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CRUISE REPORT[1]

VESSEL: NOAA Ship *Oscar Elton Sette*, Cruise SE-13-04

CRUISE PERIOD: 12 – 26 June 2013

AREA OF OPERATION: The lee coast of the island of Hawaii (Fig. 1, Table 1)

TYPE OF OPERATION: Conductivity-temperature-depth (CTD) casts to a depth of 1000 m, mid-water net trawls, and DISON imaging sonar casts were conducted at stations in a sampling grid. Active and passive acoustic transects, marine mammal observations, and surface temperature and salinity data were collected along transects between the sampling grid stations.

ITINERARY:

12 June — 1300 Start of cruise. Embarked Phoebe Woodworth-Jefcoats, Chad Yoshinaga, Melanie Abecassis, Jessica Chen, Adrienne Copeland, Meagan Dunphy-Daly, Giacomo Giorli, Aimee Hoover, Jonathan Martinez, Eric Mooney, Adam Renick, William Truong, and Johanna Wren. Proceeded to Station A.

13 June — Arrived at station A and conducted CTD A1 at 0600. Upon successful completion of the CTD, deployed small boat to embark Kaile'a Carlson and Jennifer LeFevre from Honokahau Marina. DIDSON cast A1 was conducted at 1030, followed by active acoustic transect AC1 at 1300. Upon reaching station C, CTD C1 was conducted at 1830. Trawl C1 began at 2100.

14 June — Trawl C2 began at 0115, followed by DIDSON C1 at 0415, CTD C2 at 0600, and active acoustic transect CD1 at 0730. Upon reaching station D, CTD D1 was conducted at 1900 followed by trawl D1 at 2115.

[1] PIFSC Cruise Report CR-13-003
Issued 13 September 2013

15 June Trawl D2 began at 0115, followed by DIDSON D1 at 0400, CTD D2 at 0615, and active acoustic transect DB1 at 0730. Upon reaching station B, CTD B1 was conducted at 1900 followed by trawl B1 at 2100.

16 June Trawl B2 began at 0100. A test run of a fine-scale active acoustic sampling grid was conducted at 0345 (Fig. 2). CTD B2 was conducted at 0600, followed by active acoustic transect BF1 at 0730. Upon reaching station F, CTD F1 was conducted at 1400, followed by DIDSON F1 at 1545, CTD F2 at 1900, and trawl F1 at 2115.

17 June Trawl F2 began at 0115. CTD F3 began at 0600, followed by active acoustic transect FE1 at 0700. Upon reaching station E, DIDSON cast E1 was conducted at 1415. CTD E1 was conducted at 1900 and trawl E1 began at 2115.

18 June Trawl E2 began at 0115, followed by DIDSON E2 at 0345, CTD E2 at 0600, and active acoustic transect EA1 at 0715. Upon reaching station A, DIDSON cast A2 was conducted at 1545, followed by CTD A2 at 1900 and Trawl A1 at 2100.

19 June Trawl A2 began at 0100, followed by DIDSON A3 at 0400 and CTD A3 at 0600. Upon successful completion of the CTD, deployed small boat to disembark Johanna Wren and William Truong and embark Ali Bayless and Alexis Rudd at Honokahau Marina. Active and passive acoustic transect AB1 was conducted at 1445. Upon reaching station B, active and passive acoustic transect BA1 was conducted at 2115.

20 June Upon reaching station A, the ship transited to station EAR1 and DIDSON cast EAR1a was conducted at 0445. After completing the DIDSON cast, a fine-scale active acoustic survey grid was conducted over EAR1 at 0645, followed by DIDSON EAR1b at 0945. The ship then returned to station E and conducted active and passive acoustic transect EA2 at 1330. Upon reaching station A, CTD A4 was conducted at 1930, followed by active and passive acoustic transect AE1 at 2100.

21 June Upon reaching station E, active and passive acoustic transect EF1 began at 0215. Upon reaching station F, CTD F4 was conducted at 0845, followed by active and passive acoustic transect EF2 at 1230. CTD F5 was conducted at 1900, followed by active and passive acoustic transect FB1 at 2100.

22 June After completing transect FB1, opportunistic sampling was conducted in the vicinity of where sperm whales were detected and localized during the transect (station SPW, Fig. 1, Table 1). Active acoustic fine-scale sampling grid SPW1 was conducted at 0215, followed by DIDSON cast SPW1 at 0345 and CTD SPW1 at 0615. The ship then transited back to station F and active and passive acoustic transect FB2 began at 1015. Following this transect, active and passive acoustic fine-scale sampling grid SPW2 was conducted at 1530. The ship then

transited to station D and CTD D3 was conducted at 1915, followed by active and passive acoustic transect DB2 at 2045.

23 June — After completing transect DB2, active and passive acoustic fine-scale sampling grid SPW3 was conducted at 0215, followed by CTD B3 at 0600, active and passive acoustic transect BD1 at 0715, and passive acoustic transect DC1 at 1145. During this transect, pilot whales were detected and localized (station PW, Fig. 1, Table 1). Active and passive acoustic fine-scale sampling grid PW1 was conducted at 1615. After completing grid PW1, transect DC1 was resumed at 1745. CTD C3 was conducted at 1930, followed by active and passive acoustic transect CD2 at 2100. Due to excessive noise in the EK60 data, the ship increased speed and focused on only passive acoustic data collection.

24 June — Upon reaching station D at 0215, both active and passive acoustic data was collected for roughly 37% of the transect from D to C. Active and passive acoustic fine-scale sampling grid PW2 was conducted at 0615. Upon completing grid PW2, a large group of melon-headed whales was observed for approximately 1.5 hours. DIDSON C2 was conducted at 1015 and upon retrieval an electronic failure was detected in the DIDSON unit. Passive acoustic transect CA1 began at 1400. Upon completing the transect, the DIDSON unit was deployed for a test cast at station A at 1930. Active and passive acoustic transect AC2 was conducted at 2000.

25 June — Upon completing transect AC2 at 0000, the ship transited to EAR2 and conducted an active acoustics fine-scale survey grid over EAR2 at 0130. Having successfully repaired the electronics failure, DIDSON EAR2a was conducted at 0315. The ship then returned to station C, deployed a small boat at 0800 for the recovery of both Ecological Acoustic Recorders (EARs), and conducted DIDSON cast C3 at 0815. After completing DIDSON cast C3, the ship steamed to station A. The small boat, with both EARs was retrieved at 1145 and redeployed at 1200 to disembark Kaile'a Carlson, Jennifer LeFevre, and Adam Renick at Honokahau Marina. Upon the return of the small boat at 1300, the ship began the transit back to Pearl Harbor.

26 June — 0900 End of cruise. Disembark Phoebe Woodworth-Jefcoats, Chad Yoshinaga, Melanie Abecassis, Jessica Chen, Adrienne Copeland, Meagan Dunphy-Daly, Giacomo Giorli, Aimee Hoover, Jonathan Martinez, Eric Mooney, Ali Bayless, and Alexis Rudd.

MISSIONS AND RESULTS:

A. Collect oceanographic data from routine conductivity-temperature-depth (CTD) casts, continuous acoustic Doppler current profiler (ADCP), and thermosalinograph (TSG) measurements along a predefined grid off the west coast of Hawaii.

Twenty-one CTD casts were conducted (Table 2). All were conducted to a depth of 1000 m.

The ADCP signal interfered with EK60 data collection and was secured for the entire survey. As interference between the ADCP and EK60 has not been a problem during previous field seasons, it is recommended that investigation into this problem continue until a solution is reached that allows simultaneous operation of both instruments without degradation of data quality.

B. Perform CTD-mounted fluorometer measurements and laboratory determination of nutrients, chlorophyll, and size structure of the phytoplankton and zooplankton community from water samples collected during CTD operations. These data will be used to assess the influence of physical dynamics on the biological productivity of the region.

Two CTD-mounted fluorometers measured fluorescence profiles to a depth of 1000 m on all 21 CTD casts: an open Wetlabs fluorometer and a pumped Seapoint fluorometer. Water samples were collected at ten depths during all CTD casts. Fluorometry analysis was conducted using the Turner bench-top fluorometer while underway. Flow cytometry (to determine size structure of the phytoplankton community) will be conducted by UH-Hilo cooperating scientists Carlson and LeFevre post-cruise. Water samples for flow cytometry were collected as listed in Table 2 and 35 mL were frozen in vials prefilled with 130 μL of glutaraldehyde. Water samples were not collected for nutrients or zooplankton analysis, as this was deemed unnecessary by the cooperating scientists who were planning to collect the samples.

C. Monitor biological backscatter during mid-water trawl operations and along predefined transects using the EK60 echosounder system. This will be used to help characterize the micronekton faunal composition and densities in the forage base for large pelagic nekton.

Seventeen active acoustic transects were conducted, including at least 1 daytime and 1 nighttime transect of each leg in the survey grid (Table 3). Additionally, 8 fine-scale sampling grids were conducted (Table 4). Data was collected at 4 frequencies: 38, 70, 120, and 200 kHz.

During the cruise it was determined that both insufficient grounding and dust build-up are degrading the EK60 data quality (Fig. 3). It is recommended that each the four EK60 GPTs be grounded to the ship and not to aluminum as several currently are. Also, the GPTs' location in the laundry flat leads to excessive dust and lint build-up. While moving the GPTs up a deck would be ideal, it is recommended that they at least be enclosed in a housing to keep them clean.

D. Conduct stern mid-water trawl operations at select stations, targeting the depths of high sonic scattering layers to better our understanding of echo sounder signals collected by the EK60 echo sounder.

Twelve mid-water trawls were conducted, with duplicate nightly trawls at each station (Table 5, Fig. 4). All trawls targeted the shallow scattering layer (approximately 200 m), and all were stepped "oblique" trawls, with 4 depths sampled for 15 minutes each. Two tows were compromised by cookie cutter shark bites in the net's cod end (tows F2 and A2).

E. Collect data on cetacean distribution, school size, and school composition with a towed passive acoustic array.

Fourteen passive acoustic transects were completed, with both a daytime and nighttime transect of each of the seven grid legs. Sixty-seven cetacean detections were localized (Table 6, Fig. 5). While the data will be analyzed for species composition/distribution post-cruise, the following species were positively identified either through unique acoustic characteristics or through visual confirmation (see following section): sperm whales (*Physeter macrocephalus*), pilot whales (*Globicephala macrorhynchus*), melon-headed whales (*Peponocephala electra*), spinner dolphins (*Stenella longirostris*), rough-toothed dolphins (*Steno bredanensis*), bottlenose dolphins (*Tursiops truncatus*), and striped dolphins (*Stenella coeruleoalba*).

F. Conduct daytime visual surveys for cetaceans to help develop habitat envelope models for the Kona region.

Observers were present on the *Sette*'s flying bridge during daytime passive acoustic transects. These observers worked in coordination with the passive acoustics team to coordinate localization and identification efforts. A preliminary list of species identified is provided in the previous section.

G. Deploy a University of Hawaii DIDSON imaging sonar to collect high-resolution information on the density of high sonic scattering layers.

Fourteen DIDSON imaging sonar casts were conducted, with daytime and nighttime casts conducted at each of the 3 near-shore stations (A, C, E) and EAR1 (Table 7). The daytime cast at EAR2 had to be cancelled due to electrical difficulties. Comparison offshore casts were also conducted at stations D and F and an opportunistic cast was conducted in the vicinity of where sperm whales were localized (station SPW). All DIDSON casts targeted the deep scattering layer (approximately 500 – 700 m).

SCIENTIFIC PERSONNEL:

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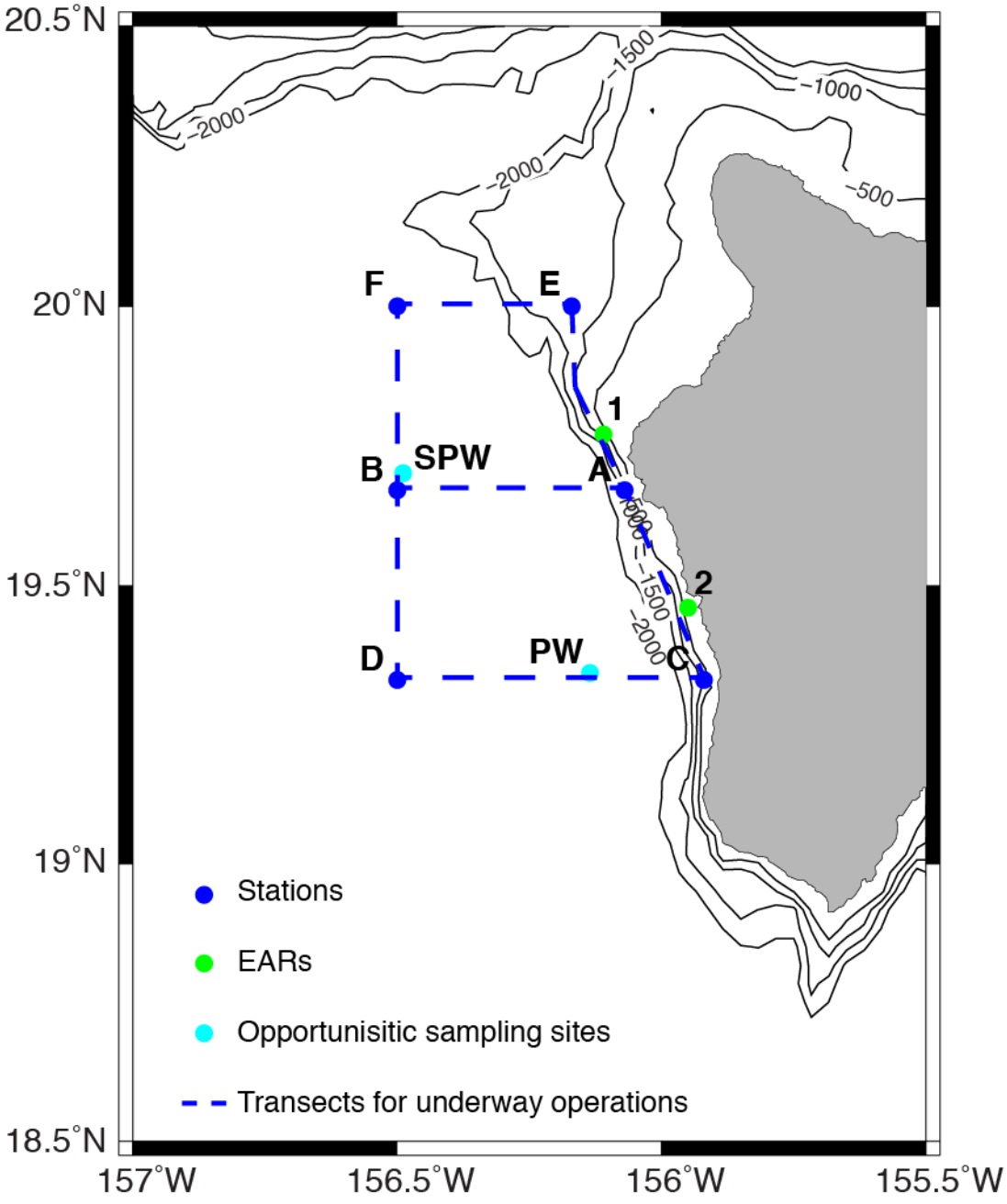

Fig. 1. Kona IEA survey grid.

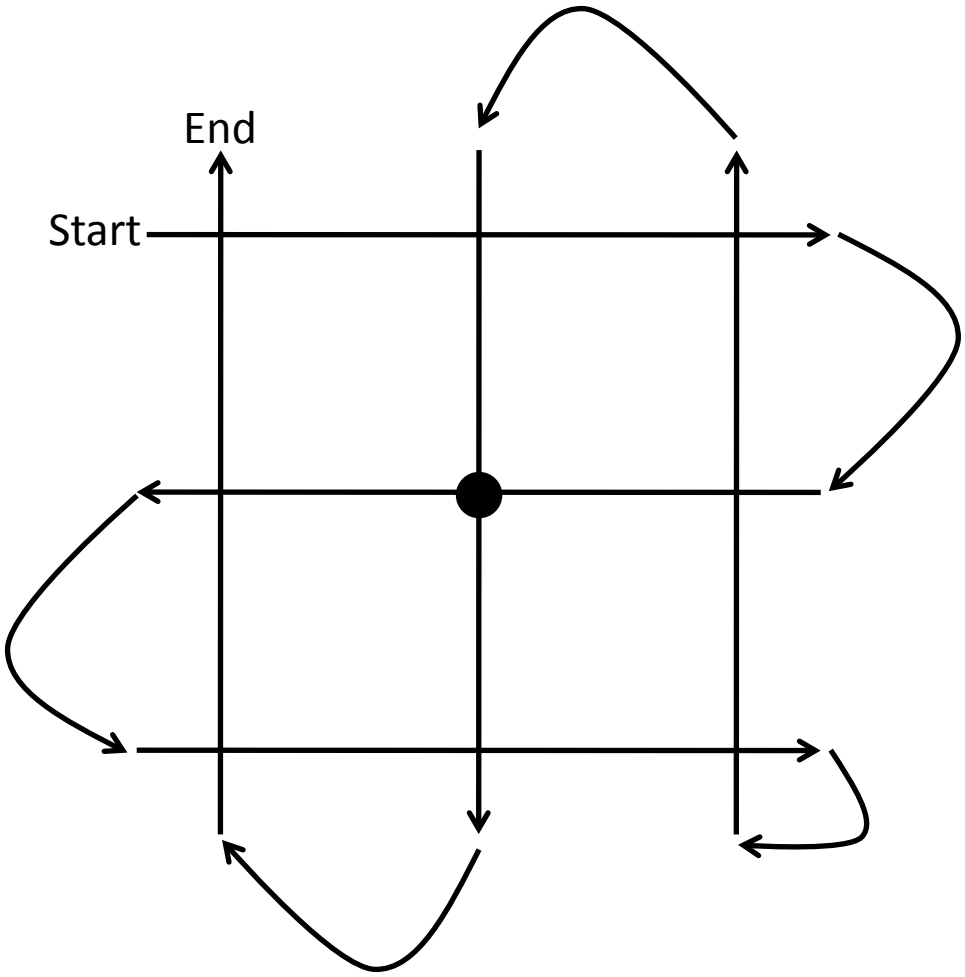

Fig. 2: Example of a fine-scale acoustic sampling grid. Target location is in the center of a 500 m × 500 m box.

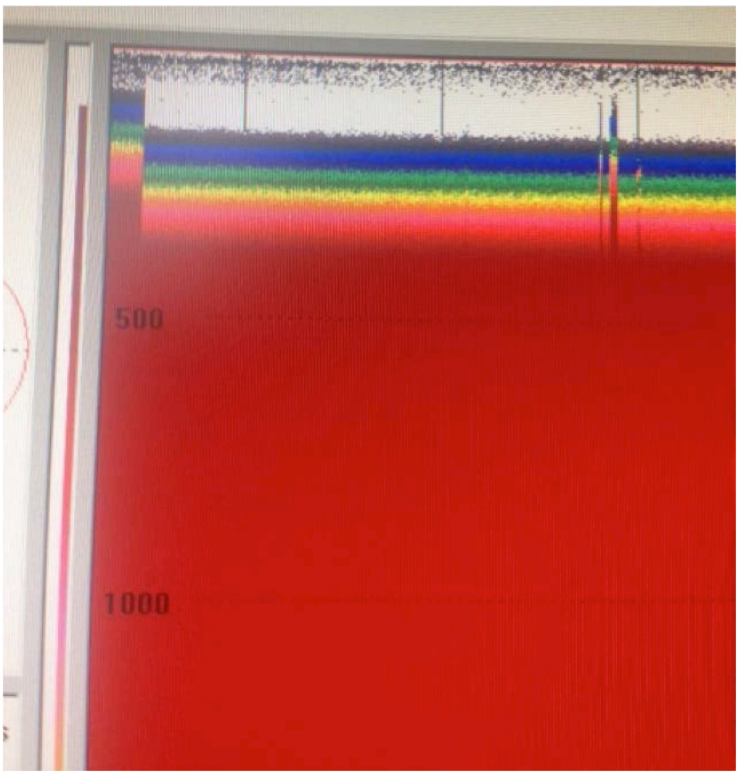

Fig. 3: Data collected at 200 kHz before (left) and after (right) dust and debris was cleaned off the GPT. Figure by Adrienne Copeland.

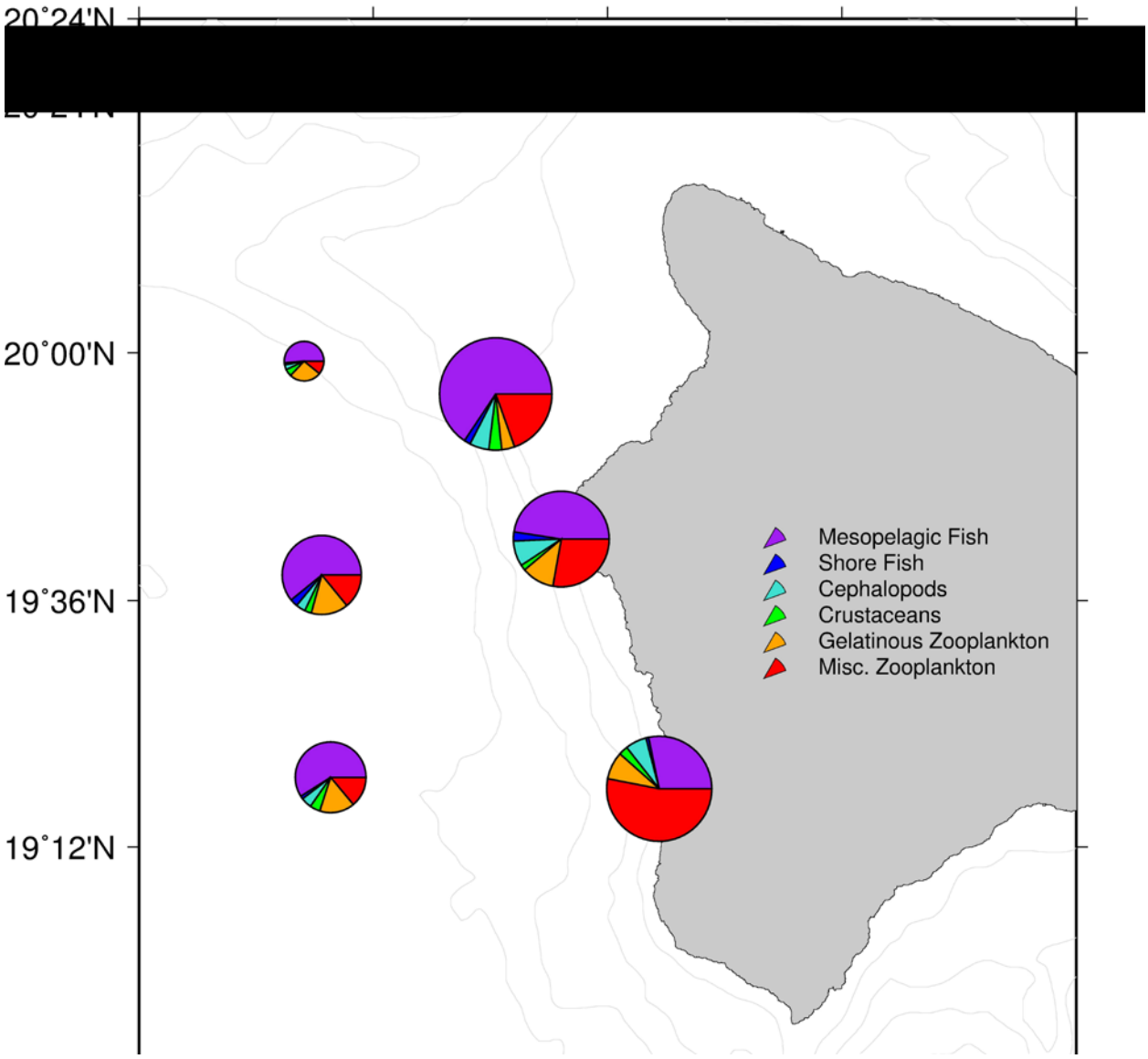

Fig. 4: SE-13-04 trawl composition, with circles scaled by catch volume. Volumes are the average of two nightly tows, with the exception of stations A (east, central) and F (northwest) where one nightly tow each was compromised by cookie cutter shark bites to the cod end. Figure by Johanna Wren.

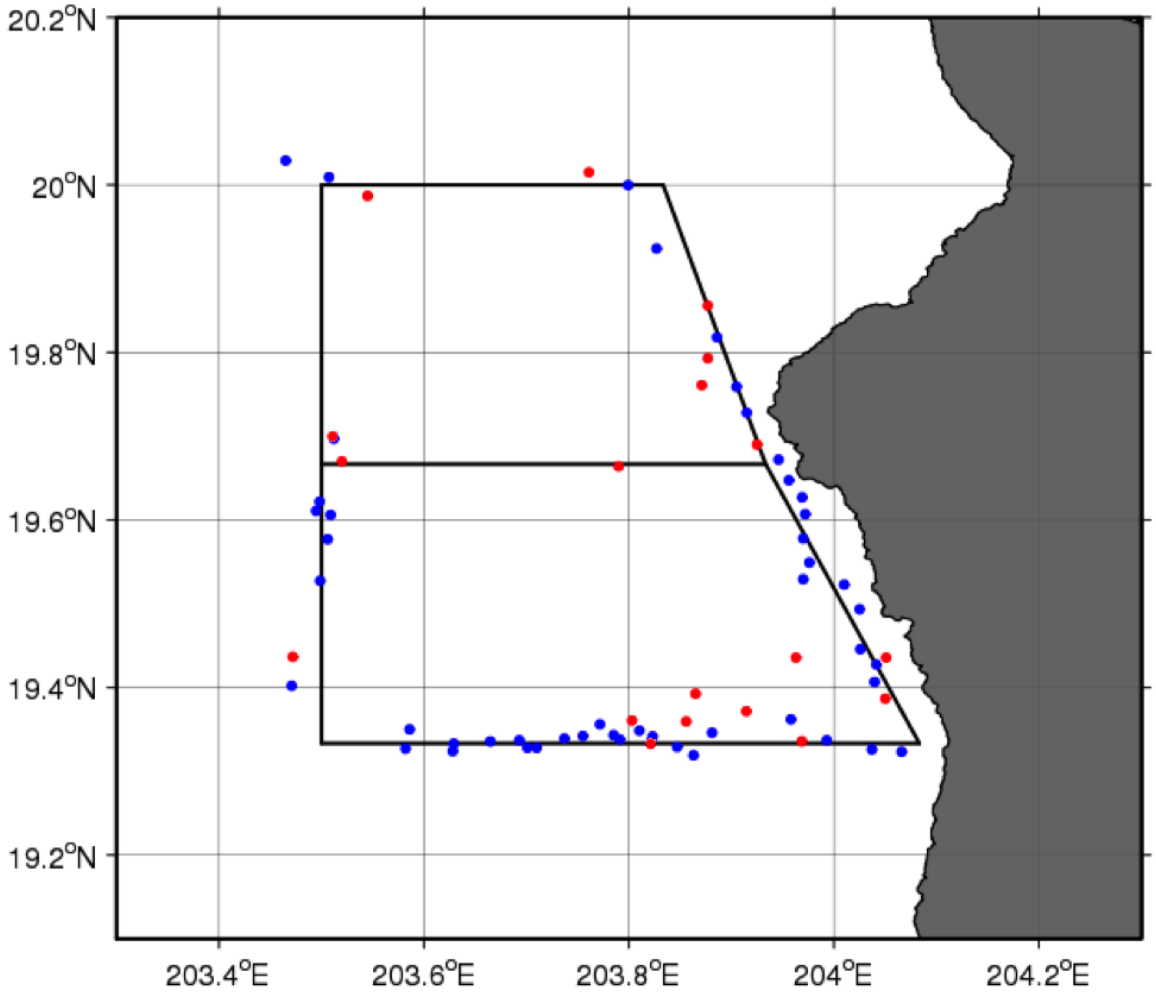

Fig. 5: SE-13-04 cetacean localizations, with red circles indicating daytime localizations and blue circles indicating nighttime localizations. Transects are also shown. Figure by Melanie Abecassis.

Table 1: SE-13-04 station list.

Station	Latitude	Longitude	Notes
A	19° 40'N	156° 04'W	Near shore – Central
B	19° 40'N	156° 30'W	Off shore – Central
C	19° 20'N	155° 55'W	Near shore – South
D	19° 20'N	156° 30'W	Off shore – South
E	20° 00'N	156° 10'W	Near shore – North
F	20° 00'N	156° 30'W	Off shore – North
EAR1	19° 46.392'N	156° 06.389'W	UH EAR
EAR2	19° 27.313'N	155° 56.795'W	UH EAR
SPW	19° 42.06'N	156° 29.34'W	Sperm whale localization
PW	19° 20.58'N	156° 08.10'W	Pilot whale localization

Table 2: Date, time, and location of 1000 m CTD casts conducted during SE-13-04. Casts are identified first by the station at which they were conducted and then by the chronological number of casts performed at that station. The Samples Collected column lists the analyses water samples were collected for during the cast.

Cast	Date and Time (HST)	Samples Collected
A1	13 June 0603	Chl
C1	13 June 1838	Chl, Flow Cytometry
C2	14 June 0558	Chl, Flow Cytometry
D1	14 June 1905	Chl, Flow Cytometry
D2	15 June 0610	Chl, Flow Cytometry
B1	15 June 1901	Chl, Flow Cytometry
B2	16 June 0601	Chl, Flow Cytometry
F1	16 June 1412	Chl, Flow Cytometry
F2	16 June 1855	Chl, Flow Cytometry
F3	17 June 0555	Chl, Flow Cytometry
E1	17 June 1855	Chl, Flow Cytometry
E2	18 June 0559	Chl, Flow Cytometry
A2	18 June 1905	Chl, Flow Cytometry
A3	19 June 0554	Chl, Flow Cytometry
A4	20 June 1935	Chl, Flow Cytometry
F4	21 June 0847	Chl, Flow Cytometry
F5	21 June 1908	Chl, Flow Cytometry
SPW1	22 June 0614	Chl, Flow Cytometry
D3	22 June 1920	Chl, Flow Cytometry
B3	23 June 0606	Chl, Flow Cytometry
C3	23 June 1932	Chl, Flow Cytometry

Table 3: Acoustic transects conducted during SE-13-04. Transects are identified by the station where they begin, the station where they end, and the chronological number of like transects completed. Transect Type indicates whether active acoustic data, passive acoustic data, or both were targeted for collection during each transect.

Acoustic Transect	Date and Time (HST)	Transect Type
AC1	13 June 1307	Active
CD1	14 June 0722	Active
DB1	15 June 0736	Active
BF1	16 June 0724	Active
FE1	17 June 0705	Active
EA1	18 June 0719	Active
AB1	19 June 1447	Active, Passive
BA1	19 June 2116	Active, Passive
EA2	20 June 1336	Active, Passive
AE1	20 June 2057	Active, Passive
EF1	21 June 0208	Active, Passive
EF2	21 June 1229	Active, Passive
FB1	21 June 2055	Active, Passive
FB2	22 June 1014	Active, Passive
DB2	22 June 2045	Active, Passive
BD1	23 June 0716	Active, Passive
DC1	23 June 1140	Passive
CD2	23 June 2101	Passive
CA1	24 June 1405	Passive
AC2	24 June 2003	Active, Passive

Table 4: Fine-scale acoustic sampling grids conducted during SE-13-04. Target Station indicates the station around which the grid was performed. Grid Type indicates whether active acoustic data, passive acoustic data, or both were collected during each sampling grid. Data Target indicates why the grid was conducted.

Target Station	Date and Time (HST)	Grid Type	Data Target
B	16 June 0344	Active	Test grid
EAR1	20 June 0652	Active	Detect EK60 with EAR to help determine EAR's range
SPW	22 June 0211	Active	Sperm whale foraging environment (presence, night)
SPW	22 June 1535	Active, Passive	Sperm whale foraging environment (absence, day)
SPW	23 June 0210	Active, Passive	Sperm whale foraging environment (absence, night)
PW	23 June 1620	Active, Passive	Pilot whale foraging environment (presence)
PW	24 June 0615	Active, Passive	Pilot whale foraging environment (absence)
EAR2	25 June 0137	Active	Detect EK60 with EAR to help determine EAR's range

Table 5: Mid-water trawls conducted during SE-13-04. Tows are identified first by the station at which they were conducted and then by the chronological number of tows performed at that station.

Tow	Date and Time (HST)
C1	13 June 2104
C2	14 June 0113
D1	14 June 2110
D2	15 June 0119
B1	15 June 2108
B2	16 June 0107
F1	16 June 2114
F2[1]	17 June 0116
E1	17 June 2117
E2	18 June 0112
A1	18 June 2107
A2[1]	19 June 0109

[1]Cod end sustained cookie cutter bites, compromising catch.

Table 6: Passive acoustic cetacean localizations achieved during SE-13-04. During daylight hours, visual observers aided in localization and species identification.

Date and Time (HST)	Latitude (°N)	Longitude (°W)	Notes
19 June 1638	19.66	156.21	
20 June 1557	19.86	156.12	Bottlenose dolphins
20 June 1630	19.79	156.12	Bottlenose dolphins
20 June 1713	19.76	156.13	Bottlenose dolphins
20 June 1818	19.69	156.08	Pilot whales
20 June 2103	19.73	156.09	
20 June 2152	19.76	156.10	
20 June 2232	19.82	156.11	
21 June 0016	19.92	156.17	
21 June 0235	20.00	156.20	
21 June 0250	20.02	156.24	
21 June 1619	19.99	156.46	Pilot whales
21 June 1649	20.01	156.49	Pilot whales
21 June 2025	20.03	156.54	
22 June 0043	19.70	156.49	Sperm whales
22 June 1522	19.70	156.49	Striped dolphins
22 June 2059	19.40	156.53	
22 June 2248	19.53	156.50	
22 June 2341	19.58	156.49	
22 June 2341	19.61	156.51	
22 June 2341	19.62	156.50	
23 June 0046	19.61	156.49	
23 June 0141	19.67	156.48	
23 June 0926	19.44	156.53	Rough-toothed dolphins
23 June 1417	19.36	156.20	Pilot whales
23 June 1530	19.36	156.14	
23 June 1601	19.39	156.14	Pilot whales
23 June 1754	19.34	156.03	
23 June 1825	19.34	156.01	
23 June 2101	19.32	155.93	Spinner dolphins
23 June 2129	19.33	155.96	
23 June 2213	19.36	156.04	
23 June 2248	19.35	156.12	Unidentified dolphins
23 June 2300	19.32	156.14	Unidentified dolphins
23 June 2315	19.33	156.15	Unidentified dolphins
23 June 2315	19.34	156.18	Unidentified dolphins
23 June 2315	19.35	156.19	Unidentified dolphins
23 June 2335	19.36	156.23	Unidentified dolphins
23 June 2353	19.34	156.21	

Date and Time (HST)	Latitude (°N)	Longitude (°W)	Notes
23 June 2358	19.34	156.26	
24 June 0026	19.33	156.30	
24 June 0047	19.34	156.34	
24 June 0058	19.33	156.37	
24 June 0129	19.33	156.42	
24 June 0323	19.35	156.41	Possible beaked whale
24 June 0402	19.32	156.37	
24 June 0447	19.34	156.31	
24 June 0455	19.33	156.29	
24 June 0521	19.34	156.25	
24 June 0524	19.34	156.22	
24 June 0546	19.33	156.18	
24 June 0800	19.37	156.09	Melon-headed whales
24 June 1455	19.44	155.95	Melon-headed or pilot whales
24 June 1531	19.44	156.04	
24 June 1727	19.67	156.05	
24 June 2004	19.65	156.04	
24 June 2030	19.63	156.03	
24 June 2052	19.61	156.03	
24 June 2107	19.58	156.03	
24 June 2131	19.55	156.02	
24 June 2137	19.53	156.03	
24 June 2144	19.52	155.99	
24 June 2204	19.49	155.98	
24 June 2231	19.45	155.97	
24 June 2240	19.43	155.96	
24 June 2258	19.41	155.96	
24 June 2307	19.39	155.95	

Table 7: DIDSON imaging sonar casts conducted during SE-13-04. Casts are identified first by the station at which they were conducted and then by the chronological number of casts performed at that station. Target Depth(s) indicates the depth of the deep scattering layer targeted during the DIDSON cast, as determined from the EK60 38 kHz data.

Cast	Date and Time (HST)	Target Depth(s) (m)
A1[1]	13 June 1037	500, 680, 780
C1	14 June 0421	500, 660
D1	15 June 0355	460, 680
F1	16 June 1549	500, 600, 700
E1	17 June 1418	500, 670, 760
E2	18 June 0347	550, 660
A2	18 June 1548	500, 660, 800
A3	19 June 0352	510, 700
EAR1a	20 June 0449	500
EAR1b	20 June 0951	570, 730
SPW1	22 June 0349	600, 680
C2[2]	24 June 1014	550, 790
EAR2a	25 June 0311	480, 630, 740
C3	25 June 0821	580, 740

[1]Data collection limited due to batteries becoming too cold at depth. Batteries were wrapped on thermal insulation on subsequent casts.
[2]No data collected during cast due to an electrical malfunction within the instrument array.