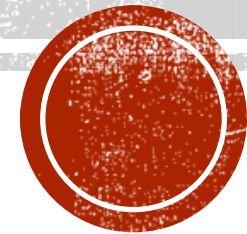# PILOT PROJECT TO TEST THE USE OF STEREOSCOPIC CAMERAS DURING THE FIRST TRANSFER AND THE AUTOMATION OF VIDEO FOOTAGE ANALYSIS

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OBJECTIVES

- Evaluate the use of stereoscopic cameras during the first transfers of bluefin tuna from purse seine vessels to transport cages for estimating weight at this stage.

- Analyze the use of software and artificial intelligence to automatically determine the number of individuals and their weight in first transfers.

CAMPAIGNS

- First transfer from a purse seiner to a transport cage in the Mediterranean.
- First transfer from a purse seiner to a transport cage in the Adriatic.
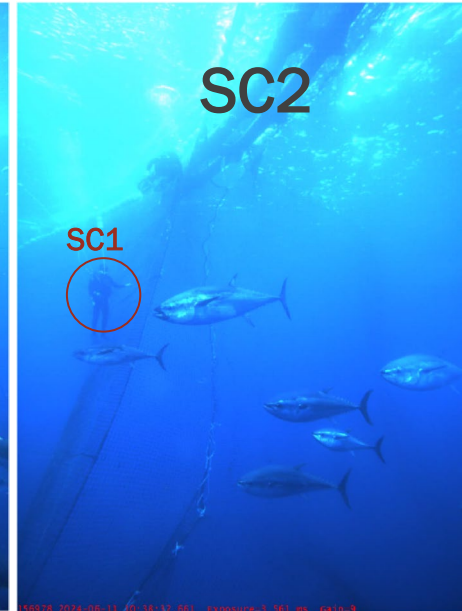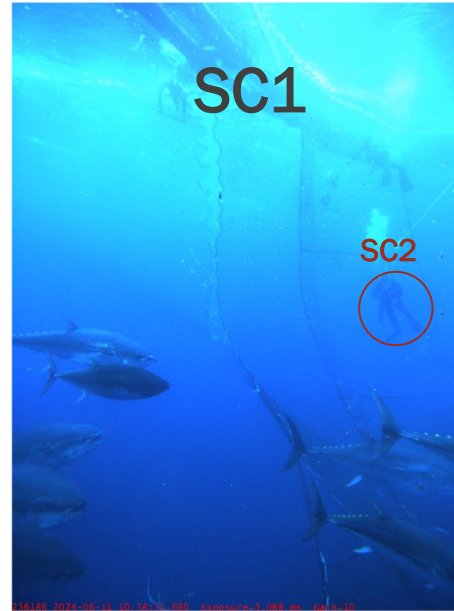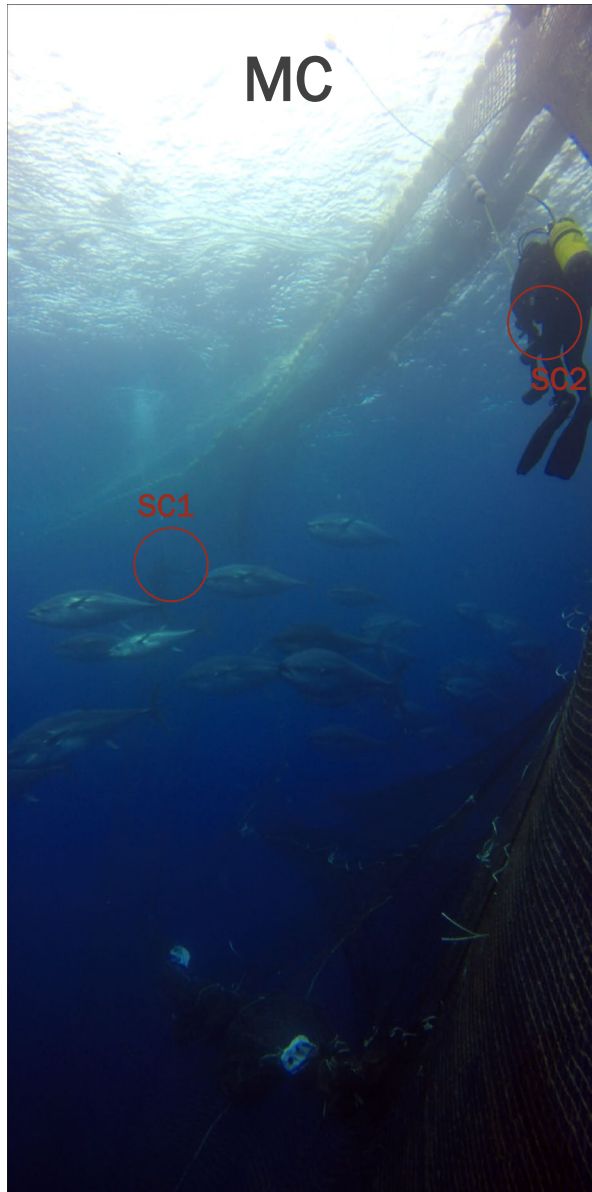
MED: RECORDING SETUP

- Mimic the recording setup at caging: monocamera for counting and stereocamera for sizing
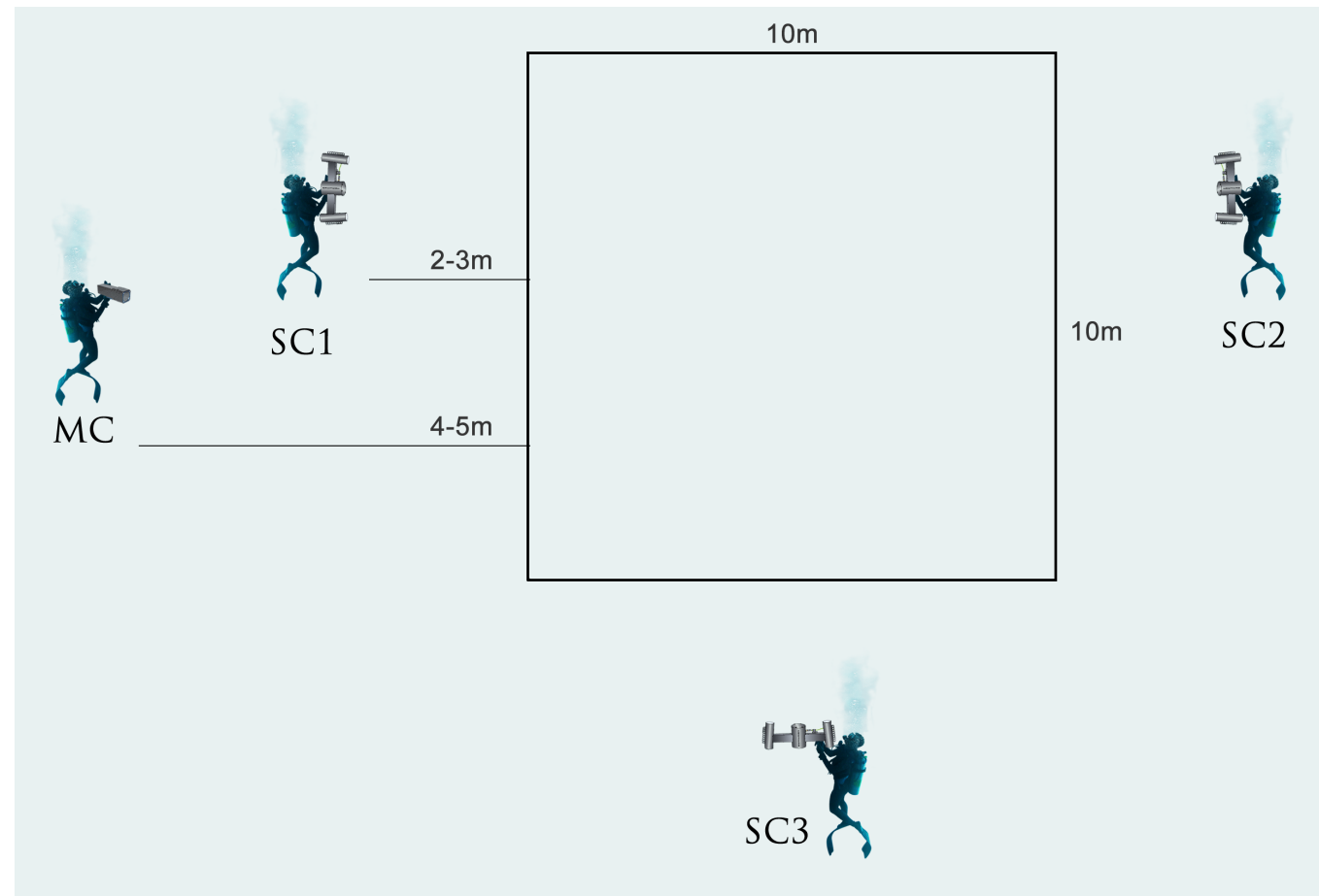
MED: RECORDING SETUP

MED: FIRST TRANSFERS

- 4 transfers from purse seine to transport cage in collaboration with Balfegó Tuna (Spain) were recorded

Transfer ID	11	12	20	21
Date and time	04/06/2024 17:23 – 18:34	05/06/2024 10:46 – 11:52	11/06/2024 10:07 – 10:57	13/06/2024 07:05 – 08:16
Video duration (min)	71	66	50	71
Number of cameras	2 lateral SC 1 ventral SC 1 MC	2 lateral SC 1 ventral SC 1 MC	2 lateral SC 1 MC	2 lateral SC 1 MC
Transport cage	ESP010R (with another transfer)		ESP014R	ESP008R

- For transfers 20 and 21, the weights estimated during first transfers could be compared to those from subsequent transfers to farm cages (no additional fish were added)

- For transfers 20 and 21 the ventral view was discarded due to operational constraints.

MED: MANUAL FISH COUNTING

First transfers ID	11	12	20	21
MC at first transfers	308/430	280/285	1379/1391	687/689
SC at first transfers	313 (-12%)	272 (-4%)	1138 (-18%)	559 (-19%)
MC at caging	1129		1315 (-5%)	653 (-5%)
Transport cages	ESP010R (with another transfer)		ESP014R	ESP008R

- At first transfers, fish can be counted with the monocamera, but not with stereocameras due to narrower camera field of view.

- In transfers 20 and 21, where no additional fish were added to the transport cage, the counting with monocamera at first transfers and at caging differs by 5%.
  - Since all fish fit within the camera's field of view, this disparity can be attributed to variations in water turbidity, differences between operators, and the inherent difficulty of counting fish in overlapping schools

MED: AUTOMATIC FISH COUNTING

SC

| First transfers ID		11	12	20	21
Manual	Number of fish	313	272	1138	559
	Time (min)	120 (2h)	90 (1.5h)	240 (4h)	180 (3h)
Auto	Number of fish	231 (-26%)	288 (+6%)	1274 (+16%)	463 (-17%)
	Time (min)	5	4	12	5

▪ The software applied to stereoscopic recordings showed differences between -26% and +16% compared to manual counting, but reduced the time invested from 10.5 hours to 26 minutes.

▪ We are working on improving algorithms for automatic fish counting, including for monocamera recordings.

MED: FISH SIZING

First transfers ID		11	12	20	21
Manual counting with monocamera		308/430	280/285	1379	687/689
Manual counting with stereocamera		313	272	1138	559
Manual	Number of samples (%SC - %MC)	97 (31% - 23%)	56 (21% - 20%)	507 (45% - 37%)	406 (73% - 59%)
	Average length (cm)	207.3	212.7	201.9	210.5
	Average distance (m)	5.6	5.6	5.8	5.4
	Time (min)	150 (2.5h)	80 (1.3h)	570 (9.5 h)	180 (3h)
Auto	Number of samples* (%SC - %MC)	230 (73% - 63%)	244 (90% - 87%)	859 (75% - 62%)	409 (73% - 59%)
	Average length (cm)	203.8 (-1.7%)	208.5 (-2.0%)	197.8 (-2.0%)	213.7 (+1.5%)
	Average distance (m)	6.3	6.0	6.0	5.5
	Time (min)	14	33	35	42
Caging: transport cage ID		ESP010R (with another transfer)		ESP014R	ESP008R
Manual	Number of samples	Not available		Not available	Not available
	Average length (cm)	Not available		Not available	Not available

- * Automatically estimate a high percentage of the fish (73%, 90%, 75%, and 73%, although the tracking algorithm needs revision to verify the actual number of samples, as these results may be inflated)
- Average length from automatic measurements closely matches manual measurements (-1.7%, -2.0%, -2.0%, +1.5%)
- Time invested is reduced from 10.5 hours to 26 minutes.

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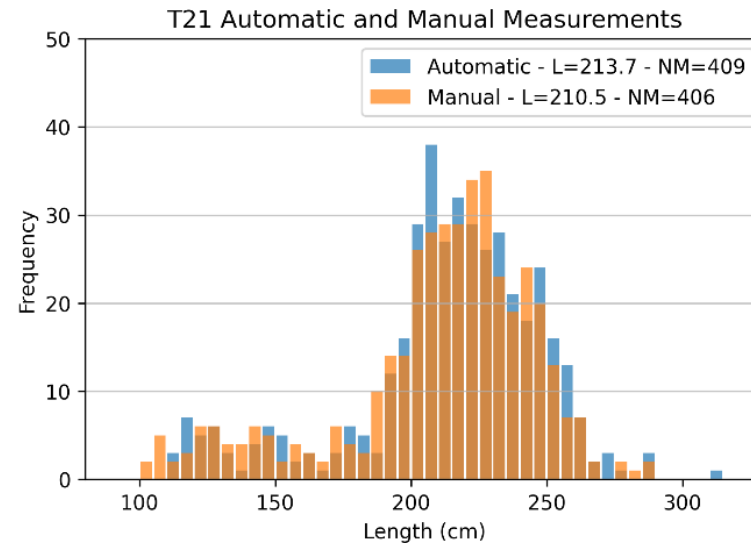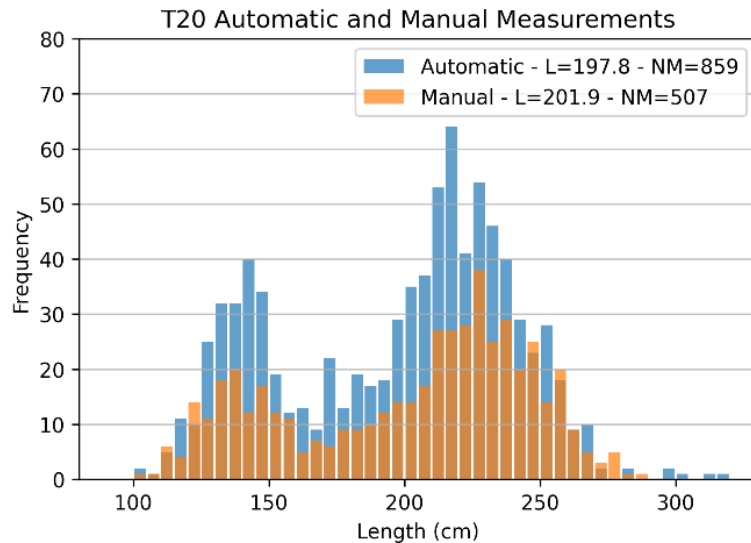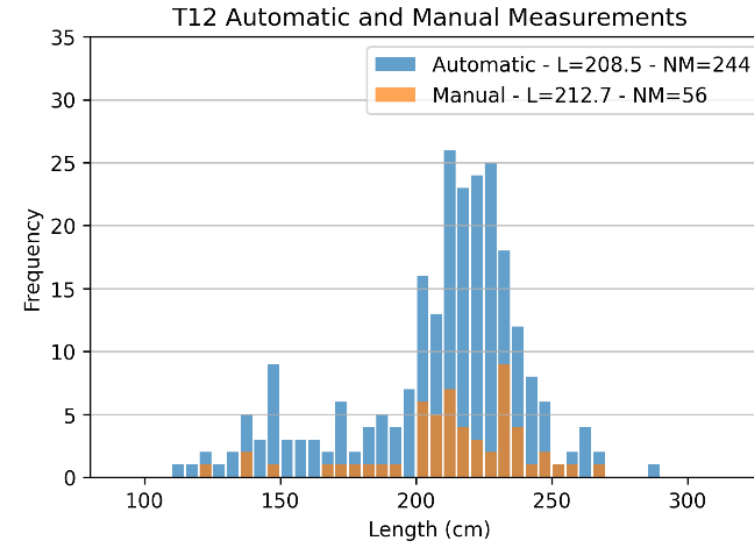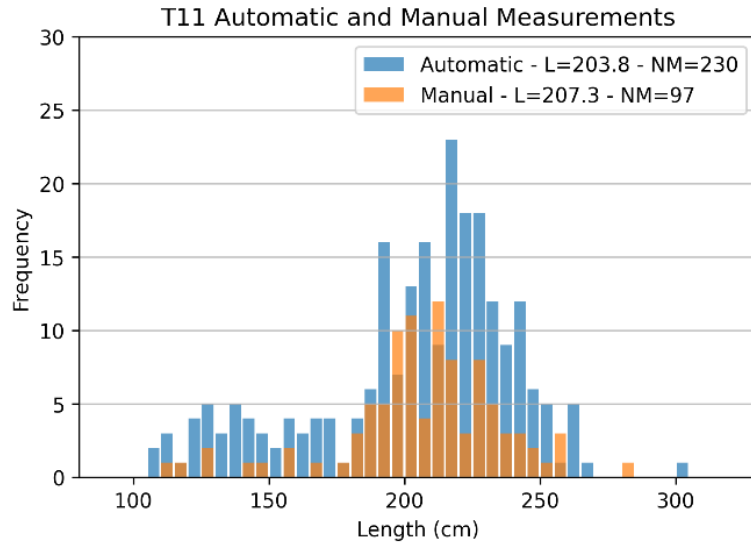
# MED: FISH SIZING

MED: FISH SIZING
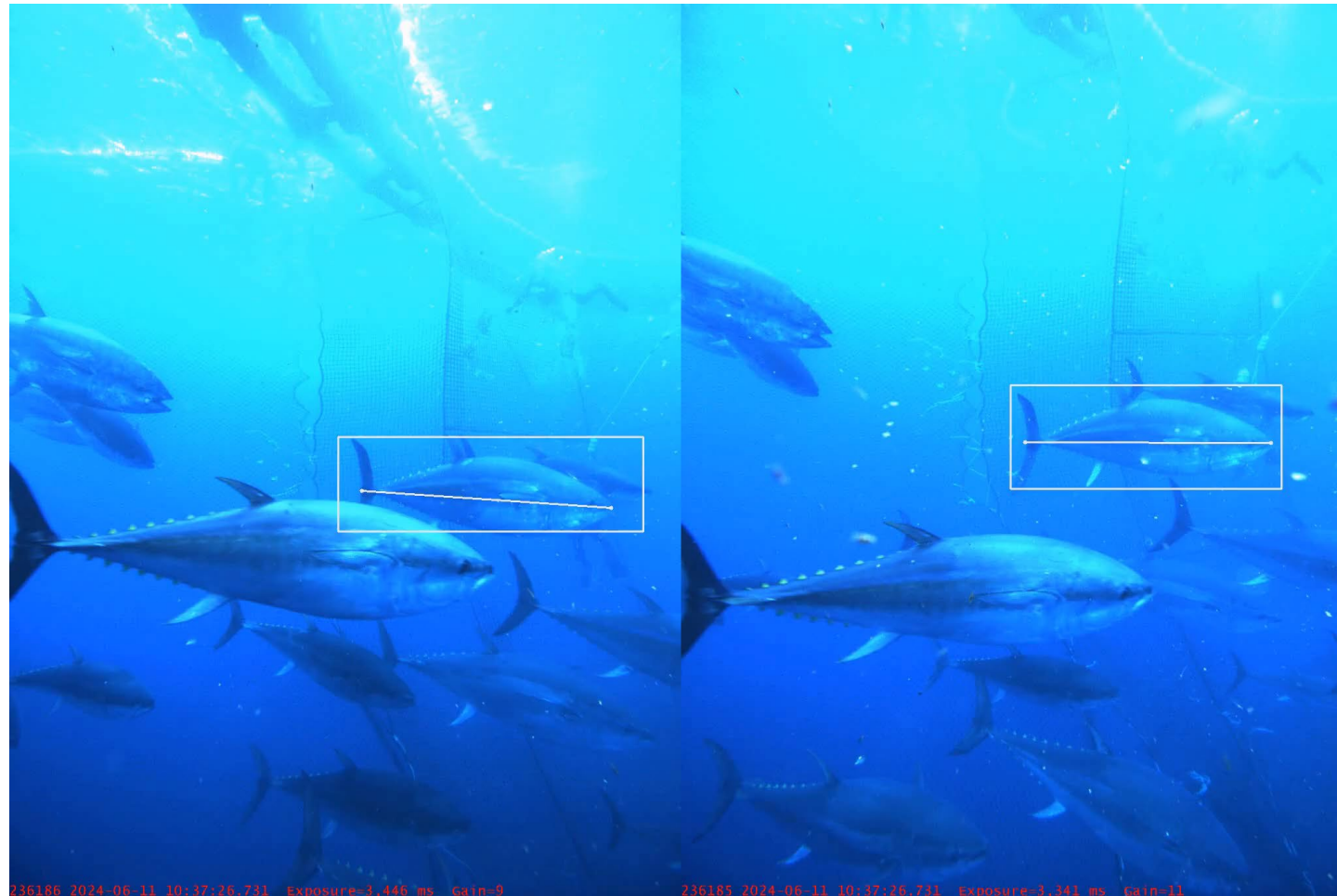
ADRIATIC: RECORDING SETUP

- Cannot mimic the recording setup at caging: very different gate sizes (4x3m at caging, 14x6m at first transfers)

- Two alternative recording setups were agreed upon with the operators:
  - Use a 7x6 meter gate and record with one stereocamera for small catches, up to 500 fish averaging 8-10 kg.
  - Maintain the 14x6 meters gate and record with two stereocameras, positioned on either side of the gate, to accommodate larger catches.

- The only transfer recorded was done with 2 SC separated 12m, what results in an approximate gate size of 10x6m.
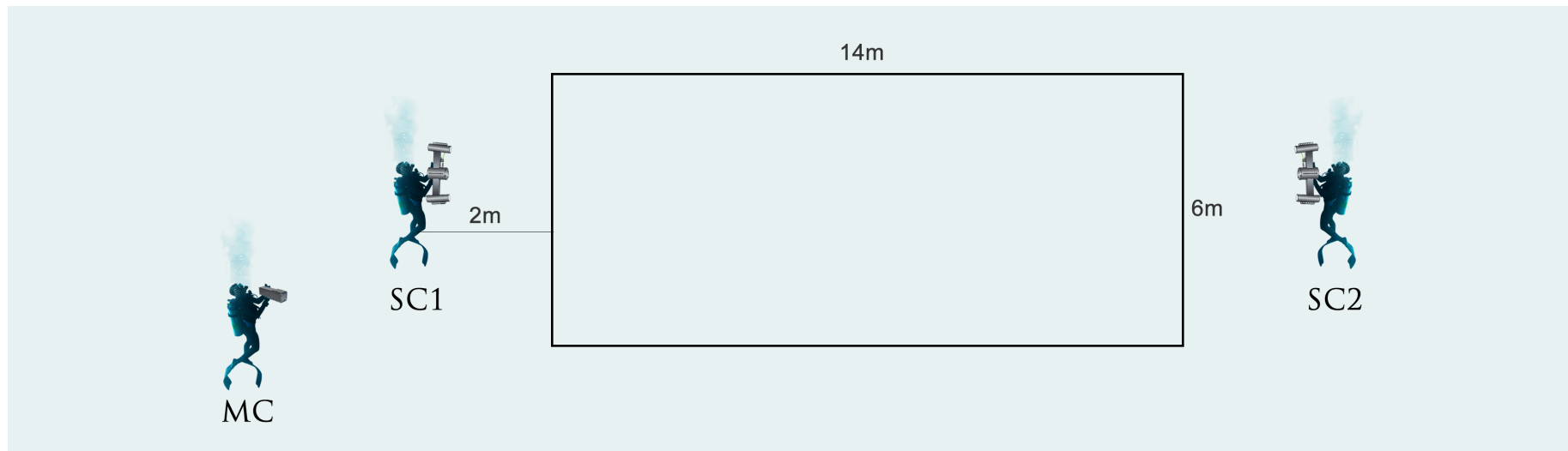
ADRIATIC: RECORDING SETUP
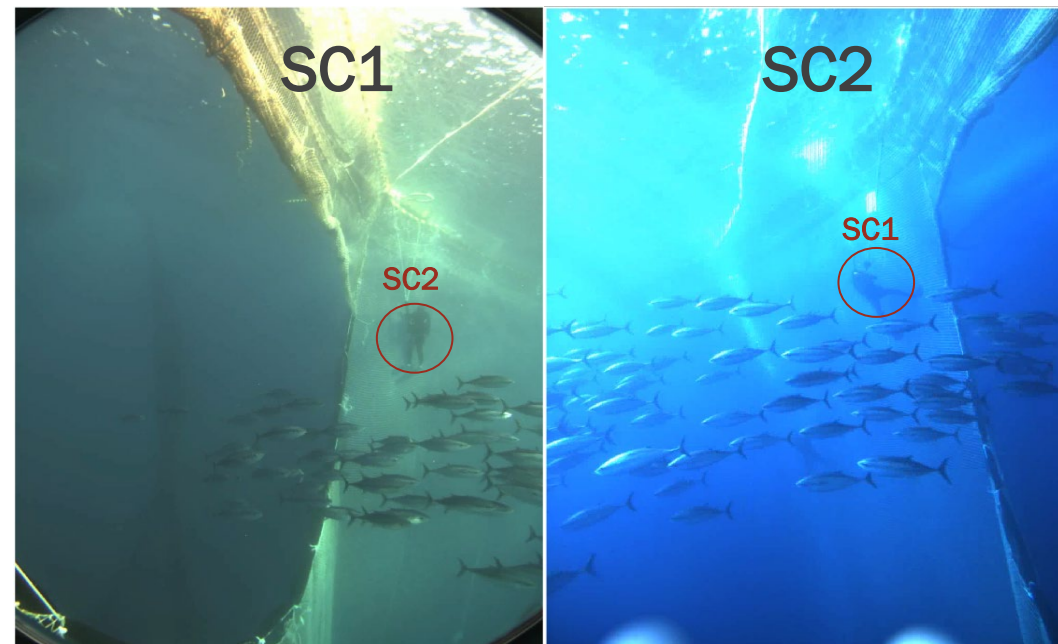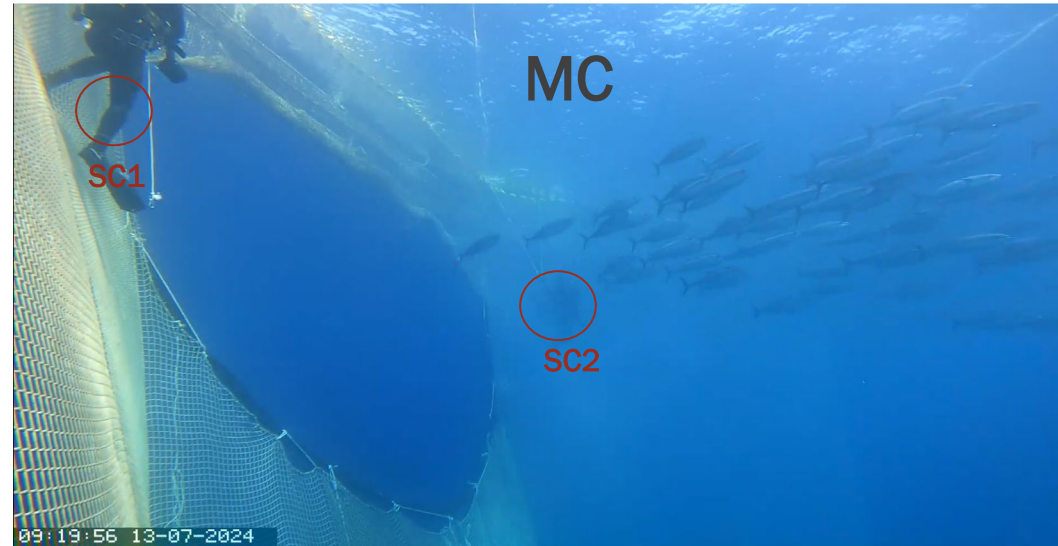
ADRIATIC: FIRST TRANSFERS

- Only one transfers from purse seine to transport cage in collaboration with Jadran Tuna (Croatia) was recorded

Transfer ID	T_CRO
Transport cage	EUHRV013 (with other 4 transfers)
Date and time	20240713 08:59-9:30
Video duration (min)	31
Number of cameras	2 lateral SC and 1 MC
Video link	Link

- The lack of additional recordings was due to a scarcity of catches during our 17-day extended stay in Croatia, primarily caused by unfavorable weather and sea conditions.

- The tests were conducted late in the season, by which time most of the quota had already been captured, as per the operators' request.

- A comparison of fish counting and sizing between first transfers and caging could not be performed, as fish from four other first transfers were placed into the transport cage.

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ADRIATIC: MANUAL FISH COUNTING

Transfer ID	T_CRO
Date and time	20240713 08:59-09:30
Video duration (min)	31
Counting in First Transfers	
Manual with monocamera	290/300
Manual with stereocamera	243/250 (-16.7%)
Counting at caging	
Manual with stereocamera	2668 (with other 4 transfers)

- All fish fit within field of view of both cameras, so the stereocamera could be used for counting, but a difference of 16.7% was observed.
- The slightly different perspective of the monocamera helps to better distinguish fish in such overlapping schools.

ADRIATIC: FISH SIZING

Transfer ID		T_CRO
Date and time		20240713 08:59-09:30
Transport cage		EUHRV013 (with other 4 transfers)
Video duration (min)		31
Length estimation in First Transfers		
Number of fish with monocamera		290/300
Number of fish with stereocamera		243/250
Manual	Number of samples	160 (SC: 65% - MC: 54%)
	Average length (cm)	80.6
	Time (min)	180 (3h)
Auto	Number of samples	30 (SC: 12% - MC: 10%)
	Average length (cm)	79.3 (-1.6%)
	Time (min)	3
Length estimation at caging		
Manual	Number of fish	2668
	Number of samples	917 (34%)
	Average length (cm)	79.1

- 65% of the transferred individuals counted with the stereocamera recording were measured manually
- The software needs further training to increase sample size (12%)
- Average length from automatic measurements closely matches manual measurements (-1.6%)
- Time invested is reduced from 3 hours to 3 minutes.

ADRIATIC: FISH SIZING
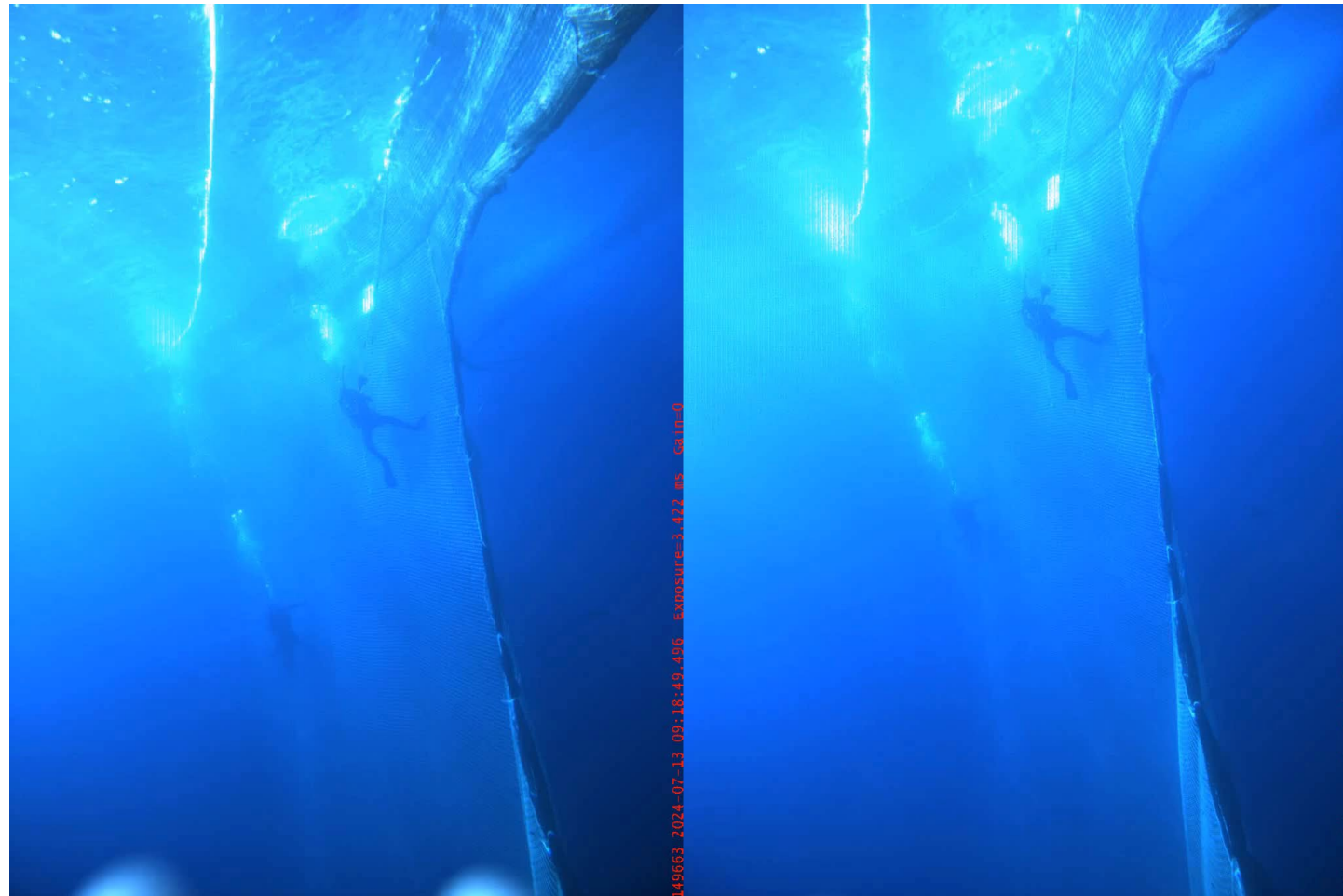
ADR_autosizing_demo.mp4

CONCLUSIONS

- Estimating weight at first transfers with stereoscopic and conventional cameras is feasible.

- Length measurements were obtained manually from stereocamera recordings by marking the snout and fork tail points of individuals (32%, 21%, 45%, and 73% for four transfers in the Mediterranean, and 65% for one transfer in the Adriatic), while fish counts were determined from monocamera recordings.

- The use of software and artificial intelligence for automatic fish counting in first transfers, applied to stereoscopic recordings, showed differences between -26% and +16% compared to manual counting, but reduced the time invested from 10.5 hours to 26 minutes.

- The use of software and artificial intelligence for automatic fish length estimation proved effective for automatically estimate a high percentage of the fish in the Mediterranean. However, further development of the tracking algorithm is needed to provide a reliable sample size, and additional training is required to improve the software's performance in the Adriatic, where only 12% of the fish were sampled

- Average lengths obtained from automatic measurements closely matched manual measurements (-1.7%, -2.0%, -2.0%, +1.5% in the Mediterranean and -1.6% in the Adriatic), and the time required was significantly reduced from 16 hours to 2 hours in the Mediterranean and from 3 hours to 3 minutes in the Adriatic.

ACKNOWLEDGMENTS