

# **VI. Return Cruise Report**

## **OPPEX-I Return Cruise:**

### **Chief Scientist Report**

#### **Chief Scientist: Eric Grabowski**

OPPEX-I Return Cruise

Vessel: R/V Kilo Moana, University of Hawaii

Cruise ID: KM 08-09

June 12 – 15, 2008

Master of the Vessel: Captain Brian Wehmeyer

OTG Marine Technicians: Dan Fitzgerald and Kuhio Vellalos

Loaded: June 11, 2008 @ 1200

Departed: June 12, 2008 @ 0800

Arrived: June 15, 2008 @ 0800

#### 1.0 Cruise Objectives:

The objective of the cruise was to verify that the wave-powered ocean pumps were operating and to locate, map and sample the biological response to 300 m seawater brought to the surface by the pumps. A Video Plankton Recorder (VPR) was to be used to map the region around and downstream of the pumps. When the feature was located, time permitting, a sediment trap array was to be deployed. Hydrographic and biogeochemical data was to be collected to characterize the upper water column in and out of the feature. A series of optic casts and net tows were also to be completed during the cruise. The misbehaving Seaglider was to be recovered at the end of the cruise.

Stations:

- 1) Station 1, the site of the VPR small boat filming, located at 21° 20.6'N, 158° 16.4'W and was to be occupied on the first day of the cruise for about 3 hours.
- 2) Station 2, the site of the sediment trap and VPR deployment, approximately located at 22° 10.8'N, 157° 36.0'W. The VPR was to be towed for 6 hours.
- 3) Station 3, the site of the single pump, its location was to be determined from the Argos positions and the radio directional finder. This station was to be occupied for about 4 hours.
- 4) Station 4, the site of the feature (bloom), its location was to be determined with the aid of the Seagliders and the VPR. This station was to be occupied for about 11 hours.
- 5) Station 5, the site outside of the feature (bloom), its location was to be determined with the aid of the Seagliders and the VPR. This station was to be occupied for about 7 hours.

## 2.0 Description of Planned Operations: *Refer to Return Cruise Schedule*

Upon arrival to Station 1 the small boat was to be deployed followed by the VPR. The VPR was to be deployed and recovered numerous times for Impossible Pictures to capture this operation on film. This location was picked because of its calm water. After the completion of this operation the small boat was to be recovered. After, the KM was to steam out to the single pump.

Upon arrival to Station 2 the sediment traps were to be deployed in a location dictated by the local currents. After the successful deployment of the sediment traps, the VPR was to be deployed for the remainder of the night. The pattern for mapping was to be decided upon on location. A couple of meetings were held prior to departure where a generalized plan was formulated.

After the VPR was to be recovered, the small boat was to be launched with divers aboard with the intention of recovering and replacing the temperature sensor in the top coupler. From the small boat, hand-lowered CTD casts will be deployed around the single pump. Depending on the results from these operations, including visual observations, the VPR may be deployed again to get a higher resolution map of the region or the ship will steam to the dual pumps and repeat small boat operations. If it was determined that the pumps were operating we will locate and sample a bloom that was created from bringing 300 m water to surface. We will also sample outside of the bloom to compare the in and out stations. Optical casts and net tows will also be completed. If the pumps were not operating and time permitted we would first recover the single pump. Before any recovery was to be attempted the misbehaving Seaglider was to be recovered. A small boat will be launched to assist in this operation. Following the Seaglider recovery, a decision will be made as to the next operations. The sediment traps need to be recovered at the end of the cruise allowing enough time for our scheduled arrival at 0800 on June 15.

### 3.0 PERSONNEL:

<u>Participant</u>	<u>Title</u>	<u>Affiliation</u>
Eric Grabowski	Chief Scientist	UH
Angelique White	Lead Scientist	OSU
Blake Watkins	Marine Engineer	UH
Steve Poulos	Technology/Seaglider	UH
Karin Björkman	Support Scientist	UH
Sam Wilson	Support Scientist	UH
Tara Clemente	Support Scientist	UH
Jay White	Support Scientist	UH
Adriana Harlan	Support Scientist	UH
Cabell Davis	VPR Scientist	WHOI
Josh Eaton	VPR Scientist	WHOI
Brian Von Herzen	Broader Impacts Scientist	Climate Foundation
Geraldine Hawkins	Line Producer	IP
Matthew Wortman	Director	IP
Ruth Roberts	Producer	IP
Sarah Newman	Production Co-Coordinator	IP
Mike Timney	Cameraman	IP
Simon De Glanville	Cameraman	IP
David Pruger	Sound Recordist	IP
Mike May	Local Camera Assistant	IP
Jennifer Languell	Presenter	IP
Basil Singer	Presenter	IP
Dan Fitzgerald	Marine Technician	OTG
Kuhio Vellalos	Marine Technician	OTG
Kevin Flanagan	UH Dive Safety Officer	UH
Tim McGovern	Dive Support	OTG

#### 4.0 Summary of Operations:

The KM departed on the OPPEX-I return cruise at 0830 on June 11. At 1030 a USCG helicopter conducted mock hoist operations around the KM. We arrived at Station 1 at 1110. Station 1 was chosen for the purpose of filming the deployment of the VPR from the small boat away from the KM because of the calm water on the leeward side of Oahu. Station 1 operations included, hoisting the VPR across the deck of the ship into deployment position, deployment of the small boat and mock VPR deployments. All operations at Station 1 were completed on time and without incident.

At 1505 the KM got underway to Station 2. It was decided to do a real VPR deployment while the KM was still in the lee of the island. This was to test all instruments and the performance of the VPR. The VPR was deployed at 1510 and recovered at 1540. All VPR tests were successful and the ship continued on to Station 2.

The KM arrived in the vicinity of Station 2 at 2145. During this time the ADCP data, the drift tracks of the pumps and the drift track of the misbehaving Seaglider were analyzed. The deployment location of the sediment traps and the VPR mapping pattern were chosen based on all of the available information. The sediment traps were then deployed at 2345. Following this deployment the ship repositioned for the deployment of the VPR. The VPR was successfully deployed on June 13 at 0050. The VPR was towed all night in a zigzag pattern between 60 m and 30 m. At 0645 the VPR was recovered in the vicinity of the single pump.

The single pump was located and the KM positioned near the pump. At 0755 the small boat was launched with divers aboard with the mission of recovering and replacing the top temperature sensor in the top coupler of the pump. The divers successfully recovered the temperature sensor and returned it to the KM at 0930. They did not replace the sensor because visual observations revealed that the upper portion of the pump was shredded. The temperature data was then downloaded and analyzed. It was found that the pump worked and pumped cold nutrient rich water to the surface for 17 hours after deployment. No cold water was observed following the 17 hours of pumping. Because the data revealed that the pump was not pumping nutrient rich water to the surface and the visual observation was made that the upper portion of the pump was not intact it was decided to locate the tethered pumps and repeat diving operations on both pumps.

The tethered pumps were located and the small boat was launched with divers aboard. Upon arrival at the tethered pumps a 16ft shark was found circling the pumps. After a closer examination the shark was identified as a whale shark. The divers entered the water and recovered both temperature sensors in the top portions of the pumps. The sensors were safely brought onboard the KM at 1200. The same visual observation was made at both pumps as the single pump that the top portions of the tubes were shredded and not intact. Because of this, the sensors were not replaced. The temperature data from both sensors were then downloaded and analyzed. The data revealed that one of the pumps did not record cold water at the surface while the other pump pumped sporadically for approximately 16 hours on June 1. Because the data showed that both pumps were not delivering cold nutrient rich water to the surface and the visual observation was made that the upper portion of the pump was not intact it was decided upon to recover the malfunctioning Seaglider.

The KM got underway to the Seaglider at 1330. En route to the Seaglider the VPR was launched for filming of the control room. The VPR was recovered 1625. The KM arrived at the Seaglider and the small boat was deployed to aid in the recovery operation. The Seaglider was successfully recovered and brought safely onboard the KM at 1655. The small boat was recovered and the KM transited back to the pumps. It was decided that CTD casts and optics casts would be completed by the single pump and the tethered pumps throughout the night. In the morning, the single pump would be recovered.

Four CTD casts were conducted around the single pump with the last one occurring on June 14 at 0020. The cyanocage was deployed at 0025 in the vicinity of the single pump. Following, the KM positioned near the tethered pumps for CTD operations. Three CTD casts were performed around the two pumps.

At 0800 on June 14 the CTD was deployed and recovered for filming purposes. The small boat was launched at 0845 with divers aboard to film the CTD underwater. These operations occurred until 0945.

At 1030 the small boat was launched to aid in the recovery of the single pump. At 1045 the working line from the ship was passed to the small boat and the hook was placed on the single pump recovery line. The winch was used to reel in the recovery line. The first mass that was brought on deck included the valve, 150 m of bag and the middle coupler. After an hour of sorting out the tangled mess the next section was brought onboard. This section included 150 m of bag and the top coupler. At 1310 the single pump buoy was successfully brought onboard. The single pump was recovered safely and without incident.

The KM then transited to the sediment traps for recovery. At 1440 a net tow was completed next to the sediment traps. The sediment traps were successfully recovered at 1540. The KM then steamed back to the dual pumps.

All operations were completed and the KM got underway to Snug Harbor at 1835. On June 15 at 0650 a helicopter circled the KM outside of the harbor for filming purposes. Mock VPR deployments were performed.

The KM docked at Snug Harbor at 0830 on June 15.

## 5.0 Detailed Summary of Operations:

### **June 11, 2008**

At 1200 the OPPEX team loaded all of the gear and supplies aboard the KM.

### **June 12, 2008**

Departed Snug Harbor at 0830.

Safety and Science meeting held in the conference room at 0915.

Conducted abandon ship drill at 1000. All personnel mustered in the staging bay. All new personnel were instructed to put on their survival suits. C/M instructed crew on the life raft launching protocol.

At 1030 USCG helicopter conducted mock hoist operations around the KM.

Arrived Station 1 at 1110.

At 1145 the green crane was rigged for hoisting the VPR across the deck into launching position. This operation was conducted for filming purposes. This was followed by many mock VPR deployments which were filmed from the deck of the ship. At 1330 the small boat was launched so IP could film the VPR deployment away from the ship. Several more mock VPR deployments were completed at 1350 and 1400. The small boat was recovered at 1450. Underway to Station 2 at 1505. At 1510 a test deployment of the VPR was conducted to check the system. The VPR was fully operating and was recovered at 1540.

Arrived Station 2 at 2145.

The sediment trap deployment location was chosen by looking at the ADCP data and the drift track of the pumps. The mapping way points used for the VPR were also chosen using the ADCP and the drift track of the pumps.

The sediment traps were deployed at 2345 at the location of 22° 20.6'N, 157° 31.3'W.

### **June 13, 2008**

The ship was then repositioned near the pumps for the deployment of the VPR.

The VPR was deployed at 0050 at the location of 22° 22.0'N, 157° 33.0'W.

The VPR was towed all night in a zigzag pattern until it was recovered near the single pump at 0645 at the location of 22° 29.0'N, 157° 30.2'W.

The single pump was then located and the ship positioned for the deployment of the small boat. The location of the single pump at the time of deployment was 22° 23.4'N, 157° 32.7'W. The boat was launched at 0755. Divers were aboard to recover and replace the top temperature sensor in the top coupler. At 0825 three divers entered the water. The small boat returned to the KM at 0930. They were successful in recovering the top temperature sensor. A replacement sensor was not installed because it was observed that

the bag material was shredded. At 0945 the temperature sensor data was downloaded and analyzed. It was found that the pump worked for approximately 17 hours but was not operating at the time of visit.

The ship then moved over to the tethered pumps where divers were deployed in the small boat to repeat the temperature sensor operations. Upon arrival at the dual pumps a 16ft shark was seen lurking below. After a closer inspection the shark was identified as a whale shark. Divers entered the water at 1050. They recovered the temperature sensors from both pumps. The divers did not replace the sensors because the top portion of the tube was shredded. The divers returned to the KM at 1200. The small boat was recovered at 1245.

At 1330 the ship got underway to recover the misbehaving Seaglider.

At 1415 the VPR was launched. This operation was for IP to film the computer room while this operation was in progress.

The VPR was recovered at 1625.

The small boat was launched to aid in the recovery of the Seaglider at 1643 at the location of 22° 52.2'N, 157° 40.1'W.

The Seaglider was successfully recovered at 1655.

The small boat was recovered 1705 and the ship got underway back to the pumps.

At 1940 the KM arrived at 22° 27.0'N, 157° 31.2'W, the location of the single pump.

The first CTD hit the water at 2004 and was recovered at 2030. The ship repositioned and the CTD was deployed again at 2130 and was recovered at 2200. The ship moved to the next station and the CTD was deployed at 2250 and recovered at 2318. The ship was repositioned again and the CTD was deployed at 2340.

## **June 14, 2008**

The CTD was recovered at 0020 near the single pump at the location of 22° 28.3'N, 157° 30.1'W.

The Cyanocage was successfully deployed and recovered at 0025 and 0100.

The ship then moved over to the tethered pumps where CTD operations were repeated.

The first CTD cast went in the water at 0155 at the location of 22° 29.9'N, 157° 31.6'W and was recovered at 0230. The KM repositioned for the next cast at the location of 22° 30.9'N, 157° 31.4'W. The CTD was deployed at 0318 and was recovered at 0350. The ship then moved to 22° 30.98'N, 157° 31.17'W for another CTD which was deployed at 0405 and recovered at 0445.

The KM then moved back to the single pump.

At 0800 the CTD was deployed and recovered for filming purposes. The small boat was launched at 0845 with divers aboard to film the CTD operations. The divers entered the water at 0907 and CTD operations continued until 0945.

At 1032 the small boat was launched to aid in the retrieval of the single pump. The working line from the ship was passed to the small boat and at 1045 the hook was placed on the recovery line of the single pump. The single pump recovery occurred until 1310 when the buoy was safely brought aboard. The recovery was successful and occurred without incident.

The KM then got underway to the sediment traps. A net was deployed at 1440 at the location of 22° 32.7'N, 157° 27.1'W (sediment traps). At 1505 the approach was made to recover the sediment traps. The sediment traps were successfully recovered at 1540.

The ship then steamed back to the dual pumps and arrived at 1720. All operations were completed and the KM got underway to Snug Harbor at 1835 for our scheduled return at 0800 on June 15.

### **June 15, 2008**

At 0650 a helicopter circled the KM for filming purposes. During this time, mock VPR deployments were performed. The KM entered Honolulu Harbor at 0740. The ship was tied up at Snug Harbor at 0830.

### RETURN CRUISE SCHEDULE:

TIME	Thur. June 12	Fri. June 13	Sat. June 14	Sun. June 15	TIME
0000		Deploy VPR			0000
0100			CTD 3 in		0100
0200					0200
0300					0300
0400			CTD 4 in		0400
0500					0500
0600		Recover VPR near single pump (0630)	Transit out 10nm St. 5		0600
0700		Deploy small boat Hand-Lowered CTD			0700
0800	Depart Snug		CTD 1 out	Arrive Snug	0800
0900		Recover Thermistor			0900
1000		Recover Small Boat Transit Dual Pump	1m Net Tow		1000
1100	Deploy Small boat		CTD 2 out		1100
1200	Deploy VPR	Deploy VPR	PRR Cyanocage		1200
1300	Recover VPR Deploy VPR				1300
1400		Recover VPR near Seaglider (1430)	CTD 3 out		1400
1500	Recover VPR	Deploy Small Boat Recover Seaglider			1500
1600	Recover Small Boat Transit St. 2	Recover Small Boat	Transit to Sed Traps		1600
1700		Transit to Feature	Recover Sed Traps		1700
1800		Open Close Net Tow			1800
1900		CTD 1 in	Transit Snug		1900
2000					2000
2100		Cyanocage			2100
2200		CTD 2 in			2200
2300	Deploy Sed Traps	1m Net Tow			2300

**June 13: Sunrise 0549 Sunset 1914**