# Hawaii Ocean Time-series
# HOT-289 Operational Cruise Plan

Cruise ID: KM 17-02
Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Captain Gray Drewry
Chief Scientist: R. Walter Deppe, University of Hawaii
Marine Technicians: Jeff Koch and Sonia Brugger and Patrick A'Hearn

Loading: January 20/21, 2017 @0900
Departure: January 22, 2017 @0900 (Science personnel on board by 0800).
Arrival: January 26, 2017 @0800

## 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, 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 January 22nd 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 January 22-25th.
3) Station 50, the site of WHOTS-13 Mooring (anchor position 22° 47.24' N, 157° 54.45' W) will be occupied on for about one hour on January 25th.
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 January 25th 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, ACS/AC9/FRRf, misc. experiments. |
| WHOTS mooring station (Sta. 50) | One CTD cast (yo-yo to 200 m), surface instrument intercomparisons. |
| Kaena (sta. 6) | One CTD cast (near bottom) |
| Underway/continuous | ADCP, thermosalinograph, fluorometry, $pCO_2$ system and meteorology. |

## 2.0. SCIENCE PERSONNEL

| Participant | Title | Affiliation | Citizenship |
|---|---|---|---|
| Susan Curless | Research Associate | UH | USA |
| Alexa Nelson | Research Associate | UH | USA |
| Dan Sadler | Research Associate | UH | USA |
| Brenner Wai | Research Associate | UH | USA |
| Timothy Burrell | Research Associate | UH | New Zealand |
| Blake Watkins | Marine Engineer | UH | USA |
| Tara Clemente | Research Associate | UH/SCOPE | USA |
| Eric Shimabukuro | Research Associate | UH/SCOPE | USA |
| Ryan Tabata | Research Associate | UH/SCOPE | USA |
| Fernando Santiago-Mandujano | Research Associate | UH | USA |
| R. Walter Deppe | Research Associate | UH | USA |
| Jefrey Snyder | Marine Technician | UH | USA |
| Andrew King | Research Associate | UH | USA |
| Svetlana Naratov | Graduate Student | UH | USA |
| Gerianne Terlouw | Post Graduate Trainee | UH | The Netherlands |
| Eint Kyi | Graduate Student | UH | Myanmar |
| Connor Love | Graduate Student | UCSB | USA |
| Vincent Varamo | Graduate Student | UH/ORE | USA |
| Fadli Syamsudin | Visiting Scholar | UH/ORE | Indonesia |
| Xiaofeng Zhao | Visiting Scholar | UH/ORE | China |
| Grant Blackinton | Consultant | UH/ORE | USA |
| Amanda Wong | Undergraduate Volunteer | UH | USA |
| Amie Dobracki | Graduate Student Volunteer | UH | USA |
| Jeff Koch | Marine Technician | OTG | USA |
| Sonia Brugger | Marine Technician | OTG | USA |
| Patrick A'Hearn | Marine Technician | OTG | USA |

## 3.0. SUMMARY SCHEDULE

| | |
|---|---|
| 12 January | Pre-cruise planning meeting 1330 hrs, MSB 307. |
| 20/21 January | Ship loading at 0900 hrs. |
| 22 January | Depart from Pier 35 at 0900 hrs. **Science personnel on-board by 0800.** |
| 22 January | Station 1 Kahe Pt. operations. |
| 22-25 January | Station ALOHA operations. Station 50 CTD yo-yo cast, Station Kaena |
| 26 January | Arrive back to Pier 35. Full offload. |

## 4.0. OPERATIONAL PLANS

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

A 1000 lb. weight-test cast to 1000m, one CTD cast to 1000 m, and a Hyperpro cast (Sect. 4.2.7) will be conducted at this location on January 22nd. The A-frame, and CTD winch will be needed 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. Sea Glider #626 Deployment

When she ship arrives inside the circle of Station ALOHA, approximately 30-60 minutes will be needed to deploy the sea glider using the winch and ship's A-frame. Once the glider is in the water (and confirmed to be floating prior to release), it will be released and the vessel is free to transit toward the circle center. If the captain knows "it is" or "will be too rough" to use a dog catcher or attempt to recover later in the cruise, then we do not deploy.

After it is deployed, the glider will perform a series of test dives and the command center will determine the status of the glider and its sensors. Should the glider malfunction, recovery of the glider via small boat or by wire noose may become necessary but could wait until daylight hours. Recovery operations will be performed at the Captain's discretion.

The glider may be diving near Station ALOHA and may transit at times through the circle. The glider will report its GPS positions to seaglider@km.soest.hawaii.edu account on the R/V KM, when it is within the circle vicinity. It is requested that OTG sisprog setup the automated contab, "fix emailing" routine with the target to "sdrifter@soest.hawaii.edu".

4.2.2. Upon arrival to Station ALOHA, the sediment traps will be deployed (Sect. 4.2.2). Then one 1000-m CTD cast will be conducted before deploying the Primary Productivity array (Sect. 4.2.3). These operations will be followed by a near-bottom CTD cast.

### 4.2.3. 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 enroute to ALOHA by local current and weather conditions. The array will be deployed from the stern, using the A-frame and SeaMac winch. After deployment we request that the Bridge verify that the radio transmitters are functioning and directionally correct.

The array will drift for about 53 hours before recovery. The array is equipped with 2 ARGOS satellite transmitters (platform #'s 60481, 84859), 2 strobe lights, and 2 radio transmitters (channel 68: 156.625 MHz). Daily positions of the array shall be transmitted by email directly to the ship (Shipboard e-mail account argosfix@km.soest.hawaii.edu and 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 continue with CTD cast operations to prepare water for the Primary Productivity Array and other experiments.

### 4.2.4. Net Trap Deployment

A free floating net trap (similar to a plankton net, with a frame) will be deployed in a vertical orientation at a depth of 175 m for about 24hrs before recovery. The array will be deployed from the stern of the vessel using the A-frame and the Sea-Mac winch. The trap diameter is 1 m with a mesh size for the net of 55 um (and the cod-end is 55 um). The net trap is attached to the surface with floats and is equipped with an ARGOS satellite transmitter (platform #'s: 84859, 60481), strobe lights and a radio transmitter (channel 72: 156.625 MHz). Prior to recovery, a pinger is hung over the side of the ship to communicate and close the trap. Once the trap is closed it can then be recovered. 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 net trap, the ship shall prepare to deploy the Primary Productivity Array.

4.2.5. Primary Production experiment

Samples for the primary productivity experiment will be collected from the rosette. Before dawn (Sunrise 0714 hrs on January 23rd), a free drifting incubation array will be deployed from the stern. We request the use of the A-frame for this operation and will also use the SeaMac winch. The array is equipped with two ARGOS satellite transmitters (platform #'s 84857, 60484 emailing positions to argosfix@km.soest.hawaii.edu, password: argosfix), strobe lights and a radio transmitter (channel 74: 156.725 MHz). 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 just at sunset (1814 hrs). CTD 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.

4.2.6. 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 crane and winch for these operations. Water samples for biogeochemical measurements will be collected on each CTD 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. 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 **(Dan Sadler and Susan Curless)**.

4.2.7. Gas Array deployment

A second 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. We request the use of the A-frame for this operation and will also use the SeaMac winch. The array is equipped with two ARGOS satellite transmitters (platform #'s 84857, 60484 emailing positions to argosfix@km.soest.hawaii.edu, password: argosfix), a strobe light and a radio transmitter (channel 74: 156.725 MHz). 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.

4.2.8. 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 and third 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.

4.2.9. 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 three profiles before the instrument is retrieved.

4.2.10. Optical Package

An optical package consisting of a SeaBird Seacat with temperature, conductivity, fluorometer, and pressure sensors, and a LISST particle size and distribution analyzer will be deployed once during the cruise.

The yo-yo deployment will consist of three profile cycles to a target depth of 200 m. The downcast will be at a constant speed of 10 m/min and upcast at 20 m/min. The A-frame and capstan will be needed for this operation.

4.2.11. Automated Trace Element Sampler (ATE)

On the morning of January 24th, the ATE will be hand deployed off the back deck to a depth of 10 m to collect at Trace Metal Free Sample. The ATE will be recovered after 30 minutes in the water. The ATE is approximately 1' tall and 4'' in diameter, weighting 5 lbs.

**If the ship has been stationary at ALOHA for previous cruise activities, it is requested that the ship steams approximately 10-15 minutes up current from current position prior to ATE deployment to limit contamination of the trace metal sample from the ship's hull.**

4.3 Gas Array and floating Sediment Trap recovery

In the early morning of January 25th, the ship shall transit for the recovery of the Gas Array. The A-frame and SeaMac winch will be needed to retrieve the arrays. After the Gas Array is recovered, the ship shall transit to recover the floating sediment trap array. After the sediment traps are recovered, the ship shall transit to Station 50 and conduct one 200 m CTD yo-yo cast.

4.4 Station 50 - WHOTS-13 Mooring

The anchor position of the WHOTS-13 mooring is 22° 47.24' N, 157° 54.45' 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 January 24th 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, a Hyperpro cast will be conducted within the circle that defines Station ALOHA. Once the Hyperpro cast is completed, the ship will transit to Station Kaena.

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 January 25th. Once the CTD cast is complete, the ship shall return to Snug Harbor.

4.6 Acoustic Doppler Current Profiler

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

4.7 Thermosalinograph, $pCO_2$ system, Fluorometer, and meteorological system

The ship's thermosalinograph, $pCO_2$ system, and fluorometer sampling the uncontaminated seawater supply system will be in operation during the duration of the cruise while the ship is outside of Snug Harbor. 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 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 be in charge of the thermosalinograph, $pCO_2$ system, Fluorometer, and meteorological suite operations.

4.8. Acoustic transducer system

One of the acoustic transducers will be run through a power amplifier to collect data on the approach and departure from the ALOHA Cabled Observatory (ACO) whenever possible when the ship is within 30km of ACO. This system will be run by Vincent Varamo, Fadli Syamsudin, Xiaofeng Zhao and Grant Blackinton.

## 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. One 20 ft. laboratory van with assorted equipment for radioisotope and general use (Van #23)
4. One 12 ft. equipment van ("Blue" Van)
5. Distilled, deionized water and all required chemicals and isotopes
6. Liquid nitrogen dewar
7. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights sediment traps and crosses
8. Drifting primary production array and gas array with light and radio transmitter, floats, weights, polypro. line, spare buoy, etc.
9. Hyperpro and other optical measuring instruments.
10. Oxygen titration system
11. Plankton nets and towing lines
12. Desktop and laptop personal computers
13. Assorted tools
14. All required sampling bottles
15. Deck incubation system (1- dark incubator, 1- big blue incubator)
16. Pertinent MSDS
17. Temperature- and light-controlled incubator
18. MIMS analyzer
19. Power amplifier for acoustic transducer
20. Cassette with glass slides to go on sediment traps

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. Space on upper deck for three 20ft laboratory vans and on the main deck for one equipment van
5. Electric power for two vans
   -208 VAC single phase at 60 amps for #23 lab van,
   -120 VAC 10 amps for blue equipment van
6. Radio direction finder
7. Space on deck and power for small capstan = 4700lbs, and the power requirements are 440/480 VAC, 3 phase 60Hz, 60amp
8. Space on upper deck for sea water incubators
9. Space on deck for ~4 deck baskets of array gear

10. Precision depth recorder
11. Shackles, sheaves, hooks and lines
12. Shipboard Acoustic Doppler Current Profiler
13. Thermosalinograph, $pCO_2$ system, and Fluorometer
14. Meteorological suite
15. Grappling hooks and line
16. Display in the lab of ship's position (charting software/GPS feed)
17. Running fresh water and seawater hoses
18. Electronic mail system
19. GPS system
20. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer, and access to real-time data through the network.
21. OTG's 24-place rosette, and 24 12L water sampling bottles (to be used as spare)
22. ~1300 lb test weight
23. OTG's transmissometer
24. Ultra (-80) Freezer in van on upper deck

**Ship: R/V *Kilo Moana*** **HOT 289 CTD CASTS** **Date: January 22-26, 2017**

| Cast | | Samples | #Bottles |
|---|---|---|---|
| **Kahe Pt.** | | | |
| s1c1 | 1000 m | $O_2$, Temp, DIC/Alk, Nuts, Chl a, LLN, LLP, DOC, FCM, Salts | 24 |
| **Station ALOHA** | | | |
| s2c1 | 1000 m | Primary Production, Salts | 22 |
| s2c2 | 4740 m (PO-1) | $O_2$, Temp, DOC, DIC/Alk, Nuts, Salts | 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), SF-S(1@5,25,45,75,100,125), Salts | 24 |
| s2c5 | 1000 m | PPO4, SF-S(1@5,25), CL(3@60 ; 2@20,40 ; 1@5), Salts | 24 |
| 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 | 16 |
| 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), EK(6@175), Salts | 14 |
| s2c10 | 1000 m | PSi, SF-S(1@5,25), KW-B(1@5,25,45), Salts | 15 |
| s2c11 | 1000 m | SF-S(1@5,25), Salts | 4 |
| s2c12 | 1000 m | ATP, DNA(2@300,400,500,770), SF-S(1@5,25), Salts | 21 |
| s2c13 | 1000 m | MC(pb SW,1@5,25,45,75,100,125,150,175), SF-S(1@5,25), Salts SW(pb MC,1@700; 1@200,300,400,500,600,700,800,900,1000) | 22 |
| s2c14 | 1000 m | HPLC, Chl a, Salts | 14 |
| s2c15 | 4740 m (PO-3) | Oxygen, DNA(1@1000,2000,3000,4000), Salts | 12 |
| **WHOTS Mooring** | | | |
| s52c1 | 200 m yo-yo | DIC/TA(1@5), KW-B(1@5,25,45), RF(1@5) | 5 |
| **Kaena** | | | |
| s6c1 | 2400 m | Chl, Salts | 13 |

**MC**=Matt Church, **SW**=Sam Wilson, **SF-S=**Sara Ferrón-Smith, **KW-B**=Kate Watkins-Brandt, **EK**=Eint Kyi, **CL**=Connor Love, **RF**=Rhea Forman

**Ship: R/V *Kilo Moana*  HOT 289  Date: January 22-26, 2017**

| TIME | Sun. 1/22 | Mon. 1/23 | Tue. 1/24 | Wed. 1/25 | Thu. 1/26 |
|---|---|---|---|---|---|
| 0000 | | Deploy sed traps | Transit to pump tanks | | Transit Pier 35 |
| 0100 | | S2C1 PP | | | |
| 0200 | | | S2C8 Gas | | |
| 0300 | | Deploy Net Trap | | Optics | |
| 0400 | | Deploy PP Array | Deploy Gas Array | | |
| 0500 | | S2C2 PO-1 | S2C9 Open | Transit gas array | |
| 0600 | | | Recover Net Trap | | |
| 0700 | | | | Recover gas array<br>Transit sed traps | |
| 0800 | | | S2C10 PSi | Recover sed traps | Arrive Pier 35 |
| 0900 | Depart Pier 35 | | | Transit St. 50 | |
| 1000 | | | Net Tow<br>ATE | | |
| 1100 | Arrive Kahe (11:30)<br>Weight cast | S2C3 PO-2<br>(Begin 36 hr) | S2C11 Open | S50C1 WHOTS | |
| 1200 | Hyperpro | Net Tow | Net Tow<br>Transit to pump tanks | Transit ALOHA | |
| 1300 | S1C1 Kahe | Hyperpro | | Hyperpro | |
| 1400 | | S2C4 PC/PN | S2C12 ATP | | |
| 1500 | Transit ALOHA | | | Transit St. Kaena | |
| 1600 | | Transit to pump tanks | | | |
| 1700 | | S2C5 PPO4 | S2C13 OPEN | | |
| 1800 | | Recover PP array | | | |
| 1900 | | | | | |
| 2000 | | S2C6 BEACH | S2C14 HPLC | S6C1 Kaena | |
| 2100 | | | Transit to pump tanks | | |
| 2200 | Deploy Sea Glider | Net Tow<br>Net Tow | Net Tow | | |
| 2300 | Arrive ALOHA | S2C7 PUR | S2C15 PO-3<br>(end 36 hours) | | |

**January 23rd: Sunrise 0714, Sunset 1814**

## 6.0 HOT-287 Watch Schedule

**0300-1500**

Alex Nelson **–** *Water Boss*
Dan Sadler – Watch Leader – *Alt. Tag*
Tara Clemente
Tim Burrell **–** *Tag*
Walt Deppe **–** Chief Scientist**–** *Console*
Jefrey Snyder – *Tag*
Svetlana Naratov

**1500-0300**

Susan Curless **–** Watch Leader – *Water Boss*
Brenner Wai – *Tag*
Eric Shimabukuro – *Tag*
Ryan Tabata – *Alt. Tag*
Fernando Santiago Mandujano **–***Console*
Andrew King – *Alt. Tag*
Amie Dobracki

**0900-2100**

Amanda Wong

**At Large**

Blake Watkins
Gerianne Terlouw
Eint Kyi
Connor Love
Vincent Varamo
Fadli Syamsudin
Xiaofeng Zhao
Grant Blackinton

**OTG**

Jeff Koch
Sonia Brugger
Patrick A'Hearn