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PROJECT REPORT

VESSEL: NOAA Ship *Oscar Elton Sette*, Project SE-22-04

PROJECT PERIOD:
June 9 – 12, 2022 gear trials
June 13 – July 10, 2022 planned project start date
June 20 – July 10, 2022 actual project start date

AREA OF OPERATION: Operations were conducted in the waters of the North Pacific along the 150°W meridian from 30°N to 10.7°N (Fig. 1).

TYPE OF OPERATION: Conductivity-temperature-depth (CTD) casts to 1300 m depth were 150° meridian from 30°N to 10°N, as well as two casts at the end of a sample cycle (approximately at 0530 and/or 1730) at the extended stations. An oblique bongo tow down to ~200 m was conducted at 0800 and 2000 daily at all 13 base stations. A 2-m ring net yo-yo tow down in the top 50 m was conducted at 0930 and 2130 daily at all 13 base stations. Operations were extended at a subset of stations along the transect, where we held station for 24 hours. At those stations, the bongo and ring-net operations were replaced by MOCNESS and IKMT tows, respectively. Acoustic backscatter and surface temperature and salinity were collected continuously throughout the project.

ITINERARY:

09 June 0800 Start of project (All times in HST). Embarked Johanna Wren, Ryan Rykaczewski, Donald Kobayashi, Jonathan Whitney, James Ruzicka, Calla Lloyd-Lim, Alexa Gonzalez, Nan Himmelsbach, Andrea Schmidt, Madison Kearsey, Gabrielle Mukai, Joshua Stone, Nayan Mallick, Jacob Snyder, Nathaniel Park, Dianna Miller-Green, Réka Domokos-Boyer, Robert McLean. Proceeded to first gear trial location off leeward Oahu and began Cobb trawl gear trials. 1800 started EK80 calibration. 2330 Completed EK80 calibration.

10 June 0750 Disembarked Dianna Miller-Green at Waiʻanae Small Boat Harbor via small boat. 0831 commenced trawl gear trials. 1930 Reported positive COVID test aboard. Suspended gear trials and returned to Pearl Harbor in the morning.

11 June 0700 Returned to port due to COVID positive test aboard. 1230 disembarked Johanna Wren, Ryan Rykaczewski, Donald Kobayashi, Jonathan Whitney, James Ruzicka, Calla Lloyd-Lim, Alexa Gonzalez, Nan Himmelsbach, Andrea Schmidt, Madison Kearsey, Gabrielle Mukai, Joshua Stone, Nayan Mallick, Jacob Snyder, Nathaniel Park, Réka Domokos-Boyer, Robert McLean.

12-17 June COVID-19 delay. Although COVID-19 complications prevented sailing away from port overnight, gear trials occurred during day trips from Pearl Harbor on 18 and 19 June.

18 June Day trip gear trial.

19 June Day trip gear trial. An issue was discovered with the Cobb trawl winch, and this issue could not be easily repaired and eliminated the possibility that the Cobb trawl could be used during the project.

20 June Resumed project. Survey location moved from 30–10°N, 140°W to 30–10°N, 150°W to accommodate the reduction from 28 DAS to 21 DAS. Further, extended stations reduced from eight (8) to five (5) to make up for COVID delay while base stations remained the same. Cobb trawl operations replaced with 10' IKMT (Isaacs Kidd Midwater Trawl) operations.

1000 Embarked Johanna Wren, Ryan Rykaczewski, Donald Kobayashi, Jonathan Whitney, James Ruzicka, Calla Lloyd-Lim, Alexa Gonzalez, Nan Himmelsbach, Andrea Schmidt, Madison Kearsey, Gabrielle Mukai, Joshua Stone, Alexander Barth, Nayan Mallick, Jacob Snyder. Proceeded to first project station A at 30°N and 150°W (Fig. 1.). Began active acoustics data collection.

21 June 0529 Stopped for first Argo buoy F1396 deployment at position 23° 14.87'N, 155° 52.35'W which is within 30 nm of preferred drop location at 23.5°N, 155.95°W. After Argo drop, proceeded towards first project station A.

22 June 0607 Stopped for second Argo buoy F1285 deployment at position 26° 14.35'N, 153° 22.81'W which is within 30 nm of preferred drop location at 26°N, 153.61°W. After Argo drop, proceeded towards first project station A.

2058 Stopped for third Argo buoy F1375 deployment at position 27° 57.71'N, 151° 44.2'W which is within 30 nm of preferred drop location at 28°N, 151.7°W. After Argo drop, proceeded towards first project station A.

23 June 1000 Deployed neuston net from starboard side aft deck crane. Net not stable at transit (10 knot) speeds so tweaks needed. 1045 neuston net test finished. 1300 commenced second neuston net test. 1320 Completed neuston net test.

1808 Arrived on station A at 30.01°N, 149.97°W. 1900 conducted CTD cast 1, an opportunistic CTD cast used for RNA collection for visiting scientist.

2003 Began extended station A night-time sampling at 30°N, 149.97°W with CTD cast 2 to 1316 Meters.

2258 Began MOCNESS tow 1 down to 1300 m at 29.97°N, 149.94°W.

24 June 0302 MOCNESS tow 1 complete.

0351 Began IKMT tow 1 down to 346 m at 29.96°N, 149.77°W. 0503 IKMT tow 1 completed.

0549 Began CTD cast 3 at 29.96°N, 149.71°W down to 2901 m for eDNA water collection. The winch wire was loose on the drum and skipping so the wire needed to be fed out all the way and re-spooled with the tension of weight of the CTD provided.

0954 Began CTD cast 4 at 29.94°N, 149.7°W down to 257 m for eDNA water collection.

1029 Finish extended station A night-time operations, repositioned the vessel as much as possible for station A day-time operations.

1121 Began extended station A day-time sampling at 29.94°N, 149.7°W with CTD cast 5 to 1317 m.

1319 Began MOCNESS tow 2 down to 1300 m at 29.93°N, 149.68°W. 1719 MOCNESS tow 2 completed. We were behind schedule so decided to forgo the planned IKMT tow to make up time spent on spooling out the CTD wire earlier at the station during CTD cast 3.

1817 Began CTD cast 6 at 29.96°N, 149.52°W down to 960 m for eDNA water collection.

2031 Began CTD cast 7 at 29.94°N, 149.51°W down to 256 m for eDNA water collection. 2111 CTD completed, transited to next station.

2131 Neuston net deployed while underway to next station at 29° 55.100'N 149° 30.406'W. This is another test to try a different tow configuration from the crane on the starboard side of the ship. Net still didn't stay steady in the water at transit speeds. 2206 Neuston net test completed at 29° 51.209'N 149° 31.447'W, continued transit to next station.

25 June 0824 Arrived at base station 1 at 28.19°N, 149.99°W and began base station operations with CTD cast 8 down to 1316 m.

1010 Began bongo tow 1 down to 158 m at 28.18°N, 149.98°W. All bongo tows have a target depth of 150 m, but we did not have real-time depth readings for any towed gear except the MOCNESS so we relied on wire out schedules and wire angles. 1038 Bongo tow 1 completed at 28.18°N, 149.98°W.

1105 Began 2-m ring net tow 1 at 28.19°N, 149.95°W. All 2-m ring net tows are yo-yo towed in the top 50 m to target bigeye tuna larvae. We did not have real-time depth monitoring so we relied on wire angle and wire out schedules. Max depth for the tow was 17 m. 1340 two-m ring net tow 1 completed, transited to next station.

2032 Arrived at base station 2 at 27.28°N, 149.97°W and began station operations with CTD cast 9 down to 1315 m.

2230 Began bongo tow 2 down to 155 m at 27.29°N, 149.94°W. 2315 Bongo tow 1 completed.

2331 Began 2-m ring net tow 2 at 27.31°N, 149.93°W. Max depth for the yo-yo tow was 76 m. 1408 two-m ring net tow 2 completed, transited to next station.

26 June 0235 Stopped for fourth Argo buoy (serial number not noted) deployment at position 27° 21.0'N, 149° 46.2'W which is within 30 nm of preferred drop location at 27°N, 150°W. After Argo drop, continued transit towards base station 3.

0811 Arrived at base station 3 at 26.45°N, 149.92°W and began base station operations with CTD cast 10 down to 1315 m.

1010 Began bongo tow 3 down to 234 m at 26.44°N, 149.92°W. 1049 Bongo tow 3 completed at 26.47°N, 149.9°W.

1059 Began 2-m ring net tow 3 at 26.48°N, 149.9°W. Max depth for the yo-yo tow was 74 m. 1320 two-m ring net tow 3 completed, transited to next station.

1815 Arrived at extended station B at 25.84°N, 149.92°W and began night-time sampling with CTD cast 11 to 1316 m.

2011 Began MOCNESS tow 3 down to 1300 m at 25.86°N, 149.9°W.

27 June 0009 MOCNESS tow 3 completed at 25.95°N, 149.79°W.

0045 Began IKMT tow 2 down to 279 m at 25.97°N, 149.78°W. 0244 IKMT tow 2 completed.

0313 Began CTD cast 12 at 26.04°N, 149.69°W down to 830 m for eDNA water collection.

0451 Began CTD cast 13 at 26.03°N, 149.68°W down to 320 m for eDNA water collection.

0530 Finished extended station B night-time operations, conducted reset for station B day-time operations.

0622 Began extended station B day-time sampling at 26°N, 149.74°W with CTD cast 14 to 1011 m.

0749 Began MOCNESS tow 4 down to 1300 m at 26°N, 149.73°W. 1135 MOCNESS tow 4 completed at 26°N, 149.59°W.

1208 Began IKMT tow 3 down to 294 m at 26°N, 149.57°W. 1425 IKMT tow 1 completed.

1503 Began CTD cast 15 at 26.01°N, 149.46°W down to 829 m for eDNA water collection.

1653 Began CTD cast 16 at 26.01°N, 149.45°W down to 317 m for eDNA water collection. 1740 CTD completed, transited to next station.

28 June 0520 Stopped for fifth Argo buoy F1374 deployment at position 24° 06.81'N, 149° 50.29'W which is within 30 nm of preferred drop location at 24°N, 150°W. After Argo drop, continued transit towards base station 4.

0606 Arrived at base station 4 at 24.03°N, 149.86°W and began base station operations with CTD cast 17 down to 1313 m.

0733 Began bongo tow 4 down to 252 m at 24.03°N, 149.84°W. 0809 Bongo tow 4 completed at 24.03°N, 149.84°W.

0818 Began 2-m ring net tow 4 at 24.03°N, 149.84°W. Max depth for the yo-yo tow was 53 m. 1024 two-m ring net tow 4 completed, transited to next station.

1813 Arrived at base station 5 at 22.88°N, 149.92°W and began station operations with CTD cast 18 down to 1335 m.

2009 Began bongo tow 5 down to 207 m at 22.88°N, 149.91°W. 2043 Bongo tow 5 completed.

2100 Began 2-m ring net tow 5 at 22.9°N, 149.9°W. Max depth for the yo-yo tow was 61 m. A GoPro was attached to the 2-m ring, faced aft, and filmed the net opening for the duration of the tow. 2304 two-m ring net tow 5 completed, transited to next station.

29 June 0634 Arrived at base station 6 at 21.9°N, 149.97°W and began base station operations with CTD cast 19 down to 1315 m.

0808 Began bongo tow 6 down to 220 m at 21.9°N, 149.96°W. 0844 Bongo tow 6 completed at 21.91°N, 149.95°W.

0856 Began 2-m ring net tow 6 at 21.91°N, 149.94°W. Max depth for the yo-yo tow was 68 m. A GoPro was attached to the 2-m ring, faced aft, and filmed the net opening for the duration of the tow. 1101 two-m ring net tow 6 completed, transited to next station.

1620 Stopped for sixth and final Argo buoy (serial number not noted) deployment at position 21° 08.7'N, 149° 56.3'W which is within 30 nm of preferred drop location at 21°N, 150°W. After Argo drop, continued transit towards extended station C.

1840 Arrived at extended station C at 20.81°N, 149.95°W and began night-time sampling with CTD cast 20 to 1317 m.

2024 Began IKMT tow 4 down to 181 m at 20.79°N, 149.95°W. The order of the MOCNESS and IKMT was changed and the IKMT was moved up to give the MOCNESS team more time to trouble shoot the issues with the depth sensor. 2208 IKMT tow 4 completed.

2251 Began MOCNESS tow 5 down to 1300 m at 20.8°N, 149.82°W.

30 June 0227 MOCNESS tow 5 completed at 20.79°N, 149.7°W.

0335 Began CTD cast 21 at 20.71°N, 149.75°W down to 795 m for eDNA water collection.

0509 Began CTD cast 22 at 20.72°N, 149.76°W down to 305 m for eDNA water collection.

0600 Finished extended station C night time operations and began resetting for station C day time operations.

0634 Began extended station C day-time sampling at 20.76°N, 149.86°W with CTD cast 23 to 1012 m.

0809 Began MOCNESS tow 6 down to 1300 m at 20.76°N, 149.86°W. 1141 MOCNESS tow 6 completed at 20.8°N, 149.76°W.

1214 Began IKMT tow 5 down to 543 m at 20.8°N, 149.74°W. A GoPro was attached to the IKMT paravane, faced aft, and filmed the net opening for the duration of the tow. 1415 IKMT tow 5 completed.

1553 Began CTD cast 24 at 20.73°N, 149.64°W down to 794 m for eDNA water collection.

1730 Began CTD cast 25 at 20.74°N, 149.64°W down to 304 m for eDNA water collection. 1810 CTD completed, transited to next station.

01 July 0637 Arrived at base station 7 at 19.03°N, 149.99°W and began base station operations with CTD cast 26 down to 1314 m.

0832 Began bongo tow 7 down to 213 m at 19.04°N, 149.99°W. 0913 Bongo tow 7 completed at 19.06°N, 149.97°W.

0929 Began 2-m ring net tow 7 at 19.06°N, 149.97°W. Max depth for the yo-yo tow was 73 m. 1146 two-m ring net tow 7 completed, transited to next station.

1851 Arrived at base station 8 at 18.11°N, 149.95°W and began station operations with CTD cast 18 down to 1314 m.

2105 Began bongo tow 8 down to 221 m at 18.1°N, 149.93°W. 2130 Bongo tow 8 completed at 18.13°N, 149.9°W.

2148 Began 2-m ring net tow 8 at 18.12°N, 149.9°W. Max depth for the yo-yo tow was 86 m. 0009 two-m ring net tow 8 completed, transited to next station.

02 July 0644 Arrived at base station 9 at 17.23°N, 150.07°W and began base station operations with CTD cast 28 down to 1315 m.

0832 Began bongo tow 9 down to 220 m at 17.23°N, 150.05°W. 0904 Bongo tow 9 completed at 17.24°N, 150.02°W.

0918 Began 2-m ring net tow 9 at 17.24°N, 150.02°W. Max depth for the yo-yo tow was 74 m. 1107 two-m ring net tow 9 completed, transited to next station.

1846 Arrived at extended station D at 16.17°N, 150°W and began night-time sampling with CTD cast 29 to 1314 m.

2108 Began MOCNESS tow 7 down to 1300 m at 16.18°N, 149.97°W.

03 July 0037 MOCNESS tow 7 completed at 16.22°N, 149.88°W.

0114 Began IKMT tow 6 down to 372 m at 16.23°N, 149.87°W. 0300 IKMT tow 6 completed.

0333 Began CTD cast 30 at 16.28°N, 149.75°W down to 911 m for eDNA water collection.

0516 Began CTD cast 31 at 16.32°N, 149.75°W down to 280 m for eDNA water collection.

0548 Finished extended station D night-time operations and began the reset for station D day-time operations.

0643 Began extended station D day-time sampling at 16.27°N, 149.86°W with CTD cast 32 to 1315 m.

0822 Began MOCNESS tow 8 down to 1300 m at 16.27°N, 149.85°W. 1200 MOCNESS tow 8 completed at 16.34°N, 149.75°W.

1228 Began IKMT tow 7 down to 268 m at 16.35°N, 149.74°W. 1450 IKMT tow 7 completed.

1537 Began CTD cast 33 at 16.4°N, 149.63°W down to 909 m for eDNA water collection.

1718 Began CTD cast 34 at 16.42°N, 149.62°W down to 277 m for eDNA water collection.

1745 CTD completed, transited to next station.

04 July 0644 Arrived at base station 10 at 14.65°N, 150°W and began base station operations with CTD cast 35 down to 1313 m.

0835 Began bongo tow 10 down to 213 m at 14.67°N, 149.98°W. 0908 Bongo tow 10 completed at 14.68°N, 149.95°W.

0924 Began 2-m ring net tow 10 at 14.68°N, 149.95°W. Max depth for the yo-yo tow was 65 m. A GoPro was attached to the 2-m ring, faced aft, and filmed the net opening for the duration of the tow. 1145 two-m ring net tow 10 completed, transited to next station.

1840 Arrived at base station 11 at 13.7°N, 149.91°W and began station operations with CTD cast 36 down to 1315 m.

2112 Began bongo tow 11 down to 236 m at 13.69°N, 149.89°W. 2201 Bongo tow 11 completed at 13.73°N, 149.86°W.

2210 Began 2-m ring net tow 11 at 13.74°N, 149.85°W. Max depth for the yo-yo tow was 75 m. 0003 two-m ring net tow 11 completed, transited to next station.

05 July

0639 Arrived at base station 12 at 12.87°N, 149.96°W and began base station operations with CTD cast 37 down to 1315 m.

0808 Began bongo tow 12 down to 156 m at 12.86°N, 149.95°W. 0843 Bongo tow 12 completed at 12.87°N, 149.93°W.

0859 Began 2-m ring net tow 12 at 12.88°N, 149.93°W. Max depth for the yo-yo tow was 62 m. A GoPro was attached to the 2-m ring, faced aft, and filmed the net opening for the duration of the tow. 1051 two-m ring net tow 12 completed, transited to next station.

1845 Arrived at base station 13 at 11.73°N, 150°W and began base station operations with CTD cast 38 down to 1315 m.

2112 Began bongo tow 13 down to 308 m at 11.73°N, 149.98°W. 2155 Bongo tow 13 completed at 11.74°N, 149.97°W.

2202 Began 2-m ring net tow 13 at 11.75°N, 149.97°W. Max depth for the yo-yo tow was 171 m. 2331 two-m ring net tow 13 completed, and the final base station sampled. Transited to the next station.

06 July

0641 Arrived at extended station E at 10.69°N, 149.98°W and began day-time sampling with CTD cast 39 to 1316 m.

0832 Began MOCNESS tow 9 down to 1300 m at 10.68°N, 149.98°W. 1223 MOCNESS tow 9 complete at 10.76°N, 149.9°W.

1249 Began IKMT tow 8 down to 316 m at 10.76°N, 149.89°W. A GoPro was attached to the paravane, faced aft, and filmed the net opening for the duration of the tow. 1506 IKMT tow 8 completed.

1528 Began CTD cast 40 at 10.82°N, 149.83°W down to 827 m for eDNA water collection.

1712 Began CTD cast 41 at 10.84°N, 149.85°W down to 203 m for eDNA water collection.

1816 Began CTD cast 42 at 10.84°N, 149.85°W down to 304 m for eDNA water collection. This was an opportunistic CTD to collect water to filter through a compressed air pump used for RNA studies.

1850 Finish extended station E day-time operations and began reset for station E night-time operations.

2013 Began extended station E night-time sampling at 10.72°N, 149.95°W with CTD cast 43 to 1314 m.

2203 Began IKMT tow 9 down to 275 m at 10.73°N, 149.94°W. We switched the order of the IKMT and MOCNESS for this last station so the deck crew could rinse the cable during MOCNESS haulback since it is the deepest tow of the two. 0016 IKMT tow 9, the last IKMT tow of the project, completed.

07 July 0048 Began MOCNESS tow 10 down to 1300 m at 10.8°N, 149.88°W. 0409 MOCNESS tow 10 completed at 10.82°N, 149.8°W, the final MOCNESS of the project.

0433 Began CTD cast 44 at 10.83°N, 149.8°W down to 204 m for eDNA water collection.

0547 Began CTD cast 45 at 10.84°N, 149.8°W down to 826 m for eDNA water collection.

0739 Began CTD cast 46 at 10.87°N, 149.8°W down to 27 m for eDNA water collection. This was an opportunistic CTD to collect water to filter through a compressed air pump used for RNA studies. This concluded the sampling for SE2204. Began transit back to Pearl Harbor.

07-10 July Transited.

10 July 1200 Returned to Pearl Harbor. Ended active acoustics data collection. Disembarked Johanna Wren, Ryan Rykaczewski, Donald Kobayashi, Jonathan Whitney, James Ruzicka, Calla Lloyd-Lim, Alexa Gonzalez, Nan Himmelsbach, Andrea Schmidt, Madison Kearsey, Gabrielle Mukai, Joshua Stone, Alexander Barth, Nayan Mallick, Jacob Snyder.

MISSIONS AND RESULTS:

A. Conduct routine conductivity-temperature-depth (CTD) casts to a maximum 1000 m, continuous acoustic Doppler current profiler (ADCP) and thermosalinograph (TSG) measurements along the length of the project track to describe the physical environment in the ocean along the eastern edge of the North Pacific Subtropical Gyre (the eastern part of the Hawai‘i deep-set longline fishing grounds).

1. The project track was adjusted from the planned 30–10°N latitude and 140°W longitude to 150°W longitude to accommodate the 7 day reduction in DAS due to COVID delay. Additionally, extended stations had to be reduced from 7 to 5, with the stations on the outgoing and returning legs being cut. The project visited 5 extended stations where sampling took place over a 24 h period, and 13 base stations that were visited either during the daytime or nighttime and sampling lasted for 5 hours.

2. A total of 46 fully successful CTD casts were conducted (Table 1); 1 cast at each station (23 in total; 10 stations where both day and night sampling took place) to 1300 m and two additional casts at extended stations to around 750 and 250 m for water collection purposes only for eDNA analysis. One opportunistic cast was conducted at station A before station operations began to collect water for RNA analysis, and 2 additional opportunistic casts were performed at station

E for methods comparison for eDNA methodology. During all casts, profiles of temperature, conductivity, and dissolved oxygen were collected on redundant sensors, and profiles of fluorescence were collected by both an open WET Labs and pumped Seapoint fluorometer (Fig. 2).

3. EK80 was successfully calibrated as part of gear trials on June 9–10, and ADCP and EK80 were turned on for the entirety of the project. There was initial interference between the 38 kHz and the EK80 on all frequencies but after adjustment of the 38 kHz on June 22, interference was resolved.

4. TSG data were collected at a roughly 5-sec resolution throughout the survey.

B. Conduct regular CTD-mounted fluorometer measurements and water collection from CTD rosette-mounted Niskin bottles in the shallow scattering layer (approximately 0–200 m) at predetermined stations for extracted chlorophyll and nutrients, along with size-fractionation of the phytoplankton to assess the influence of the physical dynamics on the biological productivity along the project track.

1. A CTD-mounted Wetlabs ECO FLNTURTD fluorometer measured chlorophyll profiles to a depth of 1300 m during 23 CTD casts. Water samples were collected at 10 depths (surface, 20, 35, 50, 65, 80, 100, 125, 150, and 200 m) during these 23 CTDs for analysis of bulk and size fractionated chlorophyll and chlorophyll-*a* (at 20, 2, and 0.2 μm size fractions), nutrient, and flow cytometry analysis (Table 1; Fig. 3). Additionally, water was collected for carbonate chemistry analysis for a "pH from Space" project. We know little about open-ocean ocean acidification and the collected samples will help fill that knowledge gap.

2. All chlorophyll analyses were carried out on a Turner 10AU bench-top fluorometer while underway. These analyses show an increase in bulk total chlorophyll moving from north to south, along with a shift in size composition with fewer smaller (0.2 μm) and more larger (2 μm) phytoplankton moving south (Fig. 3). Water samples for nutrient analysis were stored in the ship's scientific freezer and flow cytometry samples were preserved with para-formaldehyde and stored in a liquid nitrogen dewar for post-cruise analysis.

C. At 5 stations (locations marked with blue symbols on Fig. 1), conduct water collection from CTD rosette-mounted Niskin bottles at 5 pre-determined depths for use in environmental DNA (eDNA) analysis.

During day-time and night-time operations at each of the 5 extended stations, 2 CTD casts were conducted consecutively for collection of water for eDNA analysis, for a total of 20 casts. Each cast collected water from 3 depths for a total of 24 l of water each at 6 depths for each sampling cycle (day and night). The collection depths were determined by looking at a combination of the oxygen profile from the CTD taken at the beginning of station operations and the deep and shallow acoustic scattering layer recorded by the EK80 active acoustics system with targets above, below, and at the oxygen minimum and within and below the scattering layers (Fig. 4).

D. Monitor the biological backscatter using the Simrad EK60 echosounder system in an

effort to assess the relative density, distribution, and composition of micronekton along the project track and how that relates to physical dynamics.

Bioacoustic data were collected continuously during the cruise resulting in an approximately 3500 nm long transect. Initially there was interference with the 38 kHz system during the transit to station A, but that was resolved when arriving on station A. Acoustic data were used during the cruise to determine sampling depths for eDNA and MOCNESS operations. Data will be analyzed post-cruise.

E. Deploy bongo nets with wire-mounted SeaBird CTD in the shallow scattering layer (approximately 0–200 m) to assess the influence of physical dynamics on the biomass, distribution, and composition of mesozooplankton along the project track.

A total of 13 successful bongo tows were conducted at the base stations (Fig. 1) using a 200-μm mesh net. Because of the depth limitation of the available gear, we could not attach the CTD to the conducting cable as the same cable was used for the MOCNESS. Additionally, because the MOCNESS electronics plug was terminated onto the conducting cable, it was not feasible to switch out the CTD and MOCNESS termination every time we switched gears. Therefore, depth target was determined by ship speed, wire out, and wire angle. The depth of the tow was confirmed after the tow was completed using temperature-depth recorders (TDRs). Samples from the Bongo nets were preserved for bulk and size-fractionated biomass. One net was size-fractioned into 200, 500, 1000, 20000, and 5000 μm fractions and stored in the ship's scientific freezer for post-cruise drying and weighing. The other net was split in half using a Folsom splitter with one half preserved in 95% ethanol and one in 10% formalin for post-cruise genetic analysis (of the ethanol preserved fraction) and identification and measurements using ZooSCAN (formalin preserved fraction). Fish larger than 1 cm found in the samples were removed and stored in the ship's scientific freezer for genetic work post-cruise.

F. At 5 stations (locations marked with blue symbols on Fig. 1), deploy a 1-m^2 Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) down to 1000 m to assess the influence of physical dynamics on the biomass, distribution, and composition of mesozooplankton at discrete depths along the project track.

1. A total of 10 (5 day-time and 5 night-time) successful MOCNESS tows were conducted at the extended stations A-E to a depth of 1300 m. Each tow had nine 200 μm mesh nets that were fired at 8 different depths plus the net that was open going down. The collection depths were determined by looking at a combination of the oxygen profile from the CTD taken at the beginning of station operations and the deep- and shallow acoustic scattering layer recorded by the EK80 active acoustics system with targets above, below, and at the oxygen minimum and within and below the scattering layers (Fig. 4). These depths were selected in collaboration with the eDNA team so the collection depths would be consistent for future data comparisons.

2. There was a problem with the depth sensor on the net during station B tows, but it was stable when firing the nets at each depth. Additionally, the battery

voltage kept reading zero but with successful deck tests. After disassembling the net electronics, we found condensation inside the depth sensor housing. It was allowed to dry out and depth sensor worked as normal, but the voltage never read correctly again.

3. A small leak in the bottom seam of codend #4 was found at station E after the day-time tow and have likely been present since the beginning of the cruise. Additionally, during the day-time tow at station B the net came up with net #7 open. This was the only instance that nets didn't close/fire and the MOCNESS performed above expectation and was a valuable addition to our sampling plan. A plan should be put in place to have consistent access to MOCNESS for future cruises.

4. The sample from each MOCNESS net was split in two using a Folsom splitter and one split was preserved in 10% formalin and the other split in 95% alcohol for post-cruise analyses of size and composition (formalin preserved fraction) as well as DNA analyses (ethanol preserved fraction). All fish larger than ~1 cm were removed and stored in the ship's freezer for genetic work post-cruise.

G. Deploy towed equipment, including 2-m ring net and 6-ft Isaacs-Kidd Midwater Trawl (IKMT), in the shallow scattering layer (approximately 0–200 m) in and around features of interest (fronts, eddies, etc.) in an effort to locate areas with bigeye tuna eggs and larvae.

1. For this effort a 2-m ring net with a 505-μm mesh net was yo-yo towed in the top 50 m of the water column at all base stations. A total of 13 ring net tows were successfully completed; 8 day-time tows and 5 night time tows. The net mesh size was not small enough to catch any eggs, but did capture larval fish. We focused on the top 50 m of the water colum after conversations with Barb Muhling at SWFSC regarding her success in catching bluefin tuna larvae in the Gulf of Mexico.

2. After initial coarse sorting onboard we found several tuna larvae in the trawl, but identification to species will have to be conducted post-cruise using DNA methods. These specimen will be valuable in determining spawning locations of tunas in Hawai‘i longline fishing grounds.

3. The 2-m ring net performed well and was able to catch larval tunas successfully. The large opening allows for higher volumes of water to be filtered and all tows were equipped with a flow meter so we can make quantitative estimates of volume filtered and capture rates.

H. At 5 stations (locations marked with blue symbols on Fig 1) extended sampling with a Cobb trawl (and possibly 10-ft Isaacs-Kidd Midwater Trawl (IKMT) will take place to assess size and composition of micronekton and conduct stomach content analysis on select micronekton for use in size-based ecosystem models.

1. The Cobb trawl was not operable at the time of sailing so we replaced the Cobb operations with the 10-ft IKMT. This is the largest net we have and the only gear capable of targeting micronekton successfully. While the IKMT performed

successfully during the cruise operations, the catches were small. The amount of water the 10-ft IKMT can filter is far less than the Cobb trawl. There is a gap in our size-based sampling strategy left by the lack of Cobb trawling, and having an operational Cobb trawl is essential for studying micronekton, the forage of bigeye tuna.

2. During the cruise we had 9 successful IKMT tows. The day-time tow at station A was canceled to make up for time spent on spooling and fixing the CTD wire. Daytime tows in the top 200 m were not expected to have large catches and it was decided that it was better to forgo the day-time tow and make up the time to get back on track for the rest of the project.

3. The 10-ft IKMT has a graded mesh net with a flowmeter attached during each tow. Additionally, a GoPro camera was attached to the paravane during station E day-time tow. On the camera you can clearly see the net descending through a layer of salps and later ascending through that same layer during haul back. Combining the footage with the temperature depth recorders (TDRs) on the net, the salp layer was present between 81.7 and 93.4 m. Post-cruise analysis of active acoustic data during the tow will yield valuable insites on what acoustic signals are recorded for gelatinous plankton.

I. Collect data on fine-scale zooplankton composition and vertical distribution using a CTD rosette-mounted Underwater Vision Profiler (UVP) in an effort to characterize the ichthyoplankton prey field.

1. The UVP was present and working during all 46 CTD casts. The UVP was mounted on the inside of the CTD rosette on the bottom opposite of the fluorometer. The UVP has a light source (flash) so the placement was to avoid interference with the fluorometer. There was also a protective shield mounted on the rosette to shield the fluorometer and other CTD sensors from the UVP.

2. Post-cruise processing of data will yield identifications to order for organisms larger than 500 μm and will provide counts for anything larger than 200 μm.

J. Deploy surface neuston net from boom during transits and for targeted stations in an effort to locate areas with bigeye tuna eggs and larvae, as well as acquire data on floating debris, plastic and otherwise.

An new underway neuston net brought on the cruise had never been field tested. The initial plan was to tow the net off the boom on the starboard side, but the boom was not onboard, so the neuston net was rigged from the aft crane or boat deck crane, depending on what side of the ship was the lee side. The net performed well during speeds up to ~6 knots, but at transit speeds of 9-10 knots it was not stable and ride up on its wings or flip over. After several versions of rigging the plan was abandoned and the net secured for the rest of the cruise. Valuable information was gained from the field tests and the net will be modified for our next cruise.

K. Deploy six (6) ARGO floats along the ship track.

Six Argo floats were deployed near pre-selected locations: three on the transit to station A and three between station A and C (Fig 1B, red diamonds).

SCIENTIFIC PERSONNEL:

Name	Role	Affiliation	Organization
SE-22-04 Participants			
Johanna Wren	Chief Scientist	PIFSC[1]	NMFS[2]
Ryan Rykaczewski	Supervisory Research Marine Scientist	PIFSC	NMFS
Donald Kobayashi	Research Fishery Biologist	PIFSC	NMFS
Jonathan Whitney	Research Marine Biologist	PIFSC	NMFS
James Ruzicka	Research Marine Biologist	PIFSC	NMFS
Calla Lloyd-Lim	Biological Science Technician	PIFSC	NMFS
Alexa Gonzalez	Biological Science Technician	PIFSC	NMFS
Nan Himmelsbach	Research Associate	UH[3]	CIMAR[4]
Andrea Schmidt	Research Associate	UH	CIMAR
Madison Kearsey	Research Technician	UH	CIMAR
Gabrielle Mukai	Graduate Assistant	UH	
Joshua Stone	Cooperating Scientist		SC[5]
Alexander Barth	Cooperating Scientist		SC
Nayan Mallick	Cooperating Scientist		SC
Jacob Snyder	Hollings Scholar		NMFS
Gear Trial Participants			
Nathaniel Park	Operations Lead	PIFSC	NMFS
Dianna Miller-Green	Research Marine Biologist	UH	CIMAR
Réka Domokos-Boyer	Research Oceanographer	PIFSC	NMFS
Robert McLean	Biological Science Technician	PIFSC	NMFS

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[2] National Marine Fisheries Service
[3] University of Hawaii
[4] Cooperative Institute for Marine and Atmospheric Reserach
[5] University of South Carolina

TABLES

Table 1: CTD operations during SE-22-04.

Cast	Station	Date & Time (HST)	Longitude (°W)	Latitude (°N)	Depth (m)
1	A	2022-06-23 19:00:00	149.9708	30.00733	205
2	A night	2022-06-23 20:03:00	149.9677	30.00183	1316
3	A night	2022-06-24 05:49:00	149.7135	29.96267	2901
4	A night[a]	2022-06-24 09:54:00	149.7030	29.94017	257
5	A day	2022-06-24 11:21:00	149.6977	29.93567	1317
6	A day[b]	2022-06-24 18:17:00	149.5232	29.95717	960
7	A day[c]	2022-06-24 20:31:00	149.5087	29.94383	256
8	1[d]	2022-06-25 08:24:00	149.9857	28.18833	1316
9	2	2022-06-25 20:32:00	149.9703	27.28417	1315
10	3	2022-06-26 08:11:00	149.9210	26.44650	1315
11	B night	2022-06-26 18:15:00	149.9157	25.84183	1316
12	B night	2022-06-27 03:13:00	149.6940	26.03700	830
13	B night	2022-06-27 04:51:00	149.6847	26.03317	320
14	B day	2022-06-27 06:22:00	149.7397	26.00217	1011
15	B day	2022-06-27 15:03:00	149.4563	26.01017	829
16	B day	2022-06-27 16:53:00	149.4452	26.00617	317
17	4	2022-06-28 06:06:00	149.8558	24.02600	1313
18	5	2022-06-28 18:13:00	149.9185	22.87950	1335
19	6	2022-06-29 06:34:00	149.9672	21.89650	1315
20	C night	2022-06-29 18:40:00	149.9535	20.80933	1317
21	C night	2022-06-30 03:35:00	149.7513	20.70683	795
22	C night	2022-06-30 05:09:00	149.7582	20.71950	305
23	C day	2022-06-30 06:34:00	149.8647	20.76350	1012
24	C day	2022-06-30 15:53:00	149.6425	20.73233	794
25	C day	2022-06-30 17:30:00	149.6417	20.74233	304
26	7	2022-07-01 06:37:00	149.9943	19.02867	1314
27	8	2022-07-01 18:51:00	149.9468	18.11017	1314
28	9	2022-07-02 06:44:00	150.0725	17.22717	1315
29	D night	2022-07-02 18:46:00	149.9965	16.16733	1314
30	D night	2022-07-03 03:33:00	149.7493	16.28417	911
31	D night	2022-07-03 05:16:00	149.7497	16.31633	280
32	D day	2022-07-03 06:43:00	149.8555	16.27383	1315
33	D day	2022-07-03 15:37:00	149.6277	16.40383	909
34	D day	2022-07-03 17:18:00	149.6245	16.42350	277
35	10	2022-07-04 06:44:00	149.9977	14.65383	1313
36	11	2022-07-04 18:40:00	149.9145	13.69600	1315
37	12	2022-07-05 06:39:00	149.9583	12.87017	1315
38	13	2022-07-05 18:45:00	149.9968	11.72583	1315

Table 1: CTD operations during SE-22-04. *(continued)*

Cast	Station	Date & Time (HST)	Longitude (°W)	Latitude (°N)	Depth (m)
39	E day	2022-07-06 06:41:00	149.9840	10.69000	1316
40	E day	2022-07-06 15:28:00	149.8345	10.82483	827
41	E day	2022-07-06 17:12:00	149.8455	10.83517	203
42	E day	2022-07-06 18:16:00	149.8468	10.83833	304
43	E night	2022-07-06 20:13:00	149.9482	10.72267	1314
44	E night	2022-07-07 04:33:00	149.7997	10.82583	204
45	E night	2022-07-07 05:47:00	149.8002	10.84233	826
46	E night	2022-07-07 07:39:00	149.8447	10.86883	27

[a] Bottle #12 did not fire

[b] Bottle #7 did not fire

[c] Bottle #7 did not fire

[d] Bottle #10 did not fire

Table 2: Start time and locations for MOCNESS tows during SE-22-04 extended stations.

Tow	Station	Date & Time (HST)	Long (°W)	Lat (°N)	Net Opening Depths (m)	Volume Filtered by each net (m^3)
1	A night	2022-06-23 2258	149.945	29.972	1300,1000,800,600,400,300,200,100,0	3325,1390,709.8,698.3,661.1,529.4,522.1,607.8,736
2	A day	2022-06-24 1319	149.676	29.934	1260,1000,800,600,400,300,200,100,0	2673.7,1417.2,675.6,615,689.5,645.9,878.7,549.2,818.5
3	B night	2022-06-26 2011	149.896	25.856	1200,1000,800,600,450,200,100,50,0	1951.2,915.8,1032.2,980.3,936.6,1325.8,698,514,409
4	B day	2022-06-27 0749	149.728	26.001	1190,1000,800,620,455,224,100,67,0	2283,998.4,857.4,818,821,1057,785,604,554
5	C night	2022-06-29 2251	149.821	20.799	1200,1000,800,600,400,200,100,50,0	1467,766,1227,745.6,627.4,722,723,382,1058
6	C day	2022-06-30 0809	149.863	20.764	1200,1000,800,600,400,200,100,50,0	1678,972,709,480.8,541,1161,785,189,601
7	D night	2022-07-02 2108	149.971	16.180	1200,1000,800,550,350,200,100,50,0	1456,633.3,786,818,605,713,700,700,610
8	D day	2022-07-03 0822	149.849	16.268	1200,1000,800,550,350,200,100,50,0	2185,1003,702,649,646,665,814.2,650,664
9	E day	2022-07-06 0832	149.982	10.682	1240,1000,600,380,280,150,110,50,0	1895,1108,1098,910,516,879,498,684,582
10	E night	2022-07-07 0048	149.877	10.795	1200,1000,600,380,280,150,110,50,0	1563,783,1336,653,495,458,265,565,654

Table 3: Start time and locations for IKMT tows during SE-22-04 extended stations.

Tow	Station	Date & Time (HST)	Longitude (°W)	Latitude (°N)	Max Depth (m)
1	A night	2022-06-24 0351	149.7726	29.96162	345.56
2	B night	2022-06-27 0045	149.7772	25.96613	278.81
3	B day	2022-06-27 1208	149.5736	26.00422	294.06
4	C night	2022-06-29 2024	149.9536	20.79432	180.81
5	C day	2022-06-30 1214	149.7431	20.80492	542.56
6	D night	2022-07-03 0114	149.8702	16.22725	372.06
7	D day	2022-07-03 1228	149.7391	16.34548	267.81
8	E day	2022-07-06 1249	149.8912	10.76290	315.81
9	E night	2022-07-06 2203	149.9361	10.72515	274.81

Table 4: Start time and locations for Bongo tows during SE-22-04 base stations.

Tow	Station	Date & Time (HST)	Longitude (°W)	Latitude (°N)	Max Depth (m)
1	1	2022-06-25 1010	149.978	28.179	158
2	2	2022-06-25 2230	149.944	27.288	155
3	3	2022-06-26 1010	149.920	26.442	234
4	4	2022-06-28 0733	149.845	24.030	252
5	5	2022-06-28 2009	149.907	22.880	207
6	6	2022-06-29 0808	149.963	21.902	220
7	7	2022-07-01 0832	149.988	19.038	213
8	8	2022-07-01 2105	149.933	18.098	221
9	9	2022-07-02 0832	150.047	17.234	220
10	10	2022-07-04 0835	149.976	14.671	213
11	11	2022-07-04 2112	149.893	13.687	236
12	12	2022-07-05 0808	149.950	12.863	156
13	13	2022-07-05 2112	149.983	11.735	308

Table 5: Start time and locations for 2-m ring net tows during SE-22-04 base stations.

Tow	Station	Date & Time (HST)	Longitude (°W)	Latitude (°N)	Max Depth (m)
1	1	2022-06-25 1105	149.9483	28.18627	17.06
2	2	2022-06-25 2331	149.9275	27.30705	76.04
3	3	2022-06-26 1059	149.9002	26.47562	74.31
4	4	2022-06-28 0818	149.8381	24.03417	53.06
5	5	2022-06-28 2100	149.8950	22.90247	61.06
6	6	2022-06-29 0856	149.9444	21.91243	68.06
7	7	2022-07-01 0929	149.9662	19.05993	72.97
8	8	2022-07-01 2148	149.9049	18.11850	85.81
9	9	2022-07-02 0918	150.0232	17.23572	73.81
10	10	2022-07-04 0924	149.9506	14.67607	65.06
11	11	2022-07-04 2210	149.8525	13.73587	75.06
12	12	2022-07-05 0859	149.9261	12.87635	61.56
13	13	2022-07-05 2202	149.9663	11.75042	171.06

FIGURES

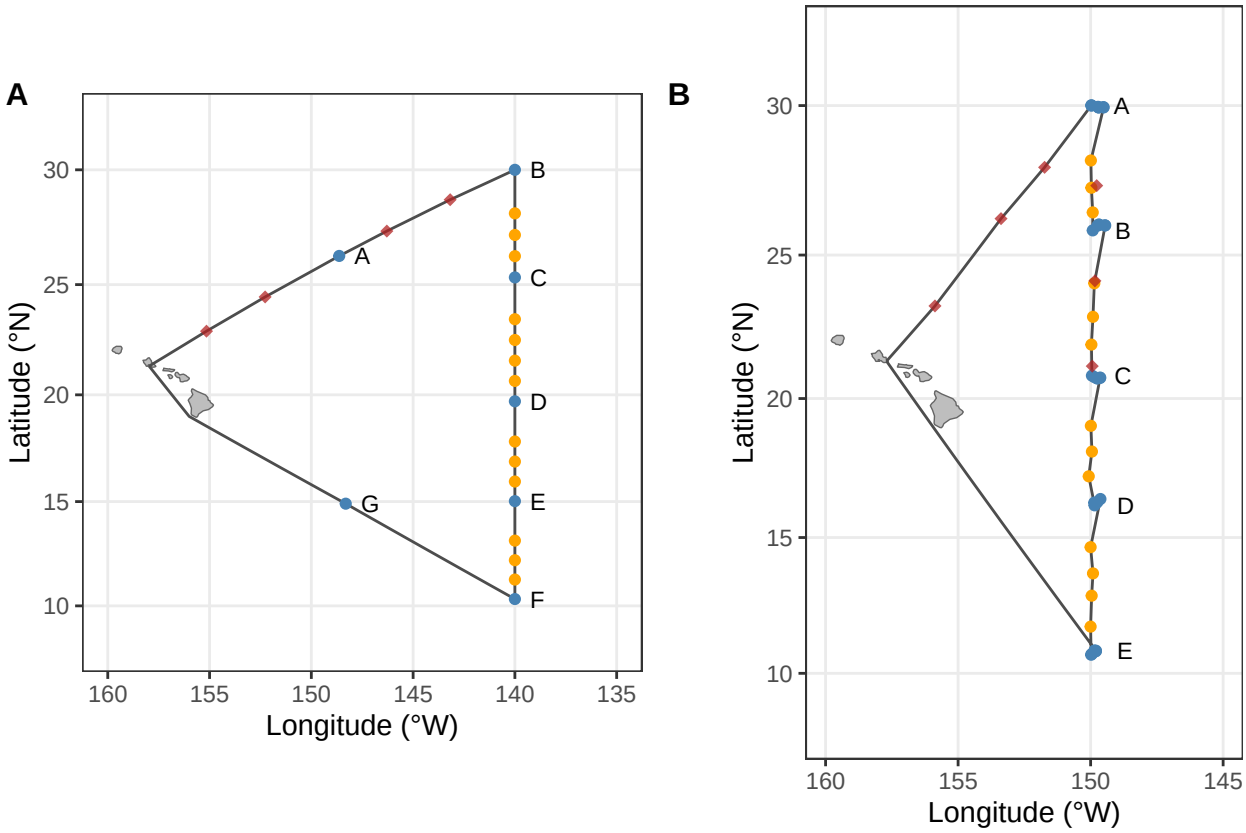

Figure 1: Project SE-22-04 planned (A) and actual (B) track line. Blue symbols mark extended stations, yellow symbols mark base stations, and red diamonds mark Argo drop locations.

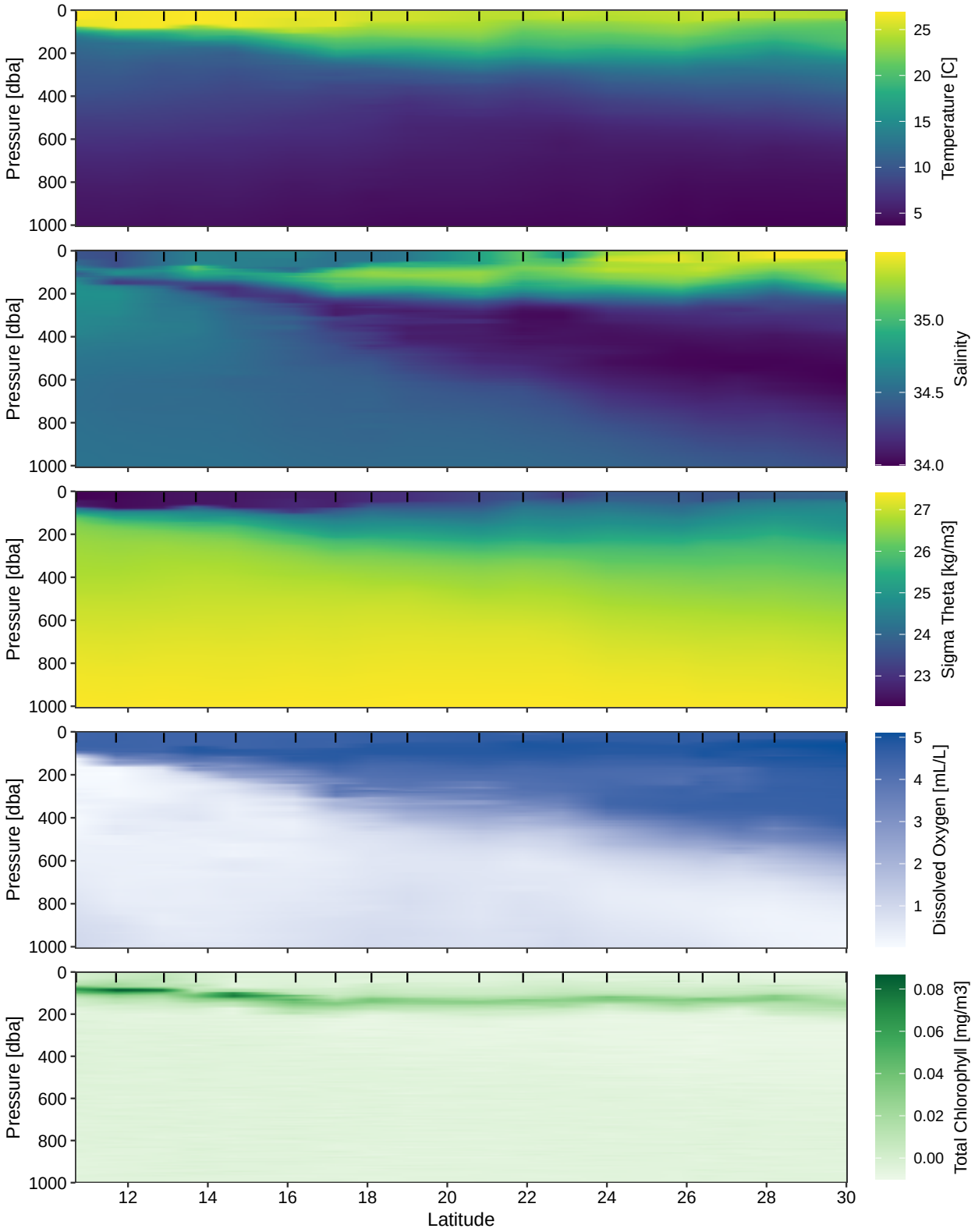

Figure 2: CTD data interpolated along the SE-22-04 track line. The rug at the top of each plot indicate the locations of the CTD sampling.

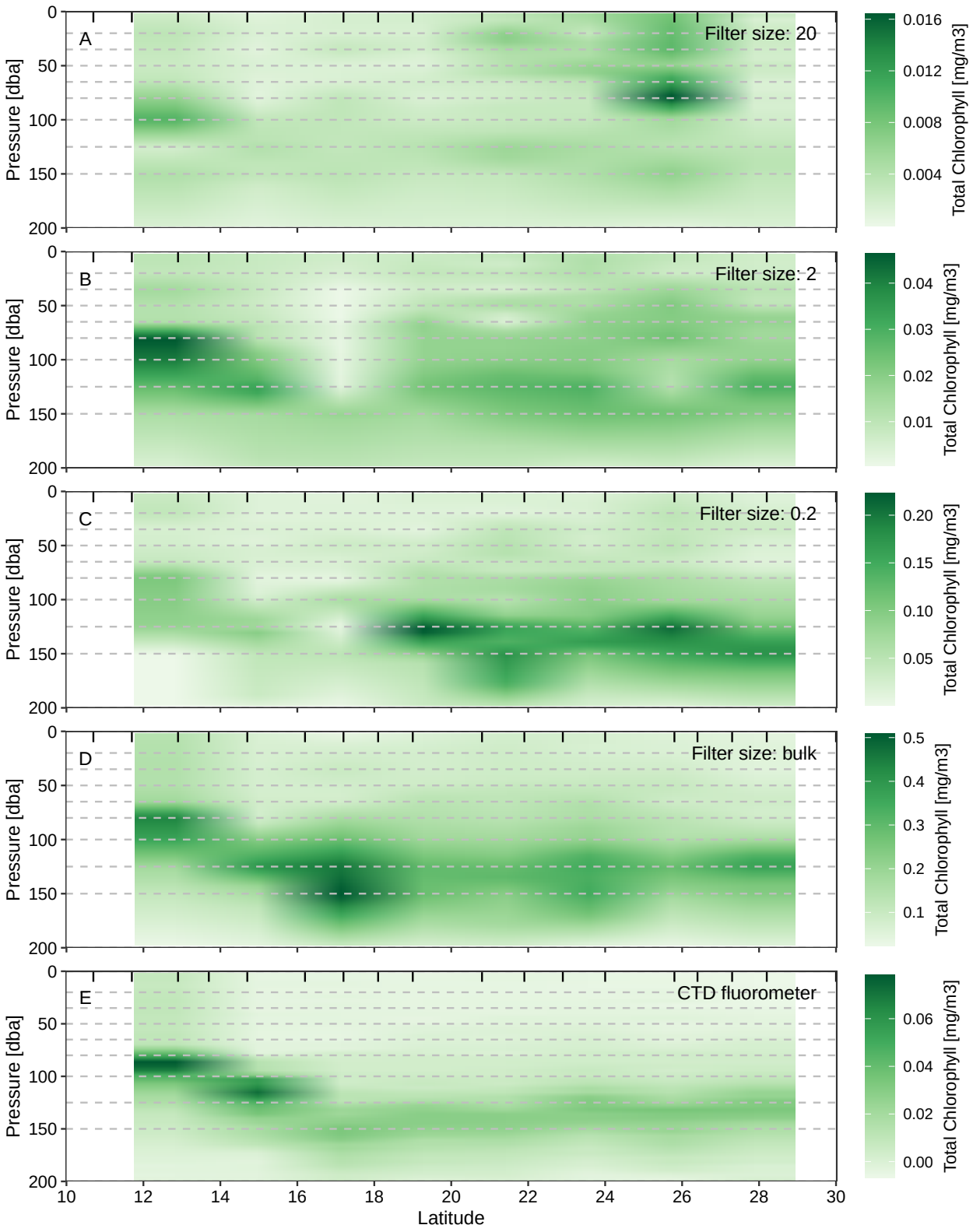

Figure 3: Total chlorophyll for size fractionated samples (a) 20 μm, (b) 2 μm, and (c) 0.2 μm, (d) bulk chlorophyll, and (e) CTD measured fluorometry along the SE-22-04 track line. Note the different scales on all figures. The rug at the top of each plot indicate the location of each CTD along the trackline, and the depths where samples were collected are marked with dashed lines.

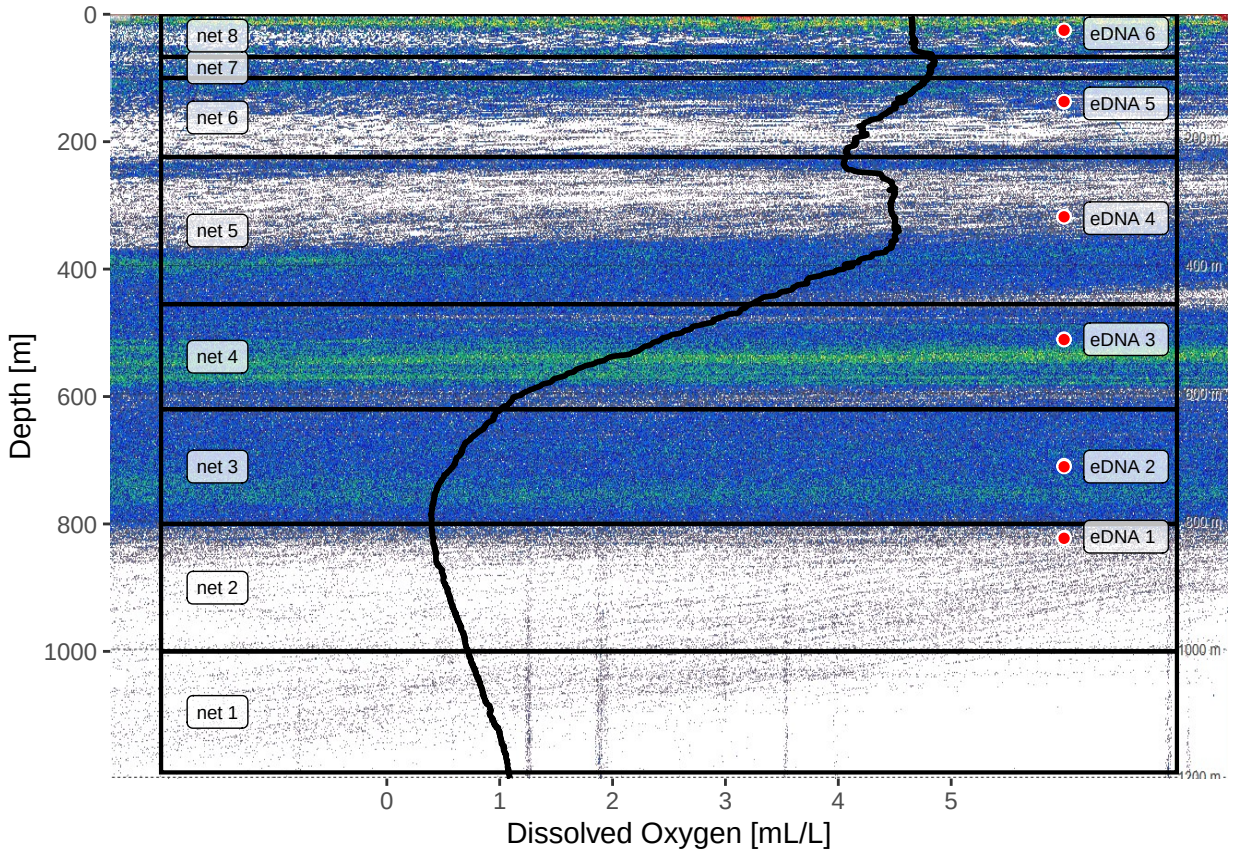

Figure 4: Active acoustics echogram from station B with dissolved oxygen profile from CTD cast overlaid in black. Red circles mark where water was collected for eDNA, and black boxes mark the water depths filtered by each MOCNESS net.

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