

EVALUATING A PURSE-SEINE CAPTAIN'S ABILITY TO ACCURATELY PREDICT SPECIES COMPOSITION, SIZES, AND QUANTITIES OF TUNAS PRIOR TO SETTING AROUND DRIFTING FISH-AGGREGATING DEVICES



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CATCH PREDICTION

OBJECTIVES

- Evaluate the Captain's ability to determine the presence of bigeye
- Evaluate the Captain's ability to estimate the amount, in tons, of skipjack, bigeye, and yellowfin present
- Evaluate the Captain's ability to estimate the amount, in tons, within one of three size classes (<2.5 kg, 2.5-15 kg, >15 kg), for skipjack, bigeye, and yellowfin
- Evaluate additional tools or technologies (ROV, high-tech echo-sounder) to determine if they can improve on the Captain's estimates

CATCH PREDICTION

Materials and Methods:

- Furuno CSH-5 Full circle multi-beam scanning sonar (60 kHz) Yolanda L
- Furuno FCV-261 echo-sounder (200 kHz) Yolanda L
- Furuno FCV-620 echo-sounder (50 kHz) aboard light boat
- Workboat (7.5 m fiberglass, enclosed pilothouse, 150 hp Yamaha outboard)
- Simrad ES-70 echo-sounder configured with a split beam 120 kHz transducer installed aboard workboat
- SEABOTIX LBV 200 mini ROV system equipped with sonar, cameras, and lasers, aboard workboat
- Acoustic and optical surveys of tuna aggregations utilizing the ES70 echo-sounder and SEABOTIX ROV aboard the workboat.
- Pre-set estimates of the species composition, sizes, and quantities of tunas provided by Captain, based on acoustics from purse-seine vessel and light boat, and visual observations from mast men.
- Tunas loaded and separated by sets within wells, so as to obtain weights by species weight classes within set, from Starkist cannery in Manta, Ecuador

YOLANDA L

CAPTAIN RICARDO DIAZ



Length: 66.46 m

Width: 12.20 m

Draft: 8.32 m

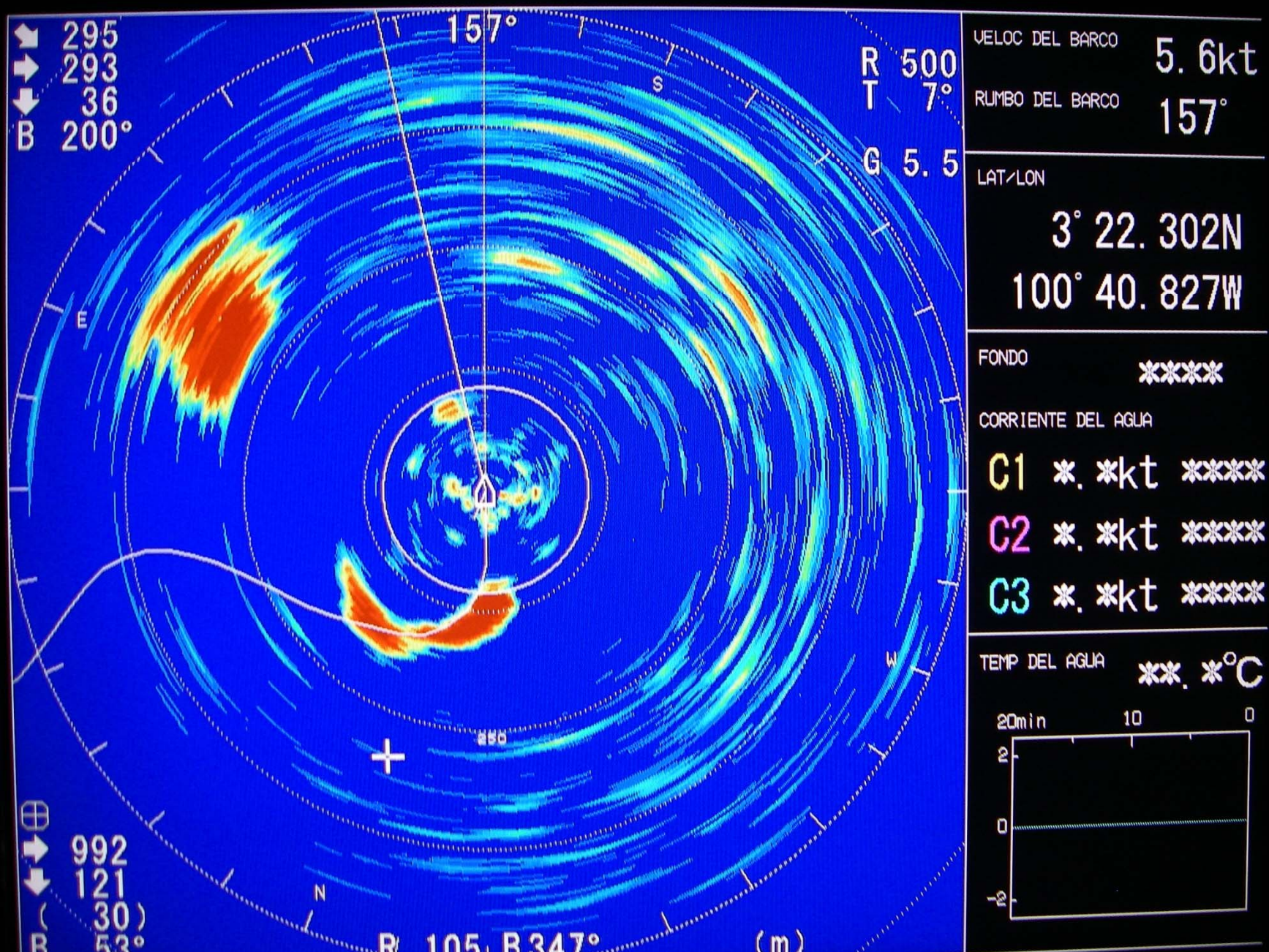
Well Volume: 1, 168 m³

Capacity (t): 1041

HP: 3, 600

Cruise Speed: 12 Knots

Furuno CSH-5 SONAR Showing a Large Tuna Aggregation



YOLANDA L Light-Boat



YOLANDA L Mast men







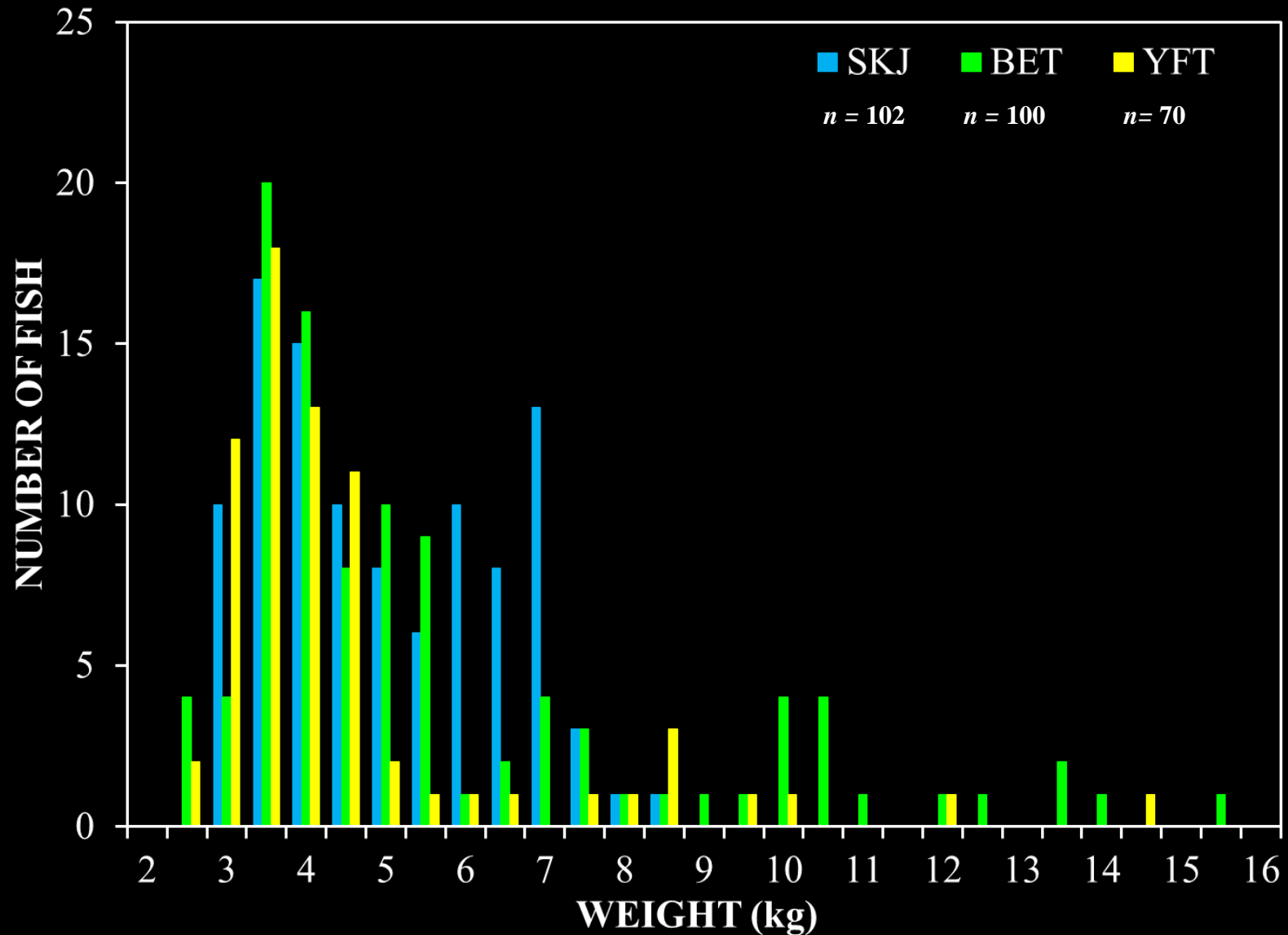




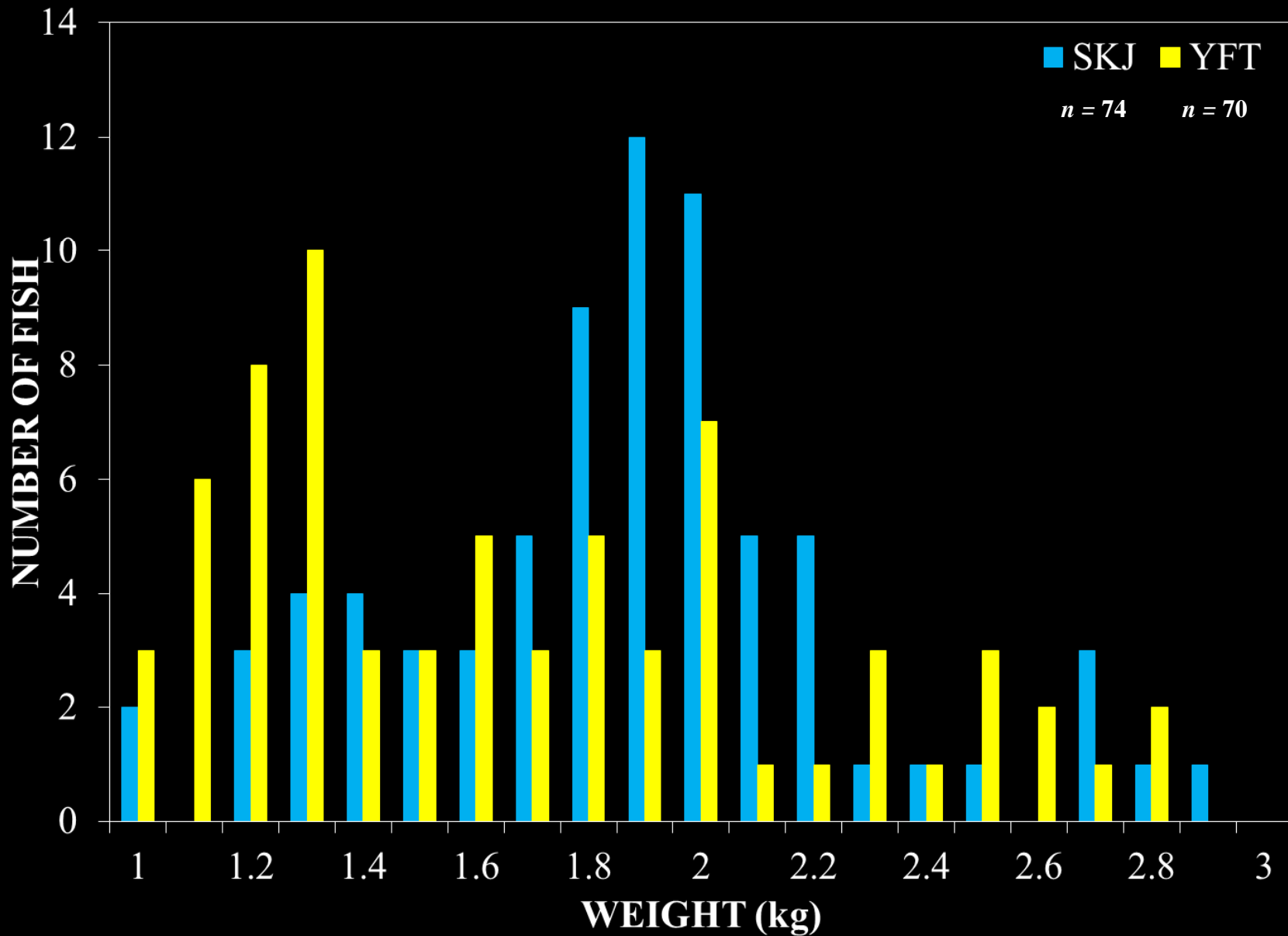
SUMMARY OF PURSE-SEINE SETS WHERE CATCH PREDICTIONS WERE CONDUCTED

| Set | Date | Position | | Catch (mt) | | | Total |
|-----|--------------|----------|-----------|------------|------|------|-------|
| | | Latitude | Longitude | SKJ | BET | YFT | |
| 1 | 27-May-2011 | 4°10 N | 103°50 W | 50.9 | 6.3 | 14.2 | 71.5 |
| 2 | 31-May-2011 | 4°20 N | 104°09 W | 55.1 | 5.9 | 13.4 | 74.5 |
| 3 | 01-June-2011 | 4°03 N | 104°11 W | 16.4 | 1.0 | 4.6 | 21.9 |
| 4 | 04-June-2011 | 3°45 N | 104°03 W | 115.1 | 13.8 | 18.0 | 146.9 |
| 5 | 09-June-2011 | 4°59 N | 104°09 W | 14.5 | 11.7 | 12.8 | 39.0 |
| 6 | 23-June-2011 | 3°22 N | 100°40 W | 166.9 | 6.6 | 8.9 | 182.4 |
| 7 | 30-June-2011 | 2°04 N | 102°17 W | 110.9 | 2.0 | 29.9 | 142.8 |
| 8 | 10-July-2011 | 4°52 N | 103°30 W | 56.3 | 2.3 | 13.7 | 72.3 |

WEIGHT FREQUENCY DISTRIBUTIONS OF MANUALLY SORTED (2.5 – 15 kg) SKJ, BET, AND YFT SAMPLED AT THE STARKIST FACILITY IN ECUADOR



WEIGHT FREQUENCY DISTRIBUTIONS OF MANUALLY SORTED (<2.5 kg) SKJ AND YFT SAMPLED AT THE STARKIST FACILITY IN ECUADOR



WEIGHTED LINEAR RELATIONSHIPS BETWEEN PREDICTED CATCH AND THE ACTUAL WEIGHT OF THE CATCH BY SPECIES AND FOR ALL SPECIES COMBINED

| | <i>Slope</i> | <i>Intercept</i> | <i>r</i> ² | <i>F</i> | <i>P</i> |
|-------------------------|--------------|------------------|-----------------------|----------|----------|
| Skipjack Tuna | 0.554 | 4.950 | 0.92 | 71.32 | 0.0002 |
| Bigeye Tuna | 1.991 | 3.564 | 0.51 | 6.32 | 0.0455 |
| Yellowfin Tuna | 1.447 | -3.017 | 0.62 | 9.96 | 0.0197 |
| Combined Species | 0.930 | 1.098 | 0.94 | 87.98 | 0.0001 |

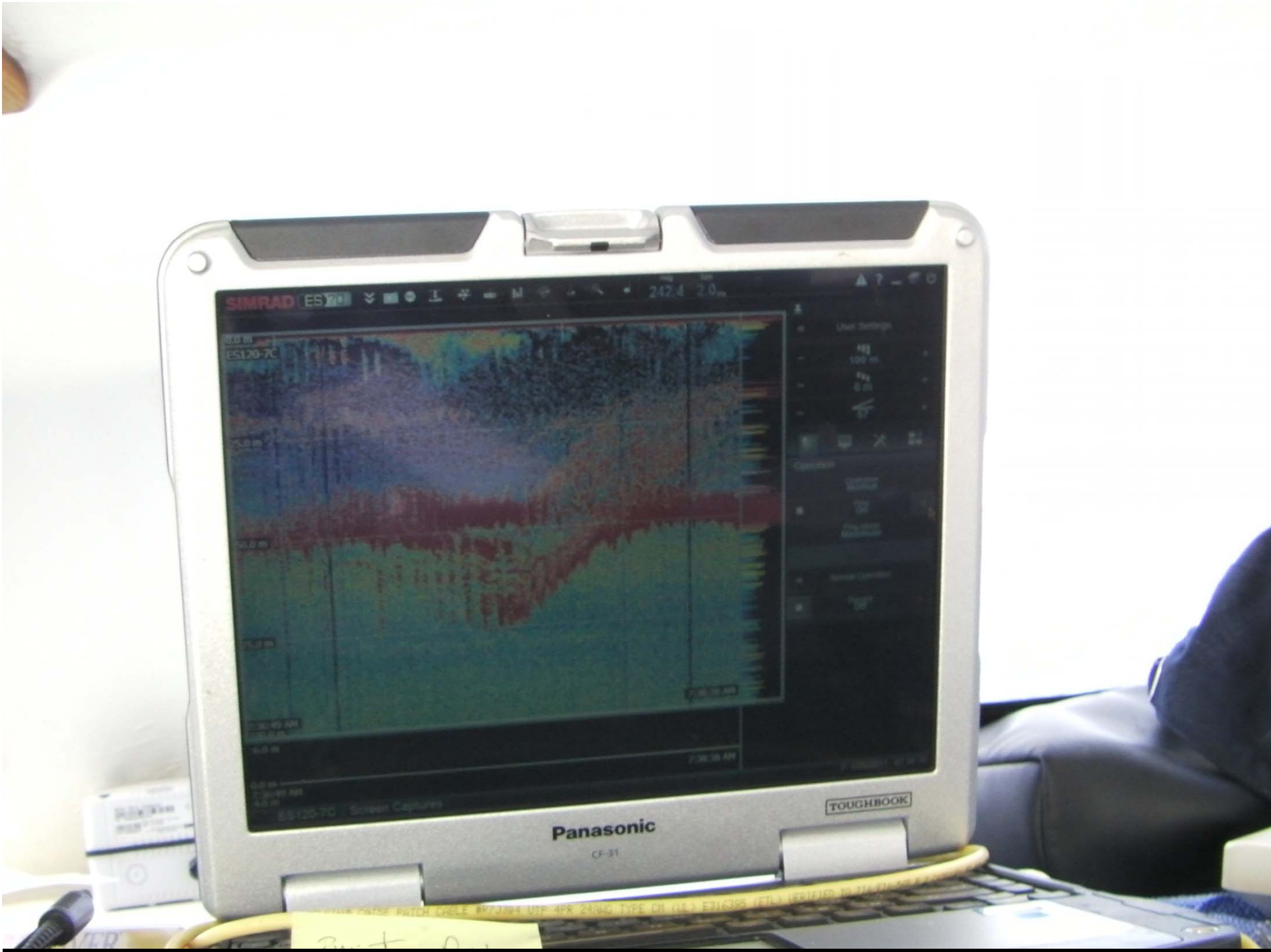
LINEAR RELATIONSHIPS BETWEEN PREDICTED CATCH AND THE ACTUAL CATCH WEIGHT BY SPECIES AND WEIGHT CLASS

| | <i>Slope</i> | <i>Intercept</i> | <i>r</i> ² | <i>F</i> | <i>P</i> |
|-----------------------------------|--------------|------------------|-----------------------|----------|----------|
| Skipjack Tuna < 2.5 kg | 0.210 | 3.55 | 0.294 | 2.50 | 0.165 |
| Skipjack Tuna 2.5-15 kg | 0.687 | 16.52 | 0.343 | 3.13 | 0.127 |
| Bigeye Tuna 2.5-15 kg | 0.475 | 12.18 | 0.044 | 0.28 | 0.616 |
| Yellowfin Tuna < 2.5 kg | 0.498 | 2.05 | 0.145 | 1.01 | 0.353 |
| Yellowfin Tuna 2.5-15 kg | 0.597 | 10.47 | 0.074 | 0.48 | 0.515 |

CAPTAIN'S PREDICTED CATCH IN WEIGHT BY SPECIES AND PERCENT DIFFERENCES FROM ACTUAL CATCH

| Set | SKJ | | | BET | | | YFT | | | YFT and BET | | |
|-----------------------------|-----------|----------|-------------|--------------|----------|-------|-------------|----------|-------|-------------|----------|-------|
| | Estimated | Captured | % Dif | Estimated | Captured | % Dif | Estimated | Captured | % Dif | Estimated | Captured | % Dif |
| 1 | 35.0 | 50.9 | 37.0 | 18.0 | 6.3 | 96.3 | 22.0 | 14.2 | 43.1 | 40.0 | 20.5 | 64.5 |
| 2 | 45.0 | 55.1 | 20.2 | 7.0 | 5.9 | 17.1 | 11.0 | 13.4 | 19.7 | 18.0 | 19.3 | 7.0 |
| 3 | 13.0 | 16.4 | 23.1 | 5.0 | 1.0 | 133.3 | 2.0 | 4.6 | 78.8 | 7.0 | 5.6 | 22.2 |
| 4 | 93.0 | 115.1 | 21.2 | 33.0 | 13.8 | 82.1 | 34.0 | 18.0 | 61.5 | 67.0 | 31.8 | 71.3 |
| 5 | 8.0 | 14.5 | 57.8 | 30.0 | 11.7 | 87.8 | 20.0 | 12.8 | 43.9 | 50.0 | 24.5 | 68.5 |
| 6 | 90.0 | 166.9 | 59.9 | 35.0 | 6.6 | 136.5 | 37.0 | 8.9 | 122.4 | 72.0 | 15.5 | 129.1 |
| 7 | 65.0 | 110.9 | 52.2 | 35.0 | 2.0 | 178.4 | 30.0 | 29.9 | 0.3 | 65.0 | 31.9 | 68.3 |
| 8 | 25.0 | 56.3 | 77.0 | 9.0 | 2.3 | 118.6 | 12.0 | 13.7 | 13.2 | 21.0 | 16.0 | 27.0 |
| Average % Difference | | | 43.5 | 106.3 | | | 47.9 | | | 57.2 | | |



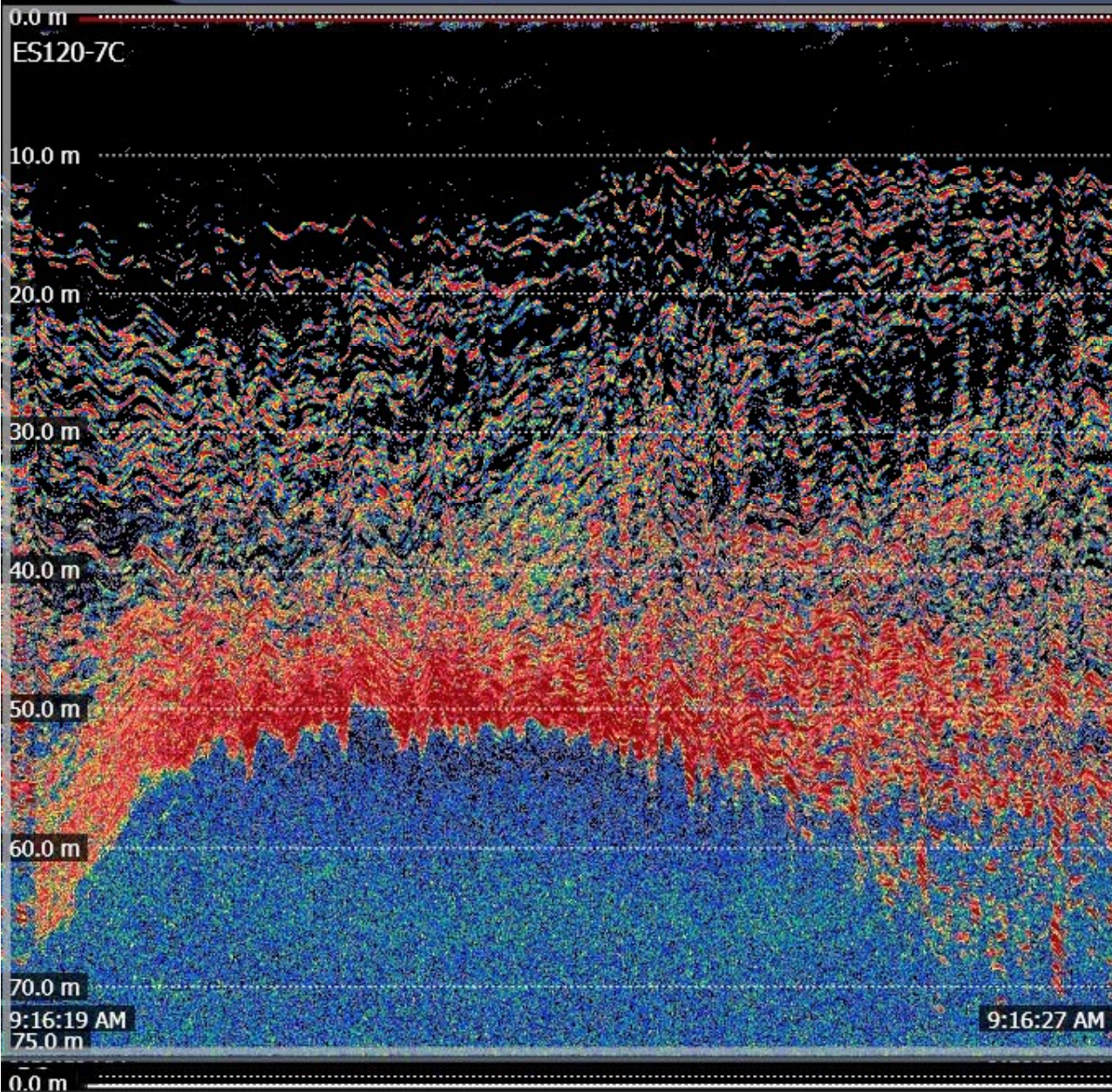


SIMRAD ES70



05° 7.329_N Hdg 80.4 Spd 3.2_{kts}
105° 7.775_W

FAD-D20110607-T161445



User Settings

75 m

0 m

47

Operation

Operation Replay

Ping Off

Ping Mode Interval

Ping Interval 250 ms

Normal Operation

Record Off

Seabotix LBV – 200 ROV



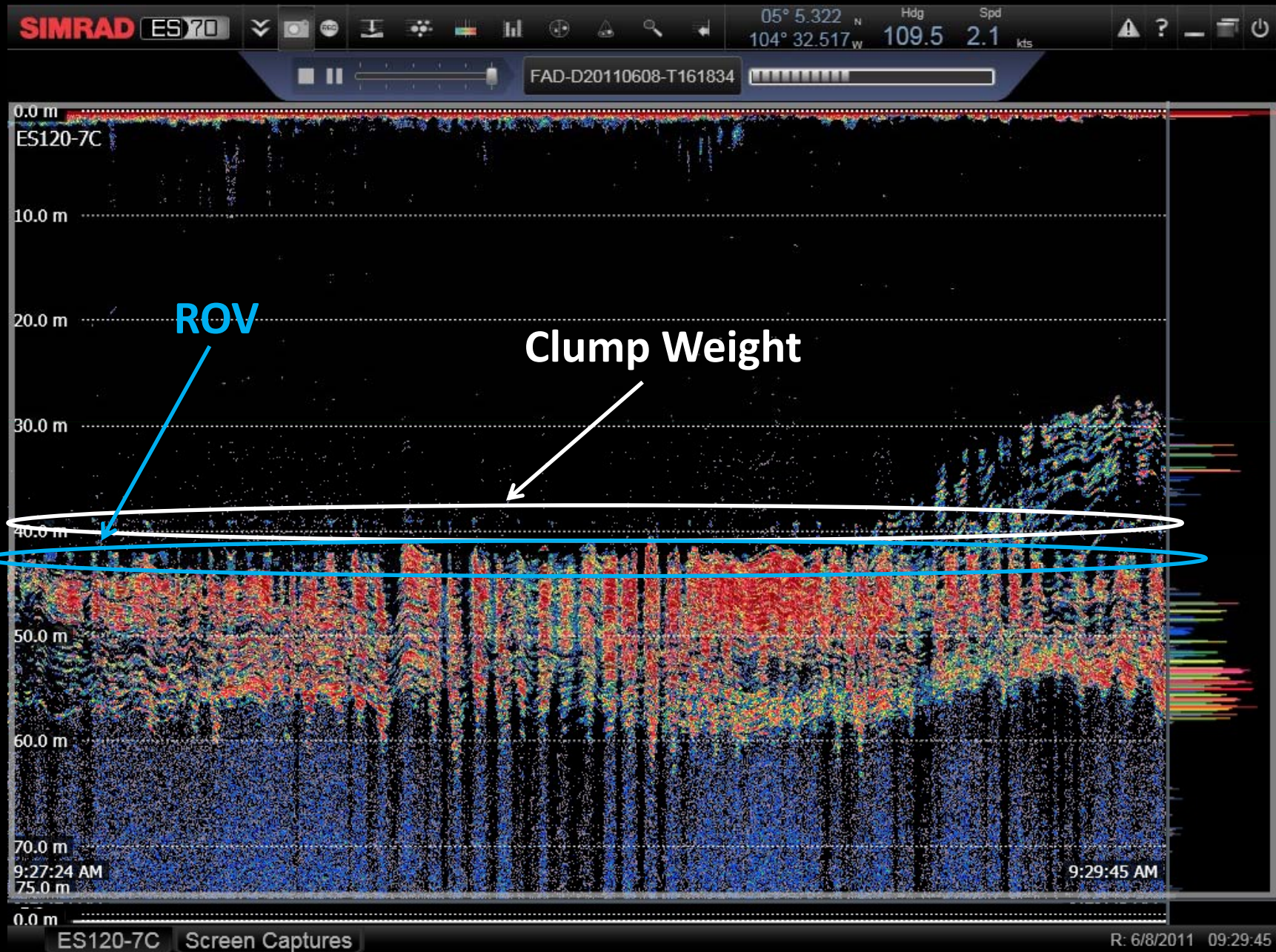
LBV – 200, Umbilical, and Honda Generator

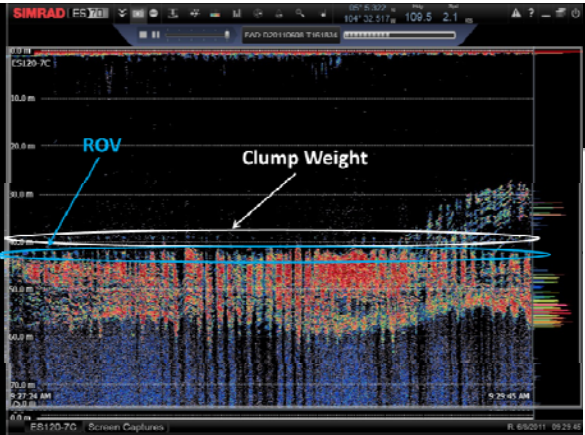


Summary of Acoustic and Video Imagery with Species Observed on Video

| Exp. # | Date | Simrad ES-70 | ROV Video | Species Observed |
|--------|-----------|--------------|-----------|------------------|
| 1 | 5/25/2011 | Y | Y | BET, SKJ, YFT |
| 2 | 5/29/2011 | Y | N | NA |
| 3 | 6/2/2011 | Y | Y | BET, SKJ, YFT |
| 4 | 6/7/2011 | Y | N | NA |
| 4 | 6/8/2011 | Y | Y | BET, SKJ, YFT |
| 5 | 6/10/2011 | Y | N | NA |
| 6 | 6/16/2011 | Y | N | NA |
| 7 | 6/22/2011 | Y | Y | BET, SKJ, YFT |
| 8 | 6/29/2011 | Y | N | NA |
| 9 | 7/7/2011 | Y | N | NA |
| 10 | 7/11/2011 | Y | N | NA |

Simrad ES-70 Showing Clump Weight, ROV, and Tuna





V8 *266HD+0 CA+30 08JUN11
H8 EL *0043.5MS 22C 08:35:45

PREDICTED CATCH IN PROPORTIONS BY SPECIES AND PERCENT DIFFERENCES FROM ACTUAL CATCH

| SET | Captain's | | | Scientist's | | | Actual | | |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|--------|-----|-----|
| | SKJ (% DIF) | BET (% DIF) | YFT (% DIF) | SKJ (% DIF) | BET (% DIF) | YFT (% DIF) | SKJ | BET | YFT |
| 1* | 47 (41) | 24 (93) | 29 (37) | 20 (112) | 50 (140) | 30 (40) | 71 | 9 | 20 |
| 2 | 71 (4) | 11 (32) | 17 (6) | 75 (1) | 10 (23) | 15 (18) | 74 | 8 | 18 |
| 4* | 65 (19) | 25 (91) | 10 (20) | 80 (2) | 10 (6) | 10 (20) | 78 | 9 | 12 |
| 5 | 58 (44) | 21 (35) | 21 (44) | 10 (115) | 40 (29) | 50 (42) | 37 | 30 | 33 |
| 6 | 56 (49) | 22 (142) | 22 (129) | 48 (63) | 4 (0) | 48 (163) | 91 | 4 | 5 |
| 7* | 50 (43) | 27 (180) | 23 (10) | 65 (18) | 15 (166) | 20 (5) | 78 | 1 | 21 |
| MEAN % DIF | 33 | 96 | 41 | 52 | 61 | 48 | | | |

* Sets where ROV operations were conducted

SUMMARY OF RESULTS

- Catch prediction experiments require rigorous logistics and validation
- The sorting of landings by species and size classes, by cannery workers, at Starkist facility, Manta, Ecuador, were verified to be highly accurate
- The Captain was able to positively identify the presence of small bigeye and yellowfin in all 8 sets
- The overall percent differences between the Captain's predicted and actual catches, by species, indicate some estimates were fairly accurate
- The overall percent differences between the Scientist's predicted and actual catches, as a proportion of the catch, were no better than that of the Captain's
- If the bigeye and yellowfin predicted catches are combined, and compared to the actual catches, then the accuracy in estimates is slightly improved
- Additional catch prediction experiments, in areas with higher proportions of bigeye present within aggregations, are warranted

Acknowledgements

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