International Seafood Sustainability Foundation
Second Meeting of the Scientific Committee of the ISSF Bycatch project
San Diego, California, August 21 - 23, 2011

1. SUMMARY

Table 1: List of activities that are to be conducted in the coming months under the bycatch project

Activity	Decision
1a Instrumented buoys	• To continue work (linked to tagging activity 2b)
1b Ecological FADs	• David, Gala and Laurent: proposal on designs of EcoFADs to promote the use of log-shape FADs without netting underneath (using alternative attractors), incorporating data from fleets (WCPO) that use these efficiently to convince other fleets that these FADs work. Deadline: early October (to be submitted to Vessel Committee by November) • Fleets should then deploy some of these EcoFADs for testing on a voluntary basis, and report on catches made using them (to National authorities). In the EPO, observers could monitor the performance of these ecoFADs over time
2a Pre-estimate of catch	• To promote the use of workboat with echosounder and drop camera (proof of concept completed during EPO cruise) • To be conducted during PS research cruise (e.g. WCPO) • Next step is to combine the use of experts' skills and skippers' knowledge to demonstrate that catches can be pre-estimated with good accuracy.
2b Natural behavior at FADs	• To continue acoustic tagging at drifting FADs. Explore possibility of conducting joint cruises with a pole and line tagging boat. • Protocol to be written by David, Kim, Kurt, Laurent. Deadline: November
2d Double FADs	• Protocol to be written by Kim, David & Laurent
3a Behavior and conditions of fish in net	• Protocol to be written by David, Kurt, Kim
3b Behavioral manipulation	• Leading sharks out of the net using a speedboat towing the FAD with a chum bucket. Protocol to be written Laurent, David, Diego, Kim
3c Modification of gear selectivity	• ISSF will look at scientifically assisting Ecuador to assess their sorting grids or to test new ones. Proposal with list of ideas by Martin, Jacques, Javier. Deadline: December • Investigation of alternative ways to bring fish on deck. Proposal by Martin & Jacques (D. Stevenson).
4a Best practices for handling sharks on deck	• Create a short list of common sense best practices by David, Laurent. Deadline: October
4b Survival of sharks released alive	• Deploy the 12 remaining miniPATs in the EPO on board PS vessels during regular fishing trips before January • Deploy additional miniPATs in WCPO and AO dedicated cruises
4c Best practices and survival of whale sharks and manta rays	• First guide for best practices (gathering information on current good practices) written by David, Laurent and Martin • Tag animals with miniPATs to study post-release survival during dedicated PS vessel cruises, applying best practices identified above (in order to test them). Includes any elasmobranch species released directly from the net (not from the deck)
4d Best practices for releasing turtles	• Guide for best practices to be written by Martin and Jacques
5 Physiological research	• Develop proposals that investigate physiological abilities of bycatch and target species which potentially allow for enhanced species segregation

A total of 17 participants attended the meeting at the ATA office in San Diego, 21-23 August 2011 (Annex 1).

2. UPDATE ON THE PREVIOUS 12 MONTHS OF THE PROJECT

Susan Jackson updated the group on ISSF's commitments and position on relevant issues. Emphasis was placed on the urgency of scientific inputs to initiate improvements within the tuna purse seine fishery to reduce bycatch around FADs.

Victor Restrepo indicated that all tuna RFMOs were aware of the project and fully support this science based initiative.

The objective of this meeting was to review the research activities for the past 12 months of the project and identify the priorities for the coming months.

The committee recognized that the project should follow a two pronged approach: rapidly obtainable results from applied research as well as fundamental investigations (a pre-requisite for the development of new ideas).

Kurt Schaefer presented an overview of the 73-day EPO cruise on board the Yollanda L, a tuna purse seiner from Ecuador, chartered by ISSF for research activities during May-July 2011. Experiments were conducted on 9 different FADs (see Annex 2 for details).

Laurent Dagorn presented an overview of the 11-day WIO cruise aboard the Maya's Dugong, a non-fishing vessel chartered from the Seychelles with armed security guard required due to the risk of pirate attacks in the area. This cruise was co-funded by the ISSF and the EU project MADE. Experiments were conducted on 8 different FADs (see Annex 3 for details).

From September 2010 to June 2011, skippers workshops were held in Ecuador, Panama, Ghana, Spain, France, Samoa, Marshall Islands, and the Federated States of Micronesia (Annex 4). These workshops provided an excellent opportunity for the promotion of awareness about the ISSF initiative across extensive number of fleets. Similarly, they allowed for the presentation of current issues regarding bycatch and the need for joint efforts between fishers and scientists to best address these problems. The level of acceptance from skippers provided the committee with insights to the feasibility and potential success of the proposed ideas as well as direction for new

proposals. The committee recognized the benefits of small groups of skippers to better facilitate free exchange of ideas.

3. REVIEW OF RESEARCH ACTIVITIES

Decisions regarding the list of research activities to be undertaken in the coming months are summarized in Table 1. Further details of activities that are not immediately apparent in this table are described below.

1) Passive mitigation of bycatch

a) Instrumented buoys
- Continue to undertake work complimentary to that conducted under the MADE project.

b) Ecological FADs
- No turtles or sharks were observed to be entangled in EPO cruise, in any of the 9 FADs visited, both traditional and EcoFADs. Contradictory to this, sharks were found entangled in both traditional and EcoFADs during the WIO cruise.
- First results from the French fleet project in the IO have shown that EcoFADs can aggregate tuna but some designs should be revised as some shark entanglements were observed (see above). Log shaped FADs automatically prevent turtles from climbing on the surface structure. These types of FADs are used by different fleets in the WCPO and the EPO. The committee encourages the testing of log shaped FADs, similar to those in the WCPO, but modifying the subsurface netting to alternative attractors that will not entangle animals. The committee (see Table 1) will propose designs of FADs and ISSF will encourage the fleets to voluntarily deploy these FADs and test them during regular fishing trips (to demonstrate that they aggregate tuna).
- The committee recommended the adoption of a new term to refer to EcoFADs but consensus could not be reached regarding this new term.
- The committee did not prioritize further tests on fully biodegradable FADs.

c) Effects of design of FADs on composition of fish aggregations
- Following information gained from skippers workshops, and recognising that any design of new FADs should respect the specifications of ecoFADs, this activity has been removed from the list of objectives and falls into the category of ecological FADs (1b).

Comment: The committee recognized that FADs should be monitored (numbers, types, drifts) which would assist in a multitude of scientific and management objectives. For example, the French fleet in the IO already provides drifts of their FADs to IRD (with a 6-month delay).

2) Avoid catching bycatch before setting

a) Pre-estimation of catch.
- Pre-set estimates of the tuna catch, by species composition and quantitites, were conducted during the EPO cruise. The PS was using a lightboat with an echosounder to help the estimation of the catch composition (a practice originating from the Captain's experience in the WCPO, but rare in the EPO). Total catch estimates were relatively accurate as well as the observation of the presence of the various species (SKJ, BET, YFT). However, SKJ catches were silghtly underestimated, BET were over-estimated and YFT were well estimated. There were only nine sets made during that cruise, with an average set size of just over 100 tons, whereas the average set size on floating objects in the EPO is closer to 40 tons. It is assumed that the accuracy is probably much better for smaller sets.
- Japanese PS vessels operating in the WCPO utilize echosounders onboard their workboats and have the technology which allows the captain of the PS vessel to view the image from the echosounder in in the workboat in real time.
- In order to demonstrate that it is possible to obtain good estimates of catch composition, the commitee recommends to test the use of a workboat with an echosounder and a drop camera as well as the combined skills of trained scientists and skippers during dedicated PS research cruises.

b) Natural behavior of fish at FADs.
   - After data obtained during the EPO and IO cruises (as well as from other projects), and recognizing the need for fundamental research in this field, the Committee acknowledged that this activity is a priority. Skippers during workshops also recognised the value of this activity. See Table 1 for future plans.

c) Skippers' ability to catch free-swimming schools of skipjack (SKJ) away from FADs.
   - Results from the EPO cruise suggest that this practice would not be a viable option for the fishery (as only small sub-schools of the entire SKJ aggregations were observed leaving the FADs). However, the committee realises that in different regions (WCPO) this practice may be viable under certain environmental conditions (availability of baitfish). This action has been removed from the list of activities as the committee recognised that it is not the objective to demonstrate skippers ability to catch such schools but rather to evaluate scientific research as to whether are the origens of nearby un-associated schools. As such, this objective has been incorporated under the activities of 2b.

d) Double FADs
   - The committee recognised the potential of this work and recommended its undertaking in future research cruises.
   - Various designs of double FADs were discussed (identical structures, variation in vertical structures 'vertical double FAD', difference in lighting, etc.). Experimental protocols will be developed as indicated in Table 1.
   - The committee recognised that the best method for initially conducting such experiments would be to switch or modify an existing FAD where fish are known to be aggregated, with an experimental double FAD to be tested.

e) Attraction of sharks away from FADs
   - After encouraging results from experiments undertaken during the IO cruise the committee felt that there was no need for further investigation of this point and the natural progression was to conduct further experiments under section 3b.

3) Release from the net

a) Behavior of fish in the net
   - The committee emphasises that this work is critical to inform the design of methods for segregation/release of species (Table 1). A high priority has been set for undertaking this research. In addition to the behaviour, understanding the condition of the various species at various stages of the net hauling and brailing processes are equally importance.

b) Behavioral manipulations (e.g. attraction or repulsion of sharks, small BET, other finfish)
   - See Table 1 for the proposed action. Further ideas will be developed once the results of 3a are obtained.
   - Important to obtain updates from Japanese colleagues with regards to the outcomes of experiments with light on behaviour of tunas.
   - The committee recognises that measures that utilise attraction rather than repulsion should be more effective (less stress and less enmeshment and better control of movement)
   - The lack of knowledge on physiological/sensory abilities led the committee to propose a new activity in section 5, regarding the requirement for fundamental research in this field. The results of these investigations will not only help for mitigation in PS fisheries but also in other large pelagic fisheries such as longlining.

c) Modifying the selectivity of the gear (e.g. sorting grids, changing mesh size, etc.). Jacques Sacchi
   - See Table 1.
   - In addition to those reflected in table 1, other ideas were mentioned, including:
     (1) Large mesh size
     (2) Dividing apron in net

(3) Skimming scoop (which are already used by some fleets of the WCPO)
(4) Sinking corks at tie of sacking up
(5) Encircling bycatch with second net to drag outside of PS net
(6) etc.

These ideas will be further discussed after results are obtained from 3a.

4) Release from the deck
   a) Best practices for releasing sharks
      - See Table 1
      - A draft list of best practices onboard as recommended from a project conducted by the French fleet (Orthongel) and MADE was presented.
   b) Survival of released sharks
      - See Table 1
      - Sharks that are alive in sac should be tagged before brailing to assess survival.

5) New activities (after information from skippers' WS and results from last experiments)
   - See Table 1
   - Whale sharks and manta rays: this new activity was added as it was identified as a priority in the WCPO (and concerns also exist in other oceans). However, it should be noted that sets on whale sharks are rare events, making the planning for these experiments not possible. Scientific staff should be awared and prepared in case of an opportunity. Some best practices from the French fleet and WCPO fleets were discussed and will be used as the first guidelines. Any of these animals encountered during dedicated PS research cruises will be tagged to assess their survival following these best practices.

4. NEXT CRUISES

WCPO Cruise

- Plans for two separate cruises: 3 weeks for anchored FADs (PNG) and 4 weeks for drifting FADs, starting in February 2012.
- The list of research activities corresponds to Table 1.
- Cruise leader will be David Itano and potential scientific staff have been identified.
- Urgent action is to send letter to ask for permits for conduction of research in study area (David Itano and Victor Restrepo)
- The anchored FAD leg should be conducted in conjunction with the PNG tagging project if possible.
- Action 2a will require assistance from SPC for port sampling.
- SPC mentioned interest for testing electronic monitoring of catch and bycatch during the research cruise.

Atlantic Ocean Cruise

- Planned for January 2012 (4 weeks)
- Research activities correspond to Table 1
- Cruise leader has yet to be identified

Research onboard regular fishing cruises

- Committee identified research activities that could be conducted during regular fishing trips:

(1) 2d Double FADs;
(2) 3b Drag FAD with chum bucket out of PS net;
(3) 4b Tagging oceanic sharks for survival;
(4) 4c Tagging whale sharks and manta rays for survival

- The committee will write documents to describe the protocols. This will require the presence of 1 or 2 scientists onboard during regular fishing trips. ISSF will ask owners of PS vessels whom may be willing to participate in this activity.

5. **OTHER MATTERS**

- Based on positive results from the ongoing activities, Susan Jackson confirmed that funding will be available for continuation of the work after the planned cruises for early 2012.
- The committee will submit an oral presentation of the project for the FAD symposium in Tahiti in November.
- Second round of skipper's workshops must be prepared. Guidelines for presentations will be identified and efforts should be made to conduct workshops in WCPO and AO prior to the start of research cruises.
- Next meeting to be organised after WCPO and AO cruises are completed.

Annex 1: List of participants

Participant	Institute, Country
Laurent Dagorn	IRD, France
David Itano	UH, USA
Martin Hall	IATTC, USA
Javier Ariz	IEO, Spain
Kim Holland	UH, USA
Kurt Schaefer	IATTC, USA
Diego Bernal	UMASSD, USA
Rich Brill	VIMS, USA
Jacques Sacchi	France
Tatsuki Ohimas	JAMARC of FRA, Japan
Peter Sharples	SPC, New Caledonia
Brian Kumasi	Fisheries, PNG
Dan Fuller	IATTC, USA
Susan Jackson	ISSF
Victor Restrepo	ISSF
Francesca Forrestal	ISSF
John Filmalter	IRD, South Africa

Annex 2:

AN OVERVIEW OF THE 2011 ISSF/IATTC EPO PURSE-SEINE RESEARCH CRUISE FOR INVESTIGATING POTENTIAL SOLUTIONS FOR REDUCING FISHING MORTALITY ON UNDESIRABLE SIZES OF BIGEYE AND YELLOWFIN TUNAS, AND SHARKS, WHEN ASSOCIATED WITH DRIFTINGS FADS

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A 73 day research cruise was undertaken, during the period of 11 May to 23 July, 2011 to the equatorial eastern Pacific Ocean (EEPO) aboard the Ecuadorian flag purse seine vessel Yolanda L., under a charter agreement between the vessel owner and the International Seafood Sustainability Foundation (ISSF), and in collaboration with the Inter-American Tropical Tuna Commission (IATTC). The objectives of the cruise included attempting to reveal practical solutions for reducing the fishing mortality on bigeye and yellowfin tunas, and sharks, as well as other undesirable species commonly captured during fishing operations by purse-seine vessels on mixed species aggregations associated with drifting fish-aggregating devices (FADs). A focus of the scientific experiments conducted, and overall research objectives is to elucidate whether the potential exists to develop alternative purse-seine fishing methods to avoid capture of undesirable sizes of bigeye and yellowfin tunas, and other species, while maximizing catches of skipjack tuna, associated with FADs.

There were five specific research activities, upon which the scientific committee of the ISSF by-catch program agreed fit within the objectives of the overall project, and should be undertaken during this first cruise to the EEPO. The first research activity objective was to test different designs of FADs that may not entangle turtles or sharks, including the potential for using biodegradable materials. Ten “ecological” FADs and 51 “standard” FADs were deployed during the routine fishing trip, preceding the research cruise. Two of the “ecological” FADs were constructed of all natural materials. The other 8 “ecological” FADs had 2” stretch purse-seine mesh net hung from the FADs, versus the common 4.5” or larger mesh net. All FADs checked during the cruise were evaluated as to their design, condition, presence of any entangled animals, and tuna biomass. There were no turtles or sharks observed entangled in the netting of any FADs during this cruise.

The second research activity objective was to evaluate the accuracy of the catch predictions by the fishing captain from the tuna aggregations associated with FADs, and the potential improvements in those estimates through the use of additional complimentary equipment and methods. Acoustic and optical surveys of the tuna aggregations were conducted utilizing a SIMRAD ES70 echo-sounder and SEABOTIX LBV 200 remotely operated vehicle (ROV) aboard a workboat. Pre-set estimates of the species composition, sizes, and quantities of tunas were provided by the Captain, based on acoustics from the purse-seine vessel and light boat, and visual observations from mastmen. Tunas loaded aboard the vessel from 9 sets were separated within wells, so as to obtain weights by species weight

classes within sets, following unloading and sorting at the Starkist cannery in Manta, Ecuador.

The third research objective was to elucidate spatial and temporal differences in the behavior of skipjack, bigeye, and yellowfin tunas within aggregations associated with drifting DFADs, in order to reveal potential opportunities for avoiding the capture of undesirable sizes of bigeye, yellowfin, and other species of concern in purse-seine sets, while optimizing the capture of skipjack tunas. Ultrasonic telemetry experiments were to be undertaken at a minimum of ten drifting FADs, with a minimum of 30 t of tunas present, including bigeye and skipjack. Proposed methods included the capture and tagging, with coded acoustic tags, 3 each of skipjack, bigeye, and yellowfin tunas, and continuous acoustic tags, in 3 additional skipjack. Each experiment was intended to be conducted for a minimum of 48 h. Should a mono-specific skipjack school be observed, while active tracking to move a distance of 1 nm away from the FAD the purse-seine vessel would target that school for capture**.** There were no such sets made during this cruise.

The fourth research objective was to investigate the behavior of tunas and sharks captured within a purse-seine net, and determine if species-specific segregations occur, and the spatial and temporal characteristics of such segregations. The workboat was to remain adjacent to the FAD during a set at pre-dawn. Records from the echo-sounder were to be recorded during the set. Following dawn the ROV was to be deployed with adequate light to observe and record the behavior of tunas and sharks within the net. Simultaneously, observations would be recorded by video from the mast of the purse-seine vessel of the behavior of the tunas and sharks within the net. Observations and recordings would be conducted for up to 6 h, after the rings are aboard and at 25% net in water. No experiments were undertaken for this activity, because the precautionary requirements stipulated by the Captain were not available during the cruise. These included sets on small tuna aggregations, and calm ocean conditions.

The fifth research objective was to determine the at-vessel mortality, post-release survival, and the physiological, biochemical, and molecular responses of sharks incidentally captured by purse seiners. The numbers, species composition, at-vessel mortality, and physical condition of sharks loaded aboard the purse seine vessel were assessed during the cruise. The physical and physiological condition of sharks immediately after loading, and prior to release were determined, to characterize the overall impact of capture and handling. The post-release mortality rates were to be determined by directly recording the sharks' vertical and horizontal movement patterns for 30-45 days, using Wildlife computers mini-PATs. There were 8 silky sharks tagged and released with mini-PATs during the cruise.

Annex 3: Scientific Report on the ISSF-MADE cruise, Western Indian Ocean, 16-27 June 2011

A scientific cruise was organized by ISSF and the EU funded MADE project which share the common objective of studying the behavior of target and bycatch species (silky sharks in particular, the main bycatch shark species caught by tuna purse seiners) associated with FADs.

The team visited 9 FADs (8 different FADs, with one being visited twice, 10 days apart) during the 11 day cruise, onboard the MV Maya's Dugong. The cruise was conducted in the area around the Seychelles. FADs belonged to both French and Spanish purse seiners who kindly informed the scientific team about the positions of their FADs in the area. Two main experiments were conducted during the cruise: studying the natural behavior of target and bycatch species around FADs, and attraction experiments on sharks (to attract them away from FADs). In addition, underwater visual surveys were conducted under each FAD which provided information on the species composition and abundance of the various species around the FADs. The cruise also provided an opportunity to test the feasibility of using a simple and inexpensive underwater camera (GoPro) to assess the presence and abundance of sharks associated with a FAD.

FAD with MV Maya dugong in back ground

A total of 53 fish (both target and bycatch species of the purse seiners) were equipped with acoustic transmitters (Vemco) around 3 different FADs: 14 silky sharks (3 were double tagged with miniaturized pop-up satellite tags), 10 yellowfin tuna (4 were double tagged with archival tags), 5 skipjack tuna, 1 bigeye tuna, 13 oceanic triggerfish and 10 rainbow runners. The acoustic transmitters provided information on the residency of fish at FADs, as well as on the patterns of association and excursions away from FADs. The mini pop-up tags and archival tags (Wildlife Computers) provide information on the large scale movements and detailed vertical behaviour of fish. The three FADs were each equipped with the new Vemco VR4-GLOBAL acoustic receivers which recorded data from acoustic transmitters when present around the receiver. This data was then transmitted via satellite (Irridium). Each FAD was also equipped with an echosounder buoy (SATLINK).

The first FAD was fished by a purse seine vessel (not the owner of the FAD) roughly two days after the fish had been tagged, ending the experiment after 48 hours. The Vemco receiver of the second FAD failed after deployment, while the echosounder SATLINK buoy of the third FAD also failed. Despite these problems, a lot of data on the behavior of target and bycatch species were collected during the cruise.

Shark attraction experiments were conducted on 5 different FADs. The scientific protocol consisted of (i) assessing the numbers of sharks around the FAD at the start of the experiment (snorkeling), (ii) using a small tender to drift slowly away from the FAD with a bag full of fish chum (bait), (iii) assessing the number of sharks attracted and maximum distance of attraction using underwater GoPro cameras and a handheld GPS. Each experiment was terminated when either the tender reached a distance of 500 m from the FAD or when no more sharks were observed for several minutes.

FAD	Number of sharks at start	Number of sharks attracted	Maximum distance
1	9	3	500 m
2	2	1	120
3	3	2	80
4	2	1	80
5	2	2	250

This pilot study provided key information:

- sharks can be attracted hundreds of meters away from FADs by simply towing a bag of bait away from the FAD
- reactions of sharks varied greatly between the experiments ranging from almost no reaction to attraction up to 500 m. It appears that many factors could be responsible for the success of the attraction: if the FAD was fished a few days before (probably affecting the natural behavior of sharks), the size of the multispecies fish aggregation, feeding

motivation, etc. The small dataset does not allow conclusions to be drawn on the respective effects of each parameter.

Sharks attracted away from the FAD by the chum

Conclusions:

The tagging experiments provided information on the precise times of the day at which target and bycatch species naturally segregate (some staying at the FAD, others leaving). The shark attraction experiment showed that sharks can be attracted using a bag of bait, but that the FAD always remains a very strong attraction stimulus. From this new knowledge, we recommend that future experiments be conducted on sharks that have already been encircled by the purse seine net. This protocol will involve placing a bag full of chum on top of the FAD, then towing the FAD out of the net and assessing the number of sharks that could be released.

Annex 4: Activity acceptance level by fleet.

ACTIVITY ACCEPTANCE LEVEL BY FLEET						
ISSF Research Activity	**Ecuador/Panama**	**Ghana**	**Spain**	**France**	**Samoa**	**Majuro/Pohnpei**
1. Passive mitigation of by-catch						
a. Instrumented buoys (echo-sounder, etc.)	HIGH	NULL	HIGH	HIGH	HIGH	HIGH
b. Ecological DFADs	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
c. FADs design composition fish aggregations	MEDIUM	HIGH	MEDIUM	NULL	MEDIUM	MEDIUM
2. Avoid catching by-catch before setting						
a. Pre-estimation of by-catch	HIGH	NULL	MEDIUM	LOW	MEDIUM	MEDIUM
b. Natural behavior	HIGH	HIGH	HIGH	HIGH	MEDIUM	HIGH
c. Catch free-swimming SKJ away from FADs	NULL	LOW	NULL	NULL	NULL	NULL
d. Double FADs	LOW	MEDIUM	HIGH	LOW	MEDIUM	MEDIUM
e. Attraction of sharks away from DFADs	MEDIUM	HIGH	NULL	NULL	NULL	LOW
3. Release from the net						
a. Natural behavior of fish in the net	HIGH	MEDIUM	HIGH	HIGH	MEDIUM	MEDIUM
b. Behavioral manipulations	MEDIUM	HIGH	LOW	LOW	LOW	LOW
c. Modifying the selectivity of gear	MEDIUM	LOW	MEDIUM	NULL	LOW	MEDIUM
4. Release from the deck						
a. Best practices for handling sharks onboard	HIGH	LOW	HIGH	HIGH	MEDIUM	HIGH
b. Survival of released sharks	MEDIUM	LOW	HIGH	HIGH	HIGH	MEDIUM