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: Biological and Chemical Characterization of NH Line off Central Oregon Coast
Date: Tuesday, April 22, 2008

Weather Data from the Bridge
Sunrise: 0618 Sunset: 2012

	WIND	SEAS	PRECIPITATION
AM	SE 15-20, G25 kts, becoming SW	Waves 5ft, S Swell 4ft @ 12 seconds (sec)	Rain showers possible
PM	W 15 kts, becoming SW	Waves 2ft, building to 4ft, S Swell 5ft @ 11 sec	Same

Legend: G = gusts, kts = knots

Science and Technology Log
What's the significance of the NH Line (Newport Hydrographic, 44^{O}39'N)? Water and biotic data acquisition at the NH Line began over 40 years ago. The NH Line then is significant on account of the long-term historical sample collection and data sets that it provides. Consequently, temporal (time) comparisons involving water and biotic data can be made over decades as opposed to shorter lengths of time such as years or months. It's my understanding that nearshore and offshore sampling along the Oregon Continental Shelf (OCS) always includes the NH Line.

Open Niskin bottles on CTD platform

My second 4-hour shift began at 0100 and ended shortly after 0500. Regardless of time of day each shift sets up and collects water samples from each of the twelve Niskin bottles on the CTD rosette. Typically, three water samples are collected at a particular depth. How does remote sub-surface water sampling work? When the CTD is deployed from the ship's fantail, initially the top and bottom lids on all twelve Niskin bottles are open as shown in the photo below.

The CTD is lowered into the water and once the desired depth is reached the requisite number of Niskin bottles are closed electronically from the ship by whoever is in the control room. For my shift it's team leader Ali Helms. After that is done, the CTD then is lowered or raised to another depth where another "firing" takes place and more water samples at a different depth are collected. When sampling is complete, the CTD is raised to the surface and onto the ship where it is secured to the fantail deck. The water in each Niskin bottle is collected and taken to the ship's wet lab where each water sample collected at a particular depth is analyzed for other water quality parameters not measured by the CTD.

Other water parameters measured on this cruise in the wet lab include: total dissolved solids (TDS), pH, and turbidity (how transparent, or conversely cloudy, is the water). A YSI 6600 datalogger interfaced with a multi-sensor water quality probe (sonde) is used to measure the aforementioned water parameters. See photos below. The CTD and Niskin bottles then are hosed down with freshwater and reset for the next sampling site.

YSI datalogger

Multi-sensor water sonde

After the CTD is reset for the next sampling site, then it's time to collect biotic samples from the surface and at different depths. Biological sampling always follows a CTD cast. On this cruise biological sampling is carried out on the ship's starboard side just fore of the fantail. Collection of marine invertebrate (boneless) organisms uses nets that vary in size, shape, density of net mesh (number of threads per inch), and volume of detachable sample collection container (called a cod end). Sampling nets are conical in shape and typically are made from Dacron or nylon threads that are woven in a consistent, interlocking pattern. Each specifically designed net is attached to a wire cable and deployed from the starboard side. If collection/sampling is done below the water's surface (also called sub-surface), a weight is attached to the net's metal frame.

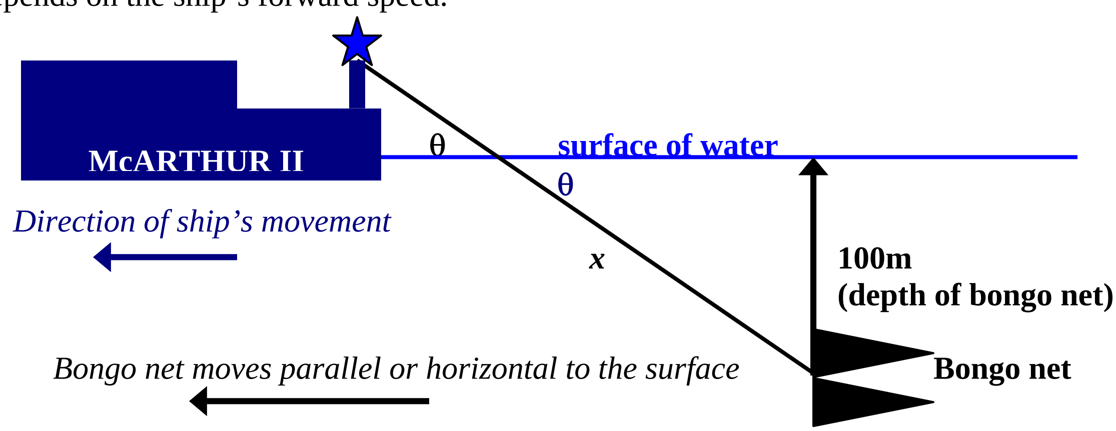
A bongo net is an example of a net used for the collection of invertebrate marine organisms at some defined depth below the surface (see photos below).

Duel sampling bongo nets ready for retrieval

Bongo nets ready for deployment

A bongo net collects organisms by water flowing into the net, which is parallel or horizontal to the water surface at some depth below the surface. Consequently, use of a bongo net requires that the ship moves forward. Deployment of a bongo net requires the use of trigonometry, a favorite math course of mine in high school a long time ago. The length of cable let out by the NOAA deckhand operating the winch with cable does not equal the depth that the bongo net is lowered below the surface. (This would be true if the net was simply dropped straight down over the side of the ship.) Let's use the drawing below to illustrate this.

Suppose sample collection is to be done at 100m (328 feet) below the water's surface. More than 100m of cable needs to be let out in order to lower the bongo net to 100m below the water's surface. How much cable beyond 100m is let out (x) depends on the angle (θ) of the net (and hence cable) to the water's surface. The angle θ is measured by a protractor attached to the cable and pulley at the position identified with the blue star in the drawing. The angle θ in turn depends on the ship's forward speed.



To calculate the length of cable that needs to be let out, the following trigonometric formula involving right triangles is used:

$$\sin \theta = \cos^{-1}\theta = \frac{100\text{m}}{x}$$

The calculated value *x* is communicated to the NOAA deckhand, who controls the winch that lets out the desired length of cable. When this cable length is reached, retrieval of the bongo net begins.

The volume of water that contains the marine organisms and that flows through the bongo net is recorded by a torpedo-shaped rotary flowmeter (left photo below), which is suspended by wires or thick fishing line in the middle of the net’s mouth. As water moves past the meter's end, it smacks into and transfers its momentum to the flowmeter’s propeller, which rotates or spins. The propeller's shaft in turn is linked to a mechanical counter inside the meter’s body (right photo below). A complete revolution of the propeller equates to a certain number of counts and that is related to a certain volume of water that has flowed past the meter.

Rotary flowmeter

Mechanical counter in flowmeter

The mathematical difference between the two numbers recorded before the net's deployment and after the net's retrieval is plugged into a mathematical formula to obtain the estimated total volume of water that flowed through the net's mouth during the time of collection. Consequently, the weight or number of biomass collected by the net can be related to the volume of water in which the biomass was found. This gives an idea about the density of biomass (weight or number of biomass units per volume seawater, g/m^3) in a horizontal column of seawater at a given depth and site.

In tomorrow’s log I’ll talk about what marine organisms a bongo net collects (including photos) and also discuss and describe the three other nets used on this cruise to collect marine invertebrates.

Personal Log
So far after one full day at sea, I haven't experienced any indications of sea sickness in spite of rough seas (see weather forecast at beginning of log). Four other science team members haven't been as fortunate.

I didn't witness any visible bioluminescent surface events on the early morning shift (0100 to 0500). I walked to the ship's bow since this would likely be the best place to witness bioluminescence given all the agitation of seawater there. I left a bit disappointed but there are still five days remaining.

The CTD and both the DO and chlorophyll probes (sensors) operated without any problems.

Bob and I communicate well and have similar personalities and intellectual interests. Before carrying out a task we discuss how it's to be done and then agree to do it as discussed and in the order discussed. Communication is critical because when sampling for biological organisms for example, the nets have large, heavy weights attached so once the net is lifted from the ship's deck for deployment the weight is airborne so to speak and free to move without resistance. Getting clobbered in the head or chest obviously would not be pleasant. The bongo net uses a 75 pound weight and the net's solid metal frame must weigh another 25 pounds. Caution and paying attention are paramount once 100 pounds are lifted from the deck, suspended from a cable free to move about with the rolling and pitching of the ship with only air providing any sort of resistance against its movement.

Bob and I have delegated certain tasks between us. We agreed that when a net is deployed, he will always control the net's upper halve where the net's "mouth" and weight are located; I in turn will control the net's bottom halve where the netting and sample containers or cod ends are located. When the net is ready to be lifted from the sea and returned to the ship's deck, the tasks for retrieval are the same as for deployment, though in reverse order from deployment. Before the net is lifted shipboard, it's washed or rinsed top to bottom with seawater from a garden hose that gets seawater pumped directly from the Pacific. Washing is necessary because the collected marine organisms adhere to the net's mesh so in order to get them into the sample container (cod end) at net's end they must be "forced" down into the cod end. Once the net is shipboard, the cod end and collected organisms are emptied into a sample jar, sample preservative is added, and the container is labeled appropriately.