Study of Benthic Invertebrates in Commencement Bay

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Abstract

Commencement Bay was listed as a Superfund Site, it has been an ongoing restoration project of many government, local, and nonprofit groups. This study was a class project intended to determine whether or not restoration attempts had improved the health of Commencement Bay since the Department of Ecology Assessment (Urban Waters Initiative) in 2008. This study evaluated the health of the benthic communities in the Bay to determine if any improvements could be detected.

Commencement Bay Sample Sites

Purpose and Objectives

For this study we will be extracting benthic samples from the Commencement Bay sediment at five varies site within the Bay and its waterways. The biodiversity within our samples can be indicative of the health status of the Bay. We can determine the biodiversity by measuring species abundance and evenness. (Becker 2011) The focus of our study was to determine the health of the bay has improved, degraded or stayed the same since the Urban Waters Initiative study in 2008.

- By sampling, analyzing and comparing our study results, we can demonstrate improvement or decline in the health of the benthic communities of Commencement Bay.
- By determining the health of these benthic communities we can determine the overall health of Commencement Bay.
- By determining the health of Commencement Bay, we can determine if restoration efforts have been successful.

Site Description

Commencement Bay is part of Puget Sound, a large waterway carved out by glaciers over several Ice Ages. The Bay is surrounded by the City of Tacoma on three sides. The Puyallup River, which begins at Mount Rainier, and flows into Commencement Bay, and creates a large delta area, or tide flats (WSDOE 2011). The City and Port of Tacoma surround the study-area boundaries to the northeast, east, and south. Included in the study area are the major industrial waterways (Thea Foss, Middle, Sitcum, Blair, and Hylebos Waterways) though not the lower Puyallup River or Puyallup Waterway (Partridge et al. 2010).

The studied site was once a Superfund site because unregulated pollution caused by industry, urbanization, and port activities were found to be toxic to the Bay. Recognizing the need for some kind of cleanup action the EPA laid out a strategy in 1989 to enforce Sediment quality Objectives, as well as a ten year cleanup and remediation plan (Linkov 2005)

Mt. Rainier and the port of Tacoma (Left) Commencement Bay and the Puyallup River(Right)

Methods and Sampling

Sediment samples and water column profiles were taken in Commencement Bay from the 65-foot research vessel *Indigo* (Service Education and Adventure, Edmonds, WA) that included five stations along a transect. Transect stations are of similar depth and sediment type. Sampling methods included the collection of a sediment sample as well as collecting station related physical data.

research vessel *Indigo*

Stations:

The five station locations are 295, 287, 292, 296, and 304. Sample stations are located in Commencement Bay. Station 296 (the first station sampled) is located in the Thea Foss Waterway. Stations 287 and 285 are located along the south shoreline of Commencement Bay. Station 292 is located in North East Commencement Bay and the final station sampled, station 304, and is located in the Hylebos Waterway. Repeated attempts to collect sediment sample at a sixth station (293) did not result in a successful grab; therefore, this station has been eliminated from the study. A map showing sample station locations and a table listing location and characterizations of each sample station can be found in the appendices .

Sampling:

Sediment samples were taken on February 8, 2011 approximately between the hours of 11:30 am – 1:00 pm.

The following procedural methods were performed at each station. At the arrival of each station, depth was determined using the *Indigo's* depth sounder. A small (18cm L x 15cm W x 10cm H) Van Veen Grab was then lowered from the side of the boat to about 5 meters above the seafloor and then dropped.

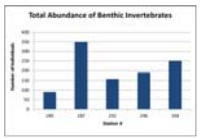
Van Veen Grab Sampler

Upon a successful grab, sediment was then evaluated on board before sieving and documented on a log sheet. The penetration of the grab was estimated using a ruler and recorded in centimeters. Temperature of overlaying water was taken with a thermometer and recorded in Celsius. A sample of this water was measured for salinity (ppt) using a refractometer. The sediment was then observed for color, odor, and sediment grain size was estimated by appearance and noted. The presence of debris, such as wood, shells, or plant material in the sediment was noted as well. A small representative sample of sediment (about 4 ml) was transferred to a labeled 15 ml tube for grain size analysis. Sediment sample was then sieved through a 1mm mesh into a jar (labeled with station number) using filtered seawater. Any visible organisms were transferred to the sample jar using forceps. When all sediment had been sieved into the jar, 250 ml of formalin (10% – 15% final concentration) was added to fix the sample which prohibits further decomposition of any included organisms.

Findings

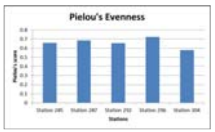
Total abundance

Total abundance is the sum of all organisms per sediment sample (Partridge et al. 2010). Individual numbers of benthic invertebrate were added up to calculate the total abundance of each station.



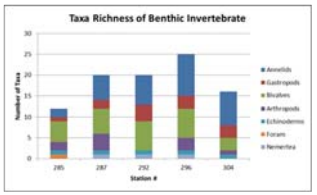
Pielou's Evenness Index:

Pielou's evenness index compares the total richness of species at a site compared against the total evenness of species at a site mathematically to give an index which can be easily interpreted by a number. The number scale is between 0-1 and the closer the number is to 1 the higher the species evenness is.



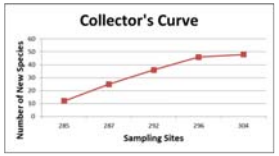
Abundance of Major Taxonomic Groups

The benthic organisms found in this sediment varied in total abundance from site to site.



Collector's Curve

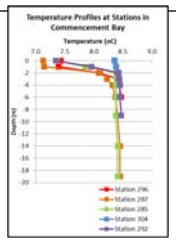
The collector's curve is a way to measure if sufficient samples have been taken in a certain area such as Commencement Bay. It is completed by adding up the species from one site and then adding to that number any new species from the second site and so on. . The curve starts to even out after site number 5 which means we were getting close to total number of species for all sites. If we continued sampling and the curve flattened out we would know we are getting close to the real number of species. More samples need to be taken to show if we have reached all the species for Commencement Bay



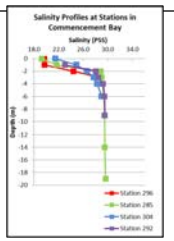
Water Column Profiles

Stations 296, 287,285, and 292 showed a very similar trend in Temperature Profiles. These stations showed a thermocline (shallow depth change, slow steady increase in temperature), and a sudden drop in depth and steady temperature at about 8.4 degrees Celsius. Station 304 showed a different profile of starting at a much warmer temperature at a lower depth than the other stations.

The overall trend for Stations 296, 285, 304, and 292 for Salinity Profiles was a lower pycnocline (salinity count for shallow depth and then a slow increase in salinity in higher depth). At about -4 (m) the salinity count was stable for higher depth. These results may have been affected by the weather and temperature for that day which was overcast and cold.



Temperature Profile by Depth



Salinity Profile by Depth

Conclusion

Commencement Bay benthic assemblage total population has not degraded by any significant measure; there has been a redistribution of population size between the annelids and mollucsa. The UWI report and Cons Bio Study showed a percentage population gain of annelids from 30% to 49% while the mollucsa have declined from 61% to 41%. Mitigating factors for the change could be related to redistribution of sediments on the bottom. Periods of heavy rain and lowland flooding could push silt from the Puyallup River mouth along the bay bottom of the south shoreline. The mixing of sand and mud could significantly change habitat conditions in favor of the annelids and to the detriment of bivalves. Significant urban storm water entering Commencement Bay also could have an influence on the habitat of less stress-tolerant species. The next UWI study in 2013 will help determine if this trend of population change and possible habitat degradation is continuing or just an aberration. The other consideration is Commencement Bay is not any less healthy for the total benthic abundance now than in the UWI report of 2008. The changes seen may be an indication of a natural process and an evolution of the efforts to clean up the bay.

References

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