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**Technical options for the utilization of underwater video to characterize species, size  
composition and spatial distribution of tunas and bycatch species**

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**David G. Itano<sup>1</sup>**

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<sup>1</sup> University of Hawaii, Pelagic Fisheries Research Program, 1000 Pope Rd., MSB 312, Honolulu, Hawaii, USA 96822

# Technical options for the utilization of underwater video to characterize species, size composition and spatial distribution of tunas and bycatch species

David G. Itano<sup>2</sup>

## Study background

Acoustic discrimination of underwater targets has been suggested as an important tool to reduce bycatch and undesirably small catch on floating object or FAD sets. This approach calls into question the competence of fishermen to identify the species and size of acoustic targets observed on commercially available echo sounder and sonar equipment. A great deal of empirical evidence exists to suggest that fishermen can become highly proficient at identifying characteristics of fish schools as interpreted from these electronic devices (Schaefer and Fuller 2007). Verification of their ability to discriminate acoustic estimates can be assumed by enumerating the catch of acoustically monitored targets, but this assumes what was seen on the screen is what was subsequently captured. Proving their abilities in real time is generally impossible but necessary if the intention is to avoid bycatch or undesirable catch, such as very small tuna or non-market species.

Scientists also struggle with acoustic discrimination despite the use of sophisticated scientific grade echo sounders capable of target strength measurements of individual targets. It is well known that swim bladder size and air volume in fish has a strong influence on target strength and can assist in species identification and size estimates (Bertrand and Josse 2000). However, the spatial orientation of the fish to the instrument, fish size, school size and environmental conditions can influence image quality and accuracy of estimates (Miguel *et al.* 2006)

A means to visually verify species, fish sizes and density of schools in association with floating objects could be very useful in verifying the accuracy of acoustic estimates and as a means of avoiding unwanted bycatch. This idea was proposed to the SC and funded in 2008 in the form of a drop camera viewing and recording .

## Previous methods and results (2008, 2009)

The system used by the study consisted of a drop camera manufactured by Splashcam Marine Video<sup>3</sup> as described in Itano (2008). This system is rated to a depth of 600 m and is equipped with a 12 volt rechargeable battery for autonomous use onboard a vessel and has an integrated surface LCD viewing screen and recording unit (**Figure 1**).

The system was tested on Central Pacific tuna tagging cruises of the SPC Pacific Tuna Tagging Project (PTTP) in 2008 and 2009 (Itano 2008; Itano *et al.* 2009). These cruises conducted tuna tagging operations on TAO oceanographic moorings<sup>4</sup> from 8°N to 5°S on the 155° W and 140°W lines of longitude in the central equatorial Pacific (**Figure 2**). These buoys are generally anchored in depths of greater than 2000 m. These tagging cruises provided opportunities to test the gear as these deepwater buoys often aggregate schools of skipjack, yellowfin and bigeye tuna mixed with associated finfish that become bycatch to purse seine fisheries, i.e. rainbow runner, pelagic triggerfish, rudderfish, dolphinfish, wahoo and oceanic sharks.

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<sup>2</sup> University of Hawaii, Pelagic Fisheries Research Program, 1000 Pope Rd., MSB 312, Honolulu, Hawaii, USA 96822

<sup>3</sup> [http://www.splashcam.com/Deep\\_Blue/db.htm](http://www.splashcam.com/Deep_Blue/db.htm)

<sup>4</sup> <http://tao.noaa.gov/refreshed/index.php>

The camera system was originally tested with 244 m of umbilical cable that supplies power and image transmission to the surface recording unit and also supports the camera head, stabilizing fin and weight. After the 2008 cruise the chord was shortened to approximately 110 m for ease of handling as it was found that almost most observations on FAD associated tuna were being recorded at depths of less than 75 m.

Fish schools were observed on the vessel echo sounder indicating a school was directly below, usually when close to or upcurrent of the moored buoy. The drop camera head was slowly lowered from the vessel into the fish school with recording taking place when fish were observed on the surface screen. An archival tag (Wildlife Computers MK9) was attached to the camera head to obtain an independent reading of actual camera depth.

The video images produced by the Splashcam system were quite quite grainy with some overexposure problems (**Figure 3**). However, tuna species could be identified to the experienced viewer using a combination of morphological characters. One of the more important applications of visual identification is related to the ability of a system to discriminate bigeye tuna from similarly appearing yellowfin tuna. The system was able to do so for fish larger than approximately 60 – 65 cm FL due to differences in the body morphology and the length and shape of the pectoral fin. However, the discrimination of bigeye tuna at less than approximately 40 cm was very difficult on the Splashcam system due to the grainy quality of the captured image. Overexposure was reduced by tilting the camera head to a slightly negative angle to avoid flare from surface light.

## 2010 Field Testing

The same Splashcam system was tested during 2010 on the 4th Central Pacific cruise of the PTPP that visited TAO oceanographic buoys from 8°N to 5°S on the 170°W and 155°W lines of longitude. On this cruise, the Splashcam system was tested in addition to a high resolution digital video system manufactured by GoPro Camera<sup>5</sup> that was housed within a waterproof housing rated to 60 m. This unit is relatively inexpensive (\$260) but does not have surface viewing or recording features. The intention was to compare video quality between the systems for species and size discrimination. **Figure 4** shows the GoPro underwater video camera mounted above the Splashcam video camera head prior to deployment. The GoPro video camera was also dropped independently of the Splashcam on a weighted fishing line and positioned to allow each camera to film the other camera inside tuna schools.

## 2010 Image results

Images captured by the GoPro camera in 2010 were clearly superior to those obtained by the Splashcam. **Figure 5** shows an image of a tuna captured by the Splashcam in (left panel) compared to an image captured by the GoPro system (right panel) on the same school at the same time on TAO buoy 2N 170W in 2010. The tuna in the GoPro image is easily identified as a juvenile bigeye while the image taken by the Splashcam can not be positively identified. The Splashcam camera head and a yellow dart tag is clearly visible in the GoPro image.

**Figure 6** provides a similar comparison for skipjack tuna. Positive identification can only be made using the image captured by the GoPro system.

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<sup>5</sup> <http://www.goprocamera.com/index.php?area=2&productid=33>

## Options for other video equipment

There are limited choices available for affordable, high resolution color video systems that provide surface viewing and recording options. An informal survey of researchers and fishermen using this gear suggests that SeaViewer<sup>6</sup> is one of the best options currently available at affordable prices. Complete systems can be configured<sup>7</sup> for \$2000 - \$2500 that include a drop or trollable camera rated to 300 m depth, drop cable, surface LCD display, 12V battery, battery charger, AC adapter, recording device and protective waterproof case for surface components.

Remotely operated vehicles (ROVs) with onboard camera systems and surface viewing screens are another option but are considerably more expensive. These systems have the advantage of being maneuverable allowing the unit and camera to be “flown” around by the operator to view and photograph anything within the limit of the umbilical tether. Several companies manufacture ROVs that can be equipped with still and video cameras, mechanical arms, sonar, and a wide range of sensors. One such company is SeaBotix<sup>8</sup> that manufactures a wide range of models for different applications. A basic system with ROV, 175m of tether, thrusters, fiber optic video, color camera, LCD display, control console, waterproof case, spare parts and training will cost more than \$34,000.

## Future work

The quality of images obtained using the inexpensive GoPro video camera were highly encouraging. The resulting images suggest that a drop camera capable of similar resolution would be very effective in identifying tuna and bycatch species in drifting object associations. The SeaViewer or similar system will be obtained for further trials during 2010.

## References

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<sup>6</sup> <http://www.seaviewer.com/index.html>

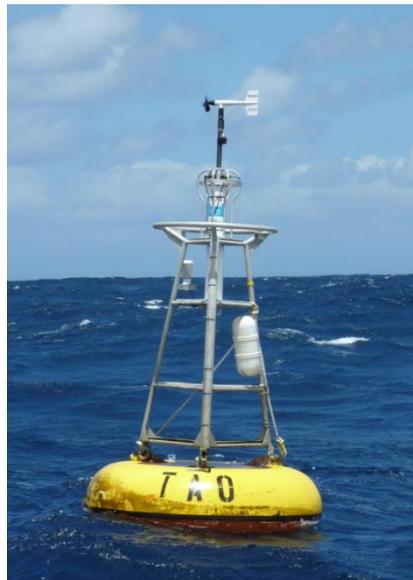
<sup>7</sup> [http://www.seaviewer.com/underwater\\_video\\_equipment\\_shopping\\_cart.html](http://www.seaviewer.com/underwater_video_equipment_shopping_cart.html)

<sup>8</sup> <http://www.seabotix.com/>

## Figures



**Figure 1. Splashcam video system with topside viewing and recording gear (left) and drop camera equipped with archival tag for depth measurement**



**Figure 2. Typical TAO oceanographic buoy where underwater video trials took place**



**Figure 3. Bigeye tuna recorded in 2008 at TAO buoy 2N, 155W**



**Figure 4. Splashcam viewing and recording system (left) and GoPro high definition video camera mounted on the Splashcam camera head prior to deployment.**



**Figure 5. Image quality from Splashcam (left panel) and GoPro video (right panel) taken at the same time at TAO 2N 170W**



**Figure 6. Comparison of skipjack image taken by GoPro video camera (top panel) compared to image of presumed skipjack taken by Splashcam (bottom panel)**



**Figure 7. High resolution trolling and drop cam video systems**



**Figure 8. SeaBotix ROV capable of surface control and viewing via high resolution video camera**