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WORKING GROUP ON BYCATCH

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RESEARCH ON REDUCING SHARK BYCATCH IN THE TUNA PURSE-SEINE FISHERY IN THE EASTERN TROPICAL PACIFIC OCEAN

1. INTRODUCTION

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

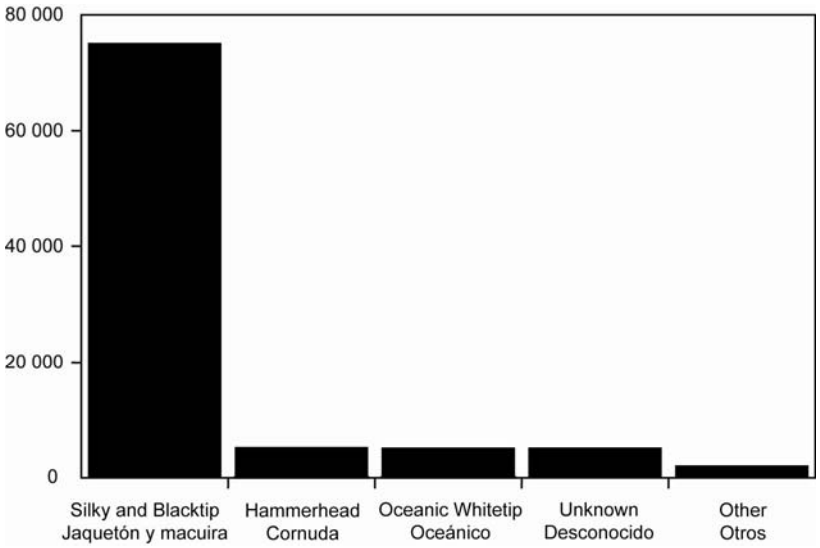

FIGURE 1. Numbers of sharks caught in floating-object sets during 2000-2004.

With regard to sharks, Resolution C-04-05 on bycatch requires the Director to "a. Develop techniques and/or equipment to facilitate their release from the deck or from the net; b. Seek the necessary funds to carry out experiments to determine the survival rates of released billfish, sharks and rays; and c. Define areas and periods in which any of these species are most likely to be caught."

The US National Marine Fisheries Service (NMFS) provided funding to the IATTC for a preliminary study on objective a), and the IATTC has been conducting ongoing studies on objective c). In an attempt to develop techniques that would reduce the capture of sharks, and thus their bycatch mortality, the staff will determine whether sharks can be attracted away from a FAD prior to a set. This exploratory study will determine the logistics of deploying a "bait station" (a device using chum, acoustic, and olfactory attractants) prior to a set, and use side-scan sonar to detect movements of sharks to the station. If this approach appears feasible, then a 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 repellents could be used to reduce bycatches.

2. RESEARCH QUESTIONS

A Bycatch workshop conducted by the NMFS in La Jolla in October 2006 (Kondell, in press[1]) reviewed this proposal and 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 the funding for this exploratory study is not sufficient to charter a vessel, carrying out the experiment would require the voluntary cooperation of the owner, captain and crew of a vessel; therefore, 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.

3. STUDY AREA

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

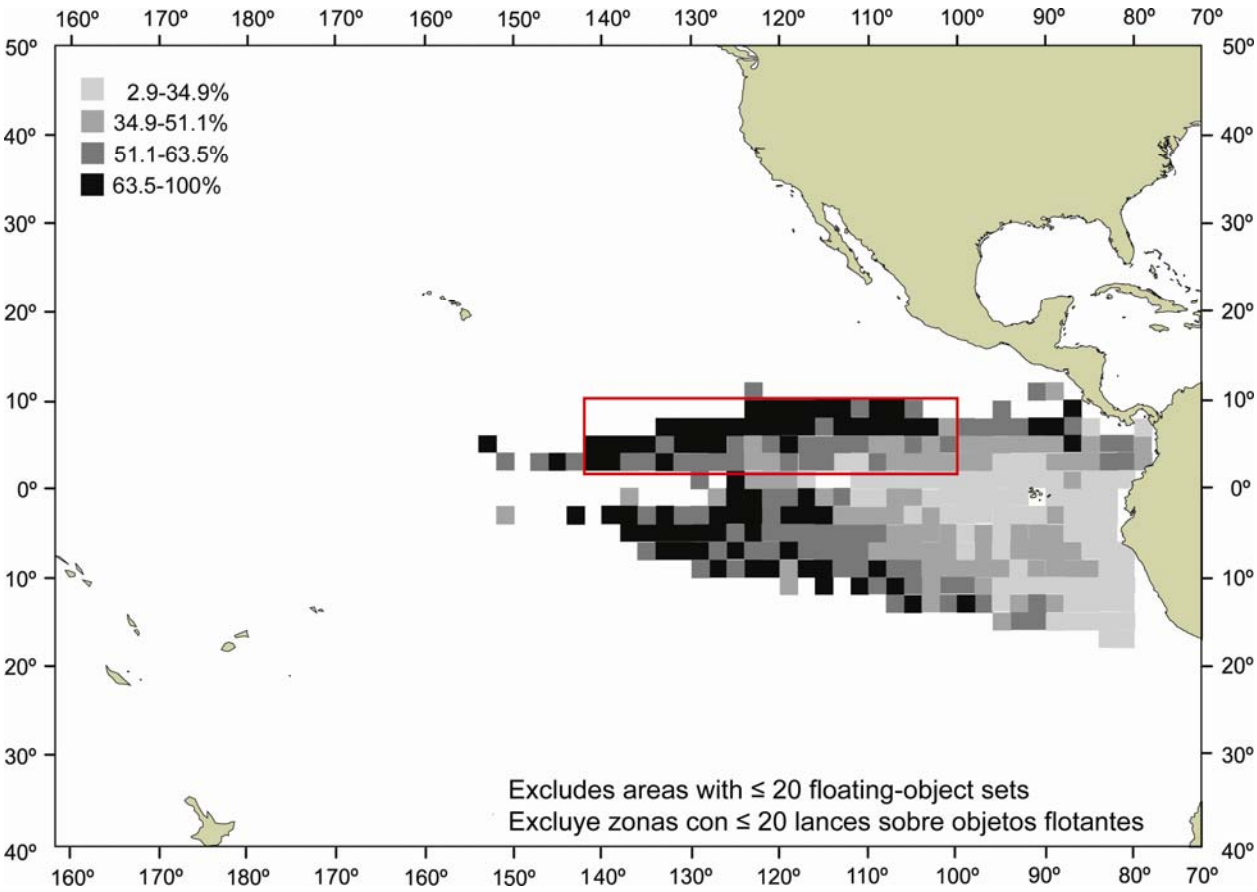

FIGURE 2. Percentage of floating-object sets with shark catches, 2000-2004, and proposed study area,

[1] Report of the ETP Purse-Seine Bycatch Reduction Workshop, October 3-4, 2006

There is a seasonal component to the FAD fishery. During May-November, purse seiners deploy their FADs north of the equator, but the fishery shifts to the south in December (Figure 3). To maximize the opportunities to encounter FADs with sharks, the study is planned for May-November 2007, when the FAD fishery typically operates north of the equator.

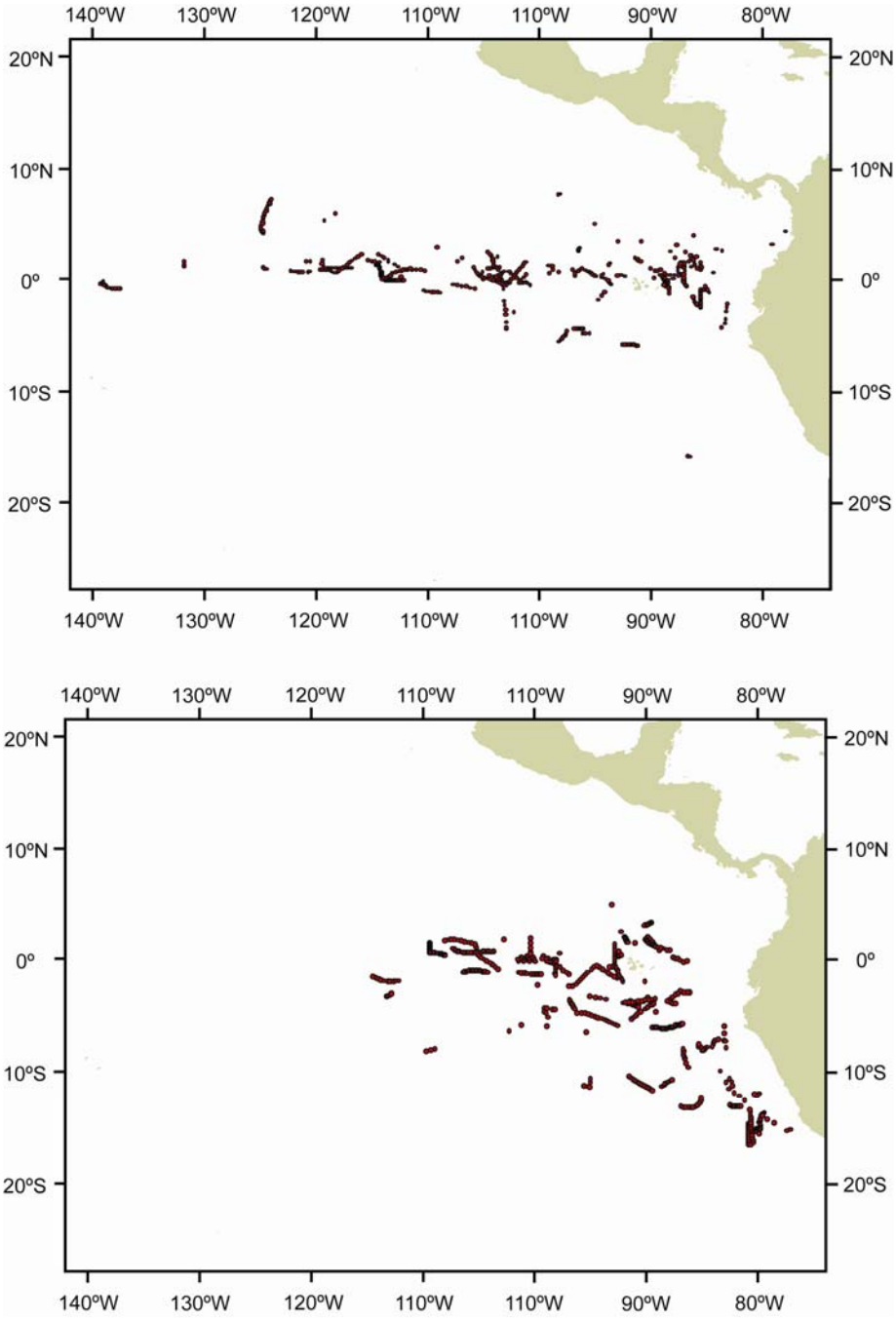

FIGURE 3. Locations of FADs deployed by purse seiners in the eastern tropical Pacific Ocean during May 2005 and 2006 (top) and December 2005 (bottom). Source: IATTC observer data as of 11 September 2006.

4. VESSEL REQUIREMENTS

The study requires the cooperation of a tuna purse-seine vessel that will fish on FADs, preferably in the proposed study area. The vessel 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 them. The vessel 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 the crew to work extra time to launch and drive the speedboat. Preferably there should also be bunk space available to accommodate an additional observer, who will assist in recording data and interpreting the sonar. The assistance of a knowledgeable crew member on the bridge, experienced in the operation and interpretation of the sonar, would be desirable. It should be emphasized that the vessel will not be expected to forego catching tuna to accommodate the experiment.

5. PERSONNEL REQUIREMENTS

The IATTC field office closest to the vessel's home port 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 vessel 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; he will also fulfill his normal data collection duties. If bunk space is available, an additional biologist will also participate in the study by recording data and monitoring the sonar.

6. 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 14-liter bucket perforated with 2.5-cm holes and containing a commercial chum mixture (to ensure homogenity of the bait attractant among sets) or, if required, a mixture of fish oil and 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 (Figure 4). 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 5; S2 Scientific Electronic Lures: http://www.makomagnet.com/fs-product.htm). The transducer will be mounted in a plastic 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.

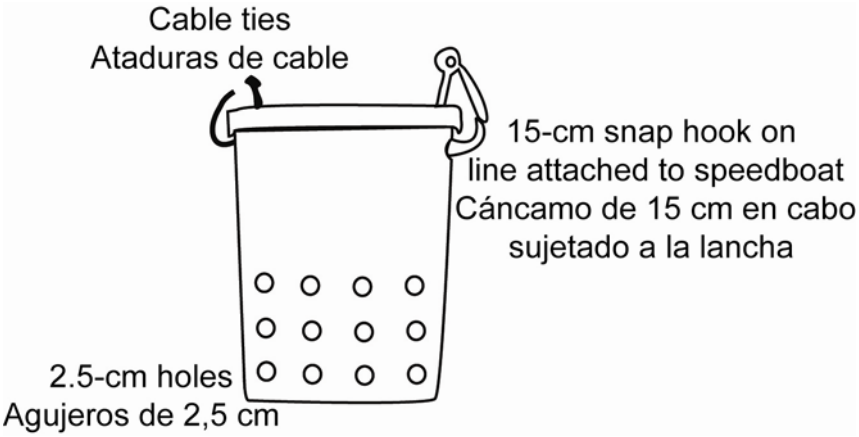

FIGURE 4. Chum bucket (14-liter). About 8 liters (5 kg) of chum are placed in the bucket, and the lid is secured shut with the towing hook and cable ties.

FIGURE 5. Transducer and power cable of the sound attractant. The transducer is placed inside a plastic crate, cable-tied to the bottom of the crate, with the cable side up. The crate is secured to the side of the speedboat; the cable is 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 FAD 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 and not 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 vessel or left to drift near the FAD for a longer period, using larger perforated chum buckets. Different trolling procedures can be attempted as well (Alternative 6, Table 1).

TABLE 1. 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 2-8 hours prior to setting
6) Troll cross-current such that the attractant plume drifts past the FAD in a broad swath
7) Suspend the chum bucket deeper in the water column

7. EXPECTED SAMPLE SIZE

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 (range 3-52; n=84 trips). Of the 879 sets made within the proposed study area (Figure 2), 309 (35%) 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 (63%+). For those sets that did have shark bycatch, an average of 11 sharks was caught per set.

8. AT-SEA PROCEDURES

Preparation: Place 8 liters (5 kg) of frozen chum in a perforated 14-liter bucket, and store inside a larger bucket secured in the speedboat (if the frozen chum does not attract sharks, it can be thawed beforehand for ½ -1 h, or longer). Secure the snap link at one end of the towing line to the bucket and its lid , and secure the other side of the lid with plastic cable ties. Attach the other end of the towing line to the

speedboat. Mount the transducer into the plastic crate using cable ties and place in the speedboat, and secure with elastic cords. Fill the drip bag with fish oil (with valve closed) and store in the storage bucket. Record the components of the bait station to be deployed. Test the handheld marine radio (156 MHz).

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 observer 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 on the speedboat will maintain contact with the bridge with the handheld 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 transducer will be tied securely along the starboard side with the transducer about 0.3 m below the surface, 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 6). The speedboat will drift for about 5 minutes 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 vessel (Figure 7; see also http://www.newenglandsharks.com/chumming.htm).

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 vessel's sonar (about 800 m; Brehmer *et al*. 2006), the observer aboard the vessel 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 that can be observed. 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.

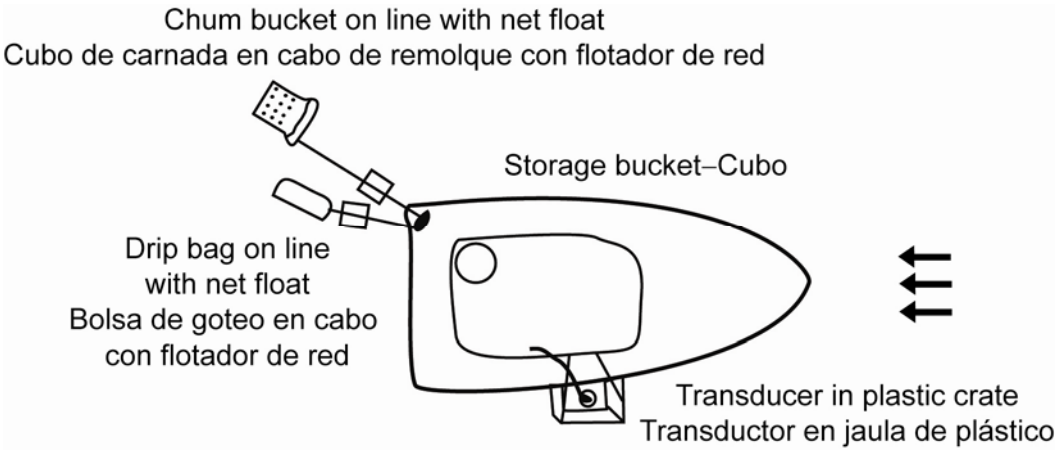

FIGURE 6. Speedboat with bait station components: 14-liter chum bucket, drip bag for fish oil, sound attractant. Chum bucket and drip bag are placed in a storage bucket when not deployed.

FIGURE 7. Normal (left) and Alternative-6 (right) trolling directions.

Just prior to the set, the observer on the vessel 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 and the sharks. The speedboat will continue trolling away from the set. The time of the set will be recorded on the experimental data sheet. The observer on the bridge will record all normal required data 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 transducer. Notes on whether sharks or tunas are observed will be recorded at 5-minute intervals. If the helicopter is used, the spotter 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 dead sharks caught and brought on board; live sharks should be photographed and rapidly returned to the water. Other bycatch will be collected, cut up, and then ground up with a food grinder to create more chum if needed.

Data: After each set, the data will be entered into the computer, along with any digital photographs taken. 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 observers will be entered, along with any relevant comments from the captain and crew. The 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 will be sent to IATTC headquarters to review the data and to discuss any necessary experimental changes.

Alternate experiment: When the sea state is rougher than Beaufort 3, the Alternative-5 experiment can be conducted instead (Table 1). A 130-liter perforated plastic container will be deployed 2-8 hours prior to the set about 200 m from the FAD, containing enough frozen chum to last until encirclement is complete (15-80 liters, assuming a consumption rate of 8 liters per hour, the rate used during shark-fishing tournaments). The container will be attached to net floats, a flag, and a floated line long enough to deploy and recover the bait station from the vessel (Figure 8). 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 vessel'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.

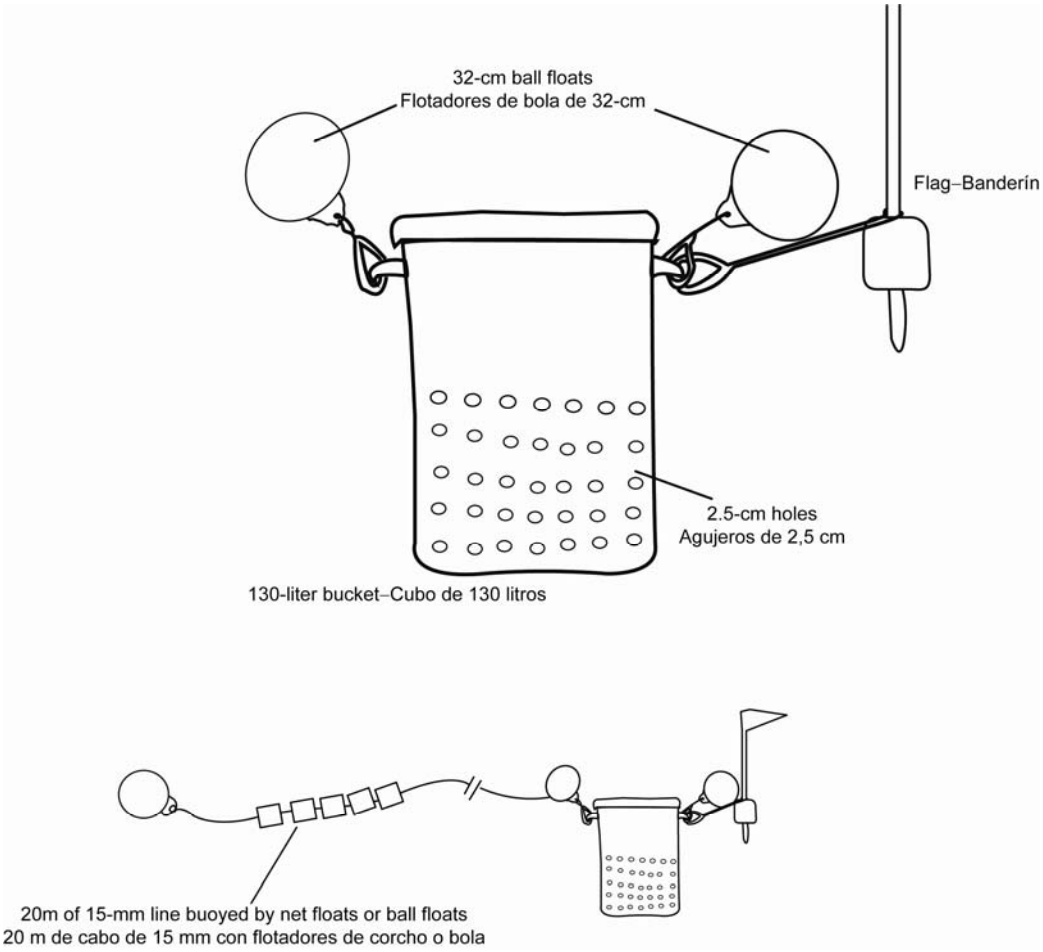

FIGURE 8. Drifting chum bucket (Alternative 5). The buoyed line allows the bucket to be lowered over the side of the vessel and retrieved. A longer line would allow the bait station to be tethered to the vessel if desired.

9. ANALYSIS

The observer(s) 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 only sharks

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.

REFERENCES

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.