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Development and testing of a release panel for sharks and non-target finfish in purse seine gear

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ABSTRACT

Dive surveys were conducted inside the purse seine net during a research cruise conducted in the WCPO in support of the International Seafood Sustainability Foundation (ISSF) #BycatchProject aimed at reducing no-target fishing mortality in the fishery. Segregation of tuna by size and species and between tuna and non-target species was repeatedly observed supporting the potential for selective release of non-target species from the net. In particular, silky sharks (*Carcharhinus falciformis*) were observed to collect in a pocket of net that often formed toward the latter stages of net retrieval. An experimental release panel was installed at this location measuring 5.5 wide that extended down from the corkline for approximately 11 m. The panel could be opened and closed with minimal loss in time to the fishing operation and with low risk of losing target catch. The release panel was tested during seven sets but only two silky sharks exited the panel. Although the panel failed to release significant quantities of non-target catch in these experimnental trials, we feel that further refinement of this concept with additional testing and experimentation is warranted.

BACKGROUND

An International Seafood Sustainability Foundation (**ISSF**) supported research cruise in the WCPO dedicated to bycatch reduction in purse seine fisheries was conducted from 22 May – 1 July 2012 on the purse seine vessel M/V Cape Finisterre. Several experiments and studies were conducted as outlined in Working Paper **SC8-EB-WP-11**. Preliminary data from tagging with pop-up satellite archiving tags (PSAT) and Survivorship PATs that can detach and report post-release condition and mortality as well as analyses of blood draws indicate that sharks that are brought onboard during the brailing process are generally in very poor condition and experience high levels of post-release mortality (Hutchinson et al. 2012). In contrast, silky sharks captured with hook and line gear or scoop net from inside the minimally constrained purse seine net indicated significantly lower levels of stress and low levels of post-release mortality[4]. The same situation appeared to be valid for non-target finfish such as mahi mahi, wahoo, rainbow runner and billfish, although from purely empirical observations.

Technical options for avoiding encircling these unwanted species or releasing non-target fish prior to the sacking and brailing stage of purse seining appears to be the best options for further research and development. Threfore the second half of this research cruise focused on the testing and observation of a release protocol for non-target species with particular emphasis on the live release of oceanic sharks.

[4] Preliminary data and observations

MATERIALS AND METHODS

a) Concept for a release mechanism

Visual observations of tuna and non-target catch using scuba and skin dive gear in the pursed net revealed clear separation of tuna by size class and of tuna from non-target species (Muir et al. 2012). The degree of separation was surprising and encouraging as it suggested the possibility of selective release of undesirable species from the fishing operation. Silky shark were the only elasmobranch observed in any quantity during the cruise and comprised a significant proportion of total non-target catch. A striking feature of the separation of species in the net were repeated observations that silky sharks often grouped together and eventually ended up in a tight bend of the net that forms when about 3/4ths of the net has been retrieved.

This area of the net is located at the most distal bend of the corkline (away from the power block and on port side of the vessel) as the large net skiff tows the vessel in the opposite direction. In order to maintain the proper angle of the net as it enters the power block, the bow thruster is periodically engaged to maintain the boat axis perpendicular to the net.

These actions physically transport the main vessel to starboard that creates a current that sweeps outward from the boat and forms the bend in the net we named “the pocket”. Divers soon learned that they would end up in the “pocket” with the sharks if they did not consciously and continuously swim toward the vessel. Silky sharks, mahi mahi, rainbow runner and wahoo were observed to remain shallow (above 10 m) and end up in the pocket while tuna typically remained deep in the net and closer to the vessel. In this respect, the towing action created a situation that is analogous to a low velocity “backdown” procedure as has been developed to release dolphins from purse seines in the eastern tropical Pacific tuna fishery.

b) Location of the Panel

This phenomenon was well documented with digital still and video cameras mounted in underwater housings. It appeared that sharks and other non-target catch could easily swim free of the net if that area of the pocket could be opened at will. After viewing the images the Captain was fully supportive to develop a release system and was able to convince the vessel owner/operator to invest in the idea.

Additional diving observations in the net were made to determine the optimal location for the release panel. Scientists expressed concern that sharks may not be concentrated enough if the panel was placed too far from the end of the net while fishermen were concerned that tuna may escape if the panel was too close to the end of the net (near the sack). A compromise position was agreed upon located 100 fathoms (183m) from the bow oertza (end of the net containing the sack). This position represents the last 11% of the net that measures a total of 940 fathom (1719m). This area is between the “rolling strip that is located next to the sack and the main body of the net. **Figure 1** shows the position of the experimental escape panel and the flow of current created as the vessel is pulled in the opposite direction.

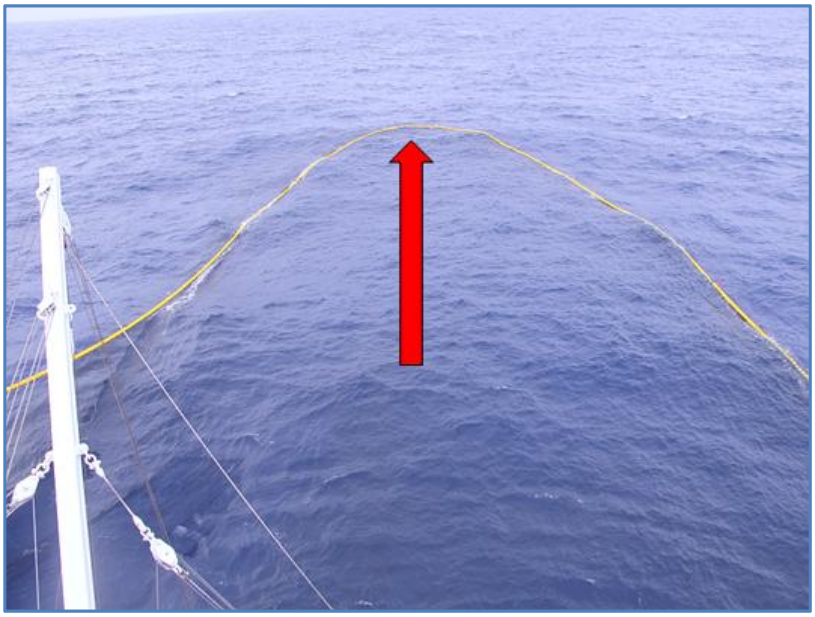

Figure 1. Location of the experimental escape panel and direction of surface current

c) Design and construction

The vessel returned to Pago Pago on the evening of June 10 at the end of the first leg of the cruise to drop off one scientist and pick up his replacement. The visit also provided an opportunity to meet exchange one scientific staff member and to meet with the Tri Marine vessel owner who had already agreed to fly in their net expert to design and oversee construction of the release panel. This was a critical factor as any modification to the net must be designed to not jeopardize the strength and integrity of the net during a large haul. If the net failed due to structural issues caused by the escape panel, it is likely the idea would never be adopted by the fleet.

The initial design was proposed by the vessel Captain, consisting of a flap of net that could be opened and allowed to drop with gravity. The Tri Marine net expert expanded on this idea and decided to use a series of steel rings on the net and "door" that could be laced together with a rope that could be pulled free like a zipper to open the panel. The panel was located just below the corkline selvedge where a rectangular panel of net was cut free but remained attached at the bottom. A braided Sampson line was laced into the edge of the door and opening to provide strength. The panel measured 3 fathoms wide across the corkline and as deep as the first strip of netting or approximately 3x6 fathoms (5.5 x 11 m). The effective width of the panel is actually wider as the width was along the corkline while the net has a 27% hanging ratio to allow proper pursing. The netting on either side and below the door was reinforced for by doubling the webbing for 3 fathoms on each side. **Figure 2** shows the general design and the crew constructing the escape panel.

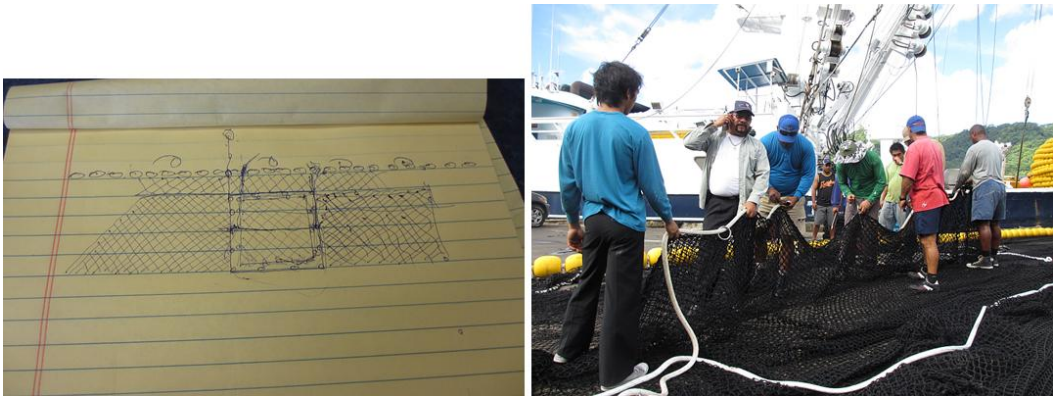

Figure 2. Sketch of release panel concept and construction in Pago Pago harbor

RESULTS

Eighteen sets were made during Cruise Leg-2 after the "release panel" was installed in Pago Pago. The behavior of sharks, tuna and bycatch species was directly observed during 14 the 18 total sets using scuba divers (8 sets) or surface skin divers only (6 sets). Diving operations could not be carried out on 6/22/12 due to rough seas and dangerous swells making towboat launch and recovery difficult and dangerous. The towboat transmission malfunctioned on 6/25/12 which eliminated diving operations during 25-26 June but snorkel observations continued after we determined how to work around the problem.

Opening the panel was accomplished by untying one end of the zipper line, attaching the other end to the towboat and slowly driving away from the corkline. After the first few trials another line was installed that allows the panel to be raised up and closed by a crewman in the workboat/towboat by pulling a rope and clipping the flap of net to a ring affixed to the corkline. This does not completely close the door but was enough of a visual barrier that tuna would not approach the area or attempt escape. **Figure 3** provides a view of the release panel with to scale and of the panel being opened.

Figure 3. The closed release panel and the panel opening immediately after the zipper line has been pulled

The panel was opened during 7 sets, and closed during 5 of these events. The work boat operator quickly learned to open and close the panel with ease with the assistance of one other crewman. The panel was opened just before it reached the point at which it was situated directly opposite of the main vessel. Once the panel reached this point, the large

net skiff attached to the starboard stern of the seiner and bow thruster were used to "pull" the boat/net and open escape panel for up to 9 minutes, in an effort to drift non-target species out of the net. After the net rolling resumed, the panel was closed to ease reassembly once the set was complete, as well as to avoid loss of target tuna species.

Sets which were selected to open the panel were relatively small to medium-sized, between 9 and 50 tons. Sharks were observed by divers during 12 out of 14 sets. Subsequent sampling of sharks during the brailing process determined that the scuba and snorkel surveys were extremely accurate in their ability to identify and enumerate sharks in the net. During the 7 sets that the panel was opened, sharks were present before opening the panel on every attempt. Of the 106 sharks observed in the net pre-panel opening, 105 were identified as silky sharks, and 1 was positively identified as an oceanic whitetip.

Only 2 silky sharks were observed to swim out of the panel during these 7 opening events, during two separate sets (i.e. one shark per set). During some sets, a group of sharks were observed directly in front of the open panel but they maintained their position inside the net relative to the seiner and net. Sharks and other non-target species (mahi mahi, rainbow runner, wahoo, triggerfish) seemed to not recognize the opening as an escape route out of the net, and perhaps still viewed the net with the opening in total as a visual barrier which they preferred to avoid. However, the two sharks that did exit the net did so without hesitation but under better conditions of current (flowing strongly out of the open escape panel.

The release panel moved through the power block without damage or incident and was easily laced together with the zipper line after the completion of net stacking.

DISCUSSION

The release results obtained during Cruise Leg-2 were discouraging but there are many factors that may have contributed to the low release ratio. The exact conditions we observed during Cruise Leg-1 of very clear water, strong outbound current and sharks balled up in a very tight corner of the net were not repeated during CL-2. Surface current was generally low, the water was generally cloudy with plankton and feed and during some sets the non-target species ended up in a pocket of net that formed below the panel.

It was also evident that during some sets the sharks and other non-tuna species were not yet alerted to their situation and seemed to prefer to remain inside "where the action was". The location of the escape panel was far enough from the end of the net that the sharks and fish were not yet reacting in an alarmed or active manner that may have contributed to their self-release.

The panel opening was chummed with fresh chunked tuna flesh during one release attempt to no avail. Divers observed sharks and other non-target species (wahoo, mahi mahi, and rainbow runners) swim directly past the opening on several occasions, indicating that they did not recognize large openings or holes in the net as an escape route or simply did not yet feel the need to "escape".

Before the panel closing line was rigged, divers observed a small school of mixed yellowfin and skipjack exit the panel as it had been pulled very close to the vessel by the power block. The school fed briefly on small baitfish on the surface outside of the net, and then quickly turned around and swam back into the net via the same opening. Tuna were never seen to

approach the opening once the closing line was operational. Only one target species, an individual large yellowfin, was observed to swim out of the opening and not return. This occurred during the same set when one of the two silky sharks exited the panel.

SUMMARY

Our experience from the cruise and when testing the panel can be summarized as follows:

1) Tuna and non-target species will not try to "sneak" out the edges of the closed panel;
2) with a little practice, the panel can be quickly opened and closed by a towboat operator;
3) tuna generally remain deep in the net or closer to the vessel and do not approach the escape panel during small to medium size sets (<50mt);
4) don't try to open the thing in large sets (>100t);
5) there appears to be no relationship between the number of sharks and non-target species vs the size of the tuna school on drifting FADs;
6) the sharks and bycatch will not always end up in a favorable position to be released;
7) each set is different and further trials are needed under different conditions (current speed/direction, skiff pulling speeds, water clarity, set sizes, species compositions, etc.).

In conclusion, observations and field testing suggest that the basic design of the release panel is functional and that it can be deployed in commercial fishing applications with minimal loss in time to the fishing operation and minimal risk of losing target species in small to medium sized loads. This is useful considering that levels of bycatch seem to be unrelated to the size of the tuna aggregation, i.e. relatively large amounts of non-target catch can be found with small amounts of tuna and vice versa.

There is no doubt that improvements to the placement, design and mechanics of this prototype panel can and should be made. In addition, ways to induce sharks and non-target species to pass through a release panel need to be developed and tested.

REFERENCES

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