Potential mitigation strategy for acidic sediment conditions in support of First Nation shellfish restoration initiatives

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Introduction

Shellfish are an important ecological, economic, and cultural component of the Pacific Northwest. Ocean acidification will strongly alter marine ecosystems. Research suggests sediment acidification (e.g. porewater pH), may have disproportionate effects on shellfish growth and survival (Figure 1). Acidic sediments can cause shell dissolution, increase mortality, and reduce population recruitment [3, 4].

Ocean Acidification

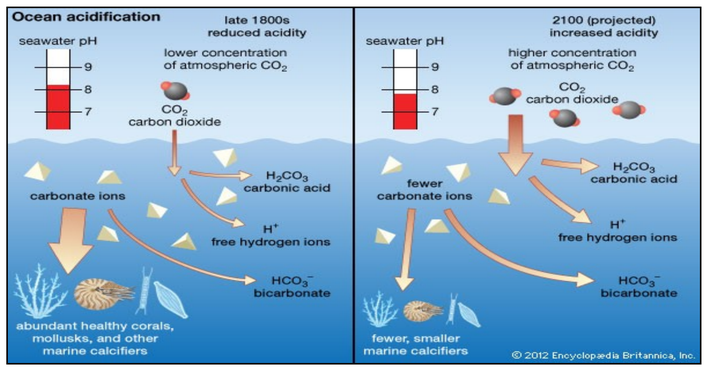

Figure 1. *Ocean carbon cycle producing acidification [6].*

Research Question

This research seeks to investigate the efficacy of shell hash to mitigate sediment acidification in Burrard Inlet, BC, Canada (Figure 2). Burrard Inlet is demonstrating a shift towards more acidic conditions (Figure 3). This could be a result of combined industrial inputs with changing coastal conditions.

A field and laboratory experimental design will assess the effect of shell hash on porewater pH and saturation state values.

Results may be applicable to First Nation resource management and restoration objectives. This is a small contribution to broader sediment acidification research and its impacts to marine benthic organisms.

Burrard Inlet

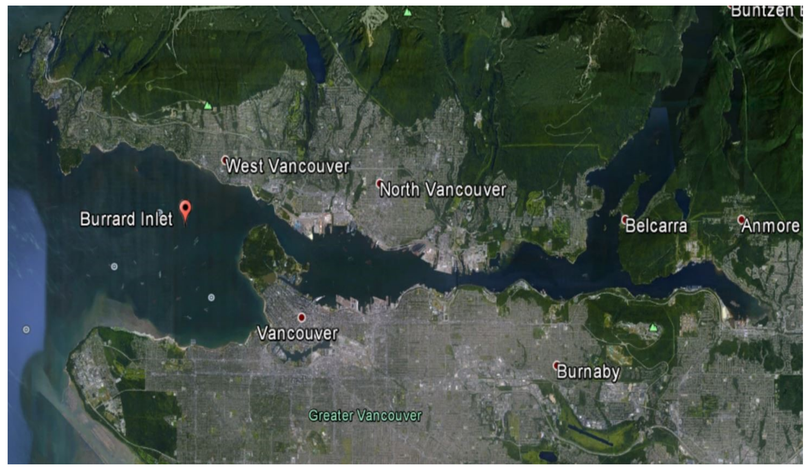

Figure 2. *Burrard Inlet , BC, Canada (Google Earth, 2015) is within the unceded territories of Musqueam, Squamish, and Tsleil-Waututh First Nations, and surrounded by Greater Vancouver and Port Metro Vancouver*

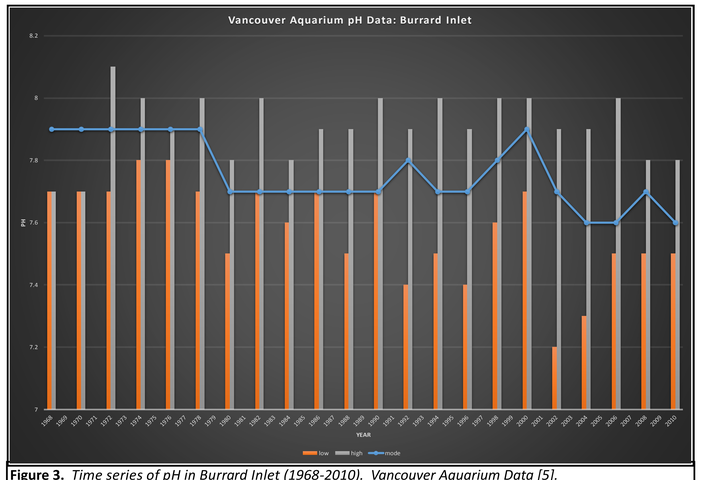

Figure 3. *Time series of pH in Burrard Inlet (1968-2010). Vancouver Aquarium Data [5].*

Figure 6. Clam species currently found in Burrard Inlet (from left to right): cockle (*Clinocardium nuttallii*), butter clam (*Saxidomus giganteus*), littleneck clam (*Protothaca staminea*), horse clam (*Tresus capax*), varnish clam (*Nuttalia obscurata*), softshell clam (*Mya arenaria*), manila clam (*Tapes philippinarum*), macoma bent-nosed clam (*Macoma nasuta*).

Methodology

Mesocosm (Field Experiment)

Intertidal Plots

Figure 4. *Maplewood Mudflats sample site.*

- Define site characteristics (shellfish community survey, sediment cores)
- Sample the large summer tides at **ebb** and **flood** tide exposure [1,2].
- Triplicate treatment and control plots at each study site.
- Rake crushed, clean, dried shell hash into the treatment plot sediment (2.26 kg/m^2).
- Insert an Interstitial Water Sampler (IWS) in each plot to allow porewater sample extraction.
- Measure pH, temperature, salinity, conductivity, alkalinity

Microcosm (Laboratory Experiment)

- Design experiment to repeat mesocosm study in a controlled environment.
- Compare shell hash treatment effects under low ph (7.0) and control pH (8.0) conditions.
- Compare differences between fresh shell hash and weathered shell hash treatments.

Data Analysis and Anticipated Results

The chosen methodology is unique by studying the in situ effect of tide on pH. Two-way ANOVA tests will be conducted using Xlstat2015 to determine the effect of factors, such as treatment, site characteristics and tide (ebb vs. flood), on pH and saturation state variables.

Figure 5. *Whey-oh-Wichen/Cates Park sampling site. Photo: http://blog.wfgates.com/2012/06/13/cates*

The following observations or results are anticipated:

- Smaller porewater pH fluctuation between ebb and flood tides in treatment plots versus control plots.
- Higher pH is expected in treatment plots versus control plots.
- Decreased pH is anticipated on ebb tides, after clams have been feeding and respiring during tidal inundation.
- Increased in porewater pH during flood tide sampling.
- The null hypothesis is shell hash has no effect on porewater pH.

References

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