Hawaii Ocean Time-series
HOT-303 Operationa1 Cruise Plan

Cruise ID: KOK-1804
Vessel: R/V *Ka'Imikai-O-Kanaloa*, University of Hawaii
Master of the Vessel: Captain Mike Hoshlyk
Chief Scientist: Dan Sadler, University of Hawaii
OTG Marine Technicians: Rob Palomares and Rory O'connell

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Dan Sadler Cell Number: (808) 393 6298

Loading: June 21, 2018 @0900
Departure: June 25, 2018 @0700 (Science personnel on board by 0630).
Arrival: June 29, 2018 @ 0800
Debrief: June 29, 2018 @ 1000 in the KOK Conference Room

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. Three stations will be occupied during the cruise, in the following order:

1) Station 1, referred to as Station Kahe, is located at 21° 20.6'N, 158° 16.4'W and will be occupied on June 25th for about 2 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 June 26th – 28th
3) Station 52, the site of WHOTS-14 Mooring (anchor position 22 40.01'N 157 57.09'W) will be occupied on for about one hour on June 28th.
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 June 28th for about 2 hours.

1.1 SCIENTIFIC OPERATIONS

Station	Activities
Kahe (Sta. 1)	Weight Cast, Hyperpro cast, CTD cast (1000 m)
ALOHA (Sta. 2)	Sediment traps, gas array, net tows, CTD operations, primary productivity measurements, optics casts, misc. experiments.
WHOTS mooring station (Sta. 52)	One CTD cast (yo-yo to 200 m), surface instrument intercomparisons.
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology

2.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
Eric Grabowski	Research Associate	UH	USA
Dan Sadler– Chief Scientist	Research Associate	UH	USA
Karin Björkman	Scientist	UH	Sweden
Blake Watkins	Marine Engineer	UH	USA
Kendra Brooks	Research Associate	UH	USA
Kellen Rosburg	Research Associate	UH	USA
Ryan Tabata	Research Associate	UH	USA
Svetlana Natarov	Research Assistant	UH	USA
Ksenia Trifonova	Research Assistant	UH	Germany
Jefrey Snyder	Marine Technician	UH	USA
Macarena Burgos	Scientist	UCádiz	Spain
Tim Burrell	Research Assistant	UH	New Zealand
Frank Pavia	Graduate Student	LDEO	USA
Alan Seltzer	Graduate Student	UCSD	USA
Kate Feloy	Graduate Student	UH	USA
Steve Poulos	Marine Engineer	UH	USA
Kun Ma	Graduate Student	UGA	China
Eric Klingberg	Undergraduate Student	UH	USA
Rob Palomeres	Marine Technician	OTG	USA
Rory O'Connell	Marine Technician	OTG	USA

3.0. SUMMARY SCHEDULE

15 June	Pre-cruise planning meeting 1330 hrs, Moore Conference Center
21 June	Ship loading at 0900 hrs.
25 June	Depart from Pier 35 at 0700 hrs. **Science personnel on-board by 0630.**
25 June	Station 1 Kahe Pt. operations.
26-28 June	Station ALOHA operations. Station 52 CTD, Station Kaena CTD
29 June	Arrive back to Pier 35. Full offload.

4.0. OPERATIONAL PLANS

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

A 500 lb. 1000 m weight-test cast, a Hyperpro cast (Sect. 4.2.9), and one CTD cast to 1000 m (Sect. 4.2.4) will be conducted at this location on June 25th. The CTD winch and starboard squirt boom will be required for these operations. 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)

4.2.1. On arrival at Station ALOHA, the sediment traps will be deployed (Sect. 4.2.2). Once the sediment trap is deployed, the Wirewalker will be deployed (Sect. 4.2.2.1). After these operations are completed, one 1000-m CTD cast will be conducted. Following this, the Primary Production array will be deployed (4.2.3); These operations will be followed by a near-bottom CTD cast and the start of the 36-hour water column obervations at Station ALOHA.

Note: 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

Upon arrival to Station ALOHA the floating sediment traps will be deployed at a location within Station ALOHA, to be determined by local current conditions. The array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. After deployment we request that the bridge verify that the radio transmitters are functioning and directionally correct.

The array will drift for about 56 hours before recovery. The array is equipped with 1 ARGOS satellite transmitter (platform #: 60484), 1 Novatech Iridium beacon (platform #: 200), strobe lights, a radio transmitter (channel 74: 156.725 MHz). Daily positions of the array shall be transmitted by email directly to the ship (argosfix@kok.soest.hawaii.edu , password: argosfix), therefore the ship will **not** need to keep within site of the array until the time of the recovery. 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.

After deployment of the sediment trap array, the ship shall prepare to deploy the wirewalker.

4.2.2.1 Wirewalker deployment

A Wirewalker (Del Mar Oceanographic) will be deployed at Station ALOHA to take hydrographic and optical observations in the upper 400 m of the water column. The instrument is about 1.5 m long and 0.6 m wide and about 30 Kg, with a 40 Kg bottom weight, and attached to a surface buoy with strobe light and Pacific Gyre positioning system (ID: DMO-GLBCN-0003 or DMO-GLBCN-0004), Xeos 51020, Iridium (platform #: 704320), and one Rockblock Beacon.

The Wirewalker will be deployed and recovered close to the sediment traps deployment and recovery, so that the two should drift in the same direction to reduce the transit time to recover them. The instrument will stay in the water for about 2 days. Deployment and recovery will be conducted from the back deck through the A-frame and using the SeaMac winch, each operation will take 30 to 60 min. Blake Watkins will be in charge of this operation with 2 or 3 members of the science party. Two ABs will be required to operate the A-frame and winch respectively.

After deployment of the primary production array, the ship shall transit to the center of the station circle to conduct a near bottom CTD cast (approximately 4740 m).

4.2.3 Primary production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0545 hrs on June 26th), a free drifting incubation array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@kok.soest.hawaii.edu , password: argosfix. The **ship shall keep within site of the array** while performing CTD operations for the last 6 hours of the approximately 12-hour time the array will be in the water unless the array drifts outside of the ALOHA circle. If the array drifts out of the circle, the ship should return inside the circle to conduct CTD casts, and the monitoring of the array will be coordinated with the watch leader. The array will be recovered at 1930, just after sunset (1921 hrs). All radioactive waste generated by the experiment shall be returned to the University of Hawaii. Only qualified personnel shall handle radioactive material.

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 Bullister 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 deployment of the

Primary Productivity Array shall be made to the near bottom (approximately 4740 m). Following this cast, a series of 1000-m casts shall be made continuously every 3 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 of time, and repositioning to the center of the Station before each cast whenever possible.

Whenever pumping of the ship's tanks is needed, 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 **(Jefrey Snyder, Kellen Rosburg)**.

4.2.5. 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 8. The gas array will be deployed from the starboard stern rail using the small crane and the Sea-Mac winch. The array is equipped with two ARGOS satellite transmitters (platform # 84857), Novatech Iridium beacon (platform #: 100), strobe lights and a radio transmitter (channel 73: 156.675 MHz). Positions of the array will be emailed to argosfix@kok.soest.hawaii.edu , password: argosfix. 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 in plotting the drift track of the array.

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4.2.6. 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 on the second, third, and fourth days (see schedule) for a total of six slots. The A-frame and small capstan will be needed for this operation. B. Watkins will be in charge of these operations.

4.2.7. Optics

An optical package including a Wet Labs AC9 that measures water column spectral absorption and attenuation at nine wavelengths, a Chelsea Fast Repetition Rate Fluorometer (FRRf), a SeaBird Seacat with temperature, conductivity, fluorometer, and pressure sensors, and a LISST particle size and distribution analyzer will be deployed two times during the cruise.

Each deployment will consist of two up and two down profiles to a target depth of 200 m at a constant speed of 10 m/min during both the downcast and upcast. An instrument soaking period at just below the surface will be required between the two profiles. The A-frame and capstan will be needed for this operation.

4.2.8. 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 fourth 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.

4.3. Gas Array and floating Sediment sediment trap recovery

In the morning of June 27th, after the optics cast has been completed, the ship shall transit for the recovery of the Gas Array. The small crane and the Sea-Mac winch will be needed to retrieve the sediment trap array. After the Gas Array is recovered, the ship shall transit to recover the floating sediment trap array. On completion of sediment trap array recovery, the ship shall transit to recover the

Wirewalker. After the sediment traps are recovered, the ship shall transit to Station ALOHA for an AC9/FRRf cast. Once the optics work is complete, the ship shall transit to Station 52 and conduct one 200 m CTD yo-yo cast.

4.4 Station 52 - WHOTS-14 Mooring

The anchor position of the WHOTS-14 mooring is 22° 40.0154' N, 157° 57.0915' W. The watch circle of the buoy 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.

4.4.1 CTD yo-yo cast (subsurface instrument intercomparison)

One 200-m CTD yo-yo cast with at least 5 full cycles will be conducted near the WHOTS mooring on June 28th for subsurface instrument intercomparison. This cast should be conducted downwind, down current, and about 200 m from the mooring.

4.4.2 Surface instrument intercomparison

While on station, the ship's meteorological system shall be in operation for surface instrument intercomparisons with the WHOTS mooring. Once the yo-yo cast is completed, ADCP intercomparisons will be run between the shipboard ADCP system and the moored instuments on the WHOTS-14 mooring line. These comparisons should also be conducted downwind, down current, and about 200 m from the mooring.

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

A near-bottom CTD cast (~2500 m) will be conducted at this location in the evening of May 25. Once the CTD cast is complete, the ship shall return to Snug Harbor.

4.6.1 Acoustic Doppler Current Profiler

The ship's acoustic Doppler current profiler (ADCP) will be in operation during the duration of the cruise. The OTG technicians will be in charge of the ADCP system.

4.7.1 Thermosalinograph and Fluorometer

The ship's thermosalinograph and fluorometer sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside Pier 35. Salinity samples to calibrate the thermosalinograph will be taken from the intake hose at 4-hour intervals throughout the duration of the cruise by the science personnel. The OTG technicians will be in charge of the thermosalinograph and fluorometer operations.

4.8.1 Seaglider Operations

Seaglider sg626 and sg148 will be transiting through and near Station ALOHA during this HOT period. One objective is to have a cross correlation with its CTD and the HOT CTD, so the seaglider sg626 will be closer to the ship during the 36 hour burst cycle of sampling to 1000 meters.

It is anticipated to recover the sg626 and sg148, the Iridium Handset phone, seaglider cradle and "dog catcher noose" will be aboard the vessel. It is requested to have the ship's position broadcast both via the standard KOK underway logging system and with a backup NovaTech beacon on one of the vans. The broadcast interval should be as a minimum, once every 30mins.

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. Rosette and 24 12L Bullister sampling bottles, and all associated spare parts
3. Two 20 ft. laboratory vans (#23, and SCOPE) with assorted equipment for radioisotope and general use. One 10 ft. blue storage van (PO) for equipment and spare storage.
4. Distilled, deionized water and all required chemicals and isotopes
5. Large vacuum waste containers
6. Liquid nitrogen dewar
7. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights, line, sediment traps and crosses.
8. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights, line primary production bottles and spreader bars.
9. Drifting diazotrophy growth rate array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and long mounting bars.
10. Drifting gas array with strobe lights, satellite and radio transmitters, floats, weights, line, 4 L bottles and short mounting bars.
11. Oxygen titration system
12. Plankton nets and towing lines
13. Desktop and laptop personal computers
14. Assorted tools
15. All required sampling bottles
16. Deck incubation system (1- dark incubator)
17. Pertinent MSDS
18. Chest Freezer (22 cubic inch)
19. Wirewalker

5.2. 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 the back deck for one laboratory van **(#23)**
6. Space on upper deck for two vans **(SCOPE and Blue Equipment van)**
7. Space on deck for ~6 deck baskets of array gear
8. Space on back deck for sea water incubators
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 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. -80°C Freezer
23. 4°C Refrigerator and -20°C Freezer
24. Distilled, deionized water system
25. Electronic mail system
26. GPS system
27. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, and access to real-time data through the network.
28. OTG's 24-place rosette, and 24 12-l water sampling bottles (to be used as spare)
29. ~1300 lb weight
30. Remote CTD dbar pressure display in the winch operator area.
31. Monitor in CTD Lab displaying ship coordinates, bottom depth and GMT.
32. OTG's transmissometer

Ship: R/V *Ka'Imikai-O-Kanaloa* HOT 303 CTD CASTS Date: June 25-29, 2018

Cast		Samples	#Bottles
Kahe Pt.			
s1c1	1000 m	O_2, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts KM(4@DCM,5m), FP(1@5m)	24
Station ALOHA			
s2c1	200 m	Primary Production, SF-S(pb 3@ 5, 25, 45, 75, 100, 125), Salts SF-S-O2(1@15)	21
s2c2	4740 m (PO-1)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts FP(pb@4700,4000,3400,2800,2200,1700)	24
s2c3	1000 m (PO-2)	O_2, Temp, DOC, DIC/Alk, Nuts, Salts	24
s2c4	1000 m	PC/PN, DNA(1@5,25,45,75),DK(1@700,4@25),Salts	23
s2c5	1000 m	PPO4, SF-S(1@5,25),SF-S-O2(1@15),Salts	18
s2c6	1000 m (BEACH)	O_2, Temp, DIC/Alk, Nuts, LLN, LLP, DOC, Keeling, Quay, Salts, SF-S(1@5,pb@25)	24
s2c7	1000 m	PUR, SF-S(1@5, 25), DNA(1@,100,125,150,175), Salts	17
s2c8	1000 m	Gas Array(3@5,25,45,75,100,125), SF-S(1@5, 25), Salts	22
s2c9	1000 m	DNA(1@200,225,250,275), SF-S(1@5, 25), MC (1@5, 25, 45, 75, 100, 125, 150, 175), SF-S-O2(1@15),Salts KM(4@DCM,5m)	14
s2c10	1000 m	PSi, SF-S(1@5, 25), PO(6@1000),FP(1000,600,250),Salts	21
s2c11	1000 m	SF-S(1@5, 25), DH(3@250), SW(3@5),Salts	12
s2c12	1000 m	ATP, DNA(1@300,400,500,770), SF-S(1@5,25) Salts	15
s2c13	1000 m	SW(1@5,25,45,75,100,125,150,175, 200, 300, 400, 800), SF-S(1@5, 25), SF-S-O2(1@15),Salts	21
s2c14	1000 m	HPLC, Chl a, Salts	14
s2c15	4740 m (PO-3)	Oxygen, DNA(1@1000,2000,3000,4000), Salts DH(3@4000), DK(2@4000)	17
WHOTS Mooring			
s52c1	200 m yo-yo	DIC/TA(1@5), KM(4@DCM,7@5m),JZ(4@5m)	16
Kaena			
s6c1	2400 m	Chl, Salts	13

MC=Matt Church, **SW**=Sam Wilson, **SF-S**=Sara Ferrón-Smith
DH=Danielle Hull, **DK**=Dave Karl, **KM**=Kun Ma, **JZ**=John Zehr**FP**=Frank Pavia

Ship: R/V *Ka'Imikai-O-Kanaloa* HOT 303 Date: June 25-29, 2018

TIME	Mon 6/25	Tue. 6/26	Wed. 6/27	Thur. 6/28	Fri. 6/29
0000		Arrive ALOHA			
0100		S2C1 PP			
0200		Deploy WireWalker	S2C8 Gas		
0300		Deploy Sed Traps		Optics	
0400		Deploy PP Array	Deploy Gas Array		
0500			S2C9 Open	Transit gas array	
0600	All Sci. Aboard	S2C2 PO-1			
0700	Depart Pier 35			Recover gas array	
0800			S2C10 PSi	Transit sed traps	Arrive Pier 35
0900	Arrive Kahe Weight cast			Recover sed traps	
1000	HyperPro		Net Tow	Transit WireWalker	Post Cruise Mtg.
1100	S1C1 Kahe	S2C3 PO-2 (Begin 36 hr)	S2C11 Open	Recover WireWalker	
1200	Transit ALOHA	Net Tow	Net Tow	Transit St. 52	
1300		Hyperpro		HyperPro	
1400		S2C4 PC/PN	S2C12 ATP		
1500				S52C1 WHOTS	
1600				ADCP Inter-comp	
1700		S2C5 PPO4	S2C13 Open	Transit St. Kaena	
1800					
1900		Recover PP array			
2000		S2C6 BEACH	S2C14 HPLC	S6C1 Kaena	
2100					
2200		Net Tow Net Tow	Net Tow Net Tow	Transit Pier 35	
2300		S2C7 PUR	S2C15 PO-3 (end 36 hours)		

June 26th: Sunrise 0549, Sunset 1921

6.0 HOT-303 Watch Schedule

0300-1500

Eric Grabowski – *Tag*
Dan Sadler - *Chief Scientist*, *Water Boss*
Jefrey Snyder – *Watch Leader, Tag*
Svetlana Natarov – *Console*
Tim Burrell – *Alt Tag*
Kate Feloy

1500-0300

Kendra Brooks – *Alt Tag*
Karin Björkman - *Water Boss*
Ryan Tabata – *Tag*
Kellen Rosburg – *Console – Watch Leader*
Ksenia Trifonova -*Tag*
Eric Klingberg

At Large

Blake Watkins
Macarena Burgos
Frank Pavia
Alan Seltzer
Kun Ma

OTG

Rob Palomares
Rory O'Connell