

Hawaii Ocean Time-series HOT-351 Cruise Plan

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

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Pre-Cruise Meeting: July 8, 2024, at 1330 via Zoom

Start pre-embarkation protocols (masking, social distancing): July, 8, 2024.

COVID Testing: July 12, 0830-0900, Pier 35.

Loading: July 12 at 0900, Pier 35.

Departure: July 15 at 0900 (Friday, **Science personnel at UHMC by 0800**).

Arrival: July 21 at 0800.

Post-Cruise Meeting: July 22 at 1330 via Zoom.

1.0 SCIENTIFIC OBJECTIVES

The objective of the cruise is to maintain a collection of hydrographic and biogeochemical data at the Hawaii Ocean Time-series (HOT) stations. Four stations will be occupied during the cruise:

- 1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W and will be occupied on July 15 for about 3-4 hours.
- 2) Station 2, referred to as Station ALOHA, is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. This is the main HOT station and will be occupied July 16 - 20.
- 3) Station 52, the site of WHOTS-20 Mooring (anchor position 22° 40.08'N, 157° 57.01'W) will be occupied for about 3-4 hours on July 20.
- 4) Station 6, referred to as Station Kaena, is located off Kaena Point at 21° 50.8'N, 158° 21.8'W and will be occupied on July 20 for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

<u>Station</u>	<u>Activities</u>
Kahe (Sta. 1)	Weight Cast, Hyperpro cast, CTD cast (1000 m).
ALOHA (Sta. 2)	Sediment traps, Primary productivity array, Gas array, Net tows, CTD operations, VPR casts.
WHOTS mooring station (Sta. 52)	One CTD cast (yo-yo to 200 m), Hyperpro, surface instrument intercomparisons.
Kaena (Sta. 6)	One near-bottom CTD cast (~ 2400 m).
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology, C-Star.

2.0. 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

3.0. SUMMARY SCHEDULE

8 July	Pre-cruise planning meeting 1330 hrs, via Zoom.
12 July	COVID TESTING 0830-0900, Pier 35.
12 July	Equipment loading at 0900 hrs, Pier 35.
15 July	Depart from Pier 35 at 0900 hrs. Science personnel to UHMC by 0800.
15 July	Station 1 Kahe Pt. operations.
16-20 July	Station 2 ALOHA operations, Station 52 CTD yo-yo cast, Station 6 deep cast.
21 July	Arrive back to Pier 35.
22 July	Post-cruise meeting at 1330 hrs via Zoom

4.0. OPERATIONAL PLANS

4.1. Station Kahe (21°20.6'N, 158°16.4'W)

A 1300 lb. weight-test cast to 500 m will be conducted, **including testing of the emergency systems on the docking head of the Hawboldt LARS system.** These tests will include the Manual Anti-2 Block Test, the Auto with LARS Anti 2-block test, and the Auto with LARS switch malfunction test as described in previous cruise plans. A Hyperpro cast (Sect. 4.2.7), one CTD cast to 1000 m (4.2.4), and a Net-Tow (4.5): the ship's A-frame, CTD winch. After the operations are satisfactorily completed, the ship shall proceed to Station ALOHA.

4.2. Station ALOHA (22°45'N, 158°W with 6 nm radius)

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4.2.1. Upon arrival at Station ALOHA, the Sediment Trap Array (Sect 4.2.2) (*) will be deployed. After this operation, a 1000-m (or 200m, depending on time) cast will be conducted to collect water for the Primary Production Array. Following this, the Primary Production array will be deployed (4.2.3). Then, CTD, VPR casts (Sect 4.10), Hand Net-tows and Hyperpro cast will be accomplished.

(*) NOTE: The deployment of all drifting arrays must be determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring.

Array tracking is facilitated through the SOEST Cruise and Drifter Tracks tool found at <http://hahana.soest.hawaii.edu/nowcast/loctable.html>

4.2.2. Sediment trap array deployment

The floating sediment traps will be from the back of the deck through the A-frame and using the SeaMac winch. After deployment we request that the bridge verify that the radio transmitters are functioning and directionally correct. The Sediment Trap array will consist of one cross with 12 particle interceptor traps (PIT) at 150 m.

The array will drift for about 70 hours or more before recovery. The array is equipped with 1 XEOS Iridium transmitter, 1 RockBlock Iridium beacon, strobe lights, and a radio transmitter (see section 6.0 for transmitter IDs). Assistance from the bridge is requested in plotting the drift track of the array. We request the use of the ship's radio direction finder for locating the array before recovery. **Blake Watkins** will direct this deployment.

4.2.3. Primary production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0557 hrs on July 16, <https://gml.noaa.gov/grad/solcalc/>), a free drifting incubation array will be deployed from the back of the deck thru the A-frame and using the SeaMac winch. The primary production incubation array will be deployed at a location within Station ALOHA and will be determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring. (See section 6.0 for Transmitter IDs).

The array will be recovered around sunset (1919 hrs on July 16). CTD or VPR operations shall continue after recovery. All radioactive waste generated by the experiment shall be returned to the University of Hawaii. Only qualified personnel shall handle radioactive material. **Blake Watkins** will direct this deployment.

4.2.4. Water column measurements

Vertical profiles of temperature, conductivity, and dissolved oxygen will be made with an instrument package consisting of a Sea-Bird CTD attached to a 24-place rosette with 12-liter sampling bottles. We will need the ship's CTD winch and crane for these operations. Water samples for biogeochemical measurements will be collected on each cast.

The cast after the VPR cast (3h) deployment on Thursday 18, shall be made to the near bottom (approximately 4740 m). Following this cast, a series of 1000-m casts shall be made continuously every three hours for a 36-hour period, ending with a second near-bottom cast. It is highly desired that this burst sampling be done without interruption, and we request the ship to maintain position within the study area for that period, and repositioning to the center of the Station before each cast whenever possible.

Whenever the ship's tanks need to be pumped, it must be conducted outside the circle that defines station ALOHA (Sect. 1.0). To avoid disruptions in the schedule, this operation should be coordinated with the chief scientist or the watch leaders (**Dan Fitzgerald and Tully Rohrer**).

4.2.5. Lowered Acoustic Doppler Current Profiler (LADCP)

The LADCP will not be deployed on this cruise.

4.2.6. Gas Array deployment

A free drifting incubation array will be deployed the third day of the cruise at Station ALOHA. Samples for the gas array will be collected from station 2 CTD cast 14. The gas array will be deployed from the back of the deck through the A-frame using the SeaMac winch. The gas array will be deployed within Station ALOHA and determined by observed local and forecasted currents to avoid possible entanglement with the WHOTS mooring. The array has GPS transmitters, strobe lights, and a radio transmitter (See Section 6.0 for transmitter IDs). The ship will **not** need to keep within sight of the array until the time of the recovery, approximately 25 hours after its deployment. Assistance from the bridge is requested to plot the drift track of the array. **Blake Watkins** will oversee this deployment.

4.2.7. Hyperpro

The Hyperpro is a profiling unit with one up-looking and one down-looking hyperspectral radiometer, a WET Labs ECO-BB2F triplet (measuring Chlorophyll-*a* fluorescence and backscattering in the blue and red wavelengths), temperature and conductivity sensors. This instrument also incorporates a ship-mounted surface radiometer. Around 1400 on the first, second, and third days, the Hyperpro will be deployed from the stern through a small block hung from the A-frame. The instrument is lowered and retrieved by hand. Each deployment will consist of two profiles and one yo-yo (5 x 20m) before the instrument is retrieved.

4.2.8. Underwater Vision Profiler (UVP)

The UVP will be installed on the rosette inside the frame using clamps provided by HOT. This instrument will require a modified CTD deployment procedure in which the CTD/rosette is lowered into the water and allowed to soak for one minute before being deployed to 15m as rapidly as is safe for the winch. The instrument will only turn on if the average descent rate is >18 m/min. HOT personnel will maintain this instrument before and after CTD casts.

4.2.9. Zooplankton Net Tows

A plankton net will be deployed from the stern and shall be towed for half-hour periods. Half-hour periods are scheduled around noon and midnight (see schedule) for a total of six slots. The A-frame and small capstan will be needed for this operation. **Blake Watkins** will direct these operations.

4.3 Gas Array and Sediment Trap Array Recovery

On the morning of July 17, the ship will transit to recover the gas array. The A-frame and the Sea-Mac winch will be needed to retrieve the array. After the Gas Array is recovered, the ship will transit to recover the floating sediment trap array. **Blake Watkins** will oversee these operations. After the sediment trap array is recovered, the ship will transit to Station 52.

4.4. Station 52 - WHOTS-20 Mooring

The WHOTS-20 mooring's anchor position is 22° 40.08'N, 157° 57.01'W. The buoy's watch circle is about 2 nautical miles. Generally, the buoy stays on the edge of the watch circle. The buoy can be detected via radar in good weather conditions but is harder to detect with larger sea states. Upon arrival at Station 52 on July 18, one 200 m CTD yo-yo cast and ADCP intercomparisons will be conducted.

4.5. Hand-held Net Tow

A hand-held plankton net tow will be deployed from the stern and towed for 10-30 minutes while the ship moves very slowly (<1 knot). Samples might also be collected while the CTD is in the water. The A-frame and the small capstan might be needed if desired. Two net tows per day are scheduled. The OTG technicians, **Sarah Frail** and **Solene Moulin** will direct these operations.

4.6. Station Kaena (21° 50.8'N, 158° 21.8'W)

A near-bottom CTD cast (~2500 m) will be conducted at this location on the evening of July 20. Once the CTD cast is complete, the ship shall return to Pier 35.

4.7. Acoustic Doppler Current Profiler

The ship's acoustic Doppler current profilers (ADCP) will be in operation throughout the cruise. The OTG technicians will oversee the ADCP system.

4.8. Thermosalinograph, Fluorometer and pCO₂

The ship's thermosalinograph, fluorometer, and pCO₂ sampling of the uncontaminated seawater supply system will operate during the cruise while the ship is outside Honolulu Harbor. The science personnel will take salinity samples to calibrate the thermosalinograph from the intake hose at about 6-hour intervals throughout the duration of the cruise. The ship's meteorological system shall be in operation throughout the cruise. Access to real-time underway data through the ship's network will be required. The OTG technicians will oversee the thermosalinograph, fluorometer, and meteorological suite operations.

4.9. Inline C-Star Transmissometer and IFCB

In addition to the continuous thermosalinograph and fluorometer sampling, the inline C-Star Transmissometer will sample continuously from the uncontaminated seawater supply system throughout the duration of the cruise while the ship is outside of Honolulu Harbor. This cruise will also use the Imaging Flow CytoBot (IFCB). Access to real-time underway data through the ship's network is required. UH personnel will oversee these instruments and operations.

4.10. Video Plankton Recorder (VPR) Cast

A digital autonomous Video Plankton Recorder (VPR) will be deployed multiple times during the cruise. The tow speed is 1.5 knots, and the payout/recovery speed is 30 meters per minute using the SeaMac winch. The system should be continuously oscillated between the surface and the maximum line-out depth. The orange synthetic Dyneema line shall be used for this deployment. Deployments should be at least 45 minutes in the water. A two- or three-hour block will allow for multiple profiles.

5.0 EQUIPMENT

5.1. The HOT science party shall be bringing the following:

1. Seabird CTD system, all sensors, deck boxes and computer CTD acquisition systems
2. One 20 ft. laboratory van (#23 - HOT Rad Van) with assorted equipment for radioisotope and general use, one 10 ft van (**#540A PO Equipment van**).
3. Distilled, deionized water and all required chemicals and isotopes
4. Large vacuum waste containers
5. Liquid nitrogen dewars
6. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights, line, sediment traps and crosses.
7. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights, line primary production bottles and spreader bars.
8. Drifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
9. Oxygen titration system
10. Plankton nets and towing lines
11. Desktop and laptop personal computers
12. Assorted tools

13. All required sampling bottles
 14. Pertinent MSDS
 15. SeaFlow
 16. Inline C-Star Transmissometer
 17. Underwater Vision Profiler (UVP)
 18. Video Plankton Recorder (VPR)
 19. 1 incubator (baby blue), stored on 02 Deck
 20. Hose Reel (43" x 43")
 21. 24-place rosette, and 24 12-l water sampling bottles (**to be used as primary system**)
2. We will need the use of the following ship's equipment:
1. A-frame
 2. A-frame block assembly
 3. CTD winch
 4. Electric power
 - 440/480 VAC, 3 phase 60Hz, 60amp for winches
 - 208 VAC single phase at 60 amps for lab vans
 5. Space on upper 01 deck port side for one 10 ft van(#540A PO Equipment van)
 6. Space on upper 01 deck port side for 20 ft. laboratory van (#23 - HOT Rad Van)
 7. Space on 02 deck for one incubator
 8. Space on deck for ~4 deck baskets of array gear
 9. Small capstan (~ 10 m/min)
 10. SeaMac Winch
 11. Radio direction finder
 12. Hand-held VHF transceivers
 13. Shackles, sheaves, hooks and lines
 14. Precision depth recorder
 15. Shipboard Acoustic Doppler Current Profiler
 16. Thermosalinograph, $p\text{CO}_2$ system, and Fluorometer
 17. Meteorological suite
 18. Grappling hooks and line
 19. Navlink2 PC or equivalent
 20. Running fresh water and seawater, hoses
 21. Uncontaminated seawater supply
 22. Source of compressed air for Trace Metal pump
 23. -80°C Freezer
 24. 4°C Refrigerator and -20°C Freezer
 25. Distilled, deionized water system
 26. Email system
 27. GPS system
 28. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, SeaFlow, and inline C-Star transmissometer and access to real-time data through the network.
 - 29. OTG's 24-place rosette, and 24 12-l water sampling bottles (to be used as backup)**
 30. ~1300 lb weight
 31. Remote CTD dbar pressure display in the winch operator area.
 32. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
 33. OTG's transmissometer
 34. OTG's altimeter

6.0 Satellite Position Transmitters Summary

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Array Name	RockBlock ID	XEOS ID	Argos ID	Radio Frequency
Sediment Trap (ST)	06	268		CH.68 (156.425 MHz)
Primary Production (PP)	08	266		CH.69 (156.475MHz)
Gas Array (GA)	08	266		CH.69 (156.475 MHz)

NOTE: Array tracking is facilitated through the SOEST Cruise and Drifter Tracks tool found at <http://hahana.soest.hawaii.edu/nowcast/loctable.html>

Ship: <i>R/V Kilo Moana</i>	HOT 351 CTD CASTS	Date: July 15-21, 2024	#Bottles
Cast	Samples		
<u>Kahe Pt.</u>			
s1c1 1000 m	O ₂ , Temp, DIC/Alk, pH, Nuts, LLN, LLP, Chl a, Salts		17
<u>Station ALOHA</u>			
s2c1 1000 m	Primary Production (3@ 5, 25, 45, 75, 100, 125, 150, 175) Chl a, FCM, DIC, Salts		24
s2c2 1000 m	Open, Salts, BB (8@DCM,25m), PD (3@5,25)		24
s2c3 1000 m	Open, Salts, DH (3@250)		7
s2c4 1000 m	Open, Salts, BB (8@DCM,25m), PD (3@5,25)		24
s2c5 1000 m	Open, Salts, SF (2@5, 10, 25, 45), DL (5,25,45,75,100,125,150,175)		12
s2c6 1000 m	Open, Salts, BB (8@DCM,25m), PD (3@5,25)		24
s2c7 1000 m	Open, Salts, BB (8@DCM,25m), PD (3@5,25)		24
s2c8 4740 m (PO-1)	O ₂ , Temp, DOC, DIC/Alk, pH, Ref Si, Nuts, Salts		24
s2c9 1000 m (PO-2)	O ₂ , Temp, DOC, DIC/Alk, pH, Nuts, Ref Si, Salts		24
s2c10 1000 m	PC/PN, Salts, PD (3@5,25)		20
s2c11 1000 m	PPO4 , Salts		16
s2c12 1000 m (BEACH)	O ₂ , Temp, DIC/Alk, pH, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts		23
s2c13 1000 m	Open, Salts		4
s2c14 1000 m	Gas Array (3@5,25,45,75,100,125), MC (1@5, 25, 45, 75, 100, 125, 150, 175) ,Salts		24
s2c15 1000 m	Open, Salts		4
s2c16 1000 m	PSi, Salts,		10
s2c17 1000 m	Open, Salts, SF (2@5, 10, 25, 45)		10
s2c18 1000 m	ATP, Salts, PD (3@5,25)		17
s2c19 1000 m	Open, Salts		4
s2c20 1000 m	HPLC, Chl a, Salts		14
s2c21 4740 m (PO-3)	Oxygen, Salts, SL (2@4000)		24
s2C22 100m	PD (3@5,25)		6
<u>WHOTS Mooring</u>			
s52c1 200 m yo-yo	1@5m, Salts		4
<u>Kaena</u>			
s6c1 2400 m	Chl a, Salts		13

MC=Matt Church, **DL** = Debbie Lindell , **BB** = Brandon Brenes, **SF** = Sarah Frail
SL = S-Lab, **PD** = Paige Dillen

Ship: R/V Kilo Moana**HOT 351****Date: July 15–21, 2024**

TIME	Monday 15/7	Tuesday 16/7	Wednesday 17/7	Thursday 18/7	Friday 19/7
0000			Deploy Sed Traps	VPR Cast 6 (3h)	
0100			VPR Cast 2 (3h)		
0200		S2C1 PP			S2C14 Gas Array
0300				S2C8 PO-1 (Deep)	
0400		Deploy PP Array	Transit to pump tanks Incinerator		Deploy Gas Array
0500		VPR Cast 1 (3h)	VPR Cast 3 (3h)		S2C15 Open
0600					Transit to pump tanks Incinerator
0700					
0800	All Sci. Aboard	Hand Net-Tow (Sarah)	S2C5 - Open (Sarah) 1020m (2@5,10,25,45)	Hand Net-Tow (Sarah)	S2C16 PSi
0900	Depart Pier 35				Hand Net-Tow (Sarah)
1000			Hand Net-Tow (Sarah)		
1100		Hyperpro (2h) – Cross comparing	Hyperpro (2h) - Cross comparing	S2C9 PO-2 (Begin 36 hr)	S2C17 Open (Sarah) 1020m (2@5,10,25,45)
1200	Arrive Kahe Weight Cast			Net Tow	Net Tow Net Tow
1300	Hyperpro	Transit to pump tanks Incinerator	VPR Cast 4 (3h)	Hyperpro	
1400	S1C1 Kahe	Hand Net-Tow (Sarah)		S2C10 PC/PN	S2C18 ATP
1500	Hand Net-Tow (Sarah)	S2C2 - Open (Brandon)		Transit to pump tanks Incinerator	Hand Net-Tow (Sarah)
1600	Transit to ALOHA		S2C6 - Open (Brandon)		
1700		S2C3 - Open (PC/PN Eric x Popp comparison)	Hand Net-Tow (Sarah)	S2C11 PPO4	S2C19 Open
1800		Transit to PP array	VPR Cast 5 (3h)	Hand Net-Tow (Sarah)	Transit to pump tanks Incinerator
1900		Recover PP array			
2000				S2C12 BEACH	S2C20 HPLC
2100		S2C4 – Open (Brandon)	S2C7 - Open (Brandon)		
2200	Pump Tanks Incinerator			Net Tow Net Tow	Net Tow
2300	Arrive ALOHA		Transit to pump tanks Incinerator	S2C13 Open	S2C21 PO-3 (Deep) (end 36 hours)

TIME	Saturday 20/7	Sunday 21/7
0000		
0100		
0200		
0300		
0400		
0500	Transit Gas Array	
0600	Recover Gas Array Transit Sed Traps	
0700	Recover Sed Traps	
0800	Transit to WHOTS (S52)	Arrive to Pier 35
0900	S52C1 WHOTS	
1000	Hand Net-Tow (Sarah)	
1100	VPR Cast 7 (3h)	
1200		
1300		
1400	S2C22 100m	
1500	Transit to Kaena	
1600	Pump Tanks Incinerator	
1700		
1800		
1900		
2000	S6C1 Kaena	
2100		
2200	Transit to Pier 35	
2300		

July 16, 2024 : Sunrise 0557 Sunset 1919
(22.75, -158; <https://gml.noaa.gov/grad/solcalc/>)

6.0 HOT-351 Watch Schedule

0300-1500

Dan Fitzgerald - Watch Leader

Dan Sadler - Water Boss

Mattia Da Fieno

Fernando Carvalho Pacheco - Console, Chief Scientist

Caroline Holmes – Volunteer

1500-0300

Karin Björkman – Water Boss

Brandon Brenes

Tully Rohrer – Console, Watch Leader

Michael Dowd

Allie Bilson – Volunteer

0900-2100

Sebastian Mieruch

At Large

Blake Watkins

Fernanda Henderikx

Sarah Frail

Solene Moulin

Paige Dillen

Angelique White

Andrew Hirzel

OTG

Jeff Koch

Lance Frymire (lead)