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Status of the Purse Seine Bycatch Mitigation Project and research cruises funded by the International Seafood Sustainability Foundation with notes on the development of best practices for the live release of encircled animals

WCPFC-SC7-2011/EB-WP-11

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David Itano³ and Victor Restrepo⁴

Reference SC7 Agenda Items 5.5(a), 5.5(b)

1. Abstract

The International Seafood Sustainability Foundation⁵ (ISSF) is funding and implementing a research program to develop and test technical options to reduce bycatch resulting from large-scale purse seine fishing on FADs. A steering committee composed of research scientists representing expertise from all oceans is developing and conducting research cruises on chartered tuna purse seine vessels with expertise in FAD fishing. Representatives from national fishery organizations, the SPC and tuna RFMOs also contribute to the development and implementation of the research plan. The project concentrates on developing ways to reduce fishing mortality on bigeye tuna and pelagic sharks that are taken in association with FADs, while work on other species (turtles, miscellaneous finfish, small tuna) are also being addressed. Cruises will take place in all ocean areas that have large-scale tuna fisheries to test mitigation techniques under different oceanographic conditions that contribute to differences in catch composition, bycatch levels and aggregative behavior of tuna and bycatch between regions. Research priorities and experiments are being developed with input from fishermen experienced in FAD fishing through a series of Skippers' Workshops that are being held in the Atlantic, Indian and Pacific regions. Research cruises have been conducted in the Indian and Eastern Pacific Oceans during 2011. The project will also develop and disseminate a series of “best practices” for the safe handling and live release of bycatch, especially certain species of special concern such as whale sharks, oceanic sharks and marine turtles. Additional cruises have been proposed for the eastern Atlantic and western Pacific during early 2012. The project steering committee will meet in late August 2011 following SC7 to review outcomes and recommendations arising from the completed cruises useful for the planning of the 2012 Atlantic and Pacific cruises.

2. Background to the ISSF Purse Seine Bycatch Project (the Project)

The ISSF is dedicated to the long-term goal of promoting the sustainable utilization of global tuna stocks while maintaining a balanced ecosystem condition. The organization is concentrating on six main areas of concern:

- Mitigate Bycatch
- Eliminate IUU Fishing
- Control Excess Fishing Capacity
- Expand Data Support
- Advance Performance in Monitoring, Control & Surveillance
- Improve Overall Tuna Stock Health

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⁵ <http://www.iss-foundation.org/home>

Bycatch in tuna fisheries occurs with practically all fishing methods. Current ISSF research efforts concentrate on minimizing bycatch in purse seine sets on FADs, which accounts for almost 37% of the catch of tropical tunas globally and close to 50% in the western Pacific Ocean. To directly address the issue, the ISSF is organizing and funding the charter of dedicated purse seine vessels in the Indian, east Atlantic, Eastern Pacific and Western Pacific Oceans to test bycatch reduction ideas and techniques.

The Project is unique in utilizing fully functional purse seine vessels manned by highly experienced commercial fishermen who are familiar with their waters and FAD fishing specifically. The concept and structure was presented to SC6 as described in Restrepo (2010). This approach represents a huge advantage over traditional research cruises that utilize research vessels and crews that are often unfamiliar and out of touch with the commercial realities of the fishery. A dedicated research platform with external funding support allows for experimental operations that commercial vessels would not otherwise conduct for fear of lower catches and reduced profitability. However, retained catch will be used to help to offset costs and provide additional income to the vessel owners.

This Project is being planned and implemented by an international steering committee of pelagic research scientists that includes Drs Laurent Dagorn (IRD, Seychelles; Committee Chair) Javier Ariz (IEO, Spain), Diego Bernal (UMASS, USA), Richard Brill (VIMS, USA), , Martin Hall (IATTC), Kim Holland (U Hawaii, USA), David Itano (U Hawaii, USA), Gala Moreno (AZTI, Spain), Hiroaki Okamoto (NRIFSF, Japan), Jacques Sacchi (IFREMER, France), and Kurt Schaefer (IATTC). Regional representatives from national fishery agencies, RFMOs and the Secretariat of the Pacific Community (SPC) are also included in the planning and implementation process. Development and implementation of the Project is based on linking scientists with to develop practical and economically viable solutions to bycatch reduction.

Research activities are being developed and implemented to address four areas of concern as they relate to Purse Seine Fishing on floating objects:

- Tuna of undesirable size and bigeye tuna in particular
- Oceanic sharks (primarily silky and oceanic white tip sharks)
- Marine turtles
- (to a lesser extent) Miscellaneous finfish (rainbow runner, jacks, triggerfish, etc.)

The Project will also take advantage of access to chartered purse seine vessels to address issues related to onboard sampling, pre-set catch estimation, video monitoring of catch and other issues that are difficult to examine in the commercial sector.

3. Project development

3.1) Initial workshop, Sukarrieta, Spain

The Project concept was initiated by a workshop hosted by ISSF and the AZTI⁶ - Tecnalia laboratory, in Sukarrieta, Bizkaia, Spain, 24-27 November 2009. The objective of the meeting was to gather tuna scientists, technicians, fishing gear experts, acousticians, biologists and purse seine captains to discuss technical solutions to reducing bycatch resulting from purse seine effort on floating objects, such as FADs (anchored and drifting) and natural drift objects. A summary

⁶ <http://www.azti.es/en/>

of this meeting was provided to SC6 (AZTI 2010). The significant conclusion arising from the meeting highlighted the importance of involving industry in all aspects of the project and the importance of a multi-disciplinary approach.

3.2) Kobe II, Brisbane Australia

The ISSF coordinated a second single-day bycatch review in conjunction with the Kobe II Bycatch Workshop (K2B) held in Brisbane, Australia June 23-25, 2010⁷. The ISSF meeting complemented the Kobe 2 process by providing information on bycatch related research on tuna purse seine fisheries and plans to move forward in the testing of additional research on chartered vessels. Invited speakers presented information summarizing global purse seine fisheries and fleets, purse seine bycatch information and plans for implementation of the Purse Seine Bycatch Project.

3.3) 1st meeting of ISSF Purse Seine Bycatch Project, Paris, France

The first real meeting of the ISSF Purse Seine Bycatch Project was held in Paris, France 8-10 September 2010 where the project steering committee (noted in Section 2 above) met to formulate a general research plan. Additional input was provided by participants from the SPC Oceanic Fisheries Programme and the National Fisheries Authority of Papua New Guinea.

The steering committee agreed that the Project would prioritize the reduction of fishing mortality of bigeye tuna of undesirable size and pelagic sharks as taken by purse seine fisheries while other bycatch species (marine turtles, other finfish, small tuna, etc.) would also be considered. It was strongly noted that the oceanographic conditions, catch composition, bycatch levels and bycatch utilization aspects varied widely between ocean areas. Participants felt that experiments will need to be conducted in all oceans to examine the influence of environment, localized productivity and thermal structure on bycatch levels and tuna behavior.

Initial thoughts to apply all experiments in the same way to all ocean basins were therefore modified. It was agreed to develop a general list of activities to investigate that may have a higher or lower priority depending on local conditions. The group developed the following list of research areas to investigate which can be divided into what can be done BEFORE, DURING and AFTER a purse seine set to reduce bycatch levels.

- 1. Passive mitigation of bycatch avoid bycatch mortality (before arriving at a FAD)**
 - a. Instrumented buoys
 - i. use of echo sounder equipped GPS buoys to estimate catch and bycatch levels to avoid high bycatch areas
 - b. "Ecological FADs"
 - i. design of FADs to minimize entanglement
 - ii. design of FADs to make them biodegradable
 - c. Drifting FAD Design
 - i. testing FAD design as a way to influence sizes and species that aggregate

⁷ TAKING STOCK, Workshop on Bycatch Research in Tuna Purse Seine Fisheries, Brisbane, Australia, 26 June 2010.

2. Avoiding bycatch (after arriving at the fad but before setting the net)

- a. Pre-estimation of bycatch
 - i. Visual verification of sonar and echo sounder images using underwater cameras and video mounted ROV devices
 - ii. Improvement of echo sounder technology through collaboration between fishermen, acousticians and manufacturers

(note, both approaches require that the entire aggregation be captured and accurately enumerated to validate the experiment)

- b. Natural behavior of fish at FADs
 - i. Investigate diurnal movements of tuna, sharks and bycatch species
- c. Possibility of catching skipjack schools when they move away from a FAD (*after dawn*)
- d. Use of Double FADs
 - i. FAD with two vertically or horizontally separated sections to split the aggregation
- e. Attraction or repulsion of sharks away from FADs
 - i. Use of various stimuli (chum, chemical, visual, auditory) to separate sharks from the set

3. Release of undesirable catch from the net (after setting)

- a. Observation of the encircled aggregation within the net
- b. Behavioral manipulations
 - i. Attractions or repulsions of tuna and bycatch
- c. Modifying selectivity of the purse seine gear
 - i. Sorting grids, exit panels
 - ii. Mesh size

4. Release of undesirable catch from the vessel (during the brailing process)

- a. Testing condition and survival of released bycatch
 - i. Use of pop-up satellite archival tags (PATs) to determine post-release mortality of sharks
 - ii. Development and Distribution of “Best Practices” for handling bycatch onboard, primarily for oceanic sharks and whale sharks (*Rhincodon typus*)

The meeting characterized research activities as being specific to an ocean area/fishery or applicable to all regions. Individual researchers were assigned to specific areas of research based on expertise and interest for inter-sessional development.

The group endorsed Kurt Schaefer (IATTC) to be chief scientist on the EPO research cruise assisted by Dan Fuller (IATTC) with collaboration on shark issues by Diego Bernal (U Mass) and

other researchers to be determined. It was agreed to convene the group again after the conclusion of the EPO research cruise to examine the pros and cons of that research design and to design the WCPO research cruise(s). The structure and timetable for outreach Skippers Workshops was then developed for 2011.

4. Skippers Workshops

The Purse Seine Bycatch Project is based on the ISSF approach of bringing science and industry together to solve a common problem. The target attendance for these workshops are purse seine fishing captains, navigators, deck bosses and other highly experienced crewmen who have years of at sea experience in tropical purse seining on FADs. For some fleets, such as the Spanish Basque vessels it was relatively easy to gather a large number of skippers who were not at sea at a particular time as most of them live in a very small area of northern Spain. However, other fleets are very difficult to contact in large numbers as they have no common home base or unloading port.

Several “Skippers Workshops” have been organized to date that bring scientists and fishermen together to discuss bycatch issues and potential solutions. The format of the workshops follow the outline of proposed research areas outlined in Section 3 above and explore additional problems and solutions that the fishermen wish to discuss. The objective of these workshops is to solicit the opinion of fishermen on the viability and merit of proposed research while looking for other areas to investigate. Appendix I is a one page explanation of the general Workshop design and agenda that has been circulated widely. Skippers Workshops in support of the Project were held in the following areas in 2010-2011:

- MANTA (ECUADOR) 18th September 2010
- PANAMA CITY (PANAMA) 22nd September 2010
- ACCRA (GHANA) 10th November 2010
- SUKARRIETA (SPAIN) 13th-17th December 2010
- MAHÉ (SEYCHELLES)/PORT LOUIS (MAURITIUS) 10th Dec 2010 – 19th Feb 2011
- PAGO PAGO (AMERICAN SAMOA) 5th March 2011
- MAJURO (MARSHALL ISLANDS) 22nd June 2011
- POHNPEI (FEDERATED STATES OF MICRONESIA) 24th June 2011

ISSF has contracted AZTI Tecnalia (Spain) to schedule and coordinate these workshops in collaboration with persons with regional experience and expertise. Mr. Jefferson Murua of AZTI is present in all workshops to as to provide continuity and consistency between workshops. An example flyer for the most recent Skippers Workshop held in the Marshall Islands and the Federated States of Micronesia is attached as Appendix II. A questionnaire developed for Skippers Workshop participants to gain further insight into their experience is attached as Appendix III.

5. Research cruises: completed

5.1) Indian Ocean

Researchers in the Indian Ocean based from the Seychelles conducted a two week cruise in the western Indian Ocean onboard the *MV Dugong* that was co-funded by the ISSF and the the European-funded project; Mitigating ADverse Ecological impacts of open ocean fisheries

(MADE). The Dugong is not a purse seine vessel but was utilized out of necessity as purse seine vessels in this area have used spare quarters to house security personnel necessary to defend against piracy. The cruise was very successful, returning to Mahe, Seychelles despite this very real threat due to piracy in this region. The project was made possible by the full cooperation of French and Spanish captains who provided essential information and exclusive access to their drifting FADs for experiments.

The cruise investigated the natural behavior of fish around FADs, the use of echo sounder equipped GPS buoys, better methods to estimate of by-catch - in particular sharks, the use of simple and inexpensive underwater cameras to estimate numbers of sharks prior to setting and experiments to attract sharks away from FADs.

Acoustic, archival and PAT tags were deployed in yellowfin tuna, bigeye tuna, skipjack, rainbow runner (*Elegatis bipinnulata*), oceanic triggerfish (*Canthidermis maculatus*) and silky shark (*Carcharhinus falciformis*) to examine the behavior of these species while aggregated to drifting FADs.

Experiments to lure sharks away from FADs using chum obtained mixed results but with some promising outcomes suggesting that further research and experiments is warranted. A complete report of this cruise is in preparation.

5.2) Eastern Pacific Ocean

Kurt Schaefer and Dan Fuller (IATTC) concluded a research cruise in the EPO on late July 2011 aboard the Ecuadorian flag purse seiner *YOLANDA L*. The scientific protocols and outcome of this cruise is described in the presentation accompanying SC7 Working Paper **WCPFC-SC7-2011/EB-WP-13**.

7. Development of Best Practices for release of encircled animals

7.1) Releasing Whale sharks and manta rays from the net

An ecologically important, but numerically small category of bycatch that should be considered for avoidance or release from the net (after setting is complete) includes large aquatic animals such as whale sharks and manta rays that are known to aggregate tuna and other fish and therefore act like a slowly moving FAD. Prohibitions on the setting of tuna schools near whale sharks have been proposed to the WCPFC and are being implemented within zones by the PNA with support from FFA member countries. A critical issue here is that it is likely that the majority of sets that are made on whale sharks are completed and in the latter stages of net retrieval before the animal is first sighted. Therefore, it is necessary to develop a system of “best practices” for the release of whale sharks, large rays and other large marine organisms that are safe for the fishermen and promote the safe, non-injurious release of the animals. The same can be said for the release of small cetaceans that are sometimes encircled on FAD sets before dawn when they could have been visually detected and avoided.

The best source of knowledge and experience in dealing with whale sharks and manta rays will come from the fishermen who have dealt with this issue for many years. In the WCPO a whale shark associated set is a rare event meaning that an observer or scientist may never witness a set of this type. It is essential to engage the fishermen and make the best use of their experience and knowledge.

Information from the Skippers Workshops and in one-on-one dialogue with purse seine captains have proved very useful in gaining insight into this issue. There appears to be a wide range of opinions about the best way to release these animals and further discussion is needed. Generally speaking, the only time fishermen attempt to release a whale shark is when it becomes accessible in the sack when the catch is ready for brailing. Before this time the animal is usually not visible or too deep in the net to deal with effectively.

A common method of removal of small and medium sized whale sharks has been to secure the tail with a heavy hawser or sling and winch it tail-first out of the net. Due to the internal physiology of sharks, the extreme weights involved and fragility of the caudal peduncle, this method is clearly unsuitable and potentially injurious or fatal to the shark. The better option for the animal is to allow it to swim out of the sack head first. In this case the animal must be faced toward the bow where it can exit the net through or over an area of the corkline between the stern oortza (end of the net) and the brailing skiff or brailing boom.

It has been noted that release of whale sharks can be assisted by by:

- a) Slacking and pushing the corkline underwater using purpose built poles.
- b) Weighting down and sinking the corkline with purpose built weights that can be lowered onto the floats manually or by winch.
- c) Cutting the corkline selvedge lacings to allow an opening for the animal to exit.
- d) Using a special technique with a rope passing beneath the shark behind the pectoral fins that is connected to a towboat to depress the corkline and help “lift” the shark over the corks.

Further discussions revealed that options (a) and (b) may no longer be practical for many fleets as the large size of their nets and catches require the use of very large purse seine floats that would be very difficult to sink. Also, sinking the corkline or cutting it free of the net lacings (option c) increases the risk of the entire tuna catch escaping or dead catch spilling out through the gap.

Option (d) has been described to Project steering committee members but details on how well this technique works or how it is actually accomplished are not clear. Additional interviews of fishermen and observers who have been involved in whale shark associated sets are necessary. The only option currently known that would allow safe release of the whale shark without injury to shark or fishermen is to release the corks at the sack which would release the entire catch. However, this represents a significant waste of the resource and economic loss to the fishers. It may be possible to lower the corkline bunch into the water with the brailing boom winch to release the shark but retain most of the catch. Additional consultation with industry experts and fishermen is required.

7.2) Releasing Oceanic sharks from the deck

Another area of development for “best practices” relates to the safe handling and release of sharks from the sack or after they have been brailed from the sack to the vessel. Relatively small oceanic sharks can be netted from the sack and released prior to brailing which is preferred. However, confinement in the sack severely restricts oxygen flow to their gills. The sooner they are released the better their chance of survival.

The size of brails, total size of the set, sorting technique and fish well configuration will have a significant impact on the condition and likelihood of survival of sharks released from the vessel. Brail sizes have increased from 2-3 mt/brail to over 7 mt per brail in the WCPO fishery.

Sharks that end up at the bottom of a 7 ton brailer full of tuna after confinement in a low oxygen situation may have little chance of survival even if they are released promptly from the upper deck. Very large sets can require hours of brailing and bycatch in the sack for long periods will probably be dead by the time they are brailed out of the sack. The ISSF Project will examine the condition and post-release survival of sharks during the chartered cruises.

Some vessels brail the catch into a “hopper” that allows the full contents of one brailer to be deposited into a large metal bin (the hopper) from where the crew sorts out sharks, non-tuna bycatch and undersize or damaged tuna on the upper work deck. Animals sorted out at this stage and returned directly to the sea have a better chance for survival. However, this will depend on the length of time they have been confined in the sack, the water temperature, individual species tolerances to stress, their position in the brailer and many other factors.

Once the brail-load has been sorted it is released down to the wet deck where it flows directly to refrigerated brine wells for freezing. Once the catch enters the well, any chance of survival is gone. On many vessels, crewmen continue to sort out sharks and other bycatch on the wet deck. However, it can be very difficult to grab bycatch species out from the loading chutes due to the sheer volume of fish and speed with which it enters the fish holds. This problem is particularly acute when large brailers are used, they are released directly to the wet deck chutes or if a well close to the loading port is being filled.

If bycatch can be culled from the catch on the wet deck, it is then necessary to return the fish directly to the sea as soon as possible if there is to be any chance for survival. Some vessels are structured so that direct access to the sea is possible if hatches are made through the hull above waterline. Conveyor lines to allow direct release of fish are an ideal solution. However, other vessels are constructed in such a way that large fish holds on either side of vessel prevent direct access to the sea.

7.3 Best practices for the release of live sharks

The safe handling of live sharks is another area where best practice techniques need to be examined and developed. Most fishers note that with experience, small sharks are easily and safely handled and returned to the sea in good condition from the upper work deck. However, sharks that are sorted out on the lower wet deck usually die as most vessels do not have a way or motivation to quickly release them. Standardized techniques that assure safety of the crew and minimal damage to the shark need to be developed and implemented. Lifting techniques and the use of slings and mechanical grabbing devices have been proposed and will be tested on ISSF cruises.

The condition and survival of released sharks is being examined on ISSF Project research cruises. Currently, the main way in which survival is being determined is by the use of PAT tags. Various parameters, such as size of set, size of brail, time in the sack, position in the brail, handling method, etc. are being taken for tagged sharks. These tags record approximate geographic position, depth, temperature at very frequent intervals and eventually transmit this data to the researchers. Constant depth, as would occur if the tag was shed and floated to the surface or if the shark died and sank to the bottom or sinking to an extreme depth triggers the tag to release, float

to the surface and transmit. In this way, the tags are capable of recording the time and position of a post-tagging mortality event.

8. Research cruises: planned

Two research cruises in support of the ISSF Purse Seine Bycatch Project are being planned for early 2012. The first is planned for the Atlantic Ocean using a purse seine vessel operating on FADs in the Gulf of Guinea. It has been proposed that this cruise will conduct experiments on echo sounder buoys, the natural behavior of tuna and bycatch species at a FAD, the use of Double FADs, the behavior of fish in the net, the release of sharks from the net and attraction of sharks away from the FAD.

A research cruise is also proposed for early 2012 concentrating on drifting FADs in the western Pacific. Due to the size and fleet diversity of the WCPO, a second cruise concentrating on the western region of the fishery and possibly examining anchored FAD bycatch issues would be ideal. Plans for these cruises will be developed at the second meeting of the Project in late August 2012.

9. Future activities

The steering committee for the ISSF Purse Seine Bycatch Project will meet August 21-23, 2011 in San Diego, California, soon after the conclusion of SC7. The purpose of this meeting is to examine and review the completed research cruises in the Indian and Eastern Pacific Oceans. The experience gained during these cruises will be used to design complimentary research cruises in the Atlantic and western Pacific planned for early 2012. The government of Papua New Guinea has provided additional funds to the WCPFC in support of purse seine bycatch mitigation efforts that can be used to assist the implementation of these and related bycatch mitigation efforts in the western Pacific.

REFERENCES

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ISSF. 2010. ISSF meeting on mitigation of by-catches in the tuna purse seine floating object fisheries: Sukarrieta, Spain 24-27 November 2009. WCPFC Scientific Committee Sixth Regular Session. 10-19 August 2010. WCPFC-SC6/FT-WP-02.

Restrepo, V. 2010. International seafood sustainability foundation initiatives to develop and test bycatch mitigation options for tropical purse seine fisheries. WCPFC Scientific Committee Sixth Regular Session. 10-19 August 2010. WCPFC-SC6/FT-WP-04.

Appendix I. ISSF Skipper's Workshop handout

BACKGROUND

T

he **International Seafood Sustainability Foundation (ISSF)** is a global partnership among leaders in marine science, the tuna industry and WWF, the world's leading conservation organization. This diverse group of stakeholders shares a common vision to promote the long-term conservation and sustainable use of tuna stocks and the ecosystems upon which they depend.



GLOBAL BYCATCH MITIGATION RESEARCH

In accordance with its Strategic Plan, ISSF is coordinating a global research project to identify best practices, new technologies and advance techniques to mitigate bycatch (including catch of small tunas) in purse seine tuna fisheries. This research project is based on a scientific approach that will capitalize on the knowledge and ideas of scientists and vessel captains.

The research will employ a dedicated purse seine vessel and facilitate continuing education workshops for the vessel community. Cruises will begin in early 2011 and will be conducted in the Pacific Ocean, Indian Ocean and Atlantic Ocean, while workshops have already begun and will continue during the research process.

THE VESSEL

The Project Steering Committee, led by Coordinator Dr. Laurent Dagorn, has identified the most promising areas in need of research and will be responsible for scheduling at-sea projects.

The vessel will be used as a research platform to test ideas;
Dedicating a fully licensed vessel allows scientists to fish in ways that captains would not otherwise allow for fear of low catches, while providing equal income to the owner and crew of a typical fishing trip;
The research vessel will not add new fishing capacity to a region's existing purse seine capacity.

THE WORKSHOPS

Workshops to communicate with fishing captains and crews the bycatch problems and solutions in the purse seine fishery on FADs are being developed, building upon the workshops pioneered by Dr. Martin Hall in the eastern Pacific Ocean. The ISSF workshops are coordinated by Dr. Gala Moreno.

To date, workshops have been held in: San Diego, California; Sukarrieta, Spain; Manta and Posorja, Ecuador; Panama City, Panama. More workshops are planned in the near future and will integrate information discovered during at-sea research.

Captain's workshops help to identify potential techniques to be tested aboard the at-sea research vessel.

The findings of the research vessel will be shared during future workshops.

A member of the ISSF Project Steering team will participate in the discussion.

THE AGENDA

For each subject highlighted in the workshop there is a period of discussion.

What is bycatch, and why do we need to pay attention to it?

Bycatch in FAD fisheries, and their significance.

Main species groups involved.

What is being done to reduce bycatch?

What research is needed?

Management solutions.

Technological and operational solutions.

Utilization of bycatch.

Ideas being considered at the global level to mitigate bycatch.

What do the captains in attendance think of the different ideas?

Additional ideas?

The role of the captains in the search for solutions.

How can we improve fishing practices?

How is bycatch handled on the vessels today?

Experience of the captains using technology or techniques in their vessels

Appendix II. ISSF Skipper's Workshop flyer for WCPO workshop



5 June 2011

I am writing to extend a personal invitation for you and skippers in your community to attend an informal educational workshop that will both share knowledge about best practices to mitigate bycatch and solicit the collective expertise of fishers to find improved solutions at-sea.

As you may be aware, the International Seafood Sustainability Foundation (ISSF) is currently facilitating a globally coordinated bycatch reduction project. Scientists at-sea are steering the exploration of new ideas aboard active purse seine vessels. The initial emphasis is on ways to reduce the incidental mortality of oceanic sharks, marine turtles and juvenile tuna, particularly bigeye, that are inadvertently taken by tropical purse seine and FAD fisheries.

Meantime, other experts on land are sitting down with skippers to talk about these ideas, determine what works and think about how we can do better.

Later this month David Itano of the *University of Hawaii* and Jefferson Murua of *AZTI-Tecnalia* will conduct a series of meetings in the Pacific Islands region, beginning in Majuro on the 21st and 22nd of June and another series in Ponape on the 24th, 27th and/or 28th of June. You can access information about the type of material covered during these workshops by visiting our website and previewing the materials (<http://iss-foundation.org/science/projects/bycatch-reduction/education/>).

A typical workshop lasts about six hours and includes a lunch break. In the past a group of about a dozen people are in the room to share ideas in a very informal atmosphere. The meetings are normally conducted in English but translation can be provided for specific situations.

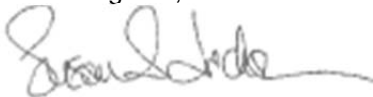
To register for a session, please contact:

David Itano at dgi@hawaii.edu and Jefferson Murua jmurua@azti.es

This workshop will also help to give you an inside look at the work being done on board the vessels ISSF charters for this work. We currently have scientists at-sea in the eastern Pacific Ocean and will launch separate cruises in the Atlantic and western and central Pacific later this year.

I have enclosed some informational materials to help provide an understanding of the content that will be covered during these workshops. I hope that you are able to attend.

Sincere Regards,



SUSAN JACKSON
President

Appendix III. ISSF Bycatch Questionnaire for Skipper's Workshops

ANONYMOUS QUESTIONNAIRE ISSF SMALL TUNA AND BY-CATCH WORKSHOP

Workshop date and location:

Ocean in which you currently work:

Specify if you have worked in other oceans and time period:

Job title:

Years working as a captain:

PLEASE MARK SELECTED OPTIONS AND WRITE ANY COMMENTS. The abbreviation **DFADS** (**drifting fish aggregation devices**) will be used hereafter to refer to man-made artificial structures deployed to attract tuna.

SECTION 1 - DFAD STRUCTURE

1) Capacity to attract non-target species:

Which type of object do you think attracts more small tuna?

- a) DFADs
- b) Natural objects (e.g. logs)
- c) Does not depend on the type of object
- d) Others, please specify

2) Which type of object attracts more non-target species (wahoo, dolphinfish, etc)?

- a) DFADs
- b) Natural objects (e.g. logs)
- c) Does not depend on the type of object
- d) Others, please specify

3) The quantity of small tuna aggregated around a DFAD depends on: (choose the two most important options)

- a) Time a DFADs has been drifting at sea
- b) The structure of the DFAD
- c) The trajectory followed by the DFAD
- d) The geographical area where the DFAD is
- e) Time of the year

4) Do you think that the depth of the submerged part of the DFAD (i.e. length of net hanging down) is critical to attract more tuna?

- a) The capacity to attract tuna is not related to the depth of the submerged structure
- b) Yes, it depends on depth. Please specify for which species and sizes

Comments:

5) What is the depth (in metres) reached by the hanging net in the DFADs that you use?

6) Have you noticed if the behaviour of tuna (e.g. more active, more movement between DFADs) is different in areas with many DFADs and those with fewer DFADs?

- a) Tuna behaviour is always the same

b) Tuna behaviour depends on the number of DFADs in an area
Comment:

SECTION 2 - ACOUSTICS ONBOARD

7) Before setting on a DFAD, do you check first which species are present?

- a) Always
- b) Only sometimes (specify when)
- c) I only check the quantity, not the species present

Comment:

8) ¿Which echo sounder and sonar best discriminate the species aggregating around a DFAD?:

Echo sounder:

- a) Simrad ES60
- b) Furuno
- c) Others/none of which I use

Sonar:

- a) Furuno Fsv84
- b) Simrad SP90
- c) Others (specify)

9) What are you able to distinguish using the echo sounder and sonar? (Please select more than one if appropriate)

- a) Non-target species
- b) Bigeye from the rest of tuna (skipjack and yellow fin)
- c) Skipjack from the rest of tuna
- d) Skipjack from non-target species
- e) Small tuna from big tuna
- f) I can't distinguish

Comment (please explain answer):

SECTION 3 - USE OF DFADs BY TUNA

10) Is there a spatial separation between the different fish species and sizes inside the net?

- a) There is a vertical separation between (specify):
- b) There is a horizontal separation between (specify):
- c) Depends on the species present
- d) At the beginning species are mixed, but after they separate
- e) There is no clear pattern or separation

Comment (How do you observe this?)

11) Do you think that tuna species (skipjack, yellow fin and bigeye) leave a DFAD all in one go at the same time or at different times?

- a) Tuna disappears all together suddenly
- b) They leave little by little
- c) I don't know
- d) Depends on the species present (specify)

Comment:

12) Do the different species of tuna leave a DFAD together or separately?

- a) Tuna disappear together
- b) They disappear by species
- c) They disappear by sizes

Comment:

13) Do you work with buoys fitted with a sounder?

- a) Yes
- b) No (Why?)

PLEASE FILL IN SECTION 4 **ONLY IF YOU HAVE WORKED WITH BUOYS WITH SOUNDERS**, OTHERWISE GO DIRECTLY TO SECTION 5

SECTION 4 - BUOYS WITH SOUNDER

14) Please select the brands of buoys with sounder that you are currently using:

- a) Zunibal
- b) Nautical
- c) Satlink
- d) Others (specify)

15) Why do you use these brands?

- a) Ship owner's decision
- b) I think it is the best brand
- c) Price
- d) Others (specify)

16) What percentage of the total amount of buoys you use have sounders?

- a) <25% have sounders
- b) 25-50% have sounders
- c) >50% have sounders

17) How much do you trust the tonnage estimation given by the buoys with sounder?
Give an answer from 1 to 10, with 1 being non reliable to 10 being completely reliable

18) Please fill in for each brand of buoy with sounder that you use:

Brand name:

- a) 0-4
- b) 5-6
- c) 7-8
- d) 9-10

Comments:

Brand name:

- a) 0-4
- b) 5-6
- c) 7-8
- d) 9-10

Comments:

19) When using buoys with sounders, how important are they when to decide where to go next?

- a) Not important
- b) Very little
- c) Very important
- d) It is just another tool

Comment:

20) When you check the sounder from a DFAD buoy, what do you use as a guide, the tonnage estimation or the image sent?

- a) The image (colours, shape, intensity)
- b) Estimated tonnage
- c) Both
- d) None

Comment:

21) Are you able to distinguish the type of fish present around a DFAD using the buoy sounder (specify brand)? Please select options for each brand

Brand:

- a) Non-target species
- b) Bigeye from the rest of tuna (skipjack and yellow fin)
- c) Skipjack from non-target species
- d) Small tuna from large tuna
- e) I can't distinguish, I only obtain tonnage estimations

Brand:

- a) Non-target species
- b) Bigeye from the rest of tuna (skipjack and yellow fin)
- c) Skipjack from non-target species
- d) Small tuna from large tuna
- e) I can't distinguish, I only obtain tonnage estimations

Comment:

SECTION 5 - TUNA SUSTAINABILITY MEASURES

22) Do you think small tuna captures with DFADs can affect the future of tuna fisheries?

- a) Yes
- b) No
- c) Possibly

23) Do you think that public campaigns (e.g. Greenpeace) showing sharks and turtles as by-catch have an impact on the opinion of the public, industry and politicians?

- a) Yes
- b) No
- c) Possibly

24) Do you think that restrictive measures (i.e. quota limitations, area closures) would be a better option for tuna sustainability than technological measures (i.e. sorting grids)?

- a) Yes
- b) No
- c) Possibly

25) At what time would it be more practical to take by-catch avoidance measures near DFADs during the fishing process?

- a) Before setting the net, avoiding capture
- b) When the fish is inside the net
- c) On deck

26) Do you think it is a good idea to wait for schools of skipjack to leave the DFAD (this behaviour is observed sometimes after dawn) to reduce by-catch as the schools of juvenile bigeye are expected to remain closely associated with the DFAD? ¿Why?

- a) Yes
- b) No

Comment:

SECTION 6 - SHARK AND TURTLE BY-CATCH

27) Do you know of any area where shark by-catch is high?

28) What percentage of netted sharks arrives on the deck alive?

- a) 0-25%
- b) 25-50%
- c) 50-75%
- d) 75-100%

29) Where are sharks sorted for release?

- a) On deck
- b) On conveyor belt

30) What is the length of time from shark arrival on deck until it is released?

- a) Under 15 minutes
- b) Between 15 and 30 minutes
- c) Over 1 hour
- d) Over 2 hours
- e) It depends (explain)

31) What are the main difficulties when having to release sharks? Mark more than one if appropriate

- a) Lack of adequate instruments/equipment
- b) Time, as the fishing operation is still taking place
- c) Danger of injury
- d) Others (specify)

32) Some captains use the technique of towing the DFAD out of the net (to keep nontarget species still aggregated around the DFAD). Do you think that this practice may help reduce by-catch? Why?

- a) Yes
- b) No

33) Which technique do you use to release whale sharks? Do you use any instrument to facilitate lowering the cork line, as done in some areas of the Pacific? Please describe which one.

34) ¿Do you use the technique of having a speedboat close to the net coming up to release tangled turtles?

35) Have you tried building DFADs with net alternatives (e.g. ropes)?
a) Yes (specify)
b) No

36) Do you retain sharks onboard?
a) Most of them
b) Some
c) Very few
d) None

IF YOU HAVE ANY OTHER COMMENT PLEASE USE THE SPACE BELOW.
THANK YOU VERY MUCH

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