SCIENTIFIC COMMITTEE
THIRD REGULAR SESSION

13-24 August 2007
Honolulu, United States of America

IATTC Research on Reducing Shark Bycatch in the Tuna Purse-Seine Fishery in the Eastern Tropical Pacific Ocean

WCPFC-SC3-EB SWG/IP-3

Michael D. Scott [1]

[1] Inter-American Tropical Tuna Commission, La Jolla, USA.

IATTC Research on Reducing Shark Bycatch in the Tuna Purse-Seine Fishery in the Eastern Tropical Pacific Ocean

Abstract

There is worldwide concern about the effect of fishery bycatch on shark populations. In the ETP, there is particular concern about the high bycatch of sharks in tuna purse-seine nets during sets on FADs. The IATTC has proposed a number of studies aimed at reducing bycatches, and the NMFS has provided funding for a preliminary study of one of these methods. This paper describes a research plan to reduce shark bycatch during FAD sets. We will attempt to study the usefullness of bait stations in attracting sharks away from FADs prior to a set and thus avoiding encirclement by the purse seine. The key questions for this study are 1) whether the bait station is more attractive to the sharks than a FAD, 2) whether the sharks can be attracted without the tunas being attracted as well, and 3) whether the use of bait stations is practical and efficient within the constraints of a purse-seine fishing operation. The cooperation of an Ecuador-based purse seiner to conduct this preliminary study has been offered, and the field work is scheduled to begin in mid-September 2007.

Introduction

During purse-seine sets on tunas associated with floating objects in the eastern Pacific Ocean, high amounts of bycatch are taken as well. Of particular concern is the effect of these bycatches on relatively slow-reproducing species such as sharks, billfish, and sea turtles. There is much concern about the viability of shark populations worldwide; in the eastern Pacific Ocean, silky sharks are particularly associated with purse-seine sets (Figure 1). In 2003-2005, 40% of the sets on floating objects resulted in shark bycatch. Currently, sets on floating objects are mainly made on fish aggregating devices (FADs).

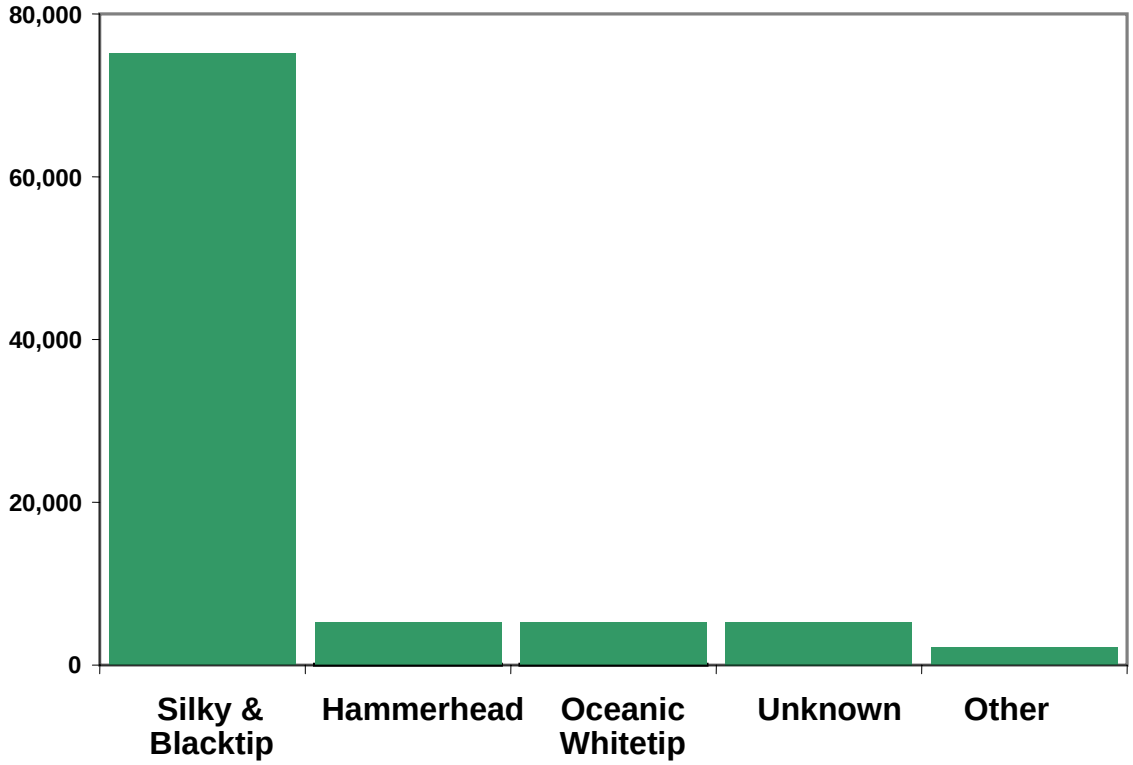

Figure 1. Numbers of sharks caught in log sets during 2000-2004.

One approach to reducing bycatch mortality of sharks is to determine whether the use of a bait attractant can draw sharks away from a FAD prior to a set. This proposal describes an exploratory operational study to determine the logistics of deploying bait station prior to a log set and using side-scan sonar to detect movements of sharks to the station. If this approach appears feasible, then a much wider study to statistically compare experimental and control sets can be conducted. Further studies using acoustic telemetry would be needed to determine how the attractants affect the movements of sharks, what attractants are the most effective, or whether shark repellants could be used to reduce bycatches.

Proposed Research

The Bycatch workshop held in La Jolla in October 2006 recommended that the initial phase of this study demonstrate that a towed bait station can draw sharks, but not tunas, away from a FAD. While it is well known that sharks can be attracted with bait, the key questions for this study are 1) whether the bait station is more attractive to the sharks than a FAD, 2) whether the sharks can be attracted without the tunas being attracted as well, and 3) whether the use of bait stations is practical and efficient within the constraints of a purse-seine fishing operation. Because funding for this exploratory study is not sufficient to charter a vessel, it is critical to convince a boat owner to volunteer the vessel and encourage the captain and crew to cooperate in the experiment. As a consequence, the experiment will have to be designed so as to impinge as little as possible on normal fishing operations and to not negatively affect tuna catches.

Study Area

The percentage of sets on FADs with shark catches are particularly high to the west of 110°W between 10°N and 10°S with less catch along the equator (Figures 2-3). The proposed study area extends from 2-10°N latitude and from 100-142°W longitude, an area where high percentages of sharks were caught in 2000-2004.

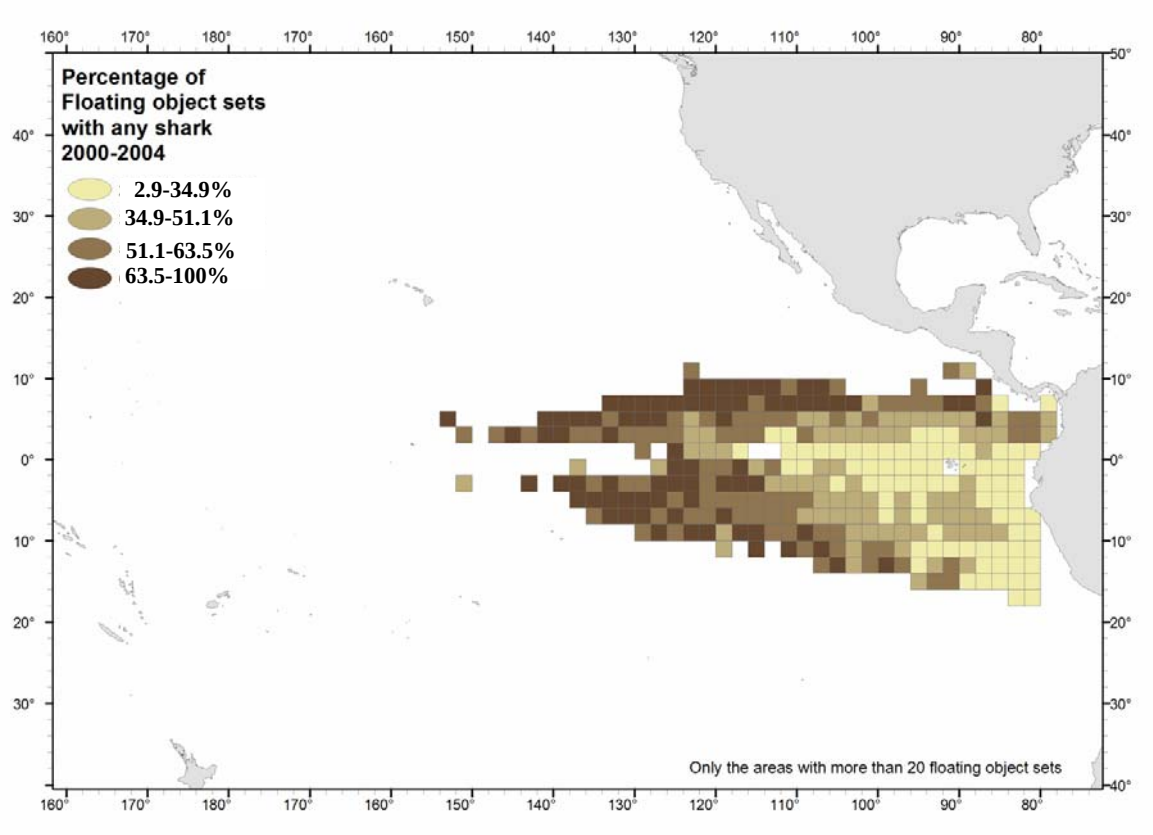

Figure 2. Percentage of floating object sets with shark catches, 2000-2004. Most floating object sets were made on FADs.

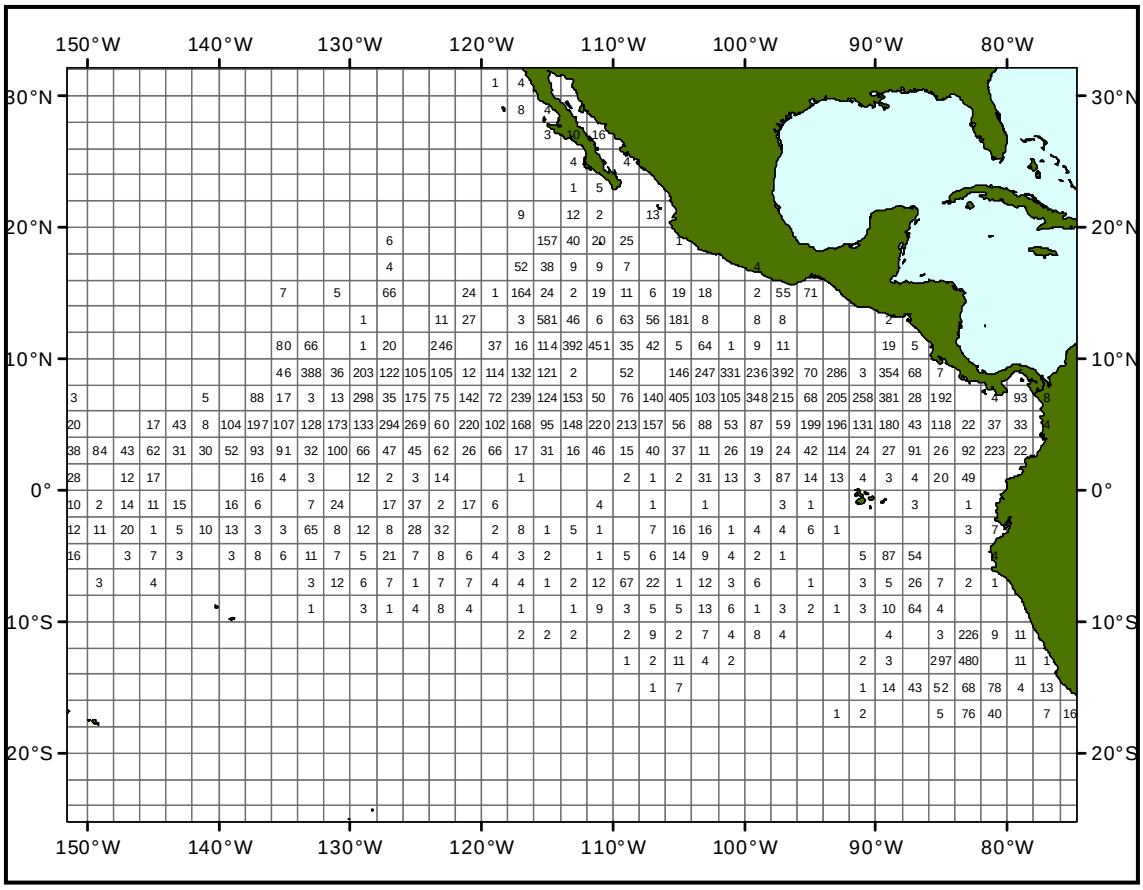

Figure 3. Number of sharks (all species) caught in each 2° quadrat during 2005.

There is a seasonal component to the FAD fishery. During May-November, purse seiners deploy their FADs north of the equator (Figure 4), but the fishery shifts to the south in December (Figure 5). To maximize the opportunities to encounter FADs with sharks, the at-sea study is planned to begin mid-September 2007 while the FAD fishery is operating north of the equator.

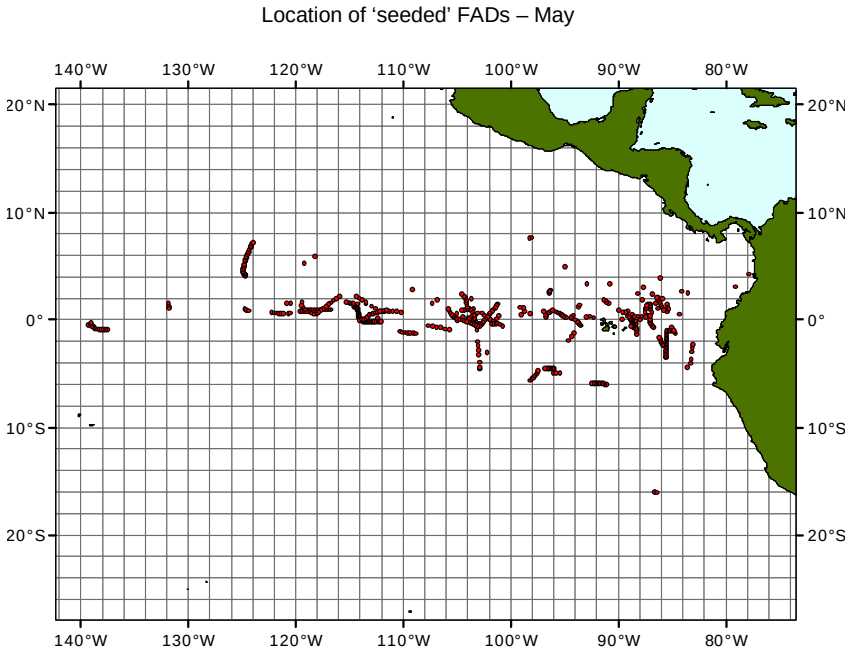

Figure 4. Locations of FADs seeded by IATTC-observed purse seiners in the eastern tropical Pacific Ocean during May in 2005 and 2006 (data as of 11 September 2006).

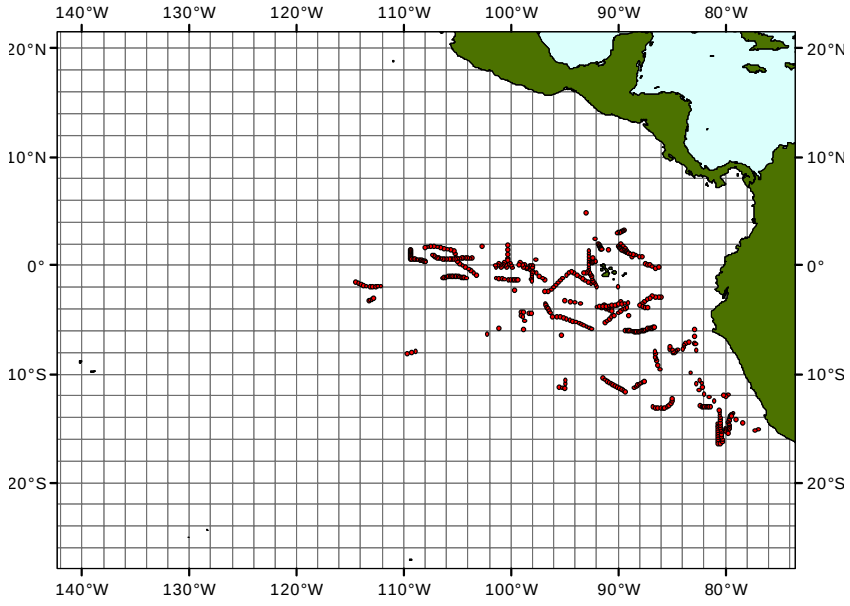

Figure 5. Locations of FADs seeded by IATTC-observed purse seiners in the eastern tropical Pacific Ocean during December in 2005 (data as of 11 September 2006).

Purse Seiner Requirements

The study requires the willing cooperation of a tuna purse seiner that will fish on FADs in the area required. The seiner must be equipped with a side-scan sonar or equivalent that can detect the presence of sharks and tunas around the bait station, and preferably distinguish between individuals of each species. The seiner also must have a speedboat capable of towing the bait station that can be launched one hour prior to a set and remain in the water until after encirclement. This would require a willingness to have crew work extra time to launch and drive speedboat, or to allow the observer to drive a speedboat. Preferably there should be additional bunk space to accommodate a second IATTC scientist who will assist in recording data and interpreting the sonar, along with a knowledgeable crewmember on the bridge experienced in the operation and interpretation of the sonar. It should be emphasized that seiner will not be expected to forego catching tuna to accommodate the experiment. A purse seiner based in Manta, Ecuador has been offered to participate in this study.

Personnel Requirements

The IATTC Manta field office will purchase supplies and build the bait station. An experienced scientific technician will be hired to build the bait station, purchase field supplies, and accompany the seiner as the observer. The observer must be experienced in small-boat handling and able to drive the speedboat, or accompany a driver from the crew, during the attractant study. The observer will also fulfill his normal IATTC data collection duties. If bunkspace is available, a second IATTC scientist will also participate in the study by recording data, monitoring the sonar, and photographing and sampling from any sharks taken onboard.

Bait Station Design

The bait station will be buoyed and consist of three types of attractants – a chum bucket, a sound attractant, and a fish-oil surface attractant. The chum bucket will be a buoyed 3.5-gallon bucket perforated with 1”-holes and containing ground offal, fish oil, and/or ground-up non-target fish caught during previous sets. The bucket will be towed 2 m behind the boat using nylon-covered cable with metal clip hooks on both ends; one end is clipped through holes in the lid and side of the bucket, the other clips to a line secured to the speedboat (Fig. 6-7). The lid will be secured on the other side with cable ties. The sound attractant will be produced with a transducer emitting sounds designed to attract sharks (Figure 8; S2 Scientific Electronic Lures: http://www.makomagnet.com/fs-product.htm). The transducer will be mounted in a plastic milk crate and secured alongside the speedboat with the transducer about 0.3 m below the surface. The fish-oil attractant will also be released from one or more dispensers attached to the speedboat’s stern to create a surface slick behind the boat.

Figure 6. Chum bucket being towed behind boat. The bucket we will use will have a greater number of holes (about 40) and larger holes (1") than the one shown in this figure to increase the attraction power of the bait station (www.newenglandsharks.com/chumming.htm).

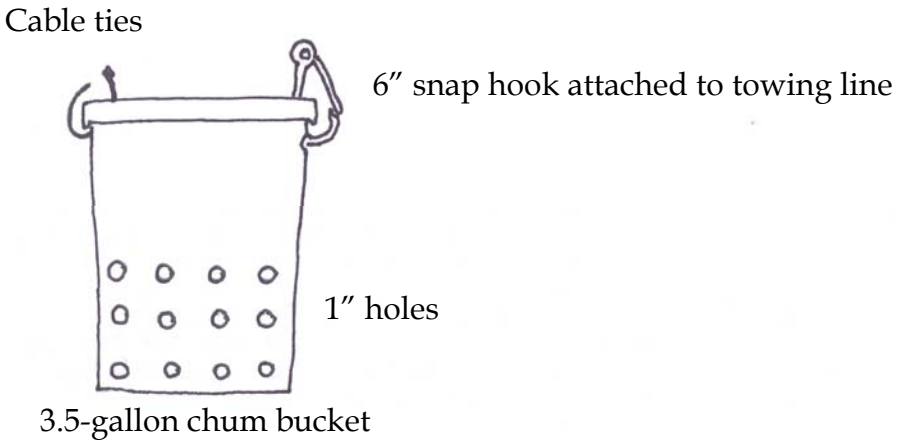

Figure 7. Chum bucket. About 2 gallons (10 lbs) of chum are place in the bucket and the lid is secured shut with towing hook and cable ties.

Figure 8. Transducer and power cable of Mako Magnet sound attractant. The transducer will be placed inside a plastic storage crate, cable-tied to the bottom of the crate, with the cable side up. The storage crate will be secured to the side of the boat; the cable will be connected to either the boat's battery or an auxiliary battery.

Initially, we will utilize all three components to maximize the chances of attracting as many sharks away from the tuna as possible. If, however, the tuna are attracted as well, then one or more components will be removed to strike a balance between attracting sharks without attracting tunas (Table 1). If the bait station does not attract sharks, within the one hour prior to the set, an untended bait station will be tethered to the seiner or left to drift near the FAD for longer periods. Larger perforated chum buckets (a metal 55-gal drum or a plastic garbage can) will be used for these longer deployments. Different trolling procedures can be attempted as well (Alternative 6, Table 1).

Table 1. Proposed testing alternatives for attracting sharks, but not tunas.

Initial test: 1) Chum bucket, sound and fish-oil attractants.
If tunas are attracted to the initial test using all three components: 2) Sound and fish-oil attractants only. 3) Sound only. 4) Alternatives 2) or 3), with the delayed addition of a chum bucket to keep sharks in the vicinity after they have been separated from the tuna.
If sharks are not attracted to the initial test: 5) Deploy a tethered or drifting bait station overnight (2-10 hours prior to set). 6) Troll cross-current such that the attractant plume drifts past the FAD in a broad swath. 7) Suspend the chum bucket deeper (10 m) in the water column.

Sample Size Expected

During 2005-2006, the average number of sets on FADs (or other floating objects) per trip by vessels that seeded FADs at sea was 22.4 (minimum 3, maximum 52; n=84 trips). Of the 879 sets made within the proposed study area (2°-10°N, 100°-142°W, which includes a high-density area for shark bycatch as shown in Figure 2), 35% (309 sets) had shark bycatch. Thus, on average, about 8 trials with sharks might be expected; however, Figure 2 shows that many 2° quadrats within this area have much higher percentages of sets with shark bycatch (64%+). For those sets that did have shark bycatch, an average of 11 sharks per set was caught.

At-Sea Procedures

Preparation: Place 2 gallons (10 lbs) of frozen chum in a perforated 3.5-gal bucket, and store inside a 5-gal bucket secured in the speedboat (if the frozen chum does not attract sharks, the chum can be thawed for ½ -1h or longer beforehand). Secure the towing line through the lid and the bucket with a carabiner, and secure the other side of the lid with plastic cable-ties. Attach the other end of towing line to the speedboat. Mount the Mako Magnet into the plastic storage crate using cable ties and place in the speedboat, and secure with bungee cords. Fill the drip bag with fish oil (with valve closed) and store in the secured 5-gal bucket. The components of the bait station to be deployed will be recorded. The handheld marine radio (156 MHz) will be tested.

Experiment: The speedboat will be launched about 1 hour prior to the set (74% of FAD sets occur between 0500-0800h, so the launching may have to be done in the dark). Preferably the observer will accompany a driver from the crew, while a second biologist will monitor the side-scan sonar, maintain radio contact with the speedboat, and record data. The time of launch will be recorded. The safety light will be mounted and turned on if the speedboat is launched prior to dawn. The observer will maintain contact with the bridge with the handheld marine-band radio. Due to safety considerations, however, the speedboat will be launched only in Beaufort-3 conditions or less.

The speedboat will motor about 200 m downcurrent from the FAD. The chum bucket and drip bag (with the valve now fully open) will be placed overboard on the windward side of the boat, the crate containing the Mako Magnet will be tied securely along the starboard side with the transducer about 0.3m below the water, and the transducer will be connected to the boat's battery (an auxiliary battery will be used if ready access to the boat's battery is not possible) (Figure 9). The speedboat will drift for about 5 min to determine the direction of the current as determined by the direction of the slick from the chum and fish oil. The speedboat will then troll the bait station at idle speed upcurrent (through the slick already created), past the FAD, and toward the seiner (Figure 10; see http://www.newenglandsharks.com/chumming.htm for description of chumming for sharks).

Once the slick is created, it is important that it not be interrupted so that the sharks can follow it. Once the bait station is within high-resolution detection range of the seiner's sonar (about 800m; Brehmer *et al*. 2006), the technician aboard the seiner will monitor the side-scan sonar for the presence of sharks or tunas around the bait station. He will record presence or absence of sharks and tuna every ten minutes around the bait station

and also plot the relative positions of the bait station, the FAD, and any aggregations of tunas, sharks, or other fish observable. Because the chum bucket will be near the surface, the speedboat crew will report any sharks or other marine life observed once it is light enough to do so.

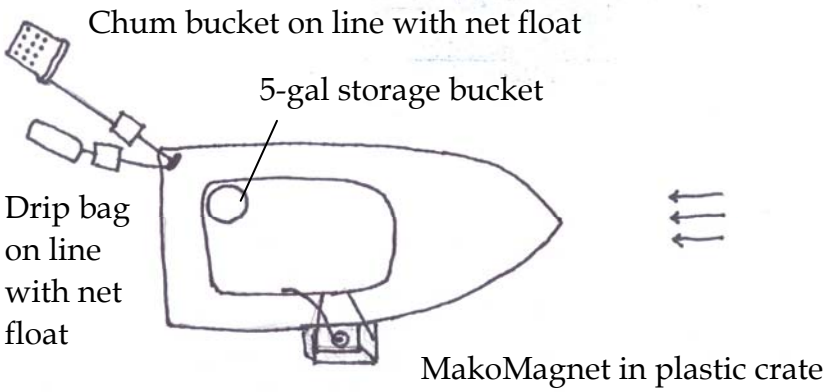

Figure 9. Speedboat with bait station components: 3.5-gallon chum bucket, drip bag for fish oil, Mako Magnet sound attractant. Chum bucket and drip bag are placed in 5-gallon storage bucket when not deployed.

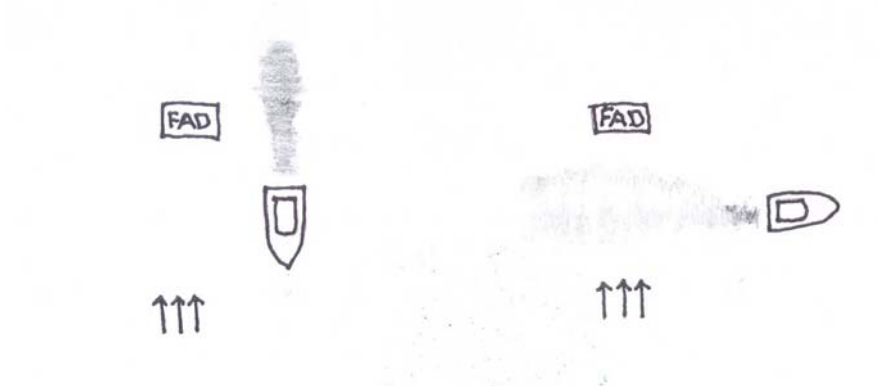

Figure 10. Normal trolling direction (left) and Alternative-6 trolling direction (right).

Just prior to the set, the seiner will monitor the side-scan sonar again for the presence of sharks and tunas. If the bulk of the tuna are now associated with the speedboat, the set will be made around the speedboat to determine how much tuna and how many sharks

were attracted to the bait station. Otherwise the set will be made around the tuna, taking care not to encircle the speedboat. The speedboat will continue trolling away from the set. The time of the set will be recorded on the experimental data sheet. The biologist on the bridge will record all normal data required on IATTC forms as well.

After encirclement has been completed, the time will be recorded on the experimental data sheet. The speedboat crew will recover the chum bucket, the drip bag (valve now closed), and the Mako Magnet. Notes on whether sharks or tunas are observed will be recorded. If the helicopter will be flying, the aerial observer will be asked to report any marine life associated with the bait station. The chum bucket will be emptied to continue keeping the sharks away from the net, and the speedboat will be brought back onboard.

Back on board, the observer will estimate how much chum and fish oil were used to better plan for future trials. Gear will be properly stowed. Normal IATTC data will continue to be recorded.

Sampling: Photographs, measurements, and tissue samples will be taken for all sharks caught and brought on board (live sharks will be rapidly returned to the water). Other non-target bycatch will be collected, cut up, and then ground-up with a food grinder to create more chum.

Data: After each set, the written data will be entered into the computer along with any digital photographs taken with the camera. Comments and suggestions from the fishing captain will be solicited during the course of the experiment regarding the practicality of incorporating the shark attractant operation into normal fishing practices. Field notes by the scientific party will be entered, along with any relevant comments from the captain and crew. An results of each trial will be evaluated in light of the main questions being asked: 1) whether the bait station is more attractive to the sharks than a FAD, 2) whether the sharks can be attracted without the tunas being attracted as well, and 3) whether the use of bait stations is practical and efficient within the constraints of a purse-seine fishing operation. Weekly reports to the La Jolla IATTC headquarters will be made to review the data and to discuss experimental changes.

Alternate experiment: When the sea state is rougher than Beaufort 3, the Alternative-5 experiment can be conducted instead (Table 1). A 32-gal perforated plastic container (or a perforated 55-gal metal drum) will be lowered 2-8 hours prior to the set about 200 m from the FAD. The bait station will contain enough frozen chum (4-20 gallons, assuming a consumption rate of 2 gallons per hour, the rate used during shark-fishing tournaments) to last until encirclement is complete. The bait station will be attached to net floats, a flag, and a floated line long enough to deploy and recover the bait station from the seiner (Figure 11). Experimentation may be required to determine where to deploy the bait station because of the difficulty in predicting the relative drifts of the FAD and the bait station. The seiner's side-scan sonar will be used to monitor the presence of sharks and tunas around the station prior to the set. If the bait station is deployed overnight, then the observer(s) will monitor the side-scan sonar and record data every two hours if the bait station is within range. If it is deployed within 2 hours of the set, monitoring will be

continuous and data will be recorded every ten minutes. The set and post-set protocols described above will then be followed.

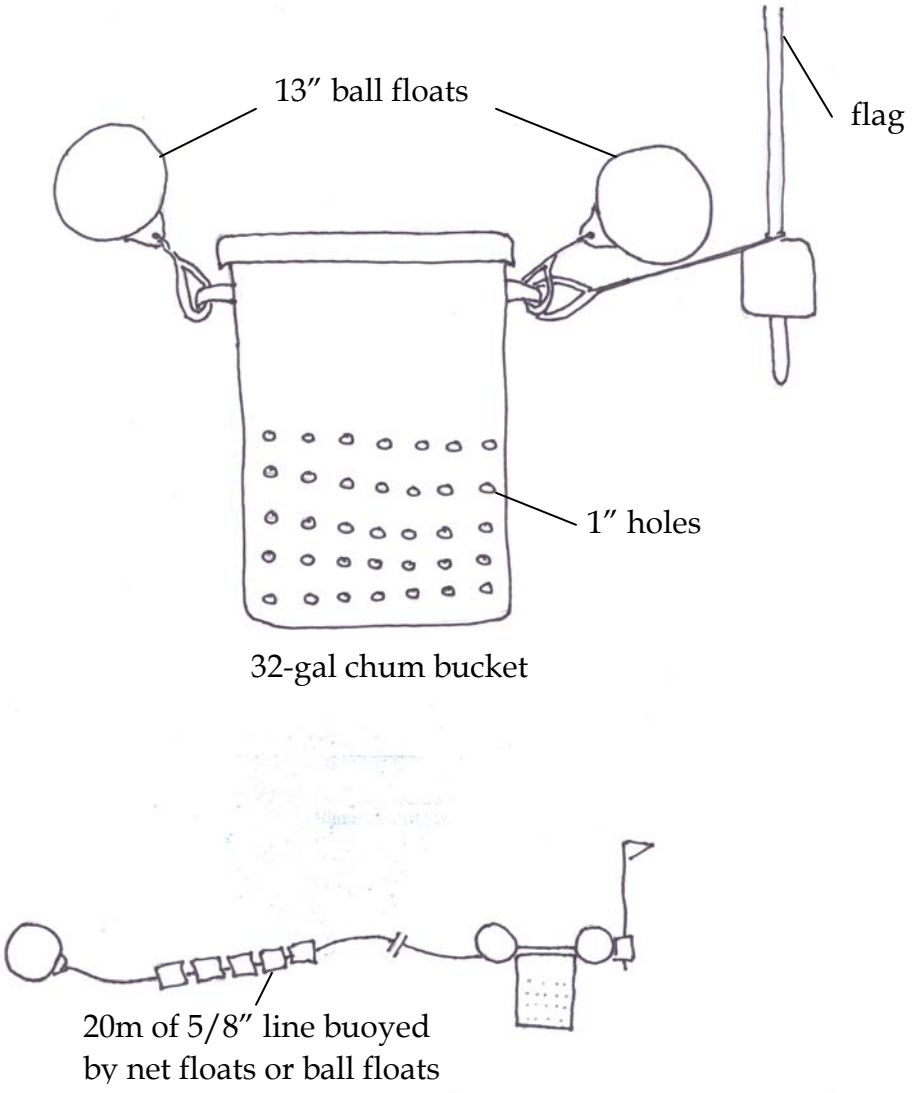

Figure 11. Drifting chum bucket (Alternative 5). The buoyed line allows the bucket to be lowered over the side of the seiner and retrieved. A longer line would allow the bait station to be tethered to the seiner if desired.

Analysis
The IATTC observer will collect normal data on the catch of tunas and the bycatch of sharks and other species. For each alternative tested (Table 1), the following comparisons will be made:

1) Number and percentage of trials that attracted sharks, but not tuna
2) Number and percentage of trials that attracted both sharks and tuna
3) Number and percentage of trials that attracted only tuna
4) Number and percentage of trials that attracted neither sharks nor tuna

Those alternatives that show high values for Comparison 1) and low values for Comparisons 2-4) will be considered promising methods for reducing the bycatch of sharks and appropriate candidates for continued research.

Reference

Brehmer, P., T. Lafont, S. Georgakarakos, E. Josse, F. Gerlotto, and C. Collet. 2006. Omnidirectional multibeam sonar monitoring: Applications in fisheries science. Fish and Fisheries 7:165-179.

Scott, M.D., W.H. Bayliff, C.E. Lennert-Cody, and K.M. Schaefer. 1999. Proceedings of the International Workshop on the Ecology and Fisheries for Tunas Associated With Floating Objects, February 11-13, 1992. IATTC Special Report 11. 480 p.