Australian Government
Department of Agriculture, Fisheries and Forestry

# Technical assessment of the 2011 commercial trial of stereo-video in the Australian southern bluefin tuna farm sector

## Executive summary


- The 2011 commercial trial demonstrated the physical robustness of the stereo-video equipment under commercial operating conditions.
  - Southern bluefin tuna (SBT) were recorded from three tow cages, with a total of eight transfers being made from those three cages.
  - In total the trial technicians counted 23,018 SBT from stereo-video recordings of 8 transfers, 10.5% of the total taken for the 2010/11 season (220,072 fish and 81 transfers).

- Stereo-video measures more fish than the current methodology, and improves the precision of the average weight estimate.
  - The stereo-video equipment maintained calibration within the agreed 1% limit throughout the trial.

- Stereo-video provides estimates of the weight of fish transferred retrospectively. This could potentially lead to overstocking or understocking farm cages.
  - Overstocking farm pontoons exposes industry to breaches of South Australian aquaculture legislation on stocking rates and environmental impact.
  - Further, overstocking creates concerns for fish health and growth rates.
  - Understocking results in the need to use more farm pontoons than would otherwise be necessary, creating additional cost to industry.

- The overall costs associated with implementing and operating stereo-video technology are greater than for the mono video (including the 40-fish sample) with an average transfer costing slightly more than twice as much as the current method.

## Introduction

This document provides a technical assessment of the criteria developed to assess the outcome of the 2011 commercial stereo-video trial. The criteria for assessment was developed by the Stereo-video Working Group and included:

1. Can the equipment be handled by one person when moving between vessels at sea?
2. Can the equipment be handled safely at sea?
3. Is there a change in the time to set up the equipment compared to mono-video?
4. Is there any change in the length of time to undertake the monitoring of a transfer?
5. Does the equipment fail in situ?
6. Are there visibility problems which prevented the use of equipment
7. Can the device be fitted to the existing transfer gates in use in the fishery?
8. Are operators able to meet SA government legislation on stocking rates?
9. Is it more difficult for the industry to manage the use of quota?
10. Time taken to undertake count of fish and length of fish to obtain the estimates of weight and number of fish?
11. Cost compared to current method?
12. Does the sampling strategy of measuring every tenth fish produce a more statistically robust estimate than taking a 40-fish sample?

The objectives of the trial were:

1. To provide a proof of concept of using commercial stereo-video technology in a commercial environment to measure the length (and subsequently determine the weight) of live free swimming SBT transferred at sea between sea cages.
2. To provide an opportunity to explore issues that may arise with the full implementation of stereo-video technology in a commercial setting and consider risk treatments that may be adopted
3. To determine if the technology
    a. is cost effective
    b. is practical
    c. can deliver estimates of average weight of SBT within an appropriate timeframe

## Method

An AFMA employee or AFMA Authorised Representative (AAR) supervised the deployment of stereo-video for every transfer from each tow cage nominated to participate in the 2011 commercial trial of stereo-video.

A copy of the transfer footage was prepared by the trial technician. Each fish was numbered and initial measurement was taken of the fish. This number and measurement were neither final nor official.

The marked up footage was provided to the AAR to review and to make the formal count and measurements.

For the purposes of the 2011 commercial trial, the SBT were measured as follows:

> Every 10th fish that broke the plane between the camera and the far edge of the transfer gate during the transfer was measured. Measurements were carried out in accordance with the methodology outlined in pages 9 and 10 of Phillips *et al*. (2008), except that the measurement was from the tip of the upper jaw so that it was consistent with the length-weight conversion factor. The AAR manually selected the location of the tip of the upper jaw and caudal fork using Event Measure Stereo software. These points were then converted into a length measurement using the software.
>
> If a selected fish was not measurable, then the next measurable fish was selected and measured. This substitution did not affect the selection of the next fish to be measured. For a fish to be deemed measurable, the whole fish had to pass through the stereo-video field of view. A fish was deemed unmeasurable if: the upper jaw and the caudal fin of the individual fish were not clearly visible; the fish passed through the frame too quickly; or there was too much flexing of a fish being measured.

Further consideration of the sampling must be undertaken and agreed prior to implementation.

For the purposes of the 2011 commercial trial, length was converted into weight using the CCSBT LL3/LL4 conversion factor for fish <130 cm of:

$$W = 0.000015577*L^{3.0214}$$

The length-weight conversion factor was applied to each individual fish measured to produce an estimated weight. The weight of each fish measured was summed and divided by the total number of fish measured to produce an average weight. The average weight was multiplied by the total number of fish in the transfer to produce the verified weight for that transfer.

## Assessment against criteria

### 1. Can the equipment be handled by one person when moving between vessels at sea?

The AM100 camera system weighs 12kg, which is classified as a safe handling weight (16 kg) under South Australian manual handling legislation for a single person. The total weight including the bracket mounting the camera system onto the transfer gate weighed approximately 15 kg, which is still below the safe handling weight. While the mono camera equipment is lighter, the AM100 can be safely moved between vessels at sea by one person.

## 2. Can the equipment be handled safely at sea?

The AM100 camera system was easy to set up at sea, and took no more time to deploy than the mono camera currently operated by the AAR. During the trial industry installed the cameras. Industry raised concerns that at sea and in rough conditions the additional weight may have breached South Australian legislation by creating health and safety risks. For any future implementation, OH&S risks associated with deployment of the AM100 camera system at sea and in rough conditions from an unstable platform would need to be assessed and managed.

## 3. Is there a change in the time to set up the equipment compared to mono-video?

There was no meaningful difference in setup time between stereo-video equipment and mono-video equipment.

## 4. Is there any change in the length of time to undertake the monitoring of a transfer?

There was no meaningful difference between the length of time taken to monitor transfers using stereo-video equipment or mono-video equipment.

## 5. Does the equipment fail in situ?

**Robustness of the camera system**

The camera system and cable proved to be robust with no failures. Additionally, the camera system maintained its calibration stability throughout the trials and there was no need to re-calibrate the camera system during the trial period. Repeated measurements of scale bar targets of a known length were measured at 5 intervals during each transfer to verify whether the stereo-video system had ‘gone out’ of calibration. All measurements from all 8 transfers were within the 1 percent tolerance.

**Robustness of the video logging system**

On two occasions technical difficulties were experienced resulting in part of the transfer not being recorded. On one occasion the recording cable was accidentally knocked out of the laptop, resulting in approximately one minute of the transfer being unrecorded. On the second occasion the logging computer unexpectedly shutdown and restarted itself resulting in approximately two minutes of the transfer not being recorded. Subsequent trials demonstrated that there was a problem with the logging computer and it was changed prior to further transfers. No further difficulties were experienced.

The above technical problems that occurred were due to human error or faulty 3rd-party hardware, both of which can be overcome.

In the second transfer it was noted that the stereo-video camera system logging computer did not record a short sequence of footage (approximately five seconds). The AM100 stereo-video system continually checks for the synchronisation of images, and periodically needs to resynchronise the cameras. The amount of time required to resynchronise the system includes: a) the time taken to unlock and clear image buffers in memory (up to 100ms); b) the time taken to disable, reconfigure, then re-enable the periodic pulse generator that creates the camera trigger (up to 1s depending on how slow the cameras are to respond). A rush of fish and the resulting pause in the synchronisation can cause errors, and may be responsible for some of errors in the STEREO-VIDEO count.

**Are the failure rates higher than mono video?**

The two technical failures for stereo-video equipment were due to human error or faulty third party software, both of which can be overcome. The trial demonstrated the physical robustness of the AM 100 stereo-video camera under operational conditions.

There have been very few failures related to the mono camera and the majority of those have been related to human error or power failure. To prevent issues relating to the loss of power, the mono camera system now has two backup power supplies to enable recording to continue in the event of a loss of mains power on the boat.

## 6. Are there visibility problems which prevented the use of equipment?

The AM100 stereo-video system was always able to be deployed whenever the mono camera was deployed. Similarly, it was observed that the clarity of the AM100 recordings appeared to be greater than the mono camera operated by the AAR. This is most likely due to the ability to be able to manually alter the light level. The image quality recorded by the AM100 stereo-video system allowed the edges of fish to be clearly seen and permitted accurate measurements and counts of fish. The stereo-video system allows control over the camera settings and excessive glare can be compensated for by adjusting the settings on the camera.

## 7. Can the device be fitted to the existing transfer gates in use in the fishery?

During the trial new gates were constructed to facilitate calibration targets; however, the device could have been fitted to existing transfer gates.

## 8. Are operators able to meet South Australian government legislation on stocking rates?

Stereo-video provides estimates of the weight of fish transferred retrospectively. This could potentially lead operators to overstock or understock farm pontoons as they do not know the average weight at the time of transfer and therefore how many fish to transfer. Overstocking farm pontoons exposes industry to breaches of South Australian aquaculture legislation on maximum tonnage stocking rates and

environmental impact benchmarks. Further, overstocking can negatively affect fish health.

This criterion could not be adequately assessed during the 2011 commercial trial.

## 9. Is it more difficult for the industry to manage the use of quota?

Under the current sampling regulations, the farmer knows the average weight before the SBT are transferred. They can therefore cease transferring fish once the target number of fish (and total weight and stocking rate) is reached.

Under a sampling strategy whereby stereo-video is deployed to monitor the transfer of SBT into farms, the average weight and total weight is not known until after the fish are transferred. Therefore, the management of quota becomes much more difficult than under the existing system.

## 10. Time taken to undertake count of fish and length of fish to obtain the estimates of weight and number of fish?

There was a time lag between footage being recorded and the raw data and mean lengths and weights being available to AFMA and industry. It took the technicians between 10 and 16 hours to measure 10% of the fish in each transfer following the operational rules defined for the trial. These measurements then had to be later validated.

## 11. Cost compared to current method

The overall costs associated with implementing and operating stereo-video technology are greater than for the mono video (including 40-fish sample; transfer monitoring; count process; measurement process; auditing; maintenance; capital investment; and compliance monitoring) with an average transfer costing slightly more than twice as much as the current method.

## 12. Does the sampling strategy of measuring every tenth fish produce a more statistically robust estimate than taking a 40-fish sample?

Measuring the length of every $10^{th}$ fish provided a more precise estimate of the length of fish in a tow cage than the 40-fish sample. By increasing the sample from 40-fish to several hundred fish, precision is increased.

**References**

Phillips K, Boero Rodriguez V, Harvey E, Ellis D, Seager J, Begg G, Honda N, Shibata K, Hender J. 2008. The accuracy and precision of stereo-video and sonar length measurements of southern bluefin tuna (*Thunnus maccoyii*). CCSBT-ESC/0809/12