HOT 351: Chief Scientist Report
Chief Scientist: Fernando Carvalho Pacheco
R/V *Kilo Moana*
July 15 – 21, 2024

Cruise ID: KM 24-10
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Benjamin Morgan
Chief Scientist: Fernando Carvalho Pacheco, University of Hawaii at Manoa
Marine Technicians: Lance Frymire (lead), Jeff Koch

1.0 COVID-19 PREVENTION

Extra precautions were set in place before the cruise to prevent the spread of COVID-19 onboard. UNOLS has provided guidelines and some were followed on this cruise.

- All of the science party were vaccinated.
- All cruise participants were antigen-tested for COVID-19.

2.0 SCIENTIFIC OBJECTIVES

The cruise objective was to maintain a hydrographic and biogeochemical data collection at the Hawaii Ocean Time-series (HOT) stations.

A copy of the detailed cruise plan is available at:

https://hahana.soest.hawaii.edu/hot/crsplan/HOT_351_Operational_Cruise_plan.pdf

Science operations were planned for four stations in the following order:

1) Station 1, referred to as Station Kahe, is at 21° 20.6'N, 158° 16.4'W.
2) Station 2, called Station ALOHA, is a circle with a six nautical mile radius centered at 22° 45'N, 158°W.
3) Station 52, the site of WHOTS-20 Mooring (anchor position 22° 40.08'N, 157° 57.01'W).
4) Station 6, referred to as Station Kaena, is located off Kaena Point at 21° 50.8'N, 158° 21.8'W.

3.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Allie Bilson	Graduate Student	HPU	USA
Angelicque White	Scientist	UH	USA
Andrew Hirzel	Post-Doc	UH	USA
Blake Watkins	Marine Engineer	UH	USA
Brandon Brenes	Graduate Student	UH	USA
Caroline Holmes	Graduate Student	UH	USA
Dan Sadler	Research Associate	UH	USA
Dan Fitzgerald	Research Associate	UH	USA
Fernanda Henderikx Freitas	Scientist	UH	BRA
Fernando Carvalho Pacheco	Research Associate (CS)	UH	BRA
Jeff Koch	OTG	UH	USA
Karin Björkman	Research Specialist	UH	SWE
Lance Frymire	OTG	UH	USA
Mattia Da Fieno	Undergraduate	UH	USA
Michael Dowd	Research Assistant	UH	USA
Paige Dillen	Graduate Student	UH	USA
Sebastian Mieruch	Post-Doc	AWI	GDR
Sarah Frail	Graduate Student	Stanford	USA
Solene Moulin	Post-Doc	Stanford	FRA
Tully Rohrer	Research Associate	UH	USA

4.0. GENERAL SUMMARY

The HOT-351 cruise was delayed from July 13-19 to July 15-21 due to a leaky lifting cylinder in the KM A-frame. Equipment loading completed on July 12, and the cruise departed on July 15. Initial loading delays caused by A-frame repairs required the HOT-PO group to prepare and test the CTD on the departure day.

At Station Kahe, operational checks of the Hawboldt LARS system, a CTD cast, a handheld net tow and a hyperpro cast were conducted before moving to Station ALOHA. At ALOHA, we completed twenty-two 1000m CTD casts, seven VPR tows, six regular net tows, and ten handheld net tows. The primary productivity (PP) array, deployed 1 nm west of the ALOHA center, drifted 3.7 nm northwest before retrieval. The sediment trap (ST) array, deployed 2 nm west, drifted 13 nm WNW before retrieval. The gas array (GA), deployed 2 nm west, drifted 7 nm before recovery.

We conducted two near-bottom CTD casts, and the 36-hour continuous CTD sampling proceeded without interruptions. A minimal delay occurred due to an encoder failure in the docking head, but all rosette samples for the core Hawaii Ocean Time-series (HOT) and related projects (see Sections 7-8) were successfully collected. Near the WHOTS mooring, a yo-yo CTD cast was completed, and a near-bottom CTD cast was conducted at Station Kaena.

There were several issues with the CTD primary conductivity and oxygen sensors and cables during multiple casts throughout the cruise. However, the secondary set of sensors functioned properly, and all issues were resolved by the end of the cruise. For more details, please refer to the Daily Activities Summary.

The 300 kHz and 38 kHz Acoustic Doppler Current Profilers (ADCPs), underway fluorometer, transmissometer, thermosalinograph worked correctly. Throughout the cruise, the ship's meteorological operated continuously, with wind speeds of 8-13 knots from the east and swells of 1-3 feet. Top currents recorded were 0.2-0.5 knots towards the northwest/north.

5.0. R/V *Kilo Moana* OFFICERS AND CREW, TECHNICAL SUPPORT

The R/V *Kilo Moana* maintained good ship support for our work. Technical support during this cruise was also excellent. OTG Lance F. and Chief Engineer Jim I. quickly identified and fixed an enconder failure in the docking head of the Hawboldt winch. Captain Benjamin Morgan and the bridge crew did a fantastic job during array recoveries.

6.0. DAILY REPORT OF ACTIVITIES (HST)

July 15, 2024

0828	Departed UH Marine Center at Pier 35.
0930	Safety briefing and abandon ship drills.
1115	Arrived at Station Kahe.
1125-1236	Performed Hawbolt crane/winch testing and a weight cast to 1000m at 21°20.8759’N, 158°16.5601’W.
1245-1327	Hyperpro Cast.
1335-1355	S1C1 CTD cast to 15m. Encountered an issue with the primary conductivity sensor, which displayed a fixed reading of 1999.0 during the soaking period, and the pump did not turn on. The PO group brought the CTD package back on deck for inspection. Dan Fitzgerald replaced the primary conductivity cable, and the pump was tested before a later redeployment.
1400-1421	Handheld Net Tow (Solene/Sarah/Angel).
1423-1530	Redeployed/restarted the S1C1 (Kahe) CTD cast to 1000m. The primary oxygen sensor displayed a large negative value. Dan Fitzgerald will inspect the sensor and cable before the next CTD cast operation.
1540	Began transit to Station ALOHA.

July 16, 2024

2300	Arrive at Station ALOHA
2355-0305	VPR Tow (22°41.7779'N, 158°00.5356'W)
0332-0639	VPR Tow (22°47.2068'N, 158°00.5484'W)
0740-1004	VPR Tow (22°47.6100'N, 157°58.4300'W)

0857-0915 Hand Net Tow from port side while VPR was in the water
1100-1230 HyperPro cross-comparison
1234 Transit to Pump Tanks
1404-1419 Hand Net Tow
1448-1547 S2C1, CTD cast to 1000m (Open). After S1C1 (Kahe), the primary oxygen sensor's cable was replaced, but it still displayed a reading of around -65 umol/kg. DF replaced the primary oxygen sensor SN 3761 with SN 43918, resolving the issue. The primary conductivity sensor (SN 3162) with the swapped cable started displaying a reading of 1999 again, so DF also replaced it with sensor SN 3984. During S2C1 (Open), the primary oxygen sensor displayed some bad data in the upper 100m, but then returned to normal. This is normally related to the Y-debbubler air release valve that gets clogged.

1653-1751 S2C2, CTD cast to 1000m (Open). Primary oxygen sensors displayed recurring issues at similar depths.
1811-2053 VPR Tow cast (22°47.2957'N, 158°04.2242'W)
2102-2223 S2C3, CTD cast to 1000m (Open). Continued issues with the primary oxygen sensor in the top 100-200m. The CTD stopped at ~65 dbar during the downcast due to HAWBOLDT winch autodeploy function issue, causing a ~25minute delay.
2239 Transit to Pump Tanks + Incinerator

July 17, 2024

0200-0306 S2C4, CTD cast to 1000m (PP). The primary oxygen sensor continued to malfunction, leading to a cable change before the next cast.
0433-0500 Deployed Primary Productivity array (22°45.1566'N, 158°01.0812'W), about 1nm west of the ALOHA center. Wind: 8-10 kts / E; Current:0.3-0.5 kts/northwestward (top 60m)
0513-0804 VPR Tow cast (22°45.1458'N, 158°00.7873'W)
0815-0926 S2C5, CTD cast to 1000m (Open). The primary oxygen sensor SN 43918 displayed faulty data from 40 dbar to 160 dbar. Furthermore, OTG requested a quick Hawboldt test during the upcast from 75 to 40 dbar. No alarms were triggered when the Hawboldt serial feed was disconnected from the PO acquisition computer. After S2C5, DF replaced the primary oxygen sensor SN 43918 with sensor SN 43262.
1018-1032 Hand Net Tow
1132-1227 HyperPro cross-comparison
1240-1549 VPR Tow cast (22°45.0362'N, 157°56.2509'W).
Wind: 11-13 kts / E; Current: 0.1 - 0.4 kts / northward (top 60m)
1608-1656 S2C6, CTD cast to 1000m (Open). No issues during the cast!
1705-1715 Hand Net Tow
1720 Transit to Pump tanks and then to PP array
1933-1954 Recovered PP array, 22 47.101N, 158 3.5834W. (3.7nm northwest of the center)
2100-2156 S2C7, CTD cast to 1000m (Open)
2215 Transit to Sediment Traps Deployment Site (~2 nm west of the center)
2358-0019 Deployed Sediment Trap array (22°45.065'N, 158°02.425'W)

July 18, 2024

0030 Transit to ALOHA center

0152	S2C8 near-bottom CTD cast (PO-1 deep cast)
0334	8 m off the bottom (4805 dbar 22°44.996'N, 158°0.002'W)
0528	End of the Deep cast (22°45.001'N, 158°0.006'W)
0654-0936	VPR Tow cast (22°45.0061'N, 157°59.7537'W)
0944-0955	Hand Net Tow
0958	Transit to ALOHA center
1046-1204	S2C9, CTD cast to 1000m (PO-Shallow)
1229-1250	Net Tow (Blake); Wind: 10 kts / ENE; Current: 0.5 - 0.7 kts / northward (top 60m)
1319-1352	HyperPro cast
1359-1500	S2C10, CTD cast to 1000m (PCPN)
1505	Transit to pump tanks + Incinerator
1654-1754	S2C11, CTD cast to 1000m (PPO4)
1806-1825	Hand Net Tow (S.Moulin)
1956-2108	S2C12, CTD cast to 1000m (Beach)
2203-2228	Net Tow (B.Watkins)
2231-2252	Net Tow (B.Watkins)
2302-2351	S2C13, CTD cast to 1000m (Open). The Hawboldt winch encountered an issue during recovery, causing the CTD package to hang above the water from 2351-0035. OTG recovered the package in manual mode instead of using auto LARS.

July 19, 2024

0045	Transit to Gas Array deployment site (~2nm west of the ALOHA center)
0200-0224	The cast was slightly delayed due to Hawboldt repairs. The issue was related to an encoder failure in the docking head. OTG Lance F. and Chief Engineer Jim quickly identified and fixed the problem.
0228-0323	S2C14, CTD cast to 1000m (Gas Array)
0440-0506	Deployed Gas Array (22 45.0442N, 158 02.1332W) Wind: 11-13kts/E; Current: 0.2-0.3kts/WNW (top 60m)
0528-0619	S2C15, CTD cast to 1000m (Open)
0625	Transit to pump tanks
0800-0856	S2C16, CTD cast to 1000m (Psi)
0908-0922	Hand Net Tow (S.Moulin)
1049-1142	S2C17, CTD cast to 1000m (Open)
1205-1228	Net Tow (B.Watkins)
1232-1257	Net Tow (B.Watkins)
1357-1453	S2C18, CTD cast to 1000m (ATP). Fluorescence glitch at around 788 dbar during the downcast.
1502-1515	Hand Net Tow (S.Moulin)
1700-1745	S2C19, CTD cast to 1000m (Open)
1750	Transit to pump tanks
1958-2059	S2C20, CTD cast to 1000m (HPLC)
2100	Transit towards center circle for PO-2 deep cast
2200-2225	Net tow (B.Watkins)
2230	Transit toward the center circle
2253	S2C21 near-bottom CTD cast (PO-2 deep)

July 20, 2024

0036	At 8m off the bottom. Pressure=4807dbar; Payout= 4793m. 22 44.989N 158 0.169W.
0211	End of the Deep cast (22 44.990N 158 0.170W). The primary conductivity sensor SN 3984 experienced a glitch at approximately 4655 dbar during the downcast, with the data quality deteriorating further during the upcast. DF removed the primary conductivity sensor SN 3984 and installed SN 2687, which failed deck tests. He then replaced SN 2687 with SN 2601, which passed the tests and displayed good data.
0225	Transit to Sediment Traps array
0400	Start Sediment Traps array recovery (22 51.0488N 158 13.0563W) about 13nm WNW of the center. Wind: 10-13kts/E; Current: 0.2-0.5kts/NNW (top 60m)
0412	First lined hooked
0416	Floats and beacons on deck
0425	Samples on deck
0433	End of the Sediment Traps array recovery (22 51.0871N 158 12.6178W)
0438	Transit to Gas Array site (~7nm away)
0538	Start Gas Array recovery (22 50.1385N 158 05.0272W) about 7nm of the center. Wind: 8-10kts/E; Current: 0.3-0.4kts/N (top 60m)
0545	First line hooked
0549	Floats and beacons on deck
0555	First samples on deck
0607	End of the Gas Array recovery (22N 158W)
0615	Transit to WHOTS-20 (~10nm). SOG=4-7kts
0850-0950	S52C1 CTD yo-yo cast to 200m. 5 profiles completed. The primary conductivity sensor SN 2601 failed just before starting S52C1. DF replaced the cable, and the data looked good on deck. No issues during the cast.
1004-1032	Hand Net Tow (S.Moulin)
1055-1226	HyperPro cross-comparison
1323-1354	S2C22, CTD cast to 200m (Open)
1405	Transit to Kaena Station; 1641: Wind: 13-16kts/E; Current: 0.4-0.5kts/W (top 60m)
2002	S6C1, CTD cast to 2500m (Kaena).
2059	Bottom of cast 9m above bottom.
2200	End S6C1
2205	Transit to PIER 35

July 21, 2024

0755	First line at Pier 35

7.0 HOT program sub-components:

Investigator	Project	Institution
Angelicque White	Core Biogeochemistry	UH
Dave Karl	Biogeochemistry	UH
John Dore	Biogeochemistry QA/QC	MSU
James Potemra	Hydrography	UH
Mike Landry	Zooplankton dynamics	SIO
Ricardo Letelier	Optical measurements	OSU
Craig Carlson	Dissolved Organic Carbon	UCSB
Bob Weller/Al Plueddemann	WHOTS mooring	WHOI

8.0 Ancillary programs:

Matt Church	Diversity and activities of nitrogen-fixing microorganisms	UM/FLBS
Andrew Dickson	CO_2 dynamics and intercalibration	SIO
Paul Quay	$DI^{13}C$	UW
Angelicque White	UVP	UH
Debbie Lindell	Seasonal Virus Sampling	Technion
Andrew Hirzel	Video Plankton Recorder	UH
Brendon Brenes	CNP stoichiometry of picoeukaryotes	UH
Sarah Frail/Ellen Yeh Solene Moulin	Marine nitrogen-fixing symbiosis an overlooked driver of ocean biogeochemical cycles	Stanford
Qian Li/Grieg Steward/ Kyle Edwards	Steward Lab Culture maintenance	UH

Danielle Hull / Kathleen Ruttenberg	SOEST Laboratory for Analytical Biogeochemistry	UH
Paige Dillen / Fernanda H.Freitas/ Angelicque White	Leveraging the Hawaii Ocean Time-series program for validation of the PACE Mission in oligotrophic waters	UH
Sebastian Mieruch	HOT-webODV	AWI