Executive Summaries of the Stereoscopic Cameras Pilot Project, Objective 2:
Automation of video footage analysis
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Executive Summary

Tests for the use of software and artificial intelligence to automatically determine the number of bluefin tuna (BFT) and their weight during the first transfers from purse seine vessels to towing cages were conducted during the fishing campaigns of 2024 in the Mediterranean and the Adriatic. The same transfers were manually measured in Objective 1 of the Pilot project, so a comparison between manual and automatic measurements can be done. This executive summary presents preliminary results, with further analyses to continue until the project's conclusion.

The software proved effective at automatically estimating a high percentage of the fish in four first transfers in the Mediterranean (73%, 90%, 75%, and 73%). However, visual inspection revealed an inflated percentage of fish measured (19%, 8%, 3%, and 14%), highlighting the need for further development of the tracking algorithm to ensure reliable sample sizes, since the same fish are sometimes mistakenly identified as different individuals and measured multiple times. The time required for fish sizing was reduced from 16 hours to 2 hours with respect to manual measurements. The average lengths were closely aligned with those from manual measurements, with differences of -1.7%, -2.0%, -2.0%, and +1.5%. Length-frequency histograms for both manual and automatic measurements showed very similar shapes, with the manual measurements, which were lower in number, fitting within the histogram of automatic measurements. For the two transfers where the number of manual samples was higher (45% and 73% of the fish), the similarity between histograms was even more pronounced. The observed differences in average length between manual and automatic measurements are likely due to sampling variations (probably not the same fish are measured and not in the same instant of time) and the inherent errors in length estimation from stereovision, where a few pixels' disparity in the image can translate into several centimeters in length. Additionally, manual measurements are subject to operator variability and timing. Regarding fish counting, the automatic software with stereocamera differed between 74% and 116% compared to manual counting, but reducing the time invested from 10.5 hours to 26 minutes. We expect improved versions algorithms for automatic fish counting shortly, able also to be applied to monocamera recordings. The automatic processing of the videos from caging transfers and the comparison with the measurements obtained by the fishing authorities is in progress, since these materials were delivered some days ago.

One first transfer in the Adriatic was analyzed automatically with the software, delivering initially a small sample size (12%) of the fish counted with stereocamera, which corresponds to 10% of the fish counted with monocamera. This limited sample size was attributed to the challenges of detecting individual fish in dense schools, compared to the more isolated swimming observed in the Mediterranean, and the limited training of the software under these conditions. A new training was done with the videos provided by authorities and the sample size increased to 45% of the fish counted with stereocamera, which corresponds to 38% of the fish counted with monocamera. The average lengths obtained manually and automatically differ by -4.6%, and the time invested was reduced

The measurement system implemented utilizes an advanced tracking algorithm that measures each fish multiple times throughout the video. The length of each fish is determined by taking the median of all individual length measurements. In the Mediterranean, fish were measured 5.5, 12.4, 9.1, and 7.4 times on average for transfers 11, 12, 20, and 21, respectively, and 2.3 times in the Adriatic. The varying number of times is primarily attributed to the density of the fish schools and the amount of time each fish remains within the camera's field of view, which is influenced by the fish's distance from the camera. The use of multiple measurements enhances the accuracy of the size estimations by filtering out incorrect measurements. An analysis of incorrect measurements revealed that such errors were minimal, constituting less than 1.5% of all correct measurements. These errors typically occurred when the snout point was mistakenly placed on one fish while the fork point was placed on another nearby fish. For an incorrect measurement to be reported, both the snout and fork points would need to be misidentified in both images of the stereocamera pair, and this error would need to be repeated across the majority of the measurements for that fish. This approach ensures high confidence in the reliability of the length estimations and mitigates the impact of occasional measurement errors.

Our software, which integrates deep learning and convolutional neural networks with a tracking algorithm, has demonstrated its readiness for automatic fish length estimation of large fish samples during first transfers in the Mediterranean and the Adriatic. The software requires minimal technical expertise and can run on a standard laptop without internet connection. With continued advancements in hardware and software, we anticipate even faster and more efficient versions in the future.

Spreadsheets containing detailed results for all transfers are available for download via the following link[1]. The link also includes all videos with the automatic detections, demonstrating the software's capabilities and providing transparency for the report's findings.

[1] Download spreadsheets via the following link.

Stereoscopic Reports, Objective 2

Executive Summary

This project analyzed ICCAT tender videos provided as part of the Remote Electronic Monitoring on Bluefin Tuna Processing Vessels (REM-BFT) Project. AQ1 AI methods were tested and compared to manual measurement and counting of the same footage. The results over the eight transfers demonstrated the AQ1 AI's accuracy in fish counting and sizing, even when video quality was affected by poor camera angles or distances. Notably, the AQ1 AI had not been pre-trained on these videos, ensuring reliable results from unseen footage. Under typical conditions, the AI processing time is faster than real-time, allowing for efficient processing of the footage.

Across the eight transfers, the AI's measurements showed an average size error of only 0.04 m (1.71%) compared to manual measurements, successfully sizing an average of 41.98% of the total fish count. This difference is comparable to the inherent error of a 3D calibrated stereo camera at the average fish distance measured, suggesting that any further accuracy improvement may not significantly improve the true operational accuracy in fish sizing. In counting, the AQ1 AI showed an average of 9.34% difference, with an error rate as low as 0.77% in transfer 21. The differences are primarily caused by occlusion and difficulties in detecting smaller, fast-moving fish within densely packed schools. Efforts are ongoing to enhance detection in these challenging scenarios.

Further comparisons are planned, pending additional videos from transfer cages, traps, and pre-harvest scenarios. Additionally, manual results provided by the control authorities are awaited to further assess accuracy. The AQ1 Gen 2 AI is now ready within the user friendly AM100 Analyser software for beta testing and will be made available to participating customers.

This work was carried out under the provision of the ICCAT. The contents of this document do not necessarily reflect the point of view of ICCAT, which has no responsibility over them, and in no ways anticipate the Commission’s future policy in this area.

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