

# **SUPER HI-CAT: Chief Scientist Report**

Survey of Underwater Plastic and Ecosystem Response between Hawaii and California

**Chief Scientist: Tara M. Clemente**

Cruise ID: KM0817

Departed Honolulu, HI: August 25, 2008 at 1800 (HST)

Arrived Port Hueneme, CA: September 5, 2008 at 1000 (PST)

Vessel: R/V Kilo Moana

Operator: University of Hawaii

Master of the Vessel: Captain Brian Wehmeyer

Chief Scientist: Tara M. Clemente

OTG Electronics/Deck Operations Technicians: Timothy McGovern and Elly Speicher

## **1. SCIENTIFIC OBJECTIVES**

The objective of the cruise was to locate and sample the microbial communities and biogeochemical properties associated with the Pacific plastic patch between Honolulu, HI and Port Hueneme, CA. Hydrographic and biogeochemical data was collected to characterize the upper water column. A Manta trawl was used to map the horizontal distribution of the plastic patch. A LISST and HYPERPRO radiometer were used to characterize particle size distribution and optical properties of the upper water column. Weather forecasts, shipboard ADCP data and satellite images were used to help us locate the plastic patch which in the past had been located in regions of calm weather between 30-35° N Latitude and 150-130°W Longitude. We planned to occupy two CTD/Trawl/Optics stations per day in hopes of locating the plastic patch with approximately 16 stations occupied en route to Port Hueneme, CA. Once the plastic patch had been located we engaged in higher resolution sampling with the intent of canceling scheduled CTD/Trawl/Optics stations as necessary to ensure an on time arrival in Port Hueneme, CA.

## **2. SCIENCE PERSONNEL**

<u>Participant</u>	<u>Title</u>	<u>Affiliation</u>
Tara Clemente	Chief Scientist	UH
Jeffery Ernst	Research Technician	AMRF
Allison Fong	Graduate Student	UH
Lucy Marcus	Photo/Videographer	UH
Barbara Mayer	Teacher	Kamehameha
Timothy McGovern	Marine Technician	OTG
Ari Patz	Volunteer	Styrophobia
Elly Speicher	Marine Technician	OTG
Brett Updyke	Research Technician	UH
Donn Viviani	Graduate Student	UH
Kim Weersing	Marine Educator	UH

Jay Wheeler  
Angel White

Research Associate  
Scientist

UH  
OSU

### 3. GENERAL SUMMARY

Operations were conducted as planned with only minor interruptions.

Hydrographic and biogeochemical data was collected to characterize the upper 150m water column at discrete depths (5m, 15m, 25m, 45m, 75m and Deep Chlorophyll Maxima) using the CTD rosette. One 350m CTD cast was conducted to collect water for a mixing experiment at the beginning of the cruise. We occupied 2-3 CTD/Trawl/Optics stations per day, for a total of 14 stations en-route to Port Hueneme, CA. Fifteen underway stations were also conducted using the ships uncontaminated seawater system to look at various biogeochemical parameters.

A Manta trawl was used to map the surface horizontal distribution of plastic at 14 stations. Samples were then size fractionated into the following size classes; 5mm and larger, 2 - <5mm and 0.2 - <2mm. All three size fractions were then sub-sampled to measure ATP, DNA/RNA and Chlorophyll.

A LISST (Laser In-Situ Scattering and Transmissometry) was used to characterize particle size distributions at all underway and CTD stations. The list was mounted to the CTD and depth profiles were collected on the downcast at a speed of 10m/min. Discrete water samples were analyzed using water collected from the ships flow-thru system and from each targeted sampling depth from the CTD (5m, 15m, 25m, 45m, 75m and Deep Chlorophyll Maxima).

At stations 2-15 a HYPERPRO free-fall profiling device was deployed to analyze the inherent (scattering, absorption and fluorescence) and apparent optical properties of the upper water column (<150m) along the transect from Hawaii to California.

Jay Wheeler and Tara Clemente performed a mixing experiment during the transit. The goal of the SUPER HI-CAT mixing experiment was to assess the microbial community and biogeochemistry in response to a pulsed, deep (350m) seawater intrusion into surface (30m) waters. This experiment was designed to mimic the addition of deep water into surface waters through wave pumping action over an extended period of time (8 days).

Donn Viviani collected samples to perform measurements of respiration, net and gross primary production in near surface un-amended whole seawater as well as seawater with plastic. He also took samples to measure bacterial production.

Allison Fong collected samples for RNA and DNA analysis.

Donn Viviani and Allison Fong performed an experiment to determine the colonization rates/effects of plastic. Plastic used for the experiment was collected on Oahu beaches the weekend before the cruise left Honolulu as well as from Manta trawls performed during the SUPER HI-CAT cruise. The plastic from Oahu beaches was then soaked in HCL over night and

rinsed with DI to remove all living organisms. Biotic plastic was collected from the Manta trawls. Abiotic and biotic pieces of plastic were then incubated in separate carboys over a 4 day period and various biogeochemical parameters were measured at three time points.

#### **4. R/V KILO MOANA, OFFICERS AND CREW, TECHNICAL SUPPORT**

The R/V Kilo Moana and her crew delivered excellent ship support for our work. The Captain, officers and crew were exceptionally helpful and accommodating throughout the cruise. Throughout our cruise, the entire crew showed enthusiasm, concern and dedication to our scientific mission.

Technical support during this cruise was excellent. OTG personnel were available at any time to assist in our work and helped keep operations running smoothly.

#### **5. DAILY REPORT OF ACTIVITIES** (all times are local time unless otherwise stated)

##### **August 23<sup>rd</sup>, 2008** – Loading Day

1000 – Equipment and science supplies were loaded on this day.

##### **August 25<sup>th</sup>, 2008**

0730 - depart Snug harbor for the fuel pier  
1030 - science party safety meeting  
1603 - fire drill and abandon ship drill  
1800 - departed Honolulu after completion of fuelling  
1930 - a short science meeting was held  
2200 - underway station (UW-1)

##### **August 26<sup>th</sup>, 2008**

1000 - underway station (UW-2)  
1300 - S1C1 mixing experiment cast (350m)  
1515 - mixing experiment (t = 0)  
2200 - underway station (UW-3)

Weather conditions at noon; wind 070 @ 13kts, sea and swell ENE'ly @ 5-6ft, Barometer 1019.1 under a partly cloudy sky.

##### **August 27<sup>th</sup>, 2008**

0808 - manta trawl-1 start  
0938 - manta trawl-1 end  
0950 - S2C1 (150m)

1040 - hyperpro-1 cast  
1502 - manta trawl-2 start  
1631 - manta trawl-2 end  
1643 - S3C1 (150m)  
1730 - hyperpro-2 cast  
2100 - underway station (UW-4)

Weather conditions at noon; wind 110 @ 6kts, sea and swell ENE'ly @ 4ft, Barometer 1020.1 under a partly cloudy sky.

### **August 28<sup>th</sup>, 2008**

0805 - S4C1 (150m)  
0841 - manta trawl-3 start  
1016 - manta trawl-3 end  
1027 - hyperpro-3 cast  
1300 - mixing experiment (t = 1)  
1502 - S5C1 (150m)  
1549 - hyperpro-4 cast  
1610 - manta trawl-4 start  
1746 - manta trawl-4 end  
1900 - a short science meeting was held  
2100 - underway station (UW-5)

Weather conditions at noon; wind 070 @ 13kts, sea and swell NE'ly @ 5ft, Barometer 1021.1 under a partly cloudy sky.

### **August 29<sup>th</sup>, 2008**

0600 - S6C1 (150m)  
0641 - manta trawl-5 start  
0809 - manta trawl-5 end  
0827 - hyperpro-5 cast  
1100 - S7C1 (150m)  
1143 - hyperpro-6 cast  
1203 - manta trawl-6 start  
1330 - manta trawl-6 end  
1601 - S8C1 (150m)  
1644 - hyperpro-7 cast  
1702 - manta trawl-7 start  
1831 - manta trawl-7 end  
2100 - underway station (UW-6)

Weather conditions at noon; wind 095 @ 10kts, sea and swell E'ly @ 4-5ft, Barometer 1025.0 under a partly cloudy sky.

## **August 30<sup>th</sup>, 2008**

0600 - S9C1 (150m)  
0646 - manta trawl-8 start  
0819 - manta trawl-8 end  
0830 - hyperpro-8 cast  
1104 - S10C1 (150m)  
1145 - hyperpro-9 cast  
1204 - manta trawl-9 start  
1331 - manta trawl-9 end  
1400 - mixing experiment (t = 2)  
1600 - S11C1 (150m)  
1641 - hyperpro-10 cast  
1700 - manta trawl-10 start  
1832 - manta trawl-10 end  
2100 - underway station (UW-7)  
2200 - changed clocks (ZD + 9)

Weather conditions at noon; wind 060 @ 15kts, sea and swell ENE'ly @ 5-7ft, Barometer 1026.2 under a partly cloudy sky.

## **August 31<sup>st</sup>, 2008**

0759 - S12C1 (150m)  
0843 - manta trawl-11 start  
1016 - manta trawl-11 end  
1030 - hyperpro-11 cast  
1503 - S13C1 (150m)  
1548 - hyperpro-12 cast  
1605 - manta trawl-12 start  
1730 - manta trawl-12 end  
2100 - underway station (UW-8)

Weather conditions at noon; wind 080 @ 16kts, sea and swell ENE'ly @ 5-6ft, Barometer 1026.4 under an overcast sky.

## **September 1<sup>st</sup>, 2008**

0801 - S14C1 (150m)  
0845 - manta trawl-13 start  
1020 - manta trawl-13 end  
1030 - hyperpro-13 cast  
1300 - mixing experiment (t = 3)  
1457 - S15C1 (150m)  
1540 - hyperpro-14 cast  
1557 - manta trawl-14 start

1732 - manta trawl-14 end  
1800 - changed clocks (ZD + 8)  
2100 - underway station (UW-9)

Weather conditions at noon; wind 060 @ 17kts, sea and swell ENE'ly @ 5-6ft, Barometer 1026.5 under an overcast sky.

### **September 2<sup>nd</sup>, 2008**

0900 - underway station (UW-10)  
1230 - a short science meeting was held  
2100 - underway station (UW-11)

Weather conditions at noon; wind 040 @ 18kts, sea and swell NE'ly @ 6-7ft, Barometer 1026.5 under a mostly cloudy sky.

### **September 3<sup>rd</sup>, 2008**

0200 - changed clocks (ZD + 7)  
0900 - underway station (UW-12)  
1400 - mixing experiment final (t = 4)  
2100 - underway station (UW-13)

Weather conditions at noon; wind 000 @ 24kts, sea and swell NNE'ly @ 9-11ft, Barometer 1019.9 under an overcast sky.

### **September 4<sup>th</sup>, 2008**

0900 - underway station (UW-14)  
1000 - cleaned and packed labs  
2100 - underway station (UW-15)

Weather conditions at noon; wind 330 @ 12kts, sea and swell NNE'ly @ 5-7ft, Barometer 1012.0 under an overcast sky.

### **September 5<sup>th</sup>, 2008**

0700 - stored all science gear to remain onboard in our Lab Van  
1000 - tied up in Port Hueneme, California  
1100 - partial offload

**CTD/Trawl/Optics Station Locations: (Station #, latitude, longitude)**

S1C1	24° 22.070 N	156° 17.109 W
S2C1	27° 43.795 N	154° 53.897 W
S3C1	28° 35.042 N	154° 34.317 W
S4C1	31° 12.787 N	153° 29.632 W
S5C1	31° 59.450 N	153° 03.452 W
S6C1	34° 05.050 N	151° 37.916 W
S7C1	34° 28.125 N	151° 19.283 W
S8C1	34° 38.423 N	150° 45.928 W
S9C1	34° 55.675 N	148° 01.812 W
S10C1	34° 59.026 N	147° 24.349 W
S11C1	35° 02.066 N	146° 48.626 W
S12C1	35° 14.797 N	143° 47.303 W
S13C1	35° 18.046 N	142° 47.506 W
S14C1	35° 25.376 N	139° 15.016 W
S15C1	35° 26.331 N	138° 15.861 W

**Underway Station Locations: (Station #, latitude, longitude)**

UW-1	21° 48.222 N	157° 19.056 W
UW-2	23° 58.283 N	156° 28.757 W
UW-3	25° 50.512 N	155° 40.871 W
UW-4	29° 10.620 N	154° 21.677 W
UW-5	32° 37.055 N	152° 43.487 W
UW-6	34° 42.818 N	150° 06.781 W
UW-7	35° 05.342 N	146° 08.232 W
UW-8	35° 20.369 N	141° 54.656 W
UW-9	35° 26.648 N	137° 38.250 W
UW-10	35° 25.775 N	134° 47.849 W
UW-11	35° 20.932 N	131° 58.042 W
UW-12	35° 12.779 N	129° 20.642 W
UW-13	35° 00.483 N	126° 34.224 W
UW-14	34° 43.972 N	123° 44.508 W
UW-15	34° 25.791 N	121° 13.430 W

# SUPER HI-CAT Sample Summary Log

## Sample log from CTD measurements

	DO	DIC	DOC	NUTS	LLN	LLP/LLSi	FCM	CHL
CTD-1								
CTD-2	8	2	6	6	6	6	12	6
CTD-3	8	2	6	6	6	6	12	6
CTD-4	8	2	6	6	6	6	12	6
CTD-5	8	2	6	6	6	6	12	6
CTD-6	8	2	6	6	6	6	12	6
CTD-7	8	2	6	6	6	6	12	6
CTD-8	8	2	6	6	6	6	12	6
CTD-9	8	2	6	6	6	6	12	6
CTD-10	8	2	6	6	6	6	12	6
CTD-11	8	2	6	6	6	6	12	6
CTD-12	8	2	6	6	6	6	12	6
CTD-13	8	2	6	6	6	6	12	6
CTD-14	8	2	6	6	6	6	12	6
CTD-15	8	2	6	6	6	6	12	6
<b>Sum</b>	<b>112</b>	<b>28</b>	<b>84</b>	<b>84</b>	<b>84</b>	<b>84</b>	<b>168</b>	<b>84</b>

	ATP	HPLC	PC/PN	PPO4	PSI	DNA/RNA	CH4/NO2
CTD-1							
CTD-2	18	6	6	6	6	6	6
CTD-3	18	6	6	6	6	6	6
CTD-4	18	6	6	6	6	6	6
CTD-5	18	6	6	6	6	6	6
CTD-6	18	6	6	6	6	6	6
CTD-7	18	6	6	6	6	6	6
CTD-8	18	6	6	6	6	6	6
CTD-9	18	6	6	6	6	6	6
CTD-10	18	6	6	6	6	6	6
CTD-11	18	6	6	6	6	6	6
CTD-12	18	6	6	6	6	6	6
CTD-13	18	6	6	6	6	6	6
CTD-14	18	6	6	6	6	6	6
CTD-15	18	6	6	6	6	6	6
<b>Sum</b>	<b>252</b>	<b>84</b>	<b>84</b>	<b>84</b>	<b>84</b>	<b>84</b>	<b>84</b>



Samples from uncontaminated seawater system

	DO	DIC	NUTS/DOC	LLN	LLP/LLSi	FCM	CHL
UW-1	3	1	1	1	1	2	1
UW-2	3	1	1	1	1	2	1
UW-3	1	1	1	1	1	2	1
UW-4	1	1	1	1	1	2	1
UW-5	1	1	1	1	1	2	1
UW-6	1	1	1	1	1	2	1
UW-7	1	1	1	1	1	2	1
UW-8	1	1	1	1	1	2	1
UW-9	1	1	1	1	1	2	1
UW-10	1	1	1	1	1	2	1
UW-11	1	1	1	1	1	2	1
UW-12	1	1	1	1	1	2	1
UW-13	1	1	1	1	1	2	1
UW-14	1	1	1	1	1	2	1
UW-15	1	1	1	1	1	2	1
<b>Sum</b>	<b>19</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>30</b>	<b>15</b>

	ATP	HPLC	PC/PN	PPO4	PSI	DNA/RNA
UW-1	3	2	2	2	2	1
UW-2	3	2	2	2	2	1
UW-3	3	2	2	2	2	1
UW-4	3	2	2	2	2	1
UW-5	3	2	2	2	2	1
UW-6	3	2	2	2	2	1
UW-7	3	2	2	2	2	1
UW-8	3	2	2	2	2	1
UW-9	3	2	2	2	2	1
UW-10	3	2	2	2	2	1
UW-11	3	2	2	2	2	1
UW-12	3	2	2	2	2	1
UW-13	3	2	2	2	2	1
UW-14	3	2	2	2	2	1
UW-15	3	2	2	2	2	1
<b>Sum</b>	<b>45</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>15</b>

**Samples from Manta Trawls**

	<b>ATP</b>	<b>CHL</b>	<b>DNA/RNA</b>
<b>MT-1</b>	5	2	19
<b>MT-2</b>	6	9	30
<b>MT-3</b>	15	9	40
<b>MT-4</b>	15	9	20
<b>MT-5</b>	15	9	20
<b>MT-6</b>	15	9	22
<b>MT-7</b>	15	9	20
<b>MT-8</b>	15	9	20
<b>MT-9</b>	15	9	20
<b>MT-10</b>	15	9	20
<b>MT-11</b>	15	9	16
<b>MT-12</b>	14	9	16
<b>MT-13</b>	15	9	20
<b>MT-14</b>	15	9	20

**Sum            190            119            303**