Research and Monitoring of HABs in the Chehalis River Basin Summer 2017

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Abstract

- Harmful algal blooms (HABs) impact aquatic ecosystems, fisheries, tourism, and human health (1).
- The research and monitoring of HABs in the Chehalis River Basin is currently of crucial importance (2).
- Increasing ocean temperatures have facilitated the intensification of HABs in the Pacific Northwest (3).
- The marine plankton diatom, *Psuedo-nitzschia* spp, is the HAB that is capable of producing the neurotoxin domoic acid (DA), responsible for causing amnesic shellfish poisoning (3).
- The objective of the research was to study and test for HABs in various sample sites in the Chehalis River Basin (4).

Photo credit: Kim Smith

Introduction

Harmful algae create bio-toxins that can have serious health and economic consequences (1). During the spring and summer months of 2015 a mega HAB of *Pseudo-nitzschia* spp. occurred along the Pacific coast from central California to Alaska resulting in significant impacts to coastal resources and marine life (5). The *Pseudo-nitzschia* spp. mega HAB of 2015 caused the razor clam fishery closure resulting in an estimated $9.2 million in lost income. The commercial crab fishery, worth roughly $84 million annually, also endured great loss during the HAB (6).

The marine diatom *Pseudo-nitzschia* spp. releases a harmful chemical called Domoic acid (DA) which can accumulate in the tissue of filter feeding shellfish like clams and oysters. These shellfish are a popular food of the Pacific Northwest and are of immediate importance to local industry, family recreation, and tourism (2).

A *Pseudo-nitzschia spp.* bloom can result in harmful consequences. Dangerous toxins like DA can transfer to animals higher up the food chain via vector species resulting in bio-accumulation. The economic impacts of the shellfish industry become severe when DA levels reach near 20ppm in the tissue of shellfish causing shellfish harvest closure (2). *Pseudo-nitzschia* spp. is found in many places around the world. They have been documented along the Pacific west coast from Alaska to southern California and along the Atlantic coast from Canada to North Carolina (7).

During the summer of 2017 six students from Grays Harbor College conducted HAB research that included weekly high tide water sampling for six weeks from various locations in the Chehalis River inter-tidal zone to the Pacific Ocean. Temperature and salinity was measured using a salinity meter. Toxins and chlorophyll tests were prepared for future analysis. Phytoplankton taxonomy and HAB monitoring involved weekly analysis using a microscope to observe live samples and to identify morphological characteristics of phytoplankton. The purpose of the study was to test for HABs and to enhance the ability of determining and preventing human exposure to environmental hazards caused by HABs in the inter-tidal area of the Chehalis River Basin.

Photo credit: Kim Smith

HABs being monitored for in this research

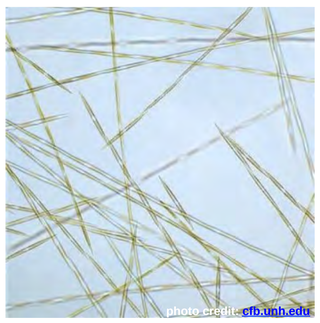


photo credit: cfb.unh.edu

Pseudo-nitzshia spp

photo credit:

Dinophysis spp

Photo credit: Jan Rines

Alexandrium catenella

2017 HAB sample sites

Methods

The materials that were used to collect water samples included one 5-gallon bucket, two 20ml scintillation vials, one 50ml whole-water conical centrifuge tube, one 50ml nutrient bottle, one 2L plastic bottle, and one 20-micron mesh phytoplankton net.

Three selected sites were monitored for HABs for six weeks. Weekly water samples were collected at high tide. Samples were used to prepare tests for nutrients, chlorophyll, and toxin. Concentrated net tow samples as well as whole water samples were used for HAB enumeration to monitor for HABs.

Upon arrival at each sample location site observations were recorded noting wind speed and direction, swell, water color and clarity.

A whole water sample was collected with a 5-gallon bucket and measured for temperature and salinity. The sample water was then added to a 2L plastic bottle, a 50ml centrifuge tube, and a 50ml nutrient bottle.

A phytoplankton net was used to concentrate whole water to aid in phytoplankton identification. These samples were placed into two 20ml scintillation vials and kept as “live” (NET-L) and “preserved” (NET-P) samples for the use of taxonomy.

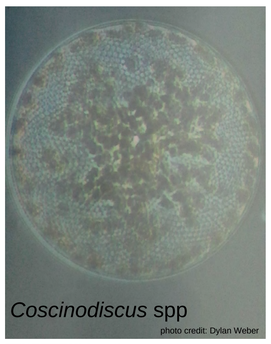
Photo credit: Kim Smith

Results

The results of this research revealed no detected HABs in samples taken from GH16, GH10, and GH9. The taxonomy data was recorded and compared to relative water conditions. There was a strong correlation of higher amounts of phytoplankton species in samples taken in cooler, saltier, marine environments of the inter-tidal zone. The common phytoplankton species observed during this research are shown in photos below. The results of this research assessed current HAB status in specific areas in Gray’s Harbor. This study collected data about HABs in the Chehalis River Basin area in order to assess current risks and prevent exposure to ill effects. Data collected during this study will be incorporated with a larger body of data collected from ongoing monitoring around the Olympic region.

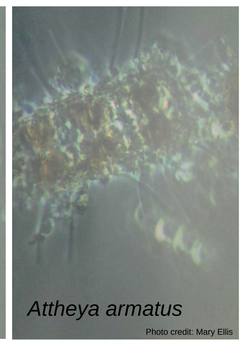
The monitoring and management of HABs in the Chehalis River Basin is of imminent importance. The harmful effects to humans caused by consuming contaminated shellfish is currently being prevented by weekly water sampling as performed during this research project.

Phytoplankton Identified:



Coscinodiscus spp

photo credit: Dylan Weber



Attheya armatus

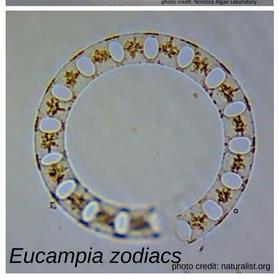
Photo credit: Mary Ellis

Thalassiosira rotula

Photo credit: Nostoca Algae Laboratory

Ditylum brightwellii

Photo credit: Dylan Weber

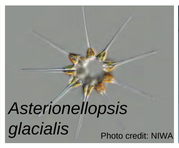


Eucampia zodiacs

Photo credit: naturalist.org

Cylindrotheca closterium

photo credit: diatomloir.eu



Asterionellopsis glacialis

Photo credit: NIWA

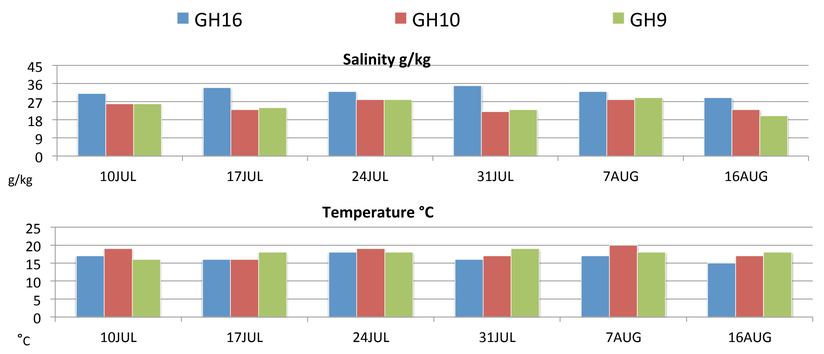
Chaetoceros vanheurckii

Photo credit: King County

Actinoptychus senarius

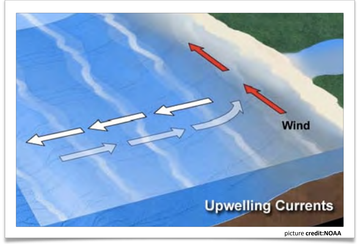
Photo credit: Dylan Weber

Discussion

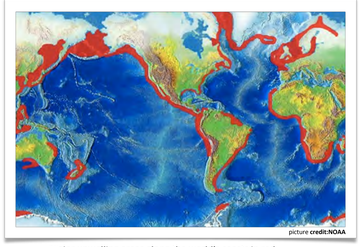


Researching favorable algae conditions helps to understand where and when HABs may occur. The previous charts displays water salinity and temperature data measured during the summer of 2017. These measurements were used in correlation with algae species identified in NET samples. The blue color data bar represents sample site GH16 at Damon Point which was in closest proximity to the open ocean and revealed conditions cooler and saltier compared to the two sites further upriver (8). The red color data bar represents site GH10 at Bowerman Airfield and the green color data bar represents GH9 at Hoquiam River boat launch.

The sample that contained the most abundant variety of phytoplankton species was taken from GH16 on July 31st. This day salinity levels were the highest of all six weeks of testing. The salinity levels can vary based on upwelling or downwelling of ocean currents, weather conditions, tidal change, and from the incoming flow of fresh water from river. Upwelling ocean currents are a major factor affecting the increase of ocean surface salinity and the decrease in water temperature. These upwelling ocean currents occur when wind blows across the ocean surface and pushes water away from an area while subsurface water rises up to replace the diverging surface water (9). The following diagrams model upwelling.



Subsurface water that rises to the surface as a result of upwelling is typically colder, rich in nutrients, and biologically productive.

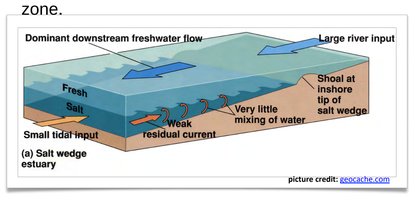


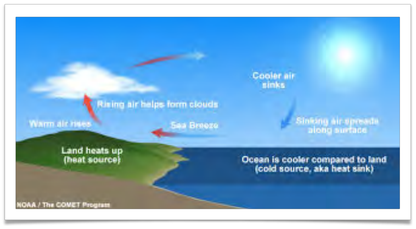
Major upwelling areas along the world's coasts in red.

Many different factors affect the water temperature in the inter-tidal zone of the Chehalis River Basin. One unique characteristic that affects both inter-tidal salinity and temperature is referred to as a “salt-wedge”. A salt-wedge occurs in estuaries when a flowing river discharges into the ocean where tidal currents are weak. Water circulation in these areas is influenced by fresh river water pushing out tidal currents rather than allowing seawater upstream. Freshwater is less dense than saltwater and floats above the seawater (10), as portrayed in the diagram below to the left. Marine and freshwater mixing through the density interface is highly tide dependent with the most intense mixing of fresh and brackish water occurring during the ebb tide (9).

Water has a higher specific heat ratio than land causing it to warm up and cool down slower. The specific heat of water is around 1.0 cal/gl compared to land at .2 cal/gl (11).The difference in specific heat between land and water creates a turbulent exchange of air resulting in frequent onshore coastal breezes. The diagram on the right below models this common coastal air cycle. The variance of water temperature measured during this research ranged from a low of 15°C to a high near 20°C.

The sample that had the highest temperature was taken from GH10 on August 7th measuring 19.8°C. This sample was also the least abundant in phytoplankton of all six weeks of research. Research reveals more favorable phytoplankton conditions in cooler and saltier water within the Chehalis River inter-tidal zone.





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