Looking for Metal Stress in Mussels in Puget Sound Using Metallothionein

Lincoln Center – Deyana Willis, Alejandra Ramirez-Rubio, Ivyanne Barnett, Essence Cavalier-Byrd, Ruben Martinez, Rafael Zamora , Zachary Dela-Cruz, Tyisha Brown El, Angela Finley, Juan Aguilar, Christopher Canche, Sheila Escobar, Jose Espinosa, London Hughes, Darien Reed, Quantaya Rhodes, Eric Smith, Jennifer Thompson,
Advisors: Lee Ann Love, Kelly Doyle, Vicky Karout, Christopher Claeys and Jim Gawel

Introduction:

•The Puget Sound is located near an urban population. We use it for recreation and commerce, and we also get part of our daily diets from the Sound.
•Puget Sound is in great danger from the following pollutants; pesticides, bacteria, nutrients, metals, phosphorus, and nitrogen. These come from people spraying pesticides on their lawn, home maintenance, and driving cars.
•The metals that end up in the Puget Sound come from a number of sources, such as cars, industry, boats, cleaners, and moss killers.

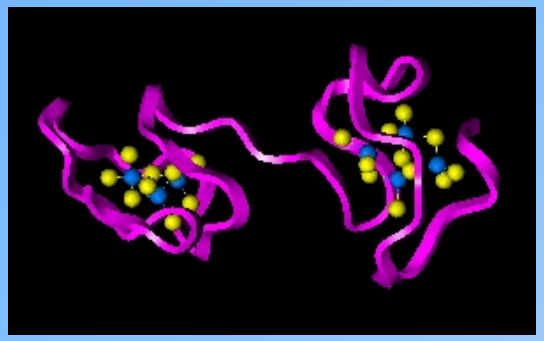

Figure 1: 3-D model of metallothionein.

•To measure metal stress in mussels we can use metallothionein (MT) because it shows a direct response in mussels exposed to metal pollution. MT is a family of sulfur-rich proteins (Figure 1). They can bind metals through their sulfur groups. MT is created by almost all organisms including humans and mussels.
•Toxic metals are natural components of the Earth's crust found throughout the ecosphere in small concentrations, if in high concentrations the effects of toxic metals on mussels include altered growth, filtration efficiency, enzyme activity and behavior.

Figure 2: Sample locations in Thea Foss and Point Defiance.

Methods:

• During October of 2010 thru May 2011 we sampled approximately 20 mussels off of a floating dock, both wild and store bought, and they were all approximately 5 cm or longer. We collected them near Thea Foss Waterway (Figure 2) because there is urbanization nearby which has a storm water drain and industries. (Note: There was some sampling loss due to people taking mussels or they were eaten for starfish.)

1. Measure shells and dissect out soft tissues and freeze.
2. Thaw mussels and then reweigh and transfer to glass tubes.
3. Homogenize the stomachs or soft tissues.
4. Extract MT using the method developed by Viarengo (1997).
5. Samples, blanks and standards for the glutathione (GSH) curve were measured in the spectrophotometer (412 nm).

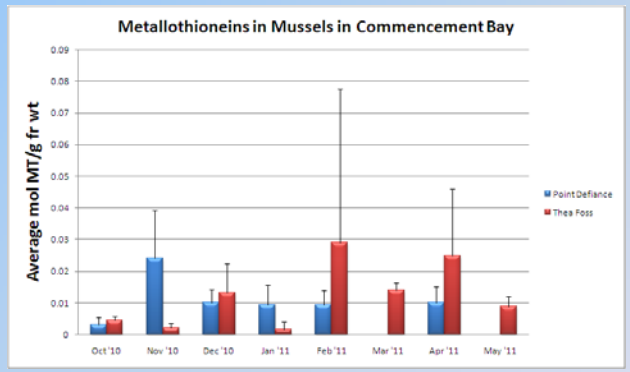

Figure 3: Metallothionein concentrations in mussels in Thea Foss and Point Defiance.

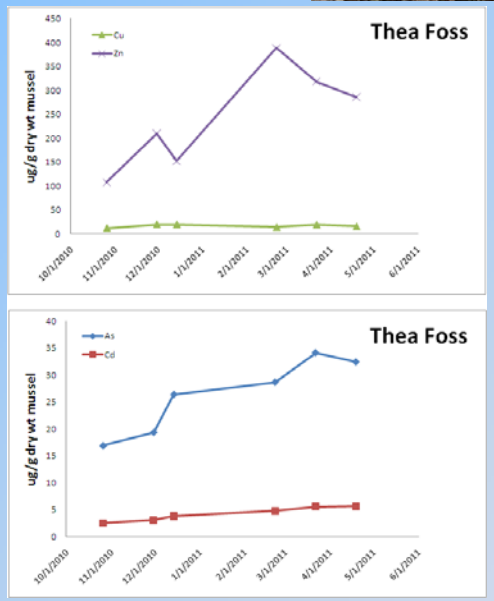

Figure 4: Metal concentrations in mussels in Thea Foss and Point Defiance.

Results/Discussion:

•At the start of fall and throughout the winter Point Defiance had higher MT than Thea Foss. While Thea Foss started lower, in February MT in Thea Foss increased and MT in Point Defiance decreased (Figure 3).
•The metals found in Thea Foss had a peak in late winter/early spring, whereas the metals in Point Defiance had a peak in late fall/early winter.
•As the amounts of copper, arsenic, zinc and cadmium increased in Thea Foss so did the production of MT in mussels (Figure 4).
•The runoff from external sources, for example cars, moss killers, etc., are the main causes of metals in the Thea Foss Waterway.

HOW CAN WE FIX IT???

One of the ways the team has concluded we can fix the problem is to find a way to filter the stormwater. Storm drains are the ideal place to target where the metals start before reaching Puget Sound. The other way to reduce metals is to stop using moss killers.