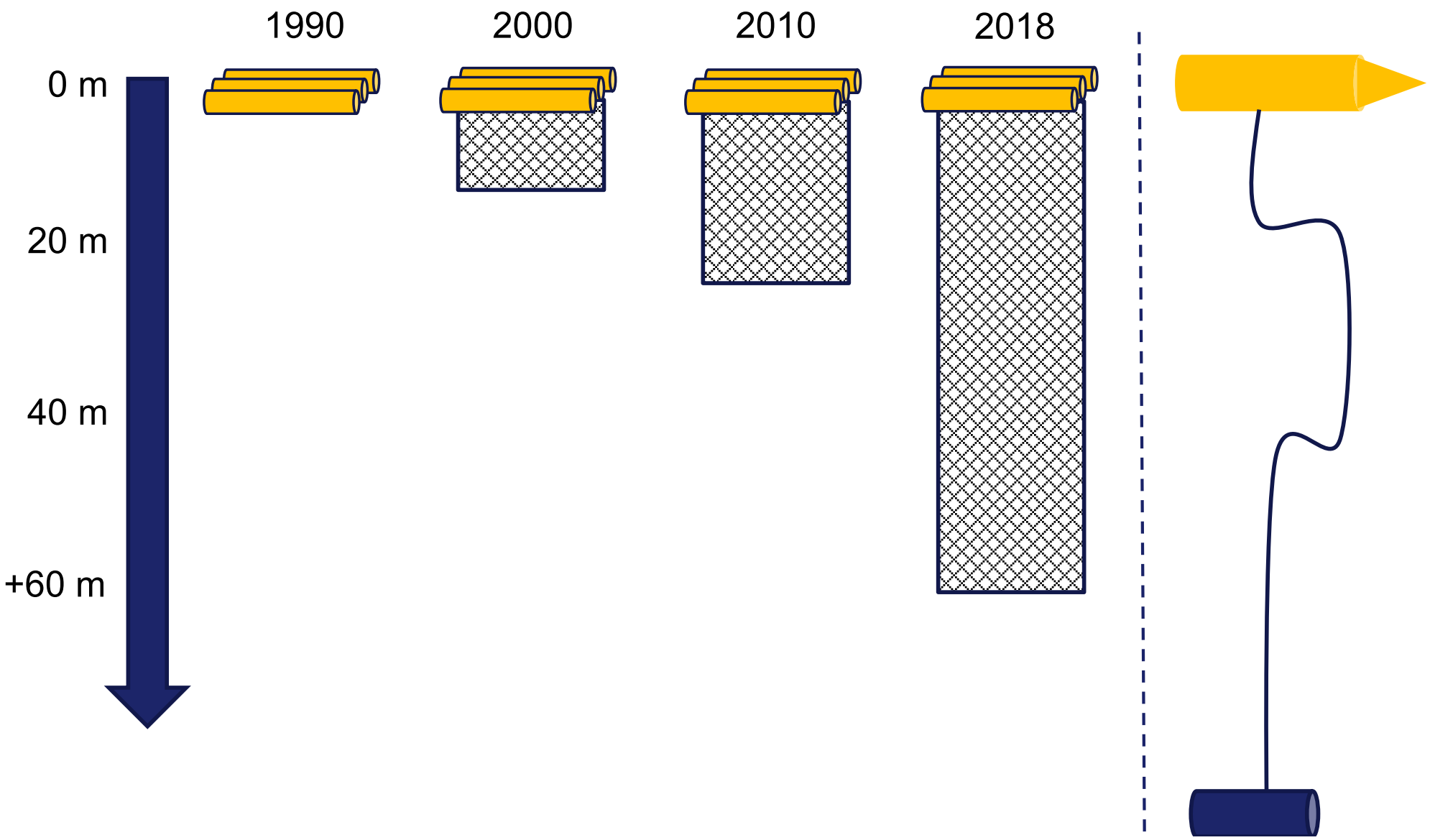
Source: Allain et al. 2016. DOI: 10.4000/books.pacific.423

High Diversity of FADs Worldwide

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION



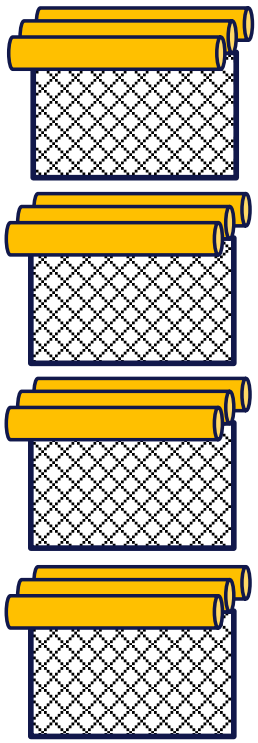
Global Trend Toward Deeper FADs



Reducing Marine Pollution by FADs

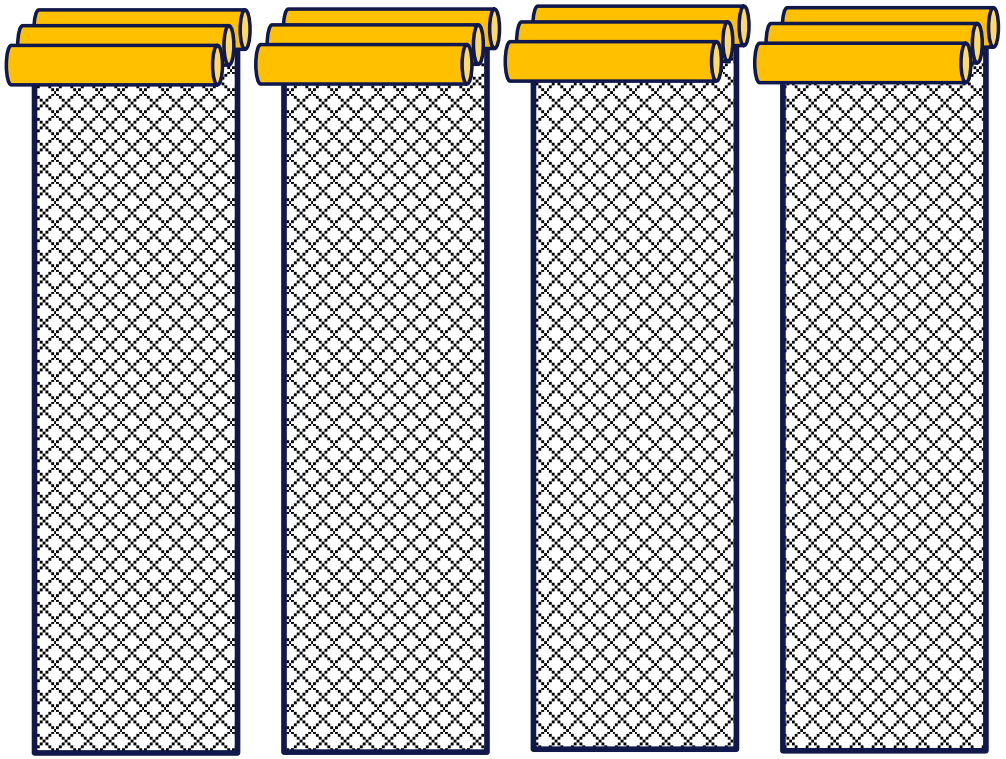
The impact is proportional to the **number** of FADs and their **size**

FAD structure
2000



Impact of
4 FADs (2000)

FAD structure
2018



Impact of 4 FADs (2018)

Impacts Caused by FAD Structure

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Ghost Fishing: Entanglement Issues

FAD Beaching & Marine Pollution

Ghost fishing: Entanglement

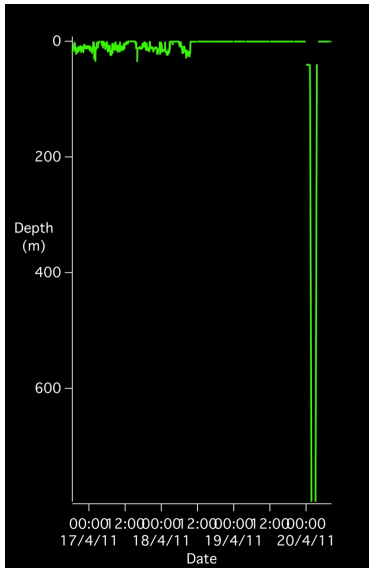
- **Before 2012**:

Problem of entanglement of sharks and turtles in nets of FADs was considered negligible compared to fishery mortality.

Two independent methods have shown the extent of the issue in the Indian Ocean

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Electronic tagging

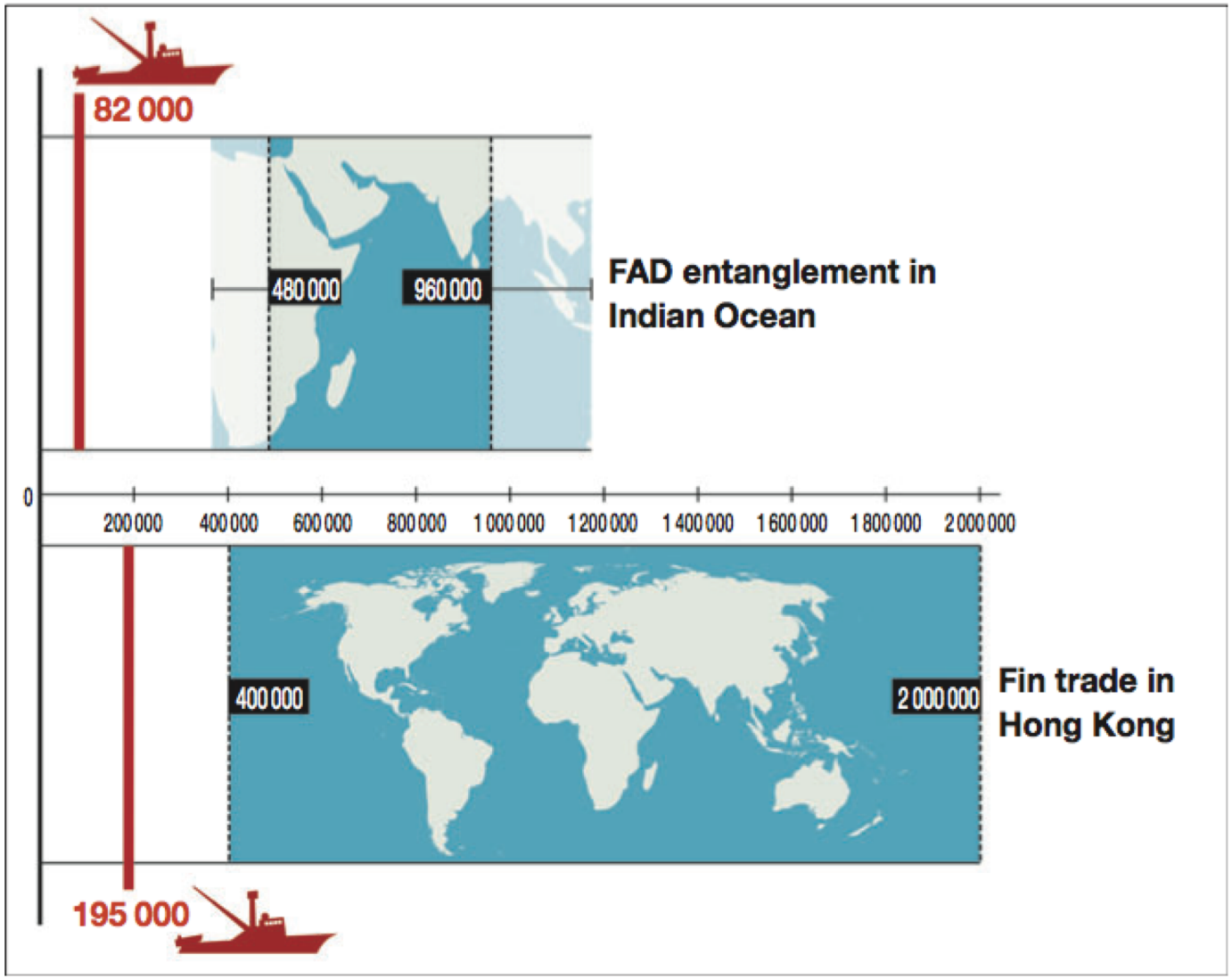


Underwater observations

- Filmalter et al. 2013. Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices

- Restrepo, V. et al 2016. Compendium of ISSF At-Sea Bycatch Mitigation Research Activities as of 12/2016.

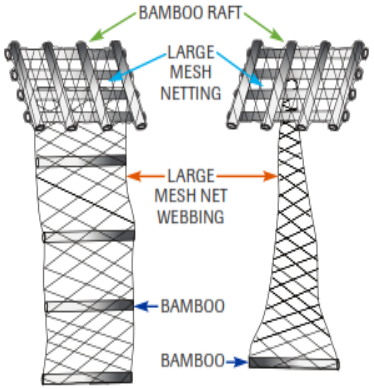
Modelling to estimate shark mortality



Non-entangling FADs guide

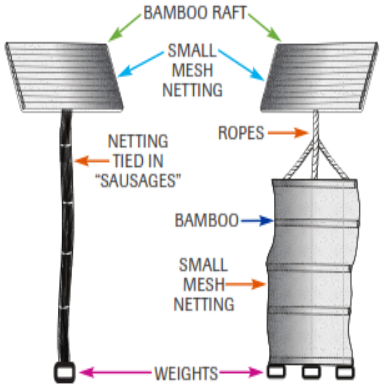
ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

HIGHEST ENTANGLEMENT RISK FADs:



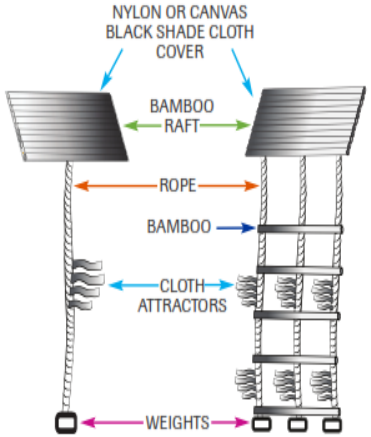
- Constructed with any netting materials, including old purse seine netting, used to cover rafts or suspended beneath in open panels
- These DFADs are known to cause entanglements with turtles and sharks

LOWER ENTANGLEMENT RISK FADs:



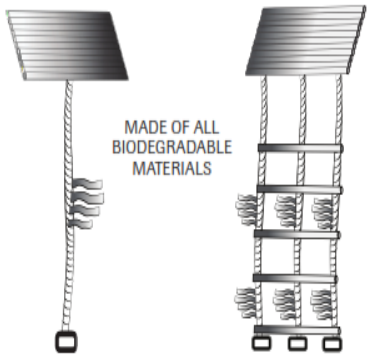
- Only small mesh netting used (e.g. < 2.5 inch (7 cm) stretched mesh)
- Rafts are tightly wrapped with small mesh netting, with no loose netting hanging from it
- The underwater structure is tightly tied into bundles (sausages)
- A single panel can be used instead of bundles, but the panel must be weighted to keep it taut
- The panel should consist of either netting with a stretched mesh of 2.5 inches (7 cm) or less, or a solid sheet (e.g., canvas or nylon)
- Despite using netting, these design elements reduce the risk of entanglement events

NON-ENTANGLING FADS:



- No netting is used in their construction
- The raft is not covered or covered with shade cloth or canvas
- The subsurface structure is made with ropes, canvas or nylon sheets, or other non-entangling materials
- These FADs are expected to have minimum risk of causing entanglement

BIODEGRADABLE NON-ENTANGLING FADS:



- In addition to having minimal risk of entanglement, they are constructed exactly like other non-entangling FADS, but using only natural and/or biodegradable materials, further reducing the environmental impact of DFADs on the oceans

HIGHEST RISK

LOWEST RISK

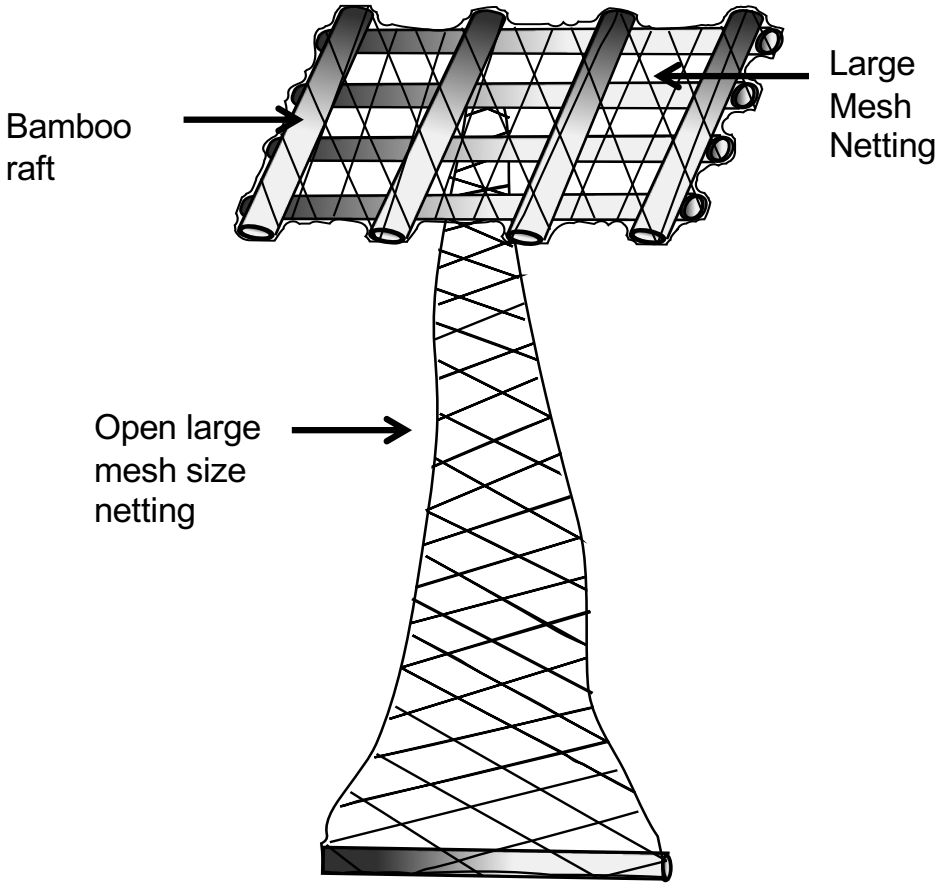
WCPFC conservation measures

From **1st January 2020**, the design and construction of any FAD shall comply with the following specifications:

•• The **raft part** (flat or rolled structure) can be covered or not. To the extent possible **the use of mesh net should be avoided**. If the FAD is covered with mesh net, it must have a **stretched mesh size less than 7 cm (2.5 inches)** and the mesh net must be well wrapped around the whole raft so that there is no netting hanging below the FAD when it is deployed.

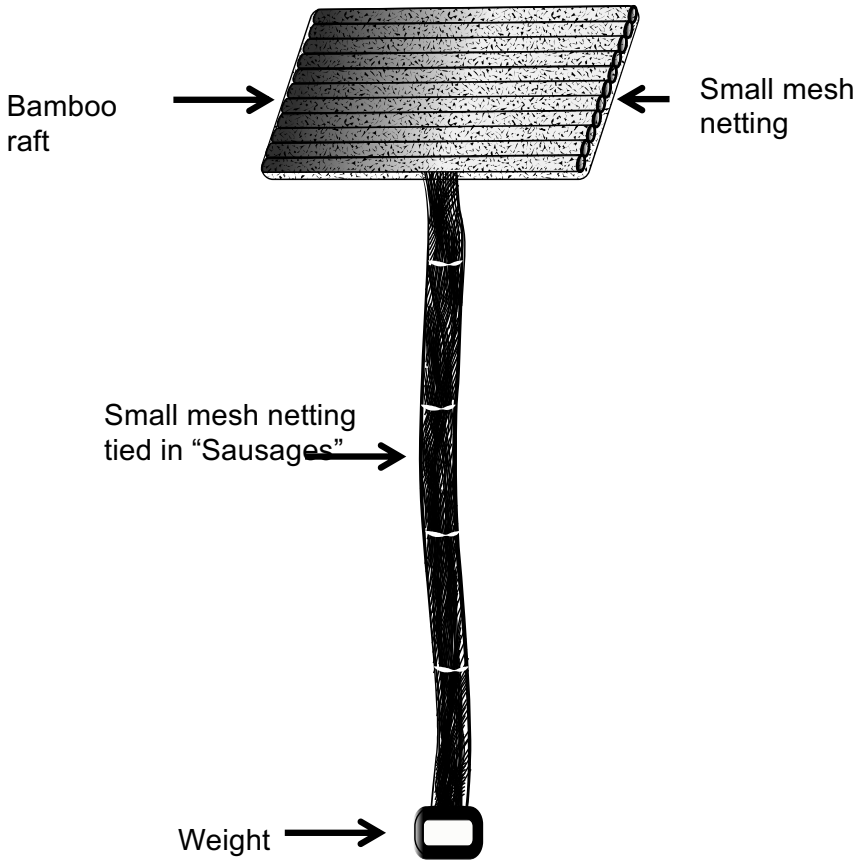
•• The **underwater or hanging part** (tail) of the FAD should **avoid the use of mesh net**. If mesh net is used, it must have a **stretched mesh size of less than 7 cm (2.5 inches) or tied tightly in bundles** or "sausages" with enough weight at the end to keep the netting taut down in the water column. Alternatively, a single weighted panel (less than 7 cm (2.5 inches) stretched mesh size net or solid sheet such as canvas or nylon) can be used.

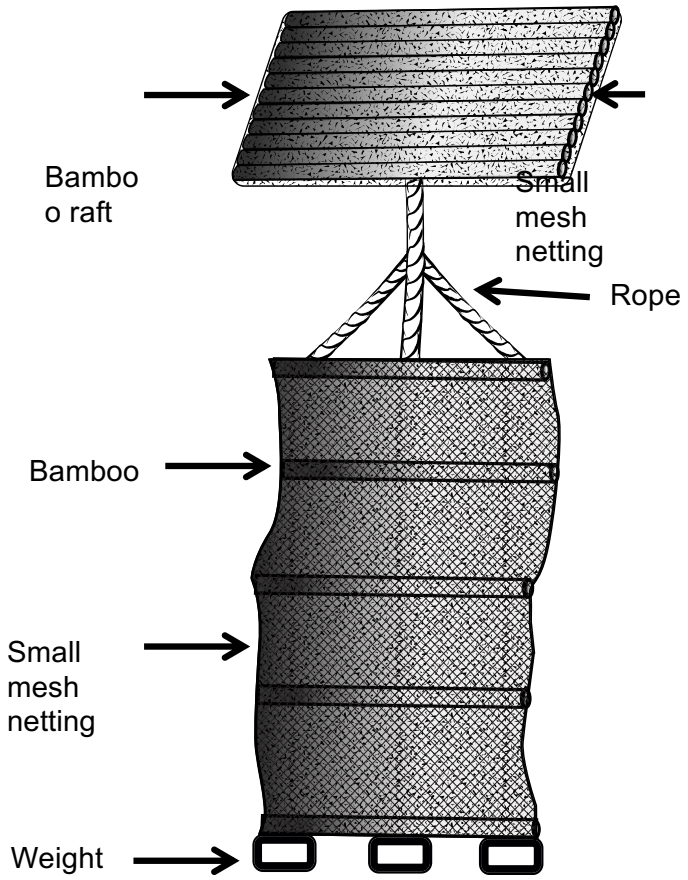
Highest entanglement risk FADs



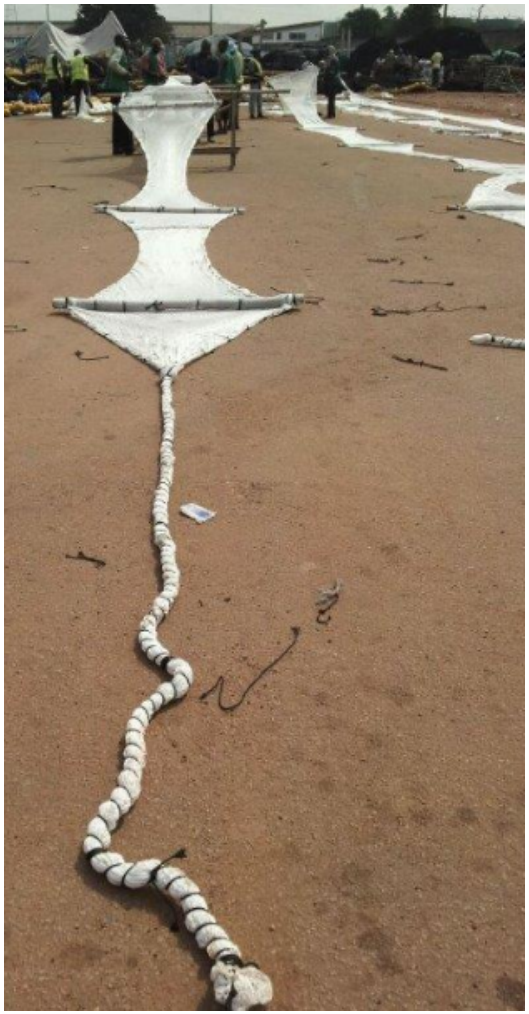
Western and central Pacific ocean DFAD types

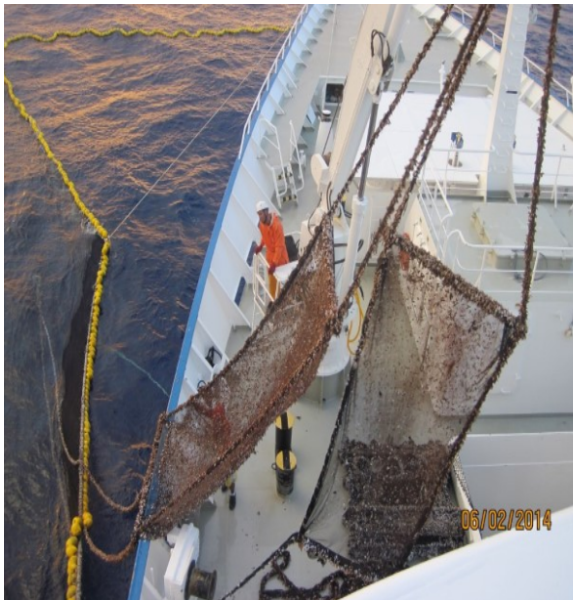
Lower entanglement risk FADs



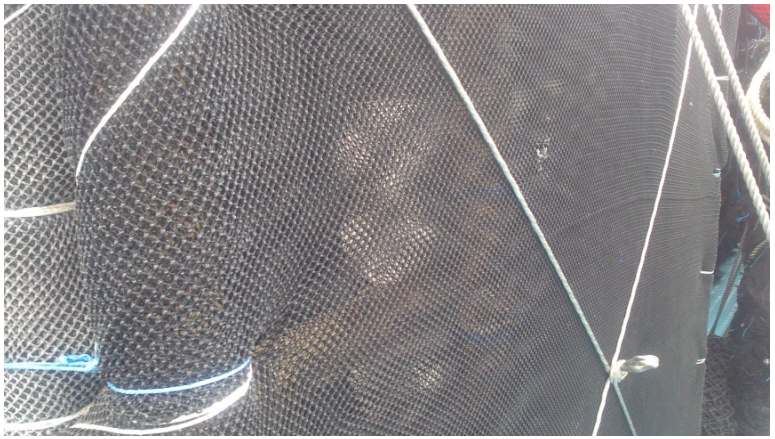


Lower entanglement risk FADs

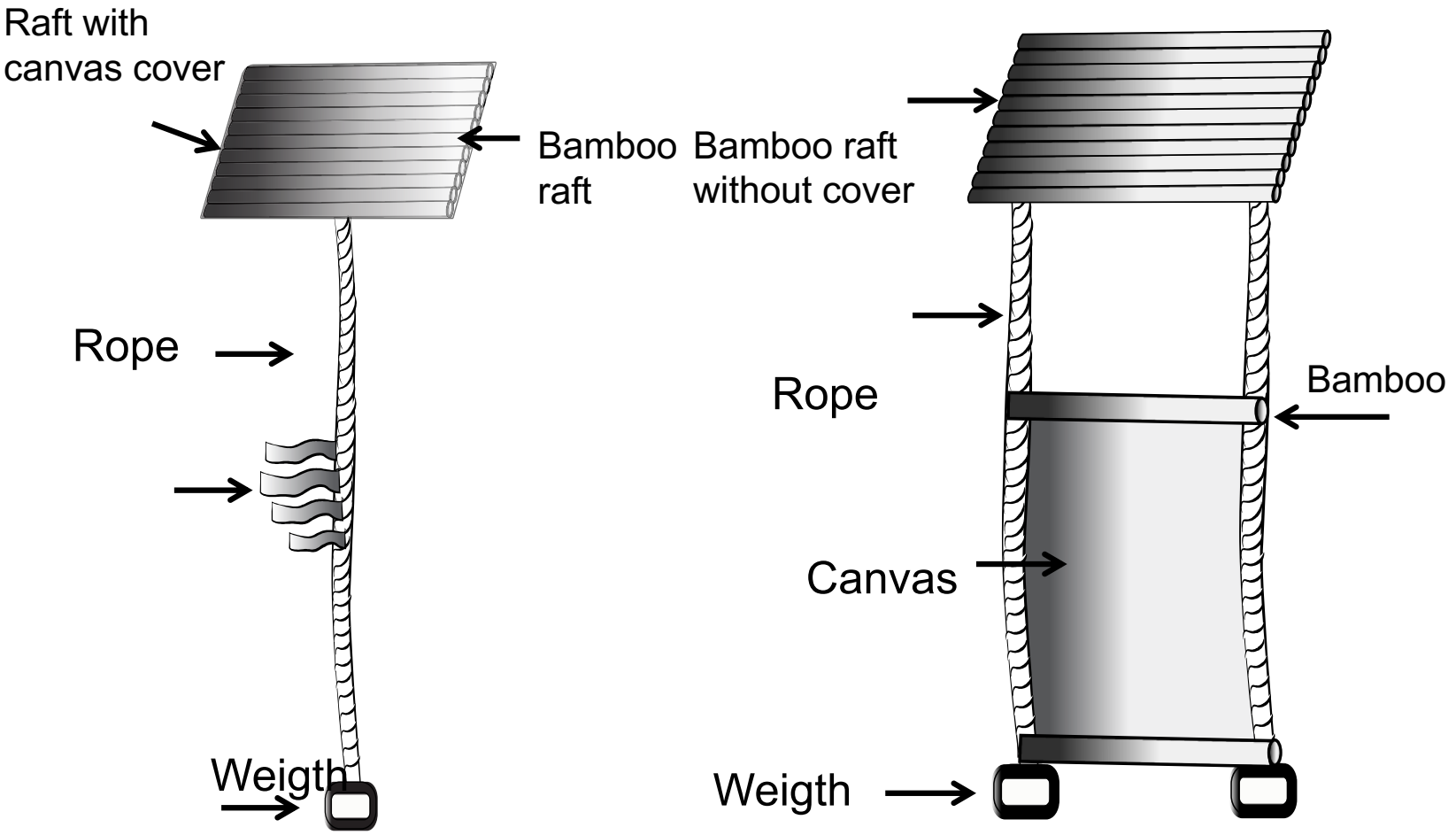




Lower entanglement risk FADs

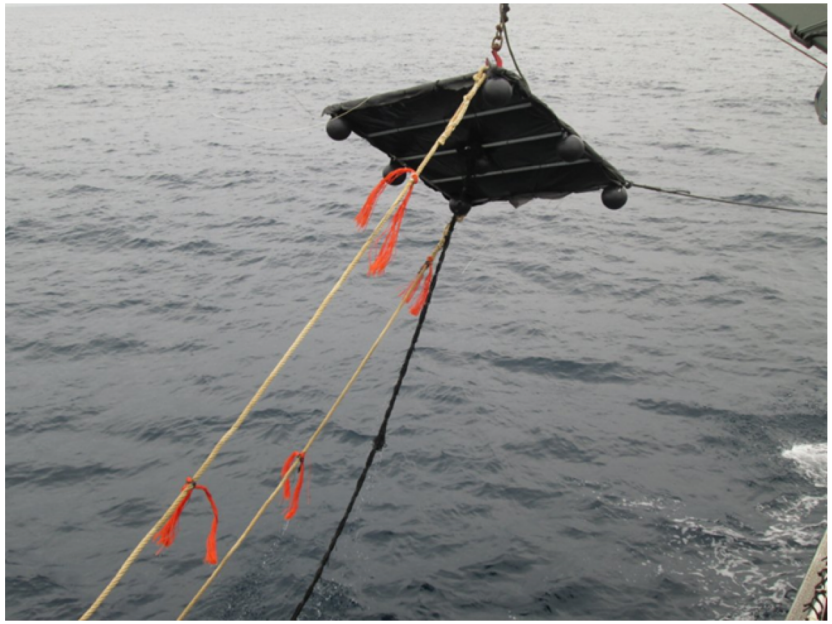


Fully Non-entangling FADs: without netting



Non-entangling FADs rafts

Non-entangling FADs tails



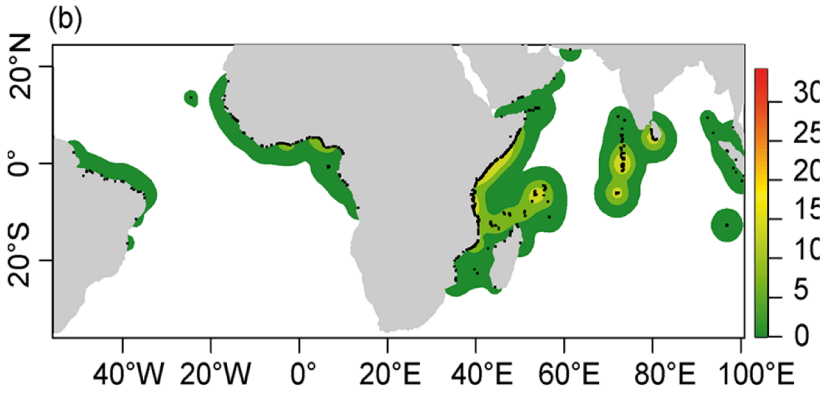
Impacts Caused by FAD Structure

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

FAD Beaching & Marine Pollution

FAD Beaching Events

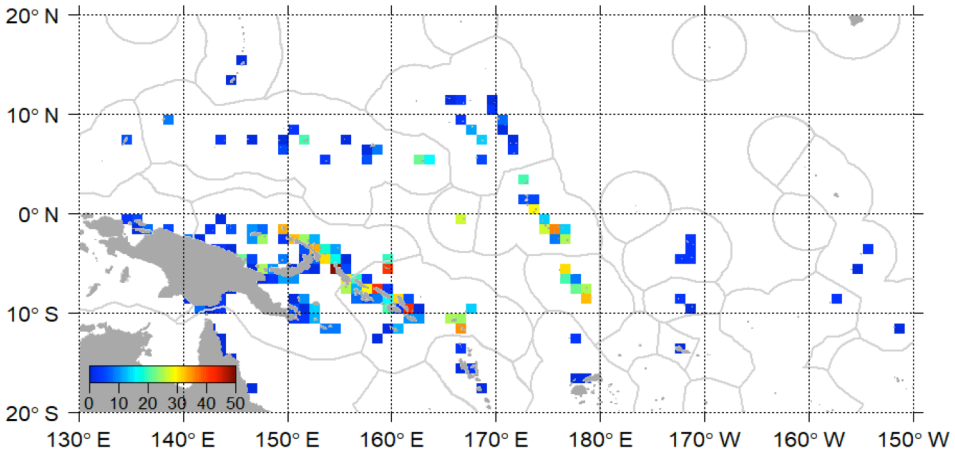
Indian & Atlantic Ocean



10% of the FADs deployed end up stranding

Maufroy et al. 2015

Western and Central Pacific



- 5% stranding
- 26% buoy 'lost', likely leading to marine pollution or unnoticed beaching

Escalle et al. 2018

Impact on coastal ecosystems

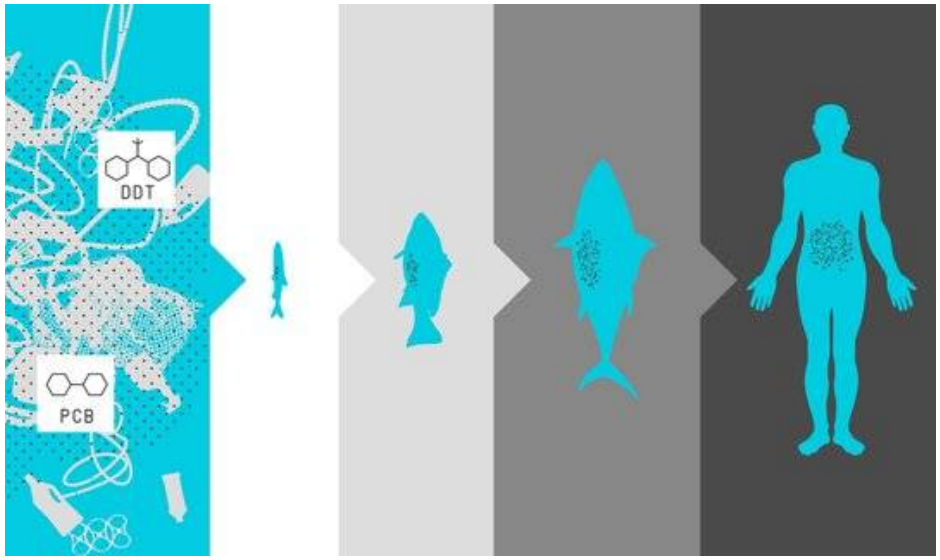
https://www.youtube.com/watch?v=xhOq2rPcezM

Impact of FAD Structures

- Damage of vulnerable ecosystems, such as coral reefs
- Marine pollution
- Interference with other economic activities
- Ghost fishing

Marine Pollution:
Oceans Can Not “Digest” Plastics

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION



Lost and abandoned FADs accumulate year after year

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

The plastic used in FADs remains at sea without degrading

It takes around 600 years to degrade a synthetic net

CMM 2018-01 BIODEGRADABLE FADS

To reduce the amount of synthetic marine debris, **the use of natural or biodegradable materials for FADs should be promoted**. The use of non-plastic and biodegradable materials in the construction of FADs is encouraged.

21. The Scientific Committee shall continue to **review research results** on the use of non-entangling material and biodegradable material on FADs, and shall provide specific recommendations to the Commission as appropriate.

22. The Commission at its 2020 annual session, based on specific guidelines defined by the FAD Management Options Intersessional Working Group and advice from SC16 and TCC16 **shall consider the adoption of measures on the implementation of non-entangling and/or biodegradable material on FADs**.

Actions to Reduce Marine Pollution by FADs

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

- ✓ **Modification of FAD structure**
- ✓ Reduce lost or abandoned FADs

Finding the solution with fishers

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

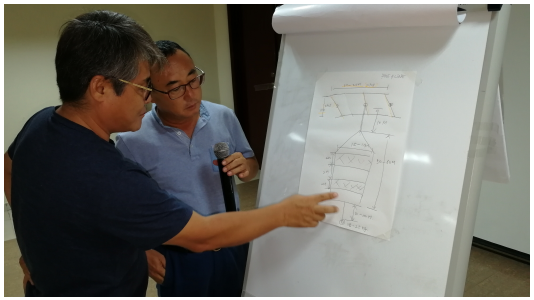
1. Determine the **working lifetime** required for a FAD in the different oceans

2. Design **biodegradable FAD structures** best suited for each oceans

3. Define the **strategy to test** biodegradable FADs in real fishing conditions

Workshops Designed to Answer These Questions

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION



Experiments at sea

1. Under-controlled conditions
2. Pilot studies to test a small number of FADs
3. Large scale projects

Experiments Under Controlled Conditions

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

FIRST STEP: Material Selection

- 100% natural fibers / materials
- Sustainably harvested
- Accessible & available in great quantities
- Available as close as possible to fishing grounds
- They can be processed to make ropes
- Rope diameter and material easy to handle onboard
- Cost

2016 Tests In Controlled Conditions: Maldives

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

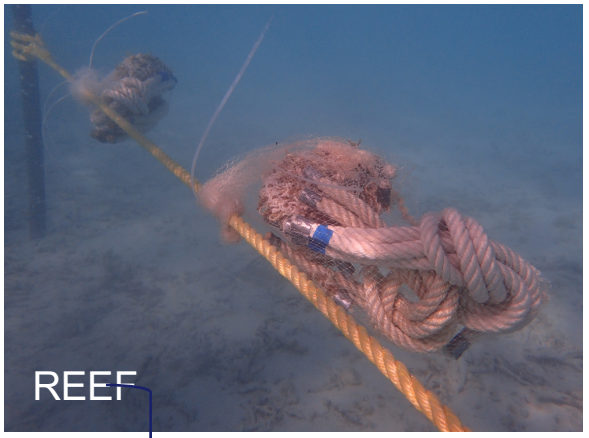
3 TYPES OF ROPE
selected:

- Raw Cotton Twisted

- Raw Cotton + Sisal

- Raw Cotton + Linen + Sisal

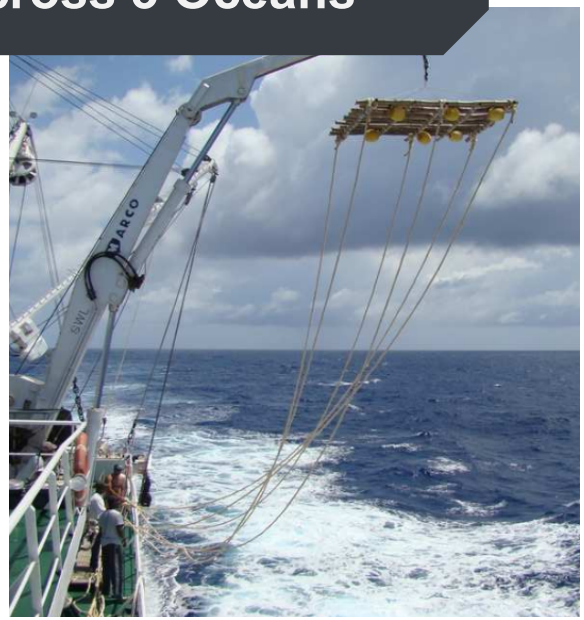
DEPLOYED IN MALDIVES

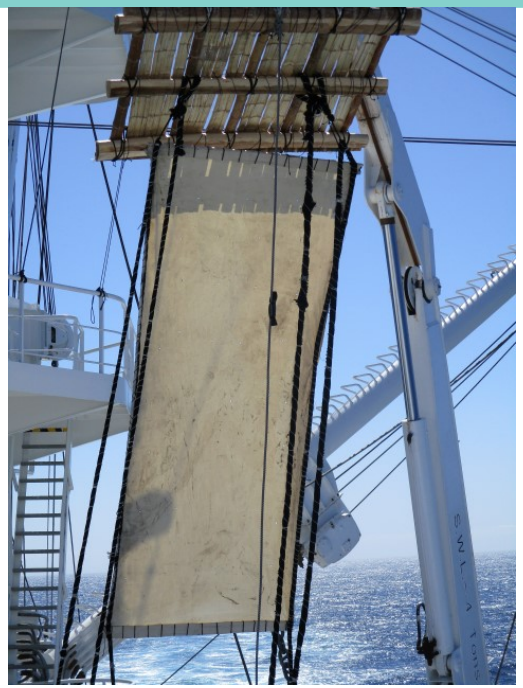


2007 to Present:
Small-Scale At-Sea Experiments

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Across 3 Oceans

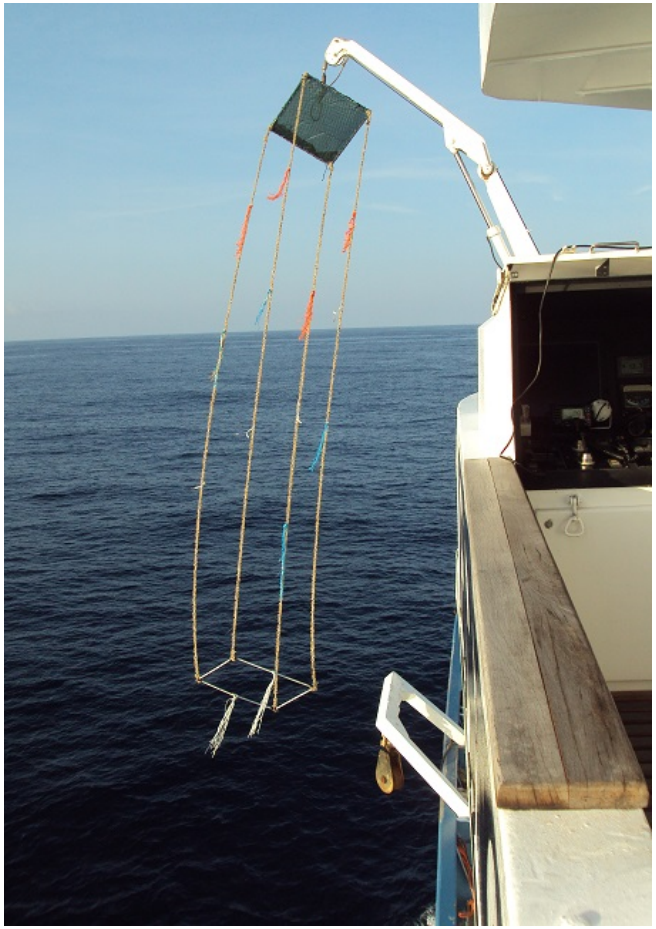




Pilot in Indian Ocean — 2017

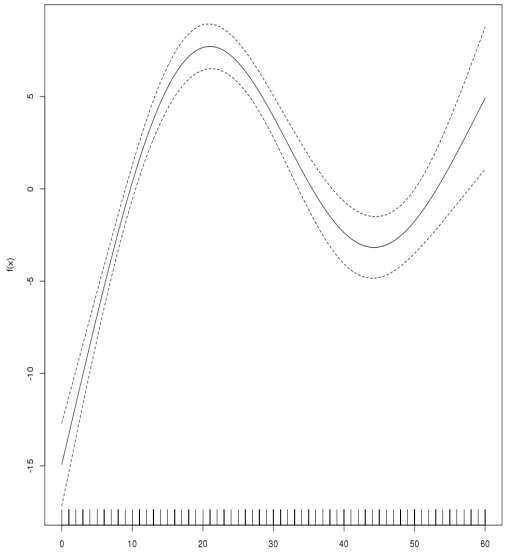
ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Testing 100 BIO-FADs in fishing conditions



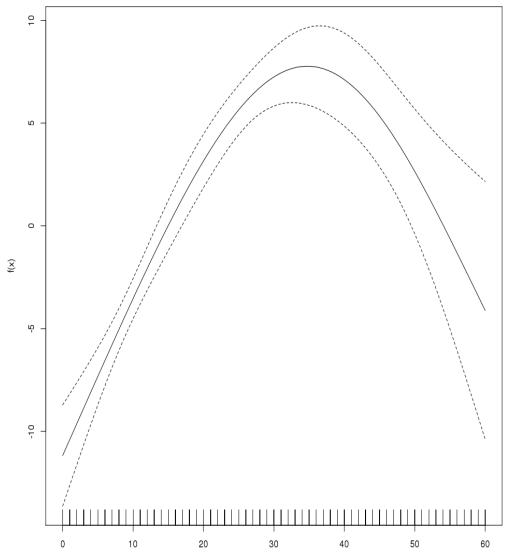
- Raft synthetic materials
- Tail structure with cotton ropes

Tuna aggregated to Biodegradable FADs



DAYS AT SEA

Tuna aggregated to Non-Biodegradable FADs



DAYS AT SEA

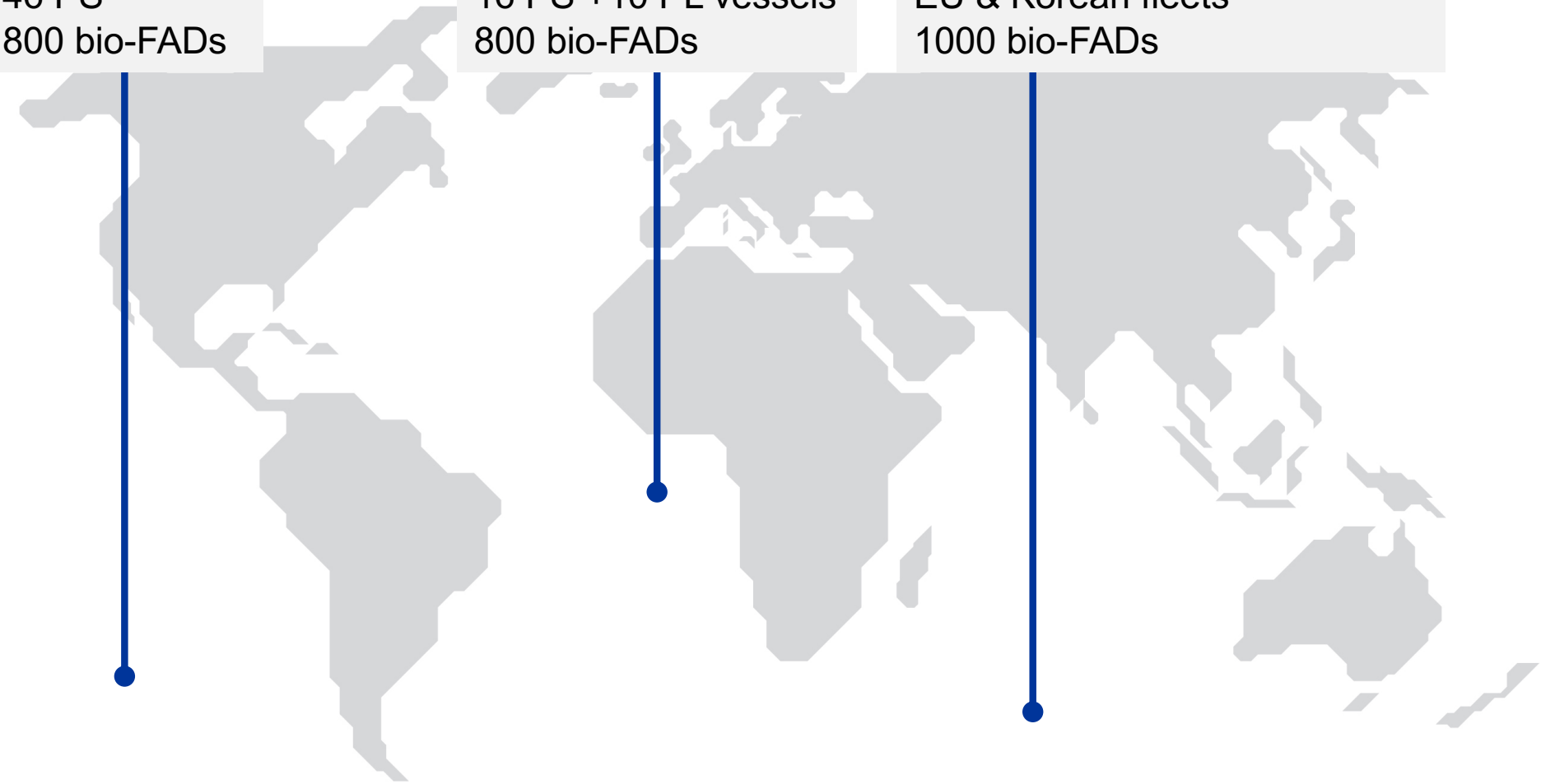
Large-Scale Deployment of Bio-FADs

INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

2019–2020
EPO fleet
46 PS
800 bio-FADs

2019
Ghanaian fleet
16 PS +10 PL vessels
800 bio-FADs

2018–2019
BIOFAD project Indian Ocean:
EU & Korean fleets
1000 bio-FADs



The final objective

What does a FAD fishery that avoids impacts on the ecosystem look like?

- ✓ Uses FADs **100% made of non-plastic or natural fibers**/materials that are sustainably harvested
- ✓ **Reduces the size and weight** of the FAD
- ✓ **Avoids FAD deployment areas** that imply high risk of stranding

Discussion on the Western Pacific case

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

1. What is the life time of your FADs in the Western and Central Pacific?

2. Do you repair FADs when found in bad condition?

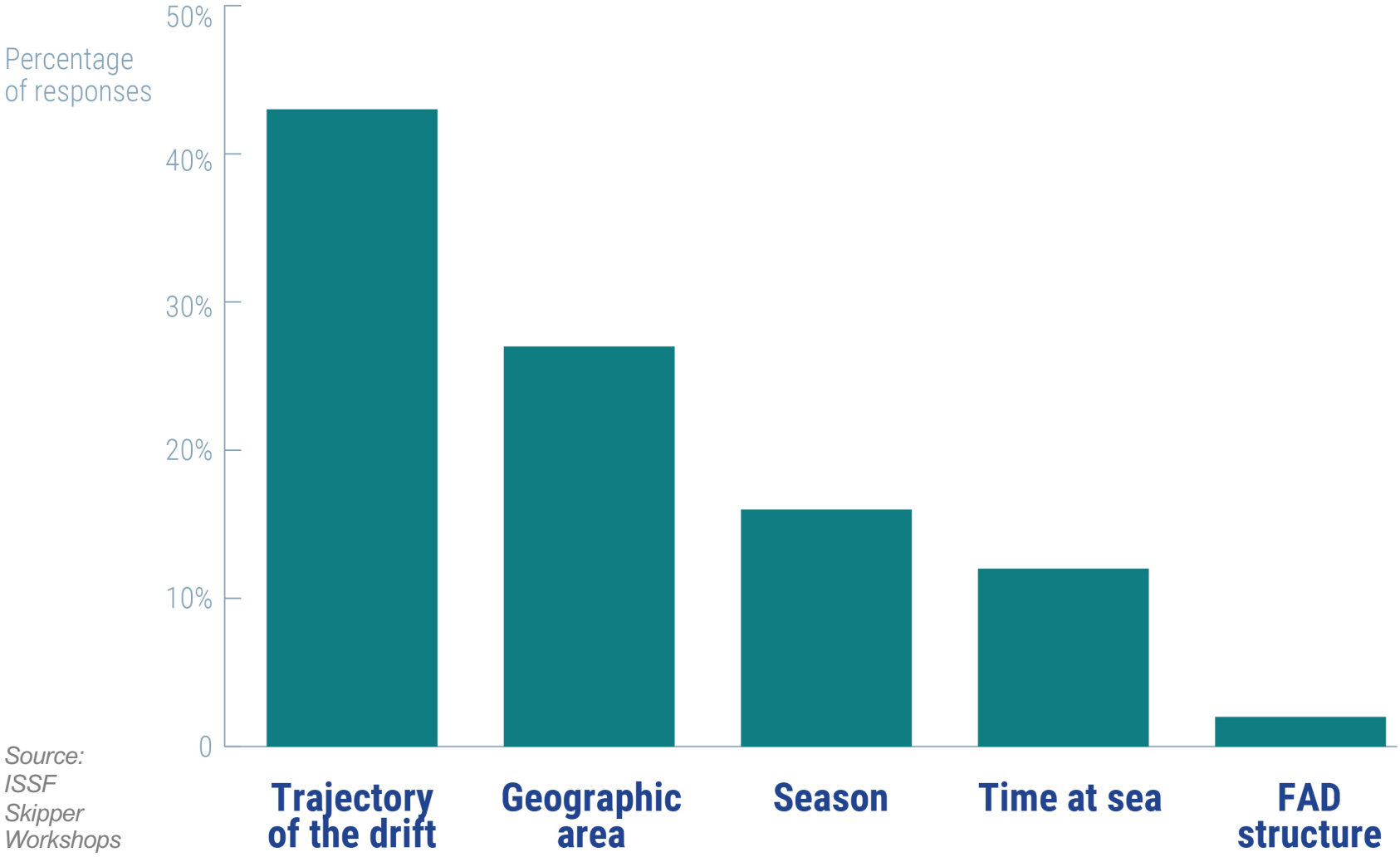
3. What characteristics of the FAD structure make it productive?

4. What is the depth of your FADs?

Research Focused on Modification of FAD Structure

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Which is the principal factor for FADs to aggregate tuna?



Source: ISSF Skipper Workshops

Research Focused on Modification of FAD Structure

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

SCIENTIFIC KNOWLEDGE:

Experiment in the EPO to compare shallow vs. normal FADs

After 60 days monitoring the 2 types:

- ✓ No significant difference in **drift speed**
- ✓ No significant difference in **total tuna catch**
- ✓ No significant difference in **species composition**

300 FADs Each Type

5 m. depth | 37 m. depth

Thank You!

www.iss-foundation.org
Email Gala Moreno: gmoreno@iss-foundation.org
Email Jefferson Murua: jmurua@azti.es

ISSF INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION | gef | Food and Agriculture Organization of the United Nations | COMMON OCEANS

Discussions

1. Design biodegradable FADs:
   - FAD design alternatives

2. Design a protocol to test them:
   - Strategy: best season, area
   - Identify main difficulties to test FADs
   - FAD marking
   - Data collection