INTER-AMERICAN TROPICAL TUNA COMMISSION
SCIENTIFIC ADVISORY COMMITTEE
2ND MEETING
La Jolla, California (USA)
9-12 May 2011

DOCUMENT SAC-02-13

RESEARCH ACTIVITIES ON FISH-AGGREGATING DEVICES (FADs)

1. CURRENT ACTIVITIES

The IATTC staff is currently involved in the following activities for collecting detailed data on fish-aggregating devices (FADs) used in the eastern Pacific Ocean. Further information and the forms are available on the IATTC website.:

1.1. Collection of data on FAD structure, components, and materials

Data collected by observers on the recently-developed *Flotsam Information Record* are being used to develop a detailed history of the technological and operational changes in the utilization of FADs in the EPO. For instance, some of the changes increase the lifespan of the FADs, allowing them,to stay afloat much longer and cover longer distances. Similar forms were recently adopted by the Western and Central Pacific Fisheries Commission (WCPFC) for its programs, and the IATTC and WCPFC programs have moved towards consistency on data collection.

1.2. Collection of data on operations on FADs

Records of deployments, sets on, and recoveries of FADs have been collected since 2006, allowing the first estimates to the total number of FADs in use, etc.

1.3. Detection systems

More detailed information on the detection systems available and in use in the seiners is also being collected.

1.4. Catches on FADs

Data on these catches, identified whenever possible to species and including size range data, are also being collected by observers. Attempts to improve the quality of the data by additional observer training, and materials to facilitate identification are also continuing.

1.5. Purse-seine description forms

Much more complete descriptions of purse-seine nets may be needed to understand how different characteristics affect catches and bycatches. A new *Purse Seine Description Form* has been developed for this purpose.

2. PROPOSALS FOR FUTURE WORK

2.1. Proposal 1: Marking FADs and monitoring their movements

Resolution C-09-01 and Recommendation C-10-01, adopted by the Commission at its 80th and 81st meetings, in June 2009 and September 2010, respectively, mandate “a pilot program for research into, and gathering information on, the FADs used to aggregate tunas in the EPO”, to include “provisions for the marking of FADs, maintaining a record of the numbers of FADs on board each vessel at the beginning and end of each fishing trip, and recording the date, time, and position of deployment of each FAD." The WCPFC has adopted a similar measure (Conservation and Management Measure 2008-01).

Pursuant to these decisions, the staff designed a pilot program to mark individual FADs in the EPO. With the information collected by such a program, the staff can conduct analyses of FAD distribution, densities, and abundance that will be important for understanding and managing tuna resources in the EPO. However, the program would be costly, and the Commission may wish to consider other possibilities,

In 2008, 120 vessels deployed FADs, and the average number of FADs deployed per trip was 23, therefore, 2,760 FADs would require a satellite buoy. Redeploying buoys when FADs are redeployed would reduce the number of buoys required, but the loss rate of approximately 14% estimated for 2008 would offsett that reduction, and it is estimated that the number of satellite buoys required to monitor every FAD deployed would be approximately 3,150.

The most efficient and economical option for gathering this information is to obtain it directly from fishing companies. FADs deployed by vessels are monitored by satellite, and the companies could provide the locations and trajectories of the FADs to the IATTC, with a time lag sufficient to eliminate concerns regarding confidentiality of the data.. However, such a system would require total cooperation by governments and the industry. This information has been requested from the member governments by the Director.

If the Commission wishes to pursue the approach set out in C-09-01 and C-10-01 of independently marking and attaching a satellite-linked buoys to each FAD deployed in the EPO, the following proposal outlines how such an program could be carried out.

2.1.1. Marking and recording of FADs

The forms used to record data on FADs (*Registro de Objetos Flotantes*, or floating-object record) will be redesigned so that IATTC and national program observers can record the quantity and identifiers of FADs that are: a) aboard the vessel when it leaves port; b) built at sea; c) deployed at sea; d) recovered at sea; and e) aboard when the vessel returns to port. Redesign of the form will be done in consultation with the IATTC Stock Assessment and Data Collection and Database programs, to ensure that all the data required will be recorded correctly. The observers will attach an alphanumeric visual tag to each FAD deployed to uniquely identify it. The visual tags will need to be small, and mounted horizontally and low on the FAD so as not to increase the detectability of the FAD by radar (fishermen go to great lengths to make their FADs detectable only to their own vessel, to avoid poaching by other vessels). However, this would mean that the tags could only be read reliably at close range; they would therefore be useful for monitoring the time, date, and location of each FAD deployment and recovery, but less useful for identifying FADs at a distance or during darkness, when many sets are made.

A technician will be hired to redesign the *Registro de Objetos Flotantes*, organize the manufacture of the tags and their distribution to IATTC and national program observers, write a manual describing the procedure for attaching tags, monitor incoming results, and help create an IATTC database. The technician will be selected from the IATTC observer corps, and will serve as the observer during the first trip of this program to test the procedures.

2.1.2. Satellite monitoring of FADs

To collect information on movements of the FADs and additional oceanographic information, such as sea surface temperature, observers will attach a satellite-linked buoy to each FAD deployed, retrieve it when the FAD is recovered, and in each case record the FAD's identification code and the date, time, and position. Receiving units at the IATTC headquarters in La Jolla and at an IATTC field office will monitor the daily locations of all FADs. If an observer cannot identify a FAD that is set on, the daily satellite locations will be cross-matched with the set locations and identifications in the IATTC and national program observer data bases.

Phase 1: First trial cruise. The technician will act as observer on the vessel and, in addition to his regular duties, will attach three satellite buoys to three deployed FADs to determine the feasibility of an observer carrying out this task during fishing operations. The data collected during this cruise will be used to determine if transmissions are reliable, the most appropriate transmission schedule for the buoys, and the best way to input the satellite information into the IATTC data base. This trip should coincide with the first visual tagging cruise mentioned above.

Phase 2. Second trial cruise. The observer will attach satellite buoys to as many as 30 FADs, in order to determine the best way to input and display large quantities of real-time data transmitted to the receiving stations on land, and to obtain estimates of loss rate, average deployment duration, and redeployment rate.

Phase 3. Satellite monitoring of all FADs. Based on information from Phase 2 of the study, a program will be initiated to monitor all FADs deployed in the EPO by Class-6 vessels. All vessels would be required to allow observers to attach visual tags and satellite buoys to any FADs deployed, and retrieve the buoys when the FAD is recovered. The technician will need to distribute the buoys to fishing ports, as required, and set up facilities to safely store the large number of buoys required.

Smaller vessels that do not carry observers could not be sampled in this manner. To do so would require that the observer program be expanded to smaller vessels, or that the governments make tagging and reporting of FADs by the fishermen themselves mandatory.

2.2. PROPOSAL 2: Monitoring the abundance, inter- and intra-specific relationships, and spatial and temporal distributions of tunas and key bycatch species within FAD communities

Objective: Develop methods for potentially reducing bycatches and selecting tunas prior to making a set based on an understanding of the behavior, temporal-spatial distribution, and ecological relationships of different tuna species and key bycatch species as communities associated with FADs. A series of FADs will be deployed at sea and monitored over a period of three months, using sonar, surveys by remotely operated vehicles (ROVs) and divers, and environmental sampling, and simultaneous tracking of tunas and bycatch species fitted with sonic tags. This study will help us to understand the movements of different species of tunas and bycatch species at FADs in response to changes in the local physical and biological environment.

Understanding changes in the abundance and intra- and inter-specific interactions of these organisms can also lead to the development of pre-set fishing strategies that both minimize bycatch and allow species-specific selection of tuna catch. For example, understanding movements of bigeye and skipjack tunas, sharks, and turtles within FAD communities may lead to the development of fishing strategies for catching skipjack tuna while excluding catches of bigeye tuna, sharks, and turtles. This study is designed to explore the following questions.

1. Which species recruited first to FADs? Is there a temporal separation from the moment of deployment in the relative abundance of bigeye and the other species? Are the presence and abundance of animals of higher trophic levels at FADs dependent on, or related to, the presence and abundance of biomass of lower trophic levels?
2. Is recruitment episodic or continuous? Do small-scale convergences/divergences contribute significantly to the diversity and abundance of fauna associated with FADs, or do fauna accumulate by random encounters? If small-scale physical forcing does contribute to FAD fauna, does this contribution vary by trophic level?
3. Do movements of different tuna species and bycatch species differ within and around mature FAD communities over the course of a day? For example, do diel changes in abundance differ between tunas and bycatch species or between tuna species? Is there a predictable vertical stratification of tuna species and bycatch species within the FAD community?
4. Are fluctuations in biomass within mature FAD communities on longer time scales episodic or gradual? Do oceanographic features such as fronts, which are naturally-occurring regions of high biomass, contribute significantly to the abundance of small fishes, sharks, turtles, mahi-mahi, and

tunas in FAD communities, or does FAD community fauna accumulate largely by random encounters? Are there differences in biomass fluctuations over longer time scales between target species and bycatch species?

5. Are the presence and abundance of different species of tunas, sharks, turtles, and mahi-mahi within mature FAD communities related to the presence and abundance of smaller fishes such as triggerfish?

6. Can the biomass and movements of tunas and bycatch species within and around mature FAD communities be identified and monitored using acoustic data? Are the acoustic signals of various tunas and bycatch species sufficiently different to allow assessments of bycatch risk within a particular FAD community from shipboard data?

Description: A chartered fishing vessel or research ship will place 'smart' FADs at sea for a period of three months. The FADs will be equipped with GPS, temperature sensors, fluorometers, current meters, zooplankton samplers, fouling plates, hydrophones, and video cameras. In conjunction with the vessel's sonar, these sensors will be used to assess changes in the physical and biological environment at the FADs over time. The biomass of tunas and bycatch species will be determined from vessel sonar and video camera data. Hydrophones will be used to measure the 'noise' generated by biological activity at FADs. Sampling from the vessel with multi-sensor instrument packages will be conducted to calibrate physical and biological data collected by the sensors attached to the FADs.

Individual skipjack and bigeye tunas, sharks, mahi-mahi, and other bycatch species will be sonically tracked. Drifting arrays of acoustic receivers will also be deployed around FADs to detect the presence of tagged individuals at the FAD. Sea turtles will be tracked with radio-tracking equipment. Active tracking of bigeye and skipjack tunas, as well as sharks, turtles, and mahi-mahi captured in association with the FAD, will be conducted for periods of 48 hours. Time-depth profiles of tuna and bycatch species will be used in conjunction with sonar and video-camera data to evaluate intra- and inter-specific interactions and acoustic signatures of species and aggregations within the FAD community.

Periodic surveys by the vessel in the general area of the FADs, using the vessel's sonar and an instrument package equipped with a CTD and fluorometer (perhaps also an ADCP and a sampler for zooplankton), would provide a description of the overall physical and biological environment around the FADs. Divers would conduct periodic censuses of fishes (for abundance and diversity) to compare with the sonar data, retrieve fouling plates, and maintain equipment. Multiple FADs can be monitored with sonic receivers for the presence or absence of the various acoustically-tagged species to study the inter- and intra-specific relationships and behavior of the associated fauna, particularly in regards to movements between nearby FADs.

2.3. PROPOSAL 3: Coordination meeting with scientists from the WCPFC – SPC to improve and harmonize databases with regards to FAD and bycatch information

The International Seafood Sustainability Foundation (ISSF) has offered to fund this meeting. The objectives of the meeting would be to analyze the IATTC and WCPFC-SPC databases, identify gaps and differences, and whenever possible propose solutions to make both databases more accurate and consistent. The components of the proposal include:

1. Comparison of observer training systems, materials, manuals, debriefing process;
2. Comparison of bycatch data collection forms (gear, daily activities, bycatches, units, *etc*.), with emphasis on FAD construction, characteristics, evolution of their use, *etc*.;
3. Quality control of data, database management;
4. Joint examination of the data for one or more bycatch taxa of interest, to identify factors leading to higher bycatches;
5. Propose improvements moving towards a unified data collection system.