Modified June 16, 2019

EAGER: Chief Scientist Training Cruise (KM1910)
June 15-24, 2019
General Cruise Plan

Vessel: R/V *Kilo Moana*, University of Hawaii
Master of the Vessel: Joey Daigle
Chief Scientist: Matthew Church, University of Montana
OTG Marine Technician: Jeff Koch and Patrick A'Hearn

Loading: June 14, 2019 @ 1300
Departure: June 15, 2019 @ 1200
Arrival: June 24, 2019 @ 0800

1.0 SCIENTIFIC OBJECTIVES

The primary goals of this research cruise, funded by the US National Science Foundation, the Office of Naval Research, and the State of Hawaii, are to provide at-sea cruise leadership experiences and training in oceanographic sampling for 18 early career biological and chemical oceanographers. Cruise participants have helped design the specific science plans for the cruise, with an overarching focus on quantifying biological processes that couple epi- and mesopelagic biogeochemistry and ecology in the oligotrophic North Pacific Subtropical Gyre (NPSG). The cruise will focus sampling at Station ALOHA (22°45´N, 158°W), the field site for the Hawaii Ocean Time-series (HOT) program, allowing cruise participants to leverage the rich time-resolved physical and biogeochemical measurements at this sampling site for context.

While at Station ALOHA, we plan to deploy a free-drifting sediment trap array (twice) during the cruise, tow a MOCNESS during both daytime and nighttime periods, use a series of Conductivity-Temperature-Depth (CTD) vertical profiles (0-1000 m) to sample plankton and chemical constituents in the water, deploy and recover drifting primary production arrays (twice), profile optical instrumentation, deploy and recover (0-500 m) a towed instrument termed "BIG SPC", conduct several upper ocean (0-200 m) integrated plankton net tows, and extensively utilize the shipboard Acoustic Doppler Current Profiles (ADCP).

Loading: We plan to begin loading the vessel on **June 14**, immediately after the HOT program completes its offloading (beginning at 1300). There will be several large items that will need to be loaded by crane operations the afternoon of June 14, including:

1) MOCNESS net system;
2) Laboratory work van (Van # 24);
3) Trace Metal Winch;
4) 3 large on-deck incubators (for the 02 deck); and
5) SWAC rosette and trace metal block
6) McLane pumps (x2) on pallet
7) 3 pallets of science equipment (2 pallets to the 02 deck, 1 to main deck)
8) 2 baskets with arrays

A number of items will be left aboard following the HOT cruise, including:

1) the large SeaMac winch;
2) the small capstan;
3) line used for HOT net tows; and

Departure and Station Kahe (S1): We plan to depart Honolulu Harbor as early on June 15, 2019 as soon possible, following completion of loading and laboratory set-up. We hope to depart before 1200 on June 15. After departing Honolulu Harbor, we will transit to Station Kahe (termed S1; 21° 20.6'N, 158° 16.4'W) to conduct an initial cast using the trace metal rosette (0-200 m). After completing this activity, we will resume transit to Station ALOHA (termed S2; 22º 45′N, 158ºW), with the intention of arriving on station in the early AM of June 16.

Arrival at ALOHA: Upon arriving at Station ALOHA, we will deploy the first free-drifting, surface-tethered sediment trap array. This array will remain deployed until its recovery the evening of June 18. The sediment trap array will include traps at 3 discrete depths (75 m, 150 m, and 300 m) and the surface buoy for this array will be equipped with radio transmitters, a strobe light, and an ARGOS satellite location transmitter.

Upon completion of the sediment trap array deployment, we will conduct a 1000 m CTD cast to collect water for an incubation experiment, followed by deployment of the BIG SPC instrument. This instrument will be deployed using the .322 hydrowire; the instrument is designed to be towed at 2-4 nautical miles per hour (equivalent to 1-3 m/s) with a descent rate of ~100 m/min (equivalent to 1-2 m/s). We have attached diagrams depicting the instruments dimensions and a photo.

Following recovery of the BIG SPC, we plan to deploy the MOCNESS using the .322 hydrowire; this operation will require the OTG techs to assist with deck set-up, deployment, and recovery. We have budgeted 6 hours for MOCNESS operations, with 3 MOCNESS operations targeted to be in the water during the daytime (with a mid-point at noon) and an additional 3 MOCNESS operations occurring at night (with a mid-point at midnight).

After the recovery of the MOCNESS, we will conduct a 1000 m CTD cast, which will be followed by deployment of McLane pumps. For this initial pump deployment, two pumps will be deployed at 25 m and 100 m from the Amsteel, trace-metal free line/winch/block. Subsequent pump deployments will utilize the .322 hydrowire. We have budgeted 4 hours for pumping operations. After recovery of the pumps, we will conduct two separate bio-optics profiles using a LISST instrument; the first deployment will be restricted to the upper 30 m, followed by a second LISST deployment to 200 m. Both of these bio-optical profiles will require the A-frame and large capstan to maintain a descent/ascent rate of 10 m/min.

Operations on June 17 will include several CTD casts using the .322 Hydrowire, deployment/recovery of the bio-optics instruments (requiring the A-frame and capstan), and deployment/recovery of the trace metal free sampling rosette (SWAC rosette) - this operation will utilize the trace metal free winch, Amsteel line, and the trace metal free block. In addition, the evening of June 17, the McLane pumps will be deployed to 25 m and 45 m using .322 Hydrowire; a total of 4 hours has been budgeted to accommodate pumping operations.

In the early AM of June 18, we have included a cast using the trace metal free sampling rosette (0-200 m; Amsteel line, trace metal free block and winch), followed by a CTD hydrocast (0-200 m) to collect water for the productivity array. Following recovery of the CTD rosette, allowing time to set-up the productivity incubations, we will deploy a free-drifting, surface-tethered productivity array. This array will need to be deployed prior to sunrise and the array free-drift until sunset when it will be recovered.

The remaining cruise schedule includes continued deployments and recoveries of the instrumentation previously described, as detailed in the daily sampling schedule. On June 19, the sediment trap will be recovered, and later that afternoon we will deploy a 2nd sediment trap array which will free-drift until the AM of June 23.

Following our sampling at Station ALOHA on June 23, the vessel will transit back to Honolulu Harbor for an 0800 return on June 24, 2019.

2.0 SCIENTIFIC OPERATIONS WHILE ON STATION

Station	Activities
Station Kahe (1)	Trace metal-free rosette cast (0-200 m)
ALOHA (2)	Sediment trap arrays (x2), McLane pumps, CTD operations (0-1000 m), primary productivity arrays (x2), MOCNESS (x6), optics casts, bongo net tows (0-200 m), misc. experiments
Underway/continuous	ADCP, thermosalinograph, fluorometry, meteorology

3.0. SCIENCE PERSONNEL

Participant	Title	Affiliation	Citizenship
1. Matthew Church	Associate Professor	U Montana	USA
2. Angelicque White	Associate Professor	U Hawaii	USA
3. Erica Goetze	Associate Professor	U Hawaii	USA
4. Macarena Burgos	Postdoctoral Researcher	U Hawaii	Spain
5. Tara Clemente	Research Associate	U Hawaii	USA
6. Aric Mine	Assistant Professor	Cal State Fresno	USA
7. B.B. Cael	Postdoctoral Researcher	U Hawaii	USA
8. Bethany Edwards	Assistant Professor	UC Berkeley	USA
9. Matthew Rau	Assistant Professor	Penn State U	USA
10. Paulina Pinedo-Gonzalez	Postdoctoral Researcher	LDEO	Mexico
11. Ashley Maloney	Postdoctoral Researcher	Princeton U	USA
12. Wei Qin	Postdoctoral Researcher	U Washington	China
13. Abigail Bockus	Assistant Professor	LUMCON	USA
14. Aspen Reese	Postdoctoral Researcher	Harvard U	USA
15. Tom Iwanicki	Graduate Student	U Hawaii	USA
16. Eric Orenstein	Postdoctoral Researcher	SIO, UCSD	USA
17. Harriet Alexander	Assistant Scientist	WHOI	USA
18. Rebecca Asch	Assistant Professor	E. Carolina U	USA
19. Adam Subhas	Assistant Scientist	WHOI	USA
20. Erin Black	Postdoctoral Researcher	Dalhousie U	USA
21. Katherine Heal	Postdoctoral Researcher	U Washington	USA
22. Nicholas Hawco	Postdoctoral Researcher	USC	USA
23. Sarah Lerch	Postdoctoral Researcher	URI	USA
24. Jeff Koch	Marine Technician	OTG	USA
25. Patrick A'Hearn	Marine Technician	OTG	USA

4.0 DAILY SUMMARY OF OPERATIONS

14 June	Load vessel (starting 1300 hrs)
15 June	Continued loading; depart from Honolulu Harbor by 1200 hrs. Science personnel on-board by 1000. Transit to Station Kahe (S1). Trace metal rosette cast (0-200 m) Station Kahe. Transit to Station ALOHA (S2)
16 June	Arrival at Station ALOHA (S2). Deploy sediment trap array #1; CTD hydrocast (0-1000 m); BIG SPC towed profile (0-500 m), MOCNESS operations; CTD cast (0-1000 m); Trace metal-free McLane *in situ* pumps (25 m / 100 m)
17 June	Complete McLane pump operations; Bio-optics profiles (LISST x 2); Bongo net tows (0-200 m); CTD hydrocasts (0-1000 m); Trace metal rosette cast (TM; 0-200 m); MOCNESS tow; BIG SPC towed profile (0-500 m); CTD hydrocasts (0-1000 m); McLane pumps (25 m / 45 m, using .322 hydrowire)
18 June	Complete McLane pumping; Trace metal-free rosette cast for productivity array (0-200 m); CTD hydrocast (0-200 m) to collect water

	for productivity array; deploy productivity array predawn; MOCNESS operations; BIG SPC towed profile (0-500 m); Trace metal rosette cast (0-100 m, diel); recover primary production array (dusk); bio-optics profiles (LISST x 2); Trace metal rosette cast (0-100 m, diel); CTD hydrocast (0-1000 m)
19 June	Bongo net tow (0-200 m); trace metal rosette cast (0-100 m, diel); CTD hydrocasts (0-1000 m); trace metal rosette cast (0-100 m, diel); recover sediment trap array #1; trace metal rosette cast (0-100 m, diel); bio-optical profiles (LISST x 2); trace metal rosette cast (0-100 m, diel); trace metal rosette cast (0-100 m, diel); deploy sediment trap array #2; BIG SPC towed profile (0-500 m); MOCNESS operations
20 June	Continued MOCNESS tow; Trace metal rosette cast (0-100 m, diel); Bongo net tow (0-200 m); trace metal rosette cast (0-100 m, diel); CTD hydrocasts (0-1000 m); trace metal rosette cast (0-100 m, diel); CTD hydrocasts (0-1000 m); trace metal rosette cast (0-100 m, diel); trace metal rosette cast (0-100 m, diel); CTD hydrocast (0-1000 m); trace metal rosette cast (0-100 m, diel); McLane in situ pumps (75 m / 100 m, using .322 hydrowire)
21 June	Bongo net tow (0-200 m); Trace metal-free rosette cast for productivity array (0-200 m); CTD hydrocast (0-200 m) to collect water for productivity array; deploy productivity array predawn; CTD hydrocast (0-1000 m); trace metal-free rosette casts (0-100 m; diel); bio-optics profiles (LISST x 2); McLane pumps (150 m, 300 m; 0.322 hydrowire); trace metal rosette cast (0-100 m, diel); Bongo net tow (0-200 m); recover primary production array (dusk); trace metal rosette cast (0-100 m, diel); MOCNESS operations
22 June	Continue MOCNESS operations; BIG SPC towed profile (0-500 m); CTD hydrocasts (0-1000 m); bio-optics towed profiles (LISST x2); Bongo net tows (0-200 m); MOCNESS operations
23 June	Continue MOCNESS tow; CTD hydrocasts (0-1000 m); recover sediment trap array #2; BIG SPC towed profile (0-500 m); MOCNESS operations; CTD hydrocast (0-1000 m); Bongo net tow (0-200 m); transit Honolulu Harbor
24 June	Return Honolulu Harbor @ 0800; offload vessel

5.0. OPERATIONAL PLANS

Operational note regarding pumping tanks: Whenever pumping of the ship's tanks is needed, it should be conducted ≥5 nmiles from the sampling locations. To avoid disruptions in the schedule, this operation should be coordinated with the chief scientist.

Sediment trap operations

A floating sediment trap array will be deployed and recovered twice during the cruise at Station ALOHA. The trap array will be deployed from the stern using the A-frame and the Sea-Mac winch. The power requirement for the winch is 440 VAC, three phase at 10 amps. After deployment, we request that the Bridge verify that the radio transmitters are functioning and directionally correct. The first sediment trap array will drift from June 16-19. The second

sediment trap array will drift from June 19-23. These arrays are equipped with ARGOS satellite transmitters, strobe lights, and radio transmitters: **ch 72 (156.625MHz) , ch.74 (156.725MHz), argos #'s 01833, 60481**. Daily positions of these arrays shall be transmitted by email directly to the ship (**argosfix@km.soest.hawaii.edu, password: argosfix**), therefore the ship will **not** need to keep within site of the arrays 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.

Primary production experiment

Samples for primary productivity experiments will be collected from both the trace metal free rosette and the CTD rosette. Twice during the cruise, before dawn, we will deploy a free drifting incubation array (there will be no radioisotopes used for these arrays). The array will be deployed from the stern and we request use of the A-frame and the Sea-Mac winch for this operation. The array is equipped with one ARGOS satellite transmitter (emailing positions **to argosfix@km.soest.hawaii.edu, password: argosfix), strobe lights and a radio transmitter (ch 68 (156.425MHz), argos #'s 03028, 60482)**. The **ship shall keep within site of the array** while performing CTD operations for the approximately 14-hour duration the array will be in the water. The array will be recovered near sunset each day. The first productivity array will be deployed/recovered on June 18, 2019; the second productivity array will be deployed/recovered on June 21.

Water column measurements (CTD)

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 need the ship's CTD winch with the 0.322 wire and A-frame for these operations. Water samples for biogeochemical measurements will be collected on each cast.

Trace metal-free rosette sampling (TM)

We will utilize a trace metal-free rosette sampler for upper ocean profiles of trace metals and to collect water for productivity array experiments. Trace metal-free sampling will utilize the SWAC rosette sampler, the Amsteel line spooled onto the trace metal-free winch and using the metal-free block. The rosette sampler includes instruments for temperature, conductivity and dissolved oxygen. For a concentrated period during the cruise we will use this rosette sampler to obtain seawater from the upper 100 m at relatively high frequencies (cast every 3-4 hours). Water samples for biogeochemical measurements will be collected on each cast.

McLane *in situ* pumps (P)

We will utilize 2 McLane in situ pumps at various times throughout the cruise. The initial deployment of these pumps will utilize the trace metal clean ¼ inch Amsteel line, trace metal winch, trace metal block, and the A-frame; pumps will be deployed at 25 m and 100 m and will pump for ~4 hours. Subsequent deployments of these pumps will utilize the .322 hydrowire and the A-frame; for these subsequent deployments, pumps will be placed at 25 m and 45 m, 75 m and 100 m, and 150 m and 300 m. All deployments are scheduled for ~4 hours.

Bio-optics (LISST) sampling

A bio-optical package that measures particle size and distribution will be deployed several times during the cruise. Each of these operations will consist of two separate profiles: the first will profile to 30 m, and the second will profile to 200 m. Each of these deployments

will consist of two up and two down profiles at a constant speed of 10 m/min during both the downcast and upcast. The A-frame and capstan will be needed for this operation.

MOCNESS Tows (MOC)

A MOCNESS plankton net system will be used to collect zooplankton biomass from discrete depths in the upper 1000 m. The MOCNESS will be deployed on the 0.322 hydrowire and will require CTD sensors and an O_2 sensor. With the assistance of the OTG techs, the MOCNESS will be deployed from the A-frame and will be in the water for up to 6 hours.

Bongo net tows

Bongo nets will be deployed from the stern and profiled through the upper 200 m. The nets will be towed for two half-hour periods during each deployment. The A-frame and capstan will be needed for this operation.

Acoustic Doppler Current Profiler

The ship's acoustic Doppler current profiler (ADCP) will be in operation during the duration of the cruise. The OTG electronics technician will be in charge of the ADCP system. Note that the science party will request regular access to these data to examine diel-scale variability in zooplankton vertical migration.

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 of Snug harbor. The OTG technician will be in charge of the thermosalinograph and fluorometer operations.

6.0 EQUIPMENT

The science party shall be bringing the following:

1. One laboratory van (van #24) for trace metal work and general lab use
2. All required chemicals
3. Vacuum waste containers
4. Liquid nitrogen dewars
5. Drifting sediment trap array with strobe lights, satellite and radio transmitters, floats, weights
6. Drifting primary production array with strobe lights, satellite and radio transmitters, floats, weights
7. Drifting primary production array with light and radio transmitter, floats, weights, polypro. line, spare buoy, etc.
8. Three on-deck incubators (these will reside on the 02 deck)
9. MOCNESS plankton net system
10. 2 x McLane pumps with associated pump heads
11. Plankton nets
12. 2 temperature-controlled incubators (Caron)
13. Trace metal clean winch
14. Amsteel ¼ inch line for deploying trace metal clean rosette
15. SWAC trace metal clean rosette
16. BIG SPC towed profiler

17. Deck baskets containing arrays
18. Oxygen titration system
19. Membrane inlet mass spectrometer
20. Desktop and laptop personal computers
21. Assorted tools
22. All required sampling bottles
23. Deck incubation systems
24. Pertinent MSDS

We will need the use of the following ship's equipment:

1. CTD rosette + pinger: including sensors (O_2, dual CTD, fluorescence, PAR), sampling bottles
2. A-frame
3. A-frame block assembly
4. Trace metal clean block
5. Small capstan
6. Winch with .322 conducting wire for CTD
7. Electric power for winches and capstan (440 VAC three phase at 10 amps) and for laboratory van (208 VAC single phase at 30 amps for lab van, 110 VAC 10 amps for equipment van)
8. Radio direction finder
9. Sea-Mac winch (440 VAC, 3 phase at 10 amps)
10. Space on upper deck for one lab van
11. Space on upper deck for 3 incubators
12. Hand-held VHF transceivers
13. Shackles, sheaves, hooks and lines
14. -80C and -20C freezers
15. 4C refrigerators
16. Shipboard Acoustic Doppler Current Profiler
17. Thermosalinograph and Fluorometer
18. Copy machine
19. Grappling hooks and line
20. Navlink2 PC or equivalent
21. Running fresh water and seawater, hoses
22. Milli-Q water system
23. Electronic mail system
24. GPS system
25. Uncontaminated seawater supply
26. Underway/on-station data acquisition system for meteorological instruments, ADCP, thermosalinograph, fluorometer
27. Small capstan
28. Large diameter line for optics and 0-200 m net tows

Date 14 - 16 June, 2019 **Sunrise 0519** **Sunset 1845**

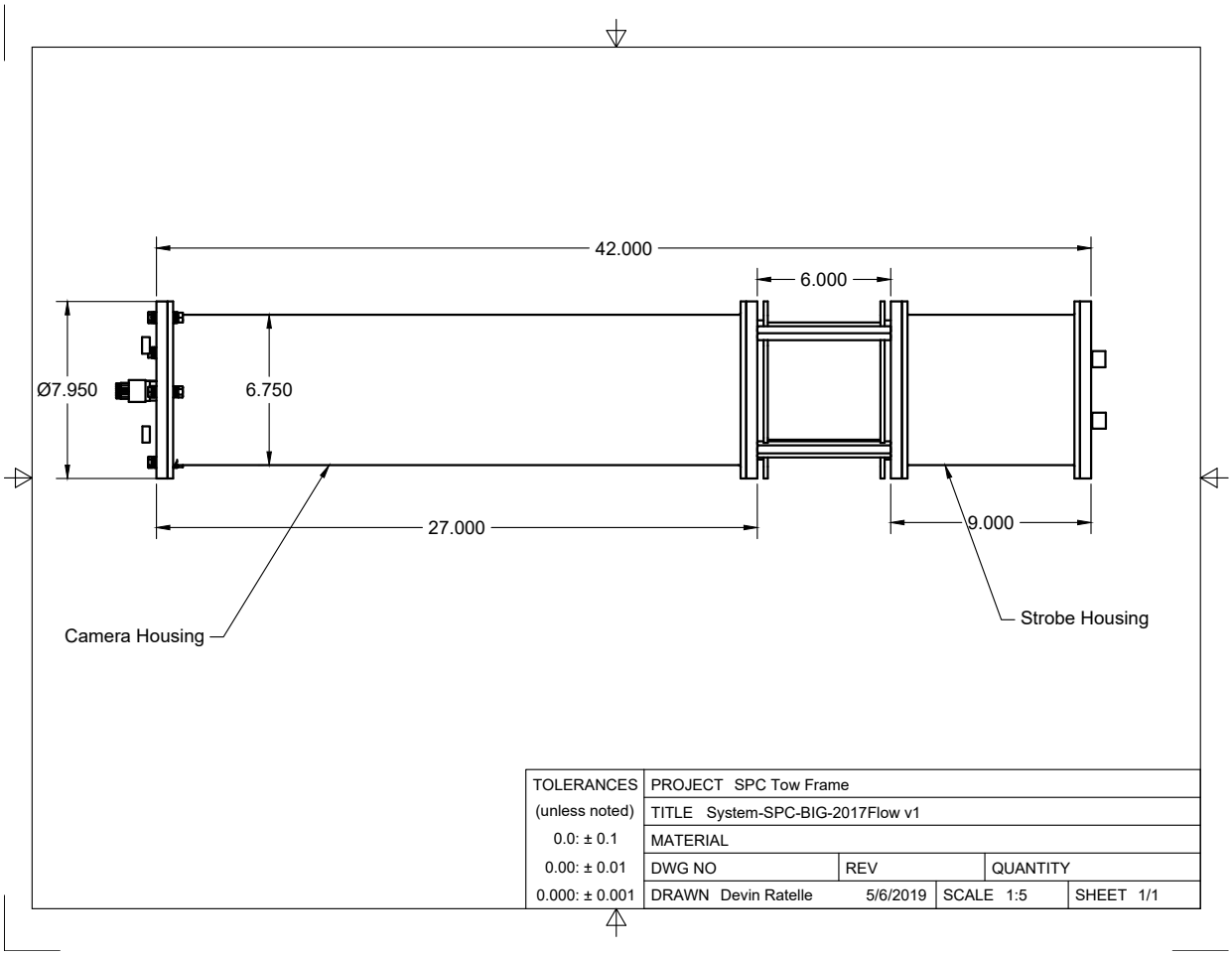
TIME	Fri 6/14	Sat 6/15	Sun 6/16
0000			Arrive Sta ALOHA (S2) S2 Bongo net tow #1 (0-200 m)
0100			S2 Deploy Sediment trap array #1 (75, 150, 300 m)
0200			
0300			S2C1 – CTD 0-200 m (incubation)
0400			
0500			S2C2 - CTD 0-200 m (metagenomics)
0600			
0700			Pump tanks
0800		Continue loading	S2 SPC profile #1 (0-500 m)
0900			MOCNESS tow #1 (S2MOC1)
1000		Depart Honolulu Harbor for Station Kahe (S1)	
1100			
1200			
1300	Science party begins loading	Arrive Station Kahe – S1TMC1 (0-200 m)	
1400		Transit Station ALOHA (S2)	
1500			
1600			
1700	Science party to stay aboard		
1800			S2 McLane pump #1 (S2P1) 25 m, 100 m (trace metal clean block/winch)
1900			
2000			
2100			
2200			
2300			S2 LISST profile #1 0-30 m

Date 17- 20 June, 2019 Sunrise 0519 Sunset 1845

TIME	Mon 6/17	Tues 6/18	Wed 6/19	Thur 6/20
0000	S2 LISST profile #2 0-200 m			
0100	S2 Bongo net tow #2 (200 m)			
0200		S2 TMC2 200 m (productivity)	S2 TMC5 100 m (diel)	
0300		S2C7 CTD 200 m (productivity)	S2C8 CTD 200 m (mixotrophy / NCP)	
0400	S2C3 - CTD 200 m (mixotrophy / NCP)	S2 Bongo net tow #3 (200 m)	S2C9 CTD 1000 m (lipids, isotopes, particles)	S2 TMC10 100 m (diel)
0500	Pump tanks	Deploy productivity array #1 *before sunrise	S2 TMC5 100 m (diel)	Pump tanks
0600	S2C4 - CTD 1000 m (protists/incubations)	pump tanks	pump tanks	
0700	S2 SPC profile #2 (0-500 m)	S2 SPC profile #3 (0-500 m)	S2 LISST profile #4 0-30 m	S2 Bongo net tow #4 (200 m)
0800	S2 TMC1 (0-200 m)		S2 TMC6 100 m (diel)	S2 TMC11 100 m (diel)
0900	S2 MOCNESS tow #2 (S2MOC2)	S2 MOCNESS tow #3 (S2MOC3)	Recover sediment trap array #1	
1000			S2 LISST profile #5 0-200 m	S2C10 CTD 1000 m (lipids, isotopes, particles)
1100				
1200			S2 TMC7 100 m (diel)	S2 TMC12 100 m (diel)
1300			pump tanks	Hyperpro
1400			Hyperpro	S2C11 CTD 1000 m (metagenomics)
1500			S2 TMC8 100 m (diel)	S2 TMC13 100 m (diel)
1600			Deploy sediment trap array #2 (75 m, 150 m, 300 m)	
1700				S2C12 CTD 1000 m (open)
1800	S2C5 - CTD 1000 m (PC/PN/PPO4/core/ NCP)	S2 TMC3 100 m (diel)	S2 TMC9 100 m (diel)	S2 TMC14 100 m (diel)
1900	Pump tanks	Recover productivity array #1	S2 BIG SPC profile #4 (0-500 m)	S2 McLane pump #3 (S2P3) (.322 wire; 75 m, 100 m)
2000	S2C6 - CTD 1000 m (lipids, isotopes, particles)	S2 LISST profile #3 0-30 m		
2100	S2 McLane pump #2 (S2P2) (.322 wire; 25 m, 45 m)	S2 LISST profile #4 0-200 m	S2 MOCNESS tow #5 (S2MOC4)	
2200		S2 TMC4 100 m (diel)		
2300		MOCNESS tow #4		

Date 21- 24 June, 2019 Sunrise 0519 Sunset 1845

TIME	Fri 6/21	Sat 6/22	Sun 6/23	Mon 6/24
0000	S2 Bongo net #5 (200 m)			
0100	S2 TMC15 200 m (productivity)			
0200	S2C13 CTD 200 m (productivity)			
0300	S2 TMC16 100 m (diel)			
0400	Deploy productivity array #2	S2 SPC profile #5	S2C18 CTD 1000 m (lipids/isotopes/particles)	
0500	S2C14 CTD 200 m (mixotrophy / NCP)	S2C15 CTD 200 m (mixotrophy / NCP)	pump tanks	
0600	S2 TMC17 100 m (diel)	pump tanks	Recover sediment trap array #2	
0700	Pump tanks	S2C8 CTD 1000 m (protists)	S2 SPC profile #6 (0-500 m)	
0800	S2 LISST profile #5 0-30 m			Arrive Honolulu Begin offload
0900	S2 LISST profile #6 0-200 m	S2C16 CTD 1000 m (metagenomics)	S2 MOCNESS #8 (S2MOC7)	
1000	S2 McLane pumps #4 (S2P4) (.322 wire; 150 m, 300 m)			
1100		S2 LISST profile #7 0-30 m		
1200		S2 LISST profile #8 0-200 m		
1300		Hyperpro		
1400		S2 Bongo net #7		
1500	S2 TMC18 100 m (diel)			
1600	pump tanks	Pump tanks	S2C19 CTD 1000 m (open)	
1700	S2 Bongo net #6 200 m			
1800		S2C17 CTD 1000 m (protists)		
1900	Recover productivity array #2			
2000	S2 TMC19 100 m (diel)	S2 Bongo net #8	S2 Bongo net tow #9	
2100	S2 MOCNESS tow #6 (S2MOC5)	S2 MOCNESS tow #7 (S2MOC6)	Transit Honolulu Harbor	
2200				
2300				



BIG SPC frame dimensions and two possible configurations for the instrument.