Metallothionein as a Biindicator of Metal Stress in Mussels

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Abstract

Field Methods:

ASARCO, American Smelting And Refining Company, was a metal smelter located in the town of Ruston, near Point Defiance which created a peninsula of slag and spread metals throughout Puget Sound. Mussels are a good biindicator species for marine pollution as they are found throughout Puget Sound. They produce metallothionein (MT) when stressed by metal pollution and provide a direct indicator of metal toxicity. Our study measures MT in mussels from the native populations of south Puget Sound. We sampled mussels in two locations, Point Defiance and Thea Foss (chosen as an indicator of urban run off). Our results show that the MT concentration in mussels in Point Defiance remain fairly consistent. Metal concentration in these mussels show a seasonal fluctuation. ASARCO may be a source of pollution in Point Defiance. After a major replacement of substrate in Thea Foss, MT production is increasing. This study may show that there continues to be a deposition of metal pollutants and that the historic metal pollutants don’t have as large of an impact as once thought. The study may also be used to decide how we should spend our clean up money more wisely.

Methods

In 2010:

- We placed plastic mesh bags containing 40-50 mussels (Mytilus sp.) in Point Defiance boat launch, each month removing five to add to the sample. For the months of March – May, 20 random mussels were gathered and used in the protein analysis.
- All samples were stored on ice for transportation and dissected within an hour.

In 2011:

- Twenty mussels were gathered monthly from December to April. We dissected the samples of mussels after recording height and weight of shell, along with the mass of the soft tissue. Samples were stored at -80 degrees Centigrade and a protein extraction protocol was performed (Viarengo et al. 1997).
- Each month we collected three bags of 20 periwinkle snails off rocks in the intertidal zone by the Point Defiance Boat launch.
- All samples treated the same as in 2010.

Results

Point Defiance Concentration of Zinc and Copper over 9 months

Point Defiance Concentration of Arsenic and Cadmium over 9 months

Discussion

Natural occurring mussels:

- Recorded 9 months of info.
- Mytilus edulis reproduce all year round with major peaks in the spring and further “opportunist spawning in the summer” (Seed and Suchanek 1992) possibly correlating with metal increases in spring.
- There are observable concentration spikes in the metals during the study period in winter and spring.
- Fig 6. Shows high concentrations of MT in calm water while PD shows lower and steady production of MT in seasonal variables over the study period.
- If the mussels are biindicators, then are other organisms experiencing similar stresses?

Point Defiance:

- Some areas of PD are observably cleaner or less polluted than the others.
- Point Defiance Marina was once the site of a large smelting operation, which is the source for the heavy metals found in slag piles.
- The seasonal change in the presence of metals could be due to storms in the wintertime disturbing sediments in PD.

Future work:

- Look at the MT in worms found in sediment, plankton, etc.
- Look at the levels of MT production in correlation to spawning cycles and seasonal weather.
- Move onto organisms higher in the food chain such as sea stars to see if the metal stress moves up the food chain.
- Look at other cities with metal pollution.
- Look at areas such as rivers and lakes that are near paper mills or other pollution sources.

Lab methods at SAM:

- Gathered our dissection tools/materials
- Opened mussel
- Cut out the digestive tract which is located on the hinge, the color is black
- Weighed and zeroed plastic bag
- Added the mussel to the bag, then weighed it. recording the mass of the mussel
- Stored digestive tract in plastic vial
- Stored vial in liquid nitrogen

Lab methods at UWT:

- Homogenized mussels and extracted MT (Viarengo et al. 1997)
- Constructed a calibration curve using glutathione
- Ressuspended MT and measured using DTNB at 412 nm in the spectrophotometer (Viarengo et al. 1997)

Work Cited


