Online Proceedings

POSTER SESSION 3

Commons West, Easel 3

2:30 PM to 4:00 PM

Variations in Phosphate and Nitrate Levels with Season in Possession Sound

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Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College

Students from the Ocean Research College Academy (ORCA), a program through Everett Community College for high school students that focuses on marine science research, have collected monthly water quality data from the Possession Sound (PS) over the past twelve years. This longitudinal data set is combined with collections of current water quality by this research group. Nutrients play an important role in the health of the PS ecosystem. We evaluated the variations in the levels of phosphates and nitrates in relation to season in the north Whidbey Basin of Puget Sound from 2012-2015. Data were collected monthly from four locations in PS and we averaged these values to analyze the resulting trends in nutrient amounts. Surface water temperature was used as a proxy for the seasonal changes in direct sunlight. Nutrients and sunlight are required by phytoplankton for photosynthesis, so as phytoplankton populations increase nutrients become less abundant as they are utilized. Nitrates and phosphates were hypothesized to decrease in spring months because there was more photosynthesis taking place during the spring with increased sunlight, while the nutrients would peak in the winter. The resulting trends supported this hypothesis with the highest average levels of nitrates in October, at 15.54 μmol, and phosphates peaking in February at 2.15 μmol. The lowest average nitrate and phosphate levels occurred in June, at 3.08 μmol and 0.43 μmol, respectively. Our study gives insight into the health of the PS ecosystem by analyzing nutrients that limit the primary production of phytoplankton. Future parameters to be studied in correlation with this research include silicate and chlorophyll levels.

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Levels of pH in Possession Sound

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Mentor: Robin Araniva, Life Sciences, Everett Community College
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Students of Everett Community College's Ocean College Research Academy (ORCA) analyzed pH trends in the Snohomish River estuary of Possession Sound using ten years of data. Influences on water chemistry include freshwater discharge from the Snohomish River and tidal currents in Possession Sound. In addition, high salinity, cold water from the Pacific Ocean may transport low pH water as a result of ocean acidification, when atmospheric carbon dioxide dissolves in seawater and decreases the pH. Students wanted to investigate whether average pH in Possession Sound had been decreasing over time. Data were analyzed during the winter months, November through March, from 2006 to 2016. We collected data from October 2015 through May 2016, with archived data collected by previous ORCA students. Water chemistry at three sample sites in the Possession Sound were compared. Recordings of pH from the surface to five meters were completed with a YSI 650 and averaged. The most significant decreases in pH occurred at locations in closer proximity to the shore, near south Whidbey Island and Mukilteo. Each had an overall decrease of 0.3, compared to only 0.1 in the middle of the sound near Hat Island. Decreased pH in an estuary system directly affects the development of many organisms, such as phytoplankton, which make up the primary levels of the trophic pyramid. Further investigation is ongoing about the effects of salinity and river discharge on these

minimal decreases in pH, along with seasonal fluctuations in primary production by phytoplankton as well as the effects of decreased pH on phytoplankton.

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Seasonal Variation of Nitrates, Ammonia, and Nitrites in Possession Sound

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In the Possession Sound area of the Whidbey Basin, Ocean Research College Academy (ORCA) students collected water samples to measure nitrate, ammonia, and nitrite levels to better understand seasonal nitrogen cycle changes in the Sound. ORCA is an early college program in cooperation with Everett Community College that allows students to pursue hands-on research in the Puget Sound region of the Salish Sea. We analyzed the archived data set from 2012-2015 with the hypothesis that nitrates would be highest in winter and spring, and lowest in summer and fall due to photosynthesis patterns. High ammonia counts follow high nitrate levels due to decomposition of organic matter, occurring in spring, summer, and fall, and be lowest in winter. Ammonia is fixed into nitrites by heterotrophic bacteria, leading to high nitrite levels in summer, fall, and winter, and low levels in spring. Data were gathered using a Niskin bottle to collect surface water samples, which were then analyzed for nutrient concentrations by the University of Washington Marine Chemistry Laboratory. The data partially supported the nitrate hypothesis, with high levels in the fall and winter, but spring and summer had seasonal variations ranging from 2.5 to 25 μM. The data did not support the ammonia hypothesis, with low spring levels of 1 μM and variation from 1-2.7 μM within summer, winter, and fall. Nitrites partially supported the hypothesis, with high winter and fall levels, but amounts varied within spring and summer, from below 0.05 to 0.1 μM. The patterns observed here lead to further questions regarding primary production by photosynthetic diatoms and their abundance patterns compared to nitrogenous nutrients and silicates used to form frustules. These results help to assess the overall health of the Possession Sound ecosystem by monitoring the abundance patterns that affect the entire food chain.

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Heavy Metal Concentrations in Possession Sound

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Mentor: Robin Araniva, Life Sciences, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College

Sources of heavy metals in the Snohomish River estuary system are influenced by both point and nonpoint sources; therefore, areas near the Snohomish River estuary are expected to have higher concentrations of heavy metals in the sediment during periods of high river discharge. At the Ocean Research College Academy, students develop research based studies through hands-on data collection in Possession Sound (P.S.). Our study focused on the effects of non-point sources on heavy metal deposits in P.S., both spatially and temporally. In consideration of the recent removal of the oil dock at Mukilteo, we hypothesized that higher levels of mercury and copper would be present at Mount Baker Terminal (MBT). Collection of arsenic and copper data involved in our group's research were taken by previous cohorts at three sites in P.S.: Buoy, located closest to the mouth of the Snohomish River; Dolphin 1 (DOL), farther from shore near Hat Island and MBT, adjacent to Mukilteo. A Ponar type sediment grab was used to retrieve sediment from the various locations to be analyzed for heavy metal concentration at the Everett Environmental Laboratory. From 2012-2015, Buoy had higher heavy metal content than the other two stations; an average of 5.5 mg/L arsenic and 15.5 mg/L copper. Furthermore, Buoy showed the strongest seasonal correlations in 2014; DOL and MBT did not. The highest concentrations of heavy metals occurred during winter; an average of 6.5 mg/L arsenic and 16.1 mg/L copper. Buoy is nearest to the mouth of the Snohomish River; therefore, it is possible that river runoff heavily influenced arsenic and copper deposits at this station. Increased levels of heavy metals can be toxic for marine life and humans, which poses health concerns in environments with high concentrations. For future studies, the effects of heavy metal contamination on marine plants will be investigated.

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Spatial Variation of Nutrients in Possession Sound

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Mentor: Robin Araniva, Life Sciences, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College

Possession Sound is located near the Port of Everett. Along with the freshwater input of the Snohomish River, the water chemistry of this area is influenced by runoff from nonpoint sources like agriculture and urban development. Our research group, part of the Ocean Research College Academy (ORCA), collected water column data by using a Niskin bottle. Nutrients were then analyzed by the University of Washington Marine Chemistry Laboratory. We hypothesized that the nutrient levels would be higher in areas closer to Everett. However, the data did not demonstrate a significant correlation between location and nutrient level. Average nitrate and nitrite levels were highest in the middle of Possession Sound, at 14.4 μmol and 1.7 μmol respectively. Ammonium levels were highest near the Snohomish River delta, at 1.6 μmol. This variance could in part be due to the transport of nonpoint sources of nitrite and ammonium from upriver, where ammonium is introduced from agricultural fertilizers and undergoes fixation through the nitrogen cycle into nitrite. If continued increases in nutrient levels from human activity is seen, an increase in harmful algal blooms could occur, leading to significant changes in water chemistry and phytoplankton biomass.

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Snohomish River Discharge Influence on Heavy Metal Concentrations in Possession Sound

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Joe Ralph

Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College

Storm events in Western Washington increase urban runoff which can transport sediments and deposit them in Puget Sound. These sediments can contain concentrations of different types of heavy metals. We hypothesized that when there was higher precipitation and river discharge, there would be a higher percentage heavy metals. The data that was being looked at was from 2012-2015 from three different stations near the Snohomish River estuary and the samples were collected by a Ponar grab. These sediment samples were later analyzed by the Everett Environmental Laboratory. The stations were labelled based on proximity to the mouth of the Snohomish River. Station 1 was closest, Station 2 was in between 1 and 3, and Station 3 was the farthest away from the Snohomish River. The river discharge at Station 1 had a median equal to 8,120 ft^3/s with averages of heavy metal concentrations that were at 18.9 mg/kg of copper, 8.38 mg/kg of arsenic, 5.07 mg/kg of lead, and 48.06 mg/kg of zinc. The river discharge at Station 2 had a median of 10,000 ft^3/s with averages of heavy metal concentrations that were 14.96 mg/kg of copper, 5.48 mg/kg of arsenic, 4.53 mg/kg of lead, and 35.22 mg/kg of zinc. The river discharge at Station 3 had a median equal to 10,550 ft^3/s with averages of heavy metal concentrations at 4.94 mg/kg of copper, 2.59 mg/kg of arsenic, 3.14 mg/kg of lead, and 22.48 mg/kg of zinc. After looking at the data, we have concluded that there is no clear correlation between river discharge and heavy metal concentration. In the future, we would try to integrate a marine biology aspect into this project to see how the heavy metal concentrations affect the plankton near the stations.

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Mercury and Lead Concentration in Possession Sound

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Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College

Students of the Ocean Research College Academy (ORCA), an early college Running Start program through Everett Community College, earn their associate's degree at the same time as their high school diploma. Students conduct boat-based research of multiple parameters in the local Snohomish River estuary system. Our study focused on using the historical data set to study the relationship between heavy metal concentrations and sediment size. Heavy metals can originate due to weathering and erosion from rainfall during storm events. Particles are deposited by size; finer sediments accumulate farther from shore while larger sediments remain closer to their point of origin. The hypothesis for our study was that

the larger sediment sizes would retain more heavy metals, because of their larger surface area, which allowed for more absorption of the heavy metals. A Ponar grab was used for collection of benthic sediments and samples were sieved according to sediment size. Complimentary samples were analyzed for heavy metal abundance by the Everett Environmental Laboratory. These data collected from previous ORCA students were analyzed for spatial trends in mercury and lead abundance with sediment size at the three different locations from 2013 to 2015. Lead and mercury are neurotoxins that when found in high abundance can cause harmful effects to marine organisms.

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Removal of Mukilteo Ferry Terminal Effect on Heavy Metals in Sediments and Water Chemistry

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Alycia Nguyen, Freshman, Biotechnology, Everett Community College
Mentor: Robin Araniva, Life Sciences, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College

Water chemistry and heavy metal data were collected from 2009 to summer 2015 by Ocean Research College Academy (ORCA) students and we continued sampling in Possession Sound in fall of 2015 to 2016. In June of 2015, the relocation of the Mukilteo Ferry Terminal began with the removal of the abandoned Tank Farm pier, at the Mukilteo location, eliminating creosote soaked pilings. It was hypothesized that the heavy metal concentrations in the sediments, as well as dissolved oxygen (DO) and pH levels, would differ both temporally, from before the removal of the pier in June of 2015 to January 2016, and spatially, between the Mukilteo site and Mount Baker Terminal (MBT) to the north. Benthic sediments were sampled offshore with a Ponar grab and analyzed by the Everett Environmental Laboratory for heavy metal concentration. DO and pH were sampled with a YSI-650. Copper, lead and zinc showed positive correlations, with an increase in the amount of heavy metals at Mukilteo from January 2009 to June 2015. Copper concentration increased by 503.31%, zinc concentration increased 573.33%, and lead concentration increased 437.20%. Additionally, amounts of heavy metals present in the sediment, regardless of temporal correlation, were consistently higher in samples from Mukilteo than samples from MBT, possibly due to proximity to the construction project. There was on average 154.27% more arsenic, 282.69% more mercury, 210.86% more cadmium, 157.95% more copper, 105.60% more lead, and 130.15% more zinc at Mukilteo. There appeared to be no changes to water chemistry in terms of DO and pH. Additionally, three other heavy metals, arsenic, mercury and cadmium, showed no temporal correlation. Further research on the bioaccumulation of heavy metals by marine organisms nearby would offer an intriguing look at the biological effects.

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Heavy Metal Deposits in Relation with Snohomish River Discharge

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Connor Boze, Freshman, Mechanical Engineering, Electrical Engineering , Everett Community College
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Mentor: Robin Araniva, Life Sciences, Everett Community College
Mentor: Ardi Kveven, Ocean Research College Academy, Everett Community College

At the Snohomish River estuary, seafloor sediment composition correlates with river discharge. With an increase in river discharge mixing of sediments occurs and the heavy metal particles become suspended in the water column. With a decrease in river discharge sediment concentrations deposit on the sea floor. Ocean Research College Academy (ORCA) students, including ourselves, collected the data used in this investigation on monthly research cruises throughout 2015. We hypothesized that in 2015, higher levels of Snohomish River discharge would lead to lower concentrations of heavy metals in the sediment. River discharge data from the Snohomish River was collected three days prior to the date of sediment collection. Arsenic, copper, and lead concentrations were sampled from three sites in Possession Sound: Mount Baker Terminal (MBT), a buoy southwest of the jetty, and the delta. The results showed that heavy metal concentration decreased with increasing river discharge, with the exception of one site. At MBT, south of the Snohomish River, all of the heavy metal concentrations declined with the increase of river discharge. A rise in river discharge of 1,980 to 25,400ftˆ3/sec caused a decrease in arsenic from 4.84 to 2.49mg/kg, copper from 15.2 to 8.53, and lead from 7.17 to 2.81mg/kg. The site at the river delta followed the same trend, with a range in river discharge of 1,980 to 10,400ftˆ3/sec correlating with a decrease in arsenic from 9.34 to 6.06mg/kg, copper from 20.5 to 13.4mg/kg, and lead from 5.94 to 3.04mg/kg. The ex-

ception was Buoy, located to the southwest of the jetty. With an increase in river discharge from 3,910 to 29,300ftˆ3/sec, arsenic rose from 5.74 to 7.14mg/kg, copper from 15.4 to 21.5mg/kg, and lead from 4.31 to 5.78mg/kg. Heavy metal concentrations have been found to be harmful to marine organisms in high concentrations. Thus for further research we will be collecting data on heavy metal concentrations found in local plankton populations, in order to find a correlation between the two.