CMOP 2008-July Wecoma Cruise W0807B Report

Project title: Science and Technology Center for Coastal Margin Observation and Prediction (NSF-STC)

10-22 July 2008

Research Vessel

R/V Wecoma; Captains: Richard Verlini

Scientists

Chief Scientist: Byron Crump
Scientific crew: Suzanne DeLorenzo, Caroline Fortunato, Melinda Ingebretson, Peter Kahn, Katylin Nichols, Justin Roberts, Jeff Schilling, Lauren Vice, Paul Walczak, Nicole West, Mouzhong Xu

Sampling Area

Coastal Oregon and Washington and the Columbia River Estuary

Cruise Report Contents

I. Activities
II. Methods
III. Contact Information
IV. Tables and Figures

I. Activities

Objectives of this cruise were:

1. Occupy a grid of stations over the Oregon and Washington continental shelf and slope to measure hydrographic (T, S, pressure), bio-optical (chlorophyll fluorescence, light transmission) and chemical (nitrate, dissolved oxygen) parameters. Combine these data with ADCP measurements of subsurface velocity to explore biophysical interactions.
2. Collect water samples for DNA- and RNA-based microbial community analyses, and measure bacterial production, primary production and water chemistry across environmental gradients in pelagic environments of the Columbia River estuary, the Columbia River plume, and along established sampling lines on the Oregon and Washington coasts. Estuary sampling will be coordinated with the R/V Barnes, which will be sampling the Estuarine Turbidity Maxima in the North and South Channels.
3. Collect surface sediments at several sites on coastal lines using a multicorer.

4. Make continuous measurements of surface water chemistry with several devices attached to the continuous flow seawater system.
5. Conduct Feature Tracking exercises using the SWAP system and model-based CORIE forecasts to identify sampling locations in the Columbia River Plume
6. Conduct 24-hour Water Mass Tracking surveys using the SWAP system and model-based CORIE forecasts to follow coastal water starting at NH-10 and GH-21, and in the Columbia River Plume beginning at the end of a strong ebb tide.

The ship was loaded at the Hatfield Marine Science Center dock in Newport, OR on 9 July, and departed the following morning. Throughout the cruise a set of instruments was attached to the surface water flow-through system of the Wecoma. This surface water mapping system passes surface water through a series of sensors to measure transmission (particles), fluorescence, salinity, and temperature.

The cruise was broken into two legs. Leg 1 was seven days long (July 10-17) and included all coastal line transects and one day of feature tracking in the Columbia Plume. Leg 2 (July 18-28) was devoted to sampling within the plume and inside the Columbia River estuary, and to four 24-hour drifter studies.

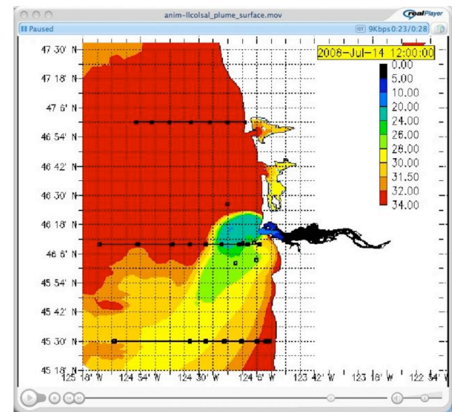
A total of 340 CTD casts (cast numbers 191 to 530) were conducted, and 121 water samples were collected (WS#364-484) (52 along coastal lines, 19 in the plume, 13 in the estuary, and 37 during drifter studies). Sediment cores were collected at six coastal stations with a multicorer. All major physical and biological measurements and collections were completed. The crew of the ship was very supportive and helped facilitate a successful cruise.

<u>Daily Log:</u>

9-July. Load Ship.

10-July. Strawberry Hill Line. We left the dock at 10 am and, working through seasickness, did CTD casts at 6 stations (SH-10, 30, 70, 100, d, f), and sampled water and sediments at two stations (SH-70 and SH-f) on the Strawberry Hill line.

11-July. Newport Hydroline. Still working through seasickness, we sampled the Newport Hydroline. We collected nearly all planned samples: 9 CTD casts (NH-3, 5, 10, 15, 20, 25, 35, 45, 55), 3 sets of water samples (NH-3, 10, 20), two core samples (NH-10, 55), and a primary productivity measurement at NH-10. On CTD cast #209 at station NH-55 the ISUS Nitrate sensor imploded destroying the sensor and damaging other nearby sensors. We spent the evening fixing the other sensors.



Screen Grab of Forecast animation of surface salinity. : Cape Falcon line (not marked) runs east to west at 44 deg, 44' latitude

12-July. Sensor repair, brief stop in Newport. When the sun came up we cast the CTD at NH-55 to collect our fourth and final set of NH water samples. We then steamed to Newport to drop off a seasick student (Nicole West). At 18:00 we began a set of CTD casts along the 100m isobath at stations NH-10, LB-100,

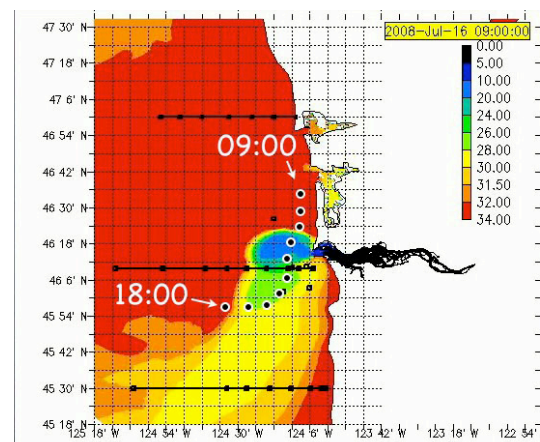
CH-10, CHCM-a, and CM-10.

13-July. Columbia River Line. We steamed to station CR-4 off the Columbia River to start an offshore transect. We cast the CTD at nine stations (CR-4, 7, 10, 15, 20, 25, 30, 35, 40), and collected water samples a four (CR-7, 15, 30, 40). We also measured primary production at station CR-7, and collected sediment cores at CR-7 and CR-40. We then steamed to station CF-b on the Cape Falcon line.

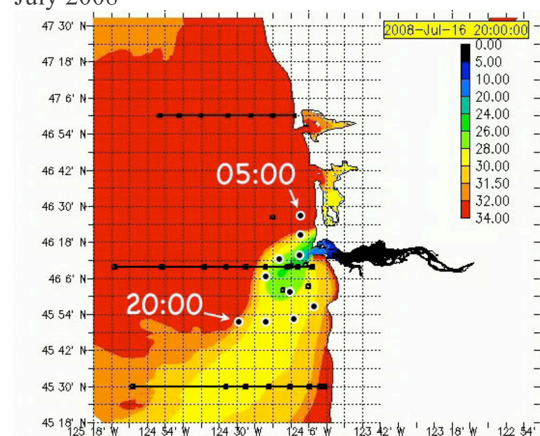
14-July. Cape Falcon Line. Today we sampled along the Cape Falcon line, which is just south of the Columbia River Line and was, according to the CORIE forecast, awash with the Columbia River Plume. The CORIE modeling team emailed an animation of surface salinity in this region, and we conducted CTD casts along the line until we found low salinity water. Coastal seawater in this area has a salinity of about 33, but plume water is less than 30. The station with the lowest salinity at the surface (28) was our farthest offshore station (CF-b), which lies more than 35 nautical miles from the river mouth. The forecast animation was correct on the salinity values, but the center of the plume crossed the Cape Falcon line farther off shore than predicted. We began this series the evening of the 13th, casting the CTD at seven stations going west to east (CF-b, a, 40, 30, 20, 10, 7, 3), and once the sun came up we repeated the stations going east to west. We collected water at two stations to characterize the aging plume water (CF-30 with surface salinity of 30, and CF-a with surface salinity of 28). After we finished this series we cruised directly to CF-10 to continue the CTD survey of the 100m isobath at stations CF-10, CFCR-a, CR-15, CRWB-a, WB-19, GH-21, GHQR-a, QR-19, and QRLP-a.

15-July. La Push Line. After completing the 100m isobath series we moved inshore to LP-4 to start the La Push line. We cast the CTD at 10 stations going east to west (LP-4, 6, 9, 12, 17, 22, 27, 32, 42, 52), collected water samples at three depths at four stations (LP-6, 17, 32, 52), measured primary production at one station (LP-6), and collected sediment cores at two stations (LP-17, 52).

16-July. Plume Feature Tracking, Spring tide. We spent the night steaming back to the mouth of the Columbia to start a Feature Tracking exercise in the 'young' plume. Grant Law from the modeling team provided a list of way points/times designed to sample across a range of surface



Feature Tracking way points/times, daytime, 16 July 2008



Feature Tracking way points/times, nighttime, 16 July 2008

salinities within the plume, including a point just outside the plume front. We cast the CTD at these 10 stations at the appropriate times, and collected water at three stations (P-2, P-4, P-7) from four depths (surface, chlorophyll max where there was an oxygen peak, below chlorophyll max where there was an oxygen minimum, and deep). One of these three stations was outside the plume. Then we did a second feature tracking exercise that evening, but with no water samples.

17-July. **Dock in Astoria**. This morning we docked at the Port of Astoria to change scientific crew members and to pick up the Argos drifters. Our coring team of Mouzhong Xu, Mindy Ingebretson and Paul Walczak got off the ship and were replaced with grad student Caroline Fortunato, undergraduate intern Lauren Vice, and webmaster/videographer Jeff Schilling. We went to Fred Meyer for some more buckets and some dry ice for transporting sediment core samples back to OHSU.

18-July. **Estuary South Channel**. We left the dock at 5:30 am pst and headed down estuary to our first sampling station. Our goal was to collect low-turbidity water samples at a range of salinities. This estuary has very strong Estuarine Turbidity Maxima (ETM) in its north and south channels. ETM are hydrodynamic phenomena in which river-borne particles are trapped and concentrated in the estuary as the freshwater moves through. These particles are resuspended by tides and settle back to the bed during slack tides. While we were sampling particle-free "background" water samples, Joe Needoba on the R/V Barnes was stationed in the region of the ETM collecting particle-filled water samples to assess microbial activity and diversity. We spent most of the day near River Mile 11 waiting for the tides to bring the right salinity water to the ship. We collected 7 water samples and measured primary productivity with water from cast 295.

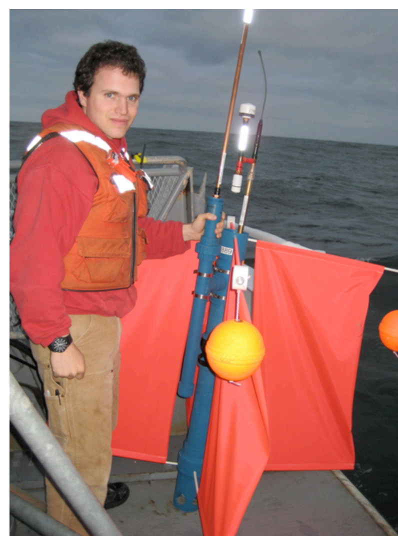
19-July. **Estuary South Channel Feature Tracking**. We anchored overnight in the North Channel near the Saturn 01 station and cast the CTD hourly until morning. We then moved to the south channel to begin a day of CTD casts with the goal of following a specific bottom water salinity (~15), up and down the estuary. We were guided by Joseph Zhang at OHSU who provided way-points and times. For most of our casts the surface water was saltier than predicted, and the bottom water was fresher than predicted, suggesting that the forecast model was not capturing the degree of water column mixing. We also conducted many cross-channel surveys, casting the CTD at three points across the channel in a reach of the South Channel between the AM Bridge and Tongue Point. Cross-channel variability was greater than expected, with more stratification on the south side of the channel, and less stratification on the north side of the channel. We cast the CTD a total of 30 times in the south channel before heading back to the nighttime anchor station in the North Channel.

20-July. **Estuary North Channel**. The goal for this day was to collect low-turbidity water samples at a range of salinities in the North Channel of the Estuary. We did the same thing in the South Channel on July 18th. At the same time the R/V Barnes was positioned in the ETM region of the North Channel collecting ETM samples. We spent most of the day moving between stations NC-7, 9, and 11. Most water samples were collected at a middle depth above the influence of ETM particles. We collected water at the following salinities: 2, 6.5, 10, 18, 26, and 31. At one point late in the flood tide a wedge of coastal water with a low oxygen concentration (<4 mg/l) moved into the estuary. We sampled this water (salinity = 31, cast 361, WS#438), as did the Barnes from

a position down-estuary from our ship. We finished the day by anchoring in our usual spot in the North Channel and casting the CTD hourly through the night.

21-July. **Estuary North Channel Feature Tracking**. Today we followed an intermediate bottom salinity as it moved up estuary on the flood and down estuary on the ebb. We waited until the strong ebb settled down at about 10:00 pdt and moved to station NC-7, which lies 7 miles up estuary from the mouth. We established a set of stations at half-mile increments from NC-7 to NC-11 near the bridge, including 3 stations spanning the channel at each point. We then worked our way up the estuary with the flood casting the CTD at several of these stations (CTD casts 381 to 410). During slack tide we continued to cast the CTD at the three NC-11 stations because our ship did not fit under the bridge. We found, however, that the weaker ebb did not change the bottom salinity very much. At 2100 we returned to the North Channel anchor station. Note that we divided the CTD cast duties among all the science team to give the primary CTD teams a break.

22-July. **Drifter Water Mass Tracking in Plume.** Today we began a new field campaign for the CMOP program. At the beginning of the strong ebb tide we released an Argos surface drifter at the mouth of the estuary on the south side of the shipping channel. We immediately cast the CTD and collected a surface water sample. Then we followed the drifter as it moved off shore, casting the CTD each hour and collecting a surface water sample every three hours. The CORIE modeling team prepared forecasts of where the drifter would go given different release points and release times. These spaghetti diagrams give several different possible trajectories. The initial suggestion from the modeling team was to release the drifter some distance up the estuary, but the captain and crew warned us off doing that. In their experience drifters released in the estuary often get stuck in shallows on the sides of the estuary mouth. They also pointed out how difficult it would be to recover the drifter from these places. So we decided to release the drifter at the mouth parallel with the end of the Southern Jetty. The drifter moved quickly off shore and slowed down about 11 nautical miles from the mouth. It then moved north east a little during flood tide, and then south during the ebb. We divided into day and night teams for water sampling. Day shift was Peter Kahn, Lauren Vice and Byron Crump. Night was Suzanne DeLorenzo and Caroline Fortunato. CTD teams remained on 12-hour shifts changing over at



ARGOS drifter on ship (with Marine Technician David O’Gorman), and in the water.

noon and midnight. Midnight to noon was Katelyn Nichols and David O'Gorman, and noon to midnight was Justin Roberts and Jeff Schilling.

23-July. **Drifter Water Mass Tracking in Plume.** We pulled the drifter out of the water at 06:30 pdt and steamed back to the mouth of the Columbia to repeat the survey. At 08:00 we deployed a drifter off the stern - the same as on July 22 - but it was immediately swept under the ship and broken by the ship's bow thruster. The lesson here is to face the ship into the current when deploying off the stern. So we turned the ship around and deployed the other drifter at 08:30 and set about following it for the next 24 hours. This time the drifter moved northwest and later began to curl back to the northeast. Surface salinity was similar to the first drifter deployment, just in a different location. This will make a fine replicate dataset.

24-July. **Plume Feature tracking.** We received waypoints/waytimes from Grant Law for this Feature Tracking exercise in the evening on 23-July. We were not able to get to the first way-point in time after pulling the drifter at 08:30, so we started our series a little late. Grant updated the surface salinity forecast for the locations and times. We cast the CTD ten times and collected water samples at two stations (P-24, P-29) at four depths matching those collected on 16-July.

25-July. **Drifter Water Mass Tracking offshore on Grays Harbor Line.** We spent the evening steaming to station GH-21 on the Grays Harbor Line. This location was chosen because it is off shore and away from the influence of the Columbia River Plume. We released the drifter at 03:00 pdt and began sampling. The CTD was cast every hour (casts 474 to 502) and surface water samples were collected every 3 hours (WS# 466 to 475). We also measured primary productivity at the beginning and end of the series (casts 474 and 499). Weather conditions were very calm, so the ship did not move very far during the 24 hours. Hundreds of birds (gulls, shearwater, albatross) floated around the ship during the series.

26-July. We ended the Grays Harbor line drifter study at 06:00 pdt and steamed to station NH-25.

27-July. **Drifter Water Mass Tracking offshore on Newport Hydroline.** We began this series at station NH-25 at 00:05 pdt. This site is also offshore, but it is influenced by the Columbia River plume, which was flowing south-west because of prevailing upwelling conditions. Surface salinity was approximately 32 and temperature 12°C. The CTD was cast every hour (casts 503 to 530) and surface water samples were collected every 3 hours (WS# 476 to 484).

28-July. **Offloaded the ship.** We ended the drifter study at 03:00 pdt and steamed to Newport to offload the ship.

Several suggestions were made to help guide future CMOP cruise leaders.

1. Communication with shore-side scientists is imperative. Internet access is very helpful, particularly for email communications and daily blogging. Cell phone contact is also important.
2. Double-check the depth limitations on sensors. ISUS Nitrate sensors have a 1000m depth limit.
3. During drifter studies – do not release the drifter from the upstream end of the ship. Surface currents will carry the drifter under the ship.

4. During Drifter studies – make sure the ship is not releasing water or other materials into the water. These things can contaminate the surface water samples. Outputs include: washing machines, water treatment tanks, kitchen sinks/disposals, evaporators.
5. Request all way-points to be in decimal minutes. This is the language of the ships captain and crew.
6. For adaptive sampling – complete planning for the next day by dinnertime so that the captain has a plan in advance. After dinner should be reserved for modifications of the plan.
7. Make sure to use online tutorials for using the model forecast system, SWAP, and blog system.

II. Methods

Water collection method:

Two to eight 10L niskin bottles are fired for each sample. Once on deck, bottles were drained with sample-rinsed 0.5" tubing into sample-rinsed 6-gal buckets (1-2 bottles/bucket). Water for HPLC pigment analyses are drawn directly off un-tapped bottles into brown PE bottles. Note - Water drains faster if top end-cap is opened. To do this, un-clip the bottom end-cap, and cock the top end cap. After water is drained, re-clip the bottom end-cap.

Water Filtering Protocol (Suzanne DeLorenzo):

Set Up/Notes:

- Assemble two filtering racks with 25mm diameter funnels, six filters per tower
- Attach two side-arm flasks to two of the funnels for water collection
- Attach tubing to vacuum pump and carboy. Be sure pump pressure does not exceed 5 mmHg when filtering
- Be sure to empty collection carboy regularly
- For liquid nitrogen, make sure dewar is open for minimal amounts of time. Be sure to replace styrofoam insert and plastic lid after each use
- After each water sample all funnels, frits, flasks, bottles, and cylinders should be rinsed with D.I. water

Labeling:

- Label all vials, bottles, etc. with the following:
    - Water sample number
    - Sample Site
    - Date
    - Replicate if applicable

Chlorophyll a: Collect duplicate samples

- Place 25mm GF/F filter (rough side up, grid down) on filter frit & screw down funnel
- Collect sample using brown Nalgene bottles. Rinse bottles and lids three times with sample before collection
- Using a sample-rinsed graduated cylinder, measure exact volumes of sample and pour into funnel. Record total volume filtered (~0.5L in coast/estuary, ~2L in open ocean)
- After filtration, fold filter in half with tweezers and place in pre-labeled 2ml cryovial
- All cyrovials are stored in liquid nitrogen dewar in designated color coded cups

High Pressure Liquid Chromatography (HPLC):

- Filtration is performed under subdued light conditions

- Place 25mm GF/F filter (rough side up, grid down) on filter frit & screw down funnel
- Collect sample directly from Niskin bottle using brown Nalgene bottles. Rinse bottles and lids three times with sample before collection
- Using a sample-rinsed graduated cylinder, measure exact volumes of sample and pour into funnel. Record total volume filtered (~1 to 4 liters)
- After filtration, fold filter in half with tweezers and place in pre-labeled 2ml cryovial
- All cyrovials are stored in liquid nitrogen dewar in designated color coded cups
- If water sample depth is below photic zone, no need to perform HPLC measurement

Particulate Organic Carbon (POC): Collect duplicate samples

- Place a pre-ashed 25mm GF/F filter (rough side up, grid down) on filter frit & screw down funnel
- Attach side arm flasks to POC filtering frits for water collection
- Using a sample-rinsed graduated cylinder, collect sample and measure exact volumes into funnel. Record total volume filtered (~1 to 4 liters)
- After filtration, fold filter in half with tweezers and place in a pre-labeled envelope
- Store envelopes in freezer in a small Ziploc bag labeled with site and sampling date

Suspended Particulate Matter (SPM): Collect during estuary and plume sampling only. Collect duplicate samples

- For SPM measurements, 25mm GF/F filters are pre-dried, weighed and stored in 47mm Petri-dishes.
- Place a pre-weighed 25mm GF/F filter (rough side up, grid down) on filter frit & screw down funnel
- Using a sample-rinsed graduated cylinder, collect sample and measure exact volumes into funnel. Record total volume filtered
- After filtration, rinse filter three times with D.I. water
- Return filter to Petri dish using tweezers and stored in freezer
- Be sure to place entire filter back into Petri dish, including bits that break off

Flow Cytometry:

- Collect sample in a small brown Nalgene bottle. Rinse bottle and lid three times with sample before collection
- Pipette 3 mL of sample into 5 mL cryovial using pipette labeled “LIVE”
- Under fume hood, pipette 100 uL of paraformaldehyde solution into cyrovial. Be sure to wear gloves!
- Vortex and place in dark (e.g., lab drawer) for 10 min
- Place sample in liquid nitrogen

Bacterial Counts (Glutaraldehyde):

- Pre-load 7 mL glass vials with 140 uL of 25% glutaraldehyde
- Under fume hood, pipette 7 mL of sample (collected in small brown Nalgene bottle) into vial and cap. Be sure not to touch pipette to edge of glutaraldehyde vial!
- Store filled vials in refrigerator

Filtered Water Collection: TDN/P, DOC, Nutrients

- Attach side arm flasks under 25mm GF/F filters that have been ashed (i.e., under POC filters) to collect water
- Collect filtered water in flask, sample rinse once, and continue collecting
- Once enough water has been collected, fill pre-labeled sample bottles
- **DOC**: fill to shoulder of bottle (20ml polypropylene vial)

- **Nutrients**: fill to shoulder of bottle (Provided by OSU analytical services)
- **TDN/P**: pipette exactly 20 mL into bottle (Provided by UMCES Horn Point Analytical Services)
- Place all bottles in freezer

DNA/RNA Sterivex Filtration Using Geopump (Caroline Fortunato)

Set up/Notes:

- Assemble Geopump with desired number of heads (1-3)
- Label Sterivex filters by water sample number, sample site ID, date, and type of fixative/solutions/buffers to be added post-filtration.
- Save some 0.2um filtered sea-water for rinsing the tubing after filtration.
- Rinse the tubing with filtered sea-water following each sample.
- Sample rinse the tubes before attaching the Sterivex filters for the next sample.
- Attach Sterivex filters to 10ml syringe tip ends inserted into tubing and set up over a 3L beaker (or other measuring device) to keep track of the amount of water filtered.
- The opposite end of the tubing should be fixed with dipsticks (10ml pipettes) which will be inserted into sample water.
    - These should be changed every 2-3 days or when varying the type of water being filtered.

Procedure

- After checking to be sure set up is properly completed and tubing is sample rinsed, turn Geopump on in forward pump direction.
- Keep track of the amount of water filtered using a 3L beaker (or other measuring device)
- Allow filters to pump desired amount of water, note however these volumes may need to be adjusted depending on individual samples, in general:
    - Estuaries and Turbid Systems: 1L
    - Seawater: 3-6L
    - Deepwater Samples (approx 1000L): 6L+
- Once filtrated water flowing through the Sterivex comes to a slow trickle (or the desired filtration amount is achieved) remove dipsticks from sample water and allow any water still in the Sterivex to be flushed out.
- Remove Sterivex filters from tubing and push out any remaining water using a 50ml syringe full of air.
- Seal bottom of Sterivex filter using Hemato-Seal Tube Sealing Compound
- With another syringe add desired fixative/solutions/buffers:
    - DEB: 1 ml (approx. ½ tube) filtered with 0.2um syringe filter
    - RNALater: 2 ml (approx. full tube)
- Cap the top of the Sterivex filter with autoclaved polycarbonate luer plug.
- Place the filters in a plastic Ziploc freezer bag labeled with the water sample number, sample site ID, and date and store at -80°C.

Fluorescence In Situ Hybridization (FISH) Protocol (Caroline Fortunato)

Wear latex gloves.

- Add 40ml of sample water into a 50 ml Falcon tube.
- Add 1.2ml of formalin

- Close, shake and let stand for 1 hour at room temperature
- Label 2 Eppendorf tubes
  - Date
  - “FISH”
  - Station ID
  - Volume Filtered
  - Water Sample Number
  - Surface, chlorophyll max (middle), bottom (S, M, B)
- Wipe tweezers and filtration apparatus with 70% ethanol.
- Filter fixed sample onto black-stained 0.2um pore size polycarbonate filters:
  - 10ml for the first tube
  - 1ml for the second tube
- Air dry filter for 5 min in a Petri dish
- Taking care not to touch the sample-side of the filters, place the filters into properly labeled Eppendorf tubes.
- Place tubes and Flacon tube in plastic bag labeled with the date, FISH, station ID, and water sample number and store at -80°C.

Bacteria Production measurements

Set up/Notes

- Pre-load 2ml microcentrifuge tubes with enough 3-H L-leucine to make the final concentration 20 nM (20ul of isotope for July 2008 Wecoma cruise).
- Double rinse and fill 250 ml dark bottles with water from each depth directly from the niskin bottles

Procedure

- Change shoes when entering rad van.
- Set temperature of incubators. The temperature on the incubators can be set using the + and – buttons. Press “MENU” to enter change and “+” to validate. Although most of the water samples have been from 3 depths, the bottom and mid-depth have been close enough to use the same incubator for these.
- Record station name, sample depth, ambient water temperature and temperature at which each sample will be incubated.
- Put on gloves.
- Remove enough charged tubes from the fridge for the number of samples being incubated (3 live and one blank per sample) and place in plastic rack in workspace. Process samples for BP so that the deep sample at each station goes in the lowest number tubes, then mid-depth, then surface. Uncap all tubes and line up caps next to rack.
- Add 75 ul 100% TCA to the kill tubes with a p200 pipettor (final concentration 5%)
- Note time. Pipette 1.5 ml into each tube with the p1000 pipettor. Use caution when loading the blank so as not to splash TCA back onto the pipette tip. It works best to add sample at an angle down the side of the microcentrifuge tube (not straight down into bottom) to avoid backsplash.
- Between each sample, fill the pipette barrel with DI and discharge into waste cup to rinse.

- When all tubes are filled, cap and vortex each one and place in the racks located in each of the incubation chambers. Try to incubate samples within 1 degree of ambient water temperature.
- Remove pipette tip and place in stand. Remove gloves. Record start time in notebook. Set timer for 55 minutes.
- Remove tubes from incubation chamber a few minutes before anticipated stop time. Remove caps of all live tubes.
- Pipette 75 um 100% TCA into each tube with a p200 pipettor.
- Remove pipette tip and place in stand. Remove gloves. Record end time in notebook.

III. Contact Information

Principal Investigators	*e-mail*	*Field of Work*
Dr. Byron Crump	bcrump@hpl.umces.edu	microbiology
Dr. Murray Levine	levine@coas.oregonstate.edu	physical oceanography
Dr. Burke Hales	bhales@coas.oregonstate.edu	biogeochemistry
Dr. Ricardo Letelier	letelier@coas.oregonstate.edu	biogeochemistry
Dr. Peter Zuber	pzuber@ebs.ogi.edu	microbiology
Dr. Antonio Baptista	baptista@stccmop.org	physical oceanography
Dr. Paul Tratnyek	tratnyek@ebs.ogi.edu	sensor development
Dr. Brad Tebo	tebo@ebs.ogi.edu	microbiology
Dr. Holly Simon	simonh@ebs.ogi.edu	microbiology
Post-doctoral Researcher		*Supervisor*
Dr. Lydie Herfort	herfortl@ebs.ogi.edu	Zuber
Graduate Students		*Supervisor*
Caroline Fortunato	cfortunato@hpl.umces.edu	Crump
Katelyn R. Nichols	krnichol@uvm.edu	Barth
Suzanne DeLorenzo	delorenz@ebs.ogi.edu	Tebo
Peter Kahn	olyarcher2@gmail.com	Zuber
Mouzhong Xu	octobercherry@gmail.com	Simon
Undergraduate students		*Supervisor*
Melinda Ingebretson	inge0221@pacificu.edu	
Justin Roberts	robertsj@stccmop.org	
Nicole West	nwest@ambcs03.stccmop.org	
Lauren Vice	lvice@ambcs03.stccmop.org	
Research Assistants		*Supervisor*
Paul Walczak	pwalczak@coas.oregonstate.edu	
Jeff Schilling	schillij@ohsu.edu	

IV. Tables and Figures

Table 1. Biological and Chemical analyses for water samples

Measurements	Coastal Lines	Plume Samples	Estuary Samples	Abbreviation description
NH4	X	X	X	Ammonia
SRP	X	X	X	Inorganic Dissolved P
NO3+NO2	X	X	X	Nitrate+Nitrite, dissolved silica
DOC	X	X	X	Dissolved Organic Carbon
TDN, TDP	X	X	X	Dissolved Nitrogen, Dissolved Phosphorous
SPM	X	X	X	Suspended Particulate Matter (for some samples we used the same filter for POC/N)
POC, PON	X	X	X	Carbon, Hydrogen, Nitrogen
ChlA	X	X	X	Chlorophyll a
HPLC pigments	X	X	X	
BP	X	X	X	Bacterial production
Prokaryotic cell abundance	X	X	X	Gluteraldehyde fixed samples
Flow Cytometry	X	X	X	Paraformaldehyde fixed samples
FISH samples	X	X	X	Paraformaldehyde fixed samples
DNA (DEB)	X	X	X	DNA on sterivex filter, fixed with DEB*
DNA (RNAlater)	X	X	X	DNA on sterivex filter, fixed with RNAlater
RNA	X	X	X	RNA on sterivex filter, fixed with RNAlater

Figure 1. CTD cast locations.