Beneath the beach: A subtidal peek at clam gardens

Lindy Hunter[1]*, Courtney Greiner[1], Julie Barber[1], Skye Augustine[2] and Hannah Kobulk[2]
[1] Swinomish Indian Tribal Community, Fisheries Department, *lhunter@swinomish.nsn.us
[2] School of Resource and Environmental Management, Simon Fraser University

Introduction

Since time immemorial, tribal communities within the Pacific Northwest have relied on local beaches and marine ecosystems for physical and spiritual sustenance. Clam gardens were developed and maintained to ensure that edible marine species would thrive and continue to serve as local food sources. Oral histories describe tribal members working together during low tides to carry rocks into the low intertidal zone. Once there, the rocks were used to construct or expand permeable walls. These structures increased suitable clam habitat by trapping sediment upland of the wall and enhanced habitat complexity for other invertebrates and algae. The knowledge and practices surrounding these ancient gardens has been passed down through generations and are a primary guide for modern restoration efforts. However, there is a lack of basic scientific data surrounding clam gardens, especially related to subtidal ecology. Using SCUBA, Simon Fraser University (SFU) and the Swinomish Indian Tribal Community (SITC) investigated three questions about subtidal clam garden habitat and associated species.

Question 1: Is there a difference in subtidal substrate on and off clam gardens?
Question 2: Does substrate type/size influence presence of aquatic vegetation?
Question 3: Does the presence of a clam garden influence the abundance of edible subtidal species?

SITC Methods

- Two subtidal clam garden survey sites were selected at Russell Island and Fulford Harbor, Gulf Islands, B.C.
- Two 50 m transects were placed at each site.
  - Shallow on wall (0.6 m corrected relative to MLLW)
  - Deep off wall (2.1 m corrected relative to MLLW)
- Invertebrates were counted and identified within a 1x50 m^2 area on each side of the line.
- Substrate and kelp were assessed along the same line using a 1 m^2 quadrat (Fig. 1).
  - Four random points selected on both sides of each transect.
  - Kelp stipe counts, macrophyte % cover, and substrate % cover were estimated.

Statistics

- Due to the small sample size of this pilot study, swath and quadrat data were averaged by each side of the transect.
- Relationships between macrophyte cover, kelp stipe, and substrate were analyzed with linear regressions.
- Differences in the count of edible species on and off of garden walls were analyzed using a one-way ANOVA.

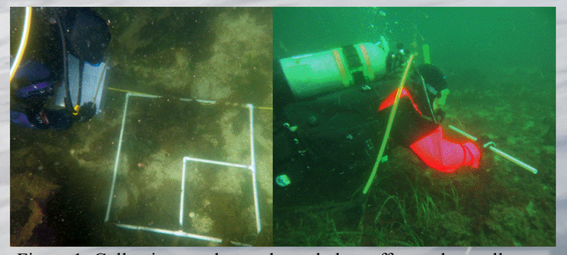

Figure 1. Collecting quadrat and swath data off a garden wall.

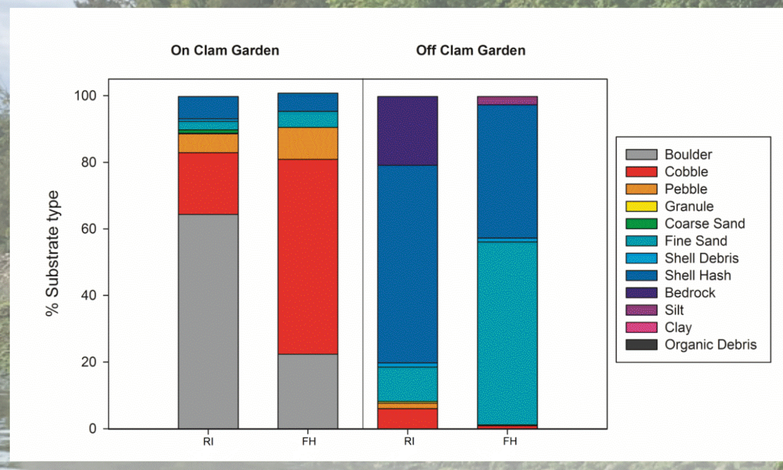

Figure 2. Substrate composition on and off clam gardens at Russell Island (RI) and Fulford Harbor (FH) from subtidal surveys conducted by SITC (n=8).

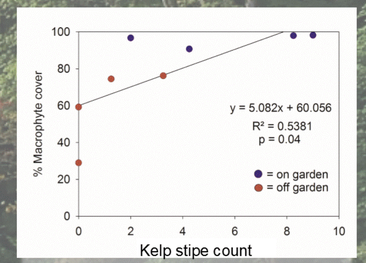

Figure 3. Relationship between kelp percent cover and stipe counts.

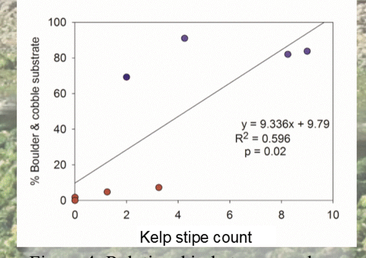

Figure 4. Relationship between rocky substrate and kelp stipe abundance.

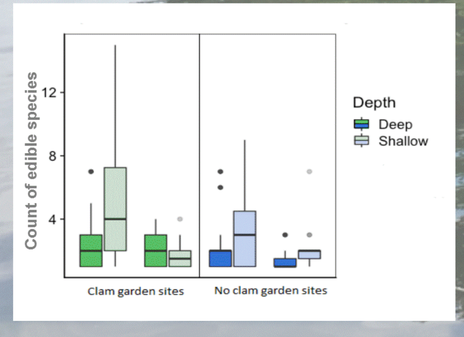

Figure 5. SFU counts of edible species on and off clam gardens during subtidal monitoring surveys.

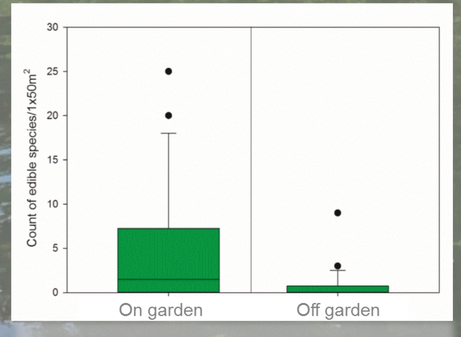

Figure 6. SITC counts of edible species per 1x50 m^2 on and off clam gardens conducted by SITC (n=8).

Results & Discussion

- Clam garden habitat is predominantly composed of large rocks while off garden sites are dominated by fine sand and shell (Fig. 2).
  - These subtidal substrate data will guide SITC's efforts to revitalize the ancient practice.
- Kelp stipe counts are positively associated with macrophyte cover and large rocky substrate (Figs. 3 & 4).
  - While the positive association between hard bottom habitat and kelp is well known, our study reaffirms that Indigenous communities understood this relationship and used it in constructing complex intertidal habitats.
- Qualitatively, the SFU study found edible species do not appear to have higher densities on or off of clam gardens (Fig. 5). However, the SITC study found significantly more edible invertebrates on clam gardens ($F_{1,46} = 7.57$, $p = 0.008$, Fig. 6).
  - These contrasting results are likely due to the different species included within analyses; the SFU study included subtidal clam species while the SITC analysis did not.

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