NOAA Teacher at Sea
Scott Donnelly
Onboard NOAA Ship McARTHUR II
April 20 – 27, 2008

NOAA Teacher at Sea: Scott Donnelly
NOAA Ship McARTHUR II
Mission: Delayed in Astoria, Oregon Due to Inclement Weather and Seas
Date: Sunday, April 20, 2008

Science and Technology Log
The start of the cruise has been delayed one day due to the rough, unpredictable, and potentially dangerous waters where the mighty eastward flowing Columbia River and its massive volume of freshwater collides head on with the cold, salty water of the vast Pacific Ocean. Where this water slugfest happens, sands bars shift repeatedly this way and that way as the pushing and shoving between the massive volumes of sea and freshwater continues without interruption. At low tide the sand bars are easily seen; they are numerous and of great area and irregular in shape.

NOAA TAS Scott Donnelly (green helmet) and fellow science team member Bob Sleeth collecting zooplankton

On account of the delay, most of the day was spent making sure instruments worked properly and non-instrument equipment was organized to maximize efficiency. Perhaps though more importantly, the delay gave the eleven science team members—most of them complete strangers to one another—extra time to get to know one another. This is important because all of us will be shipboard for eight days confined to quaint sleeping quarters, working, eating, relaxing, playing, and interacting with each other. There's no escaping once the ship moves away from the dock and goes out to sea. It also gave science team members time to get to know the ship's crew, who themselves play a key role in the overall success of the mission. Communication is a two-way street. From the science team perspective we have to communicate with each other and also with the crew in order to be productive and minimize mistakes. Ocean science truly is an interdisciplinary endeavor that relies on the talents and work ethic of the people involved.

This brings me to my next topic. Science is a uniquely human pursuit; good science relies on people. Modern scientific inquiry is all about assembling the best minds and talent possible into a highly productive team. It's not just about brains though. Personalities and people skills matter too. In fact, they matter a lot. They can make or break a scientific mission. All it takes is an individual with a 60-grit sandpaper personality to upset the ebb and flow of human group dynamics.

Ocean science is all about teamwork!

In a few hours I'll see how such dynamics work out on this cruise with this assemblage of people, the youngest being an undergraduate science major and the oldest a retired Silicon Valley engineer. Four of the eleven science team members (myself included) have never been at sea. We don't know what to expect or, for that matter, think about with respect to what lies ahead this next full week.

After lunch we met as a group with the NOAA Corps officers and reviewed the ship's rules and regulations. We then had a science team meeting whereby the cruise's Chief Scientist, Dr. Steven Rumrill, gave a brief overview of the cruise's scientific mission, discussed shipboard operations, the cruise's plans and objectives, and the itinerary and the logistics associated with sample collection and data acquisition.

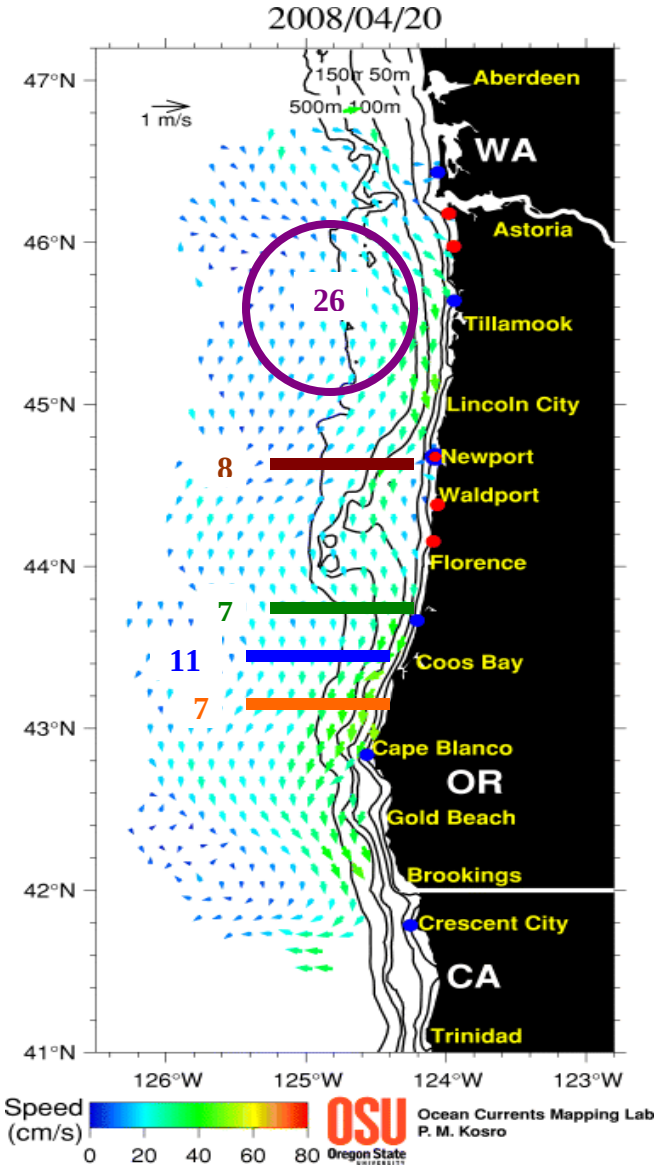
Science team meeting in the dry lab aboard NOAA ship McARTHUR II

In summary, the science team will measure a number of salient water quality parameters (see my log April 19, 2008) and collect samples of marine invertebrates (boneless organisms) along the Oregon Continental Shelf (OCS) at varying depths and distances from the coast over the period of 20-27 April 2008. This time of year was chosen because it precedes the development of an upwelling/hypoxia event that is anticipated to develop later in the summer of 2008. (The oceanographic terms upwelling and hypoxia will be discussed later in this log.) Water and biological sampling will continue non-stop for 24hrs per day, every day of the cruise except the last day when preparations are made for eventual docking.

Each work shift is four hours in length and is followed by an eight hour rest & relaxation (R&R) period. My assigned shift mate is Bob Sleeth and the team leader Ali Helms, a research cruise veteran who works full-time under Chief Scientist Steve Rumrill at South Slough National Estuarine Research Reserve (SSNERR). Ali will work the CTD controls in the dry lab while Bob

and I will collect water samples from the CTD Niskin bottles and also zooplankton and phytoplankton using specially designed nets deployed starboard (right side of ship) to various depths and eventually retrieved after a certain length of time. Our daily shift schedule is from 0100 to 0500 (1am to 5am) and 1300 to 1700 (1pm to 5pm) with an eight hour R&R period in between each shift. Once started operations will continue on a 24-hour basis without interruption unless for inclement weather or seas.

The map to the right shows the major geographical regions where sampling will occur along the continental shelf of Oregon between Astoria (46^{O}10'N, 123^{O}50'W) and Cape Blanco (42^{O}51'N, 124^{O}41'W). At each sampling site biological (phytoplankton and zooplankton) samples will be collected at varying depths using special collection nets of varying mesh and design.



Map source: http://bragg.coas.oregonstate.edu

The operating area for this cruise is the nearshore region of the Oregon Continental Shelf (OCS), between Astoria (Cape Falcon 45^{o}46'N, 124^{o}40'W) and Cape Blanco (42^{o}51'N, 124^{o}41'W) at sites or stations ranging from 3 to 55 miles off the coast. Multiple sampling stations are scheduled along the Newport Hydrographic (NH) Line (maroon line), the Umpqua Estuary Line (green line), the Coos Bay Line (blue line), and the Coquille Estuary Line (orange line). The number of sampling stations is indicated by the number adjacent each colored line. Sampling also will take place at multiple sites (26 total) south of the Columbia River-Pacific Ocean interface and north of the NH Line as indicated by the purple circle on the map at right. Weather permitting, in total there are 59 sites where chemical and biological characterization of the water column will be carried out.

Previously I mentioned the oceanographic terms upwelling. So what is upwelling? A short definition is that upwelling is a vertical water circulation pattern in which deep, cold and typically nutrient- rich seawater moves upward to the ocean surface. Upwelling occurs in a number of places around the world on the western side of continents. It is caused either by strong, consistent winds blowing parallel to the shore as is the case on the Oregon coast in the

summer months, or by deep, cold ocean currents smashing into the continental landmass and having no where to go but up as is the case in the southern hemisphere off southern Chile (South America) and Namibia (southwestern Africa). During summer in the northeastern Pacific, a clockwise rotating, high-pressure air system is positioned off the Washington-Oregon coast. Strong northerly winds blow south parallel to the Washington-Oregon coasts pushing the surface water towards the equator. At the southernmost region of the high pressure air system the water is pushed out to sea, away from the Oregon coast. As the surface water is pushed south toward the equator, deep, cold water from below upwells and thereby replaces the warmer, less dense surface water displaced to the south by winds of the high-pressure air system.

Hypoxia describes seawater that is low in dissolved oxygen gas (DO). Generally, the accepted concentration value for waters deemed hypoxic is less than (<) 1.5mg O_2/L seawater. Marine organisms vary in their oxygen demand. The more active and larger swimming marine organisms such as tuna and mackerel typically require more oxygen per body weight in order to generate the metabolic activity necessary to supply their dense muscles with the requisite energy to slice through the water oftentimes counter to the current. So an active fish that moves into hypoxic waters decreases its chance of survival.

Personal Log

As expected I didn't sleep well last night, the first night on the ship. It wasn't because of the ship's movement either. It hardly moved as the Columbia River was calm with the wind blowing weakly. It's a given that more often than not I sleep poorly in a new environment whether it's a hotel, my in-laws home, or camping. Even if dead tired at best I'll catnap for 1.5 hour intervals at the most, if lucky.

I was assigned to share living-sleeping quarters with three other science team members. The cabin contained two bunk bed units (top and bottom) separated by a wall, two small desks in the corners, ample storage space below each lower bunk bed and all along three of the four walls of the room, a (very) small lavatory with a hot/cold water shower and toilet, and a sink with hot/cold water to freshen up in the morning or before bed. In spite of the room's relatively small size (~12ft x ~12ft), the storage capacity was more than enough to accommodate the personal gear of four people for simple, Spartan living. Every square inch of wall space was utilized for storage or some other useful, practical function. Basically, no space was wasted. Wall hooks were everywhere to hang jackets. Each bed had its own reading light, a full-length curtain for privacy (relatively speaking), and a side bumper so that when the ship rolled one didn't roll out of bed onto the floor. Overall, it was a good example of efficient use of space for simple, practical, but productive living.

The mission delay provided more time for me to talk to and get to know members of science team, particularly my assigned shift mate Bob Sleeth, a retired Silicon Valley electronics engineer. After a hearty breakfast we spent Sunday morning exploring the quiet Astoria waterfront. Bob and a friend sailed in a 35 foot yacht from San Diego to French Polynesia in the South Pacific, spending a year sailing to and from the small islands that constitute the vast archipelago of beautiful islands including Bora Bora and Tahiti.

After lunch I spent a considerable amount of time studying the wrestling match between the ebb and flow of the high and low tides of the Columbia River. Salt water vs. fresh water. Bob gave me a few pointers on how wave structure gives a clue about the subtle changes in wind direction and speed at the water's surface. This led to a lengthy conversation about how the nameless but intrepid mariners of ancient times, the Vikings, and those of the Age of Maritime Discovery of the European Renaissance (Ferdinand Magellan, Christopher Columbus, James Cook and many more) used their observational powers to chart the vast oceans without the aid of longitudinal coordinates. For example, the appearance of a certain bird over water, marine organism, or the change in surface water color or texture possibly meant that land or an island, yet unseen over the curvature of the earth's surface, lay just below the horizon.

Cargo ship arriving at Astoria port

Throughout the day a number of cargo ships loaded with goods made their way slowly into port. That led to a discussion about how a seemingly small decrease in water volume translates into cargo ships having to shed weight else they run aground. Early tomorrow morning we start the mission and head out to the intimidating, deep waters of the Pacific Ocean.