

EFFECTS OF SEA OTTER (*ENHYDRA LUTRIS*) RECOLONIZATION ON ROCKY INTERTIDAL GRAZER-KELP COMMUNITIES ON BRITISH COLUMBIA'S CENTRAL COAST

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Background

Sea otters are well recognized as strongly interacting predators, having dramatic effects on subtidal benthic community structure and driving phase shifts from urchin barrens to kelp forests.¹ However, it remains unclear if these distinct alternative states exist in the intertidal; where a host of abiotic & biotic factors alter grazer and macroalgal distribution, density, size structure and species interactions.



Randall Davis Photo

Rationale

By exerting strong top-down control on benthic communities, the sea otter range expansion in British Columbia has important repercussions ecologically, socio-economically, and culturally. On the central coast of BC, the direct and indirect effects of sea otter foraging have major implications for coastal communities, including the Heiltsuk First Nation who depend on this area's marine invertebrates and kelp forest associated fish.

Study Area

Sea otters were extirpated from British Columbia's coast by 1929² and were re-introduced to Vancouver Island in the 1970's.³ The first raft to recolonize the central coast of BC was sighted in the Goose Group Islands in 1989⁴. Since then the population has grown exponentially at a rate of 11% per year and has expanded their central coast range, with a current population estimated at 600 individuals.⁴ Using a space for time substitution, we quantified the direct and indirect effects of sea otter recolonization on intertidal benthic community structure.

Sea Otter Range and Study Sites

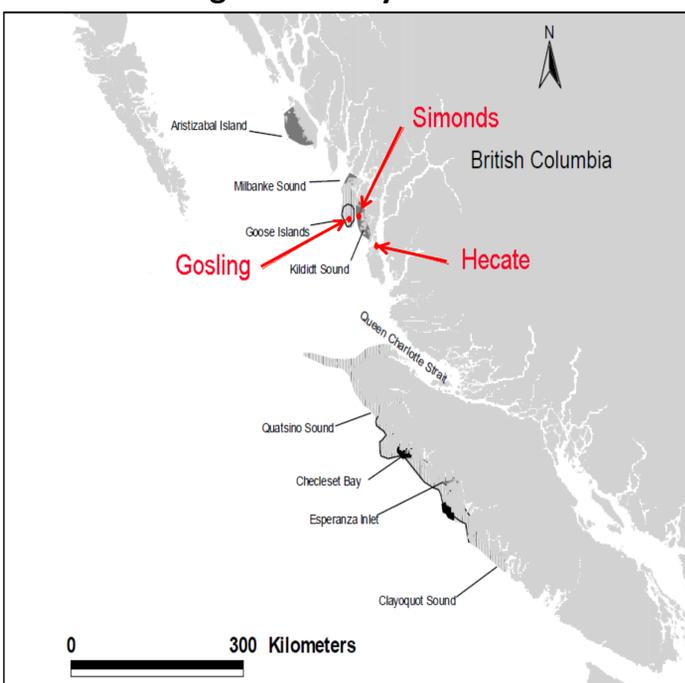


Figure 1 – Sea otter range and study sites (red). Black shaded areas: range in 1977. Black outline: range by 1995. Patterned area: range by 2001/2004. Dark grey area: range expansion by 2008. Source: DFO 2009.

Methods

We sampled intertidal kelp and macro-invertebrate communities at three sites at varying stages of sea otter recolonization:

Hecate – Not yet observed (0 yrs)^{5,6}

Simonds – Recolonized after 2004 (<5 yrs)⁵

Gosling – Raft observed in 1990 (>20 yrs)⁶

At each site, we measured macro-invertebrates in 50cm² quadrats (n=10-15), classified them as exposed or cryptic, and quantified kelp biomass in 25cm² quadrats (n=13-17).

To test for differences among sites, we used generalized linear models, with a quasipoisson likelihood for count data and a Gaussian likelihood on log-transformed biomass data. We made pair-wise comparisons with post-hoc contrasts.

Hypotheses

As years since sea otter recolonization increased, we predicted:

- 1) ↓ macroinvertebrate/grazer density
- 2) ↑ kelp biomass
- 3) ↑ proportion cryptic vs. exposed macroinvertebrates/grazers



Mark Wunsch Photo



Mark Wunsch Photo

Results

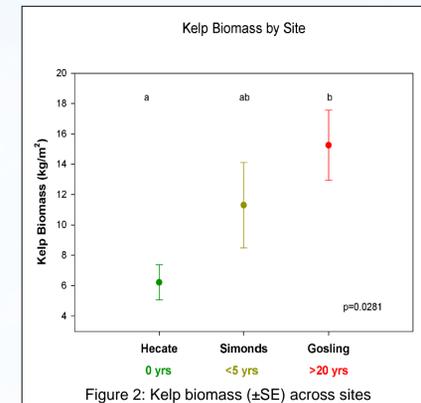


Figure 2: Kelp biomass (±SE) across sites

As predicted, we detected an increase in kelp biomass with increased time since sea otter recolonization. This pattern was predicted by our trophic cascade hypothesis, where sea otters directly reduce their prey and indirectly facilitate kelp growth.

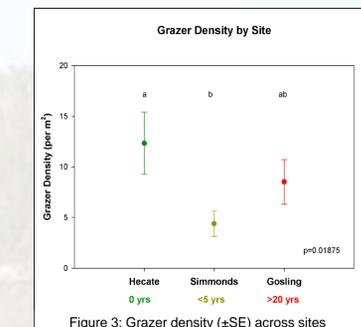


Figure 3: Grazer density (±SE) across sites

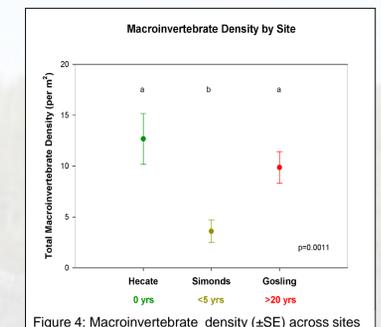


Figure 4: Macroinvertebrate density (±SE) across sites

Surprisingly, we did not see a consistent decrease in grazer or macroinvertebrate density with increased time since sea otter recolonization.

Furthermore, we observed a difference in the relative proportion of cryptic vs. exposed macroinvertebrates at the site with long-term (>20 years) sea otter presence, although this difference was not statistically significant.

*All plots are of raw data

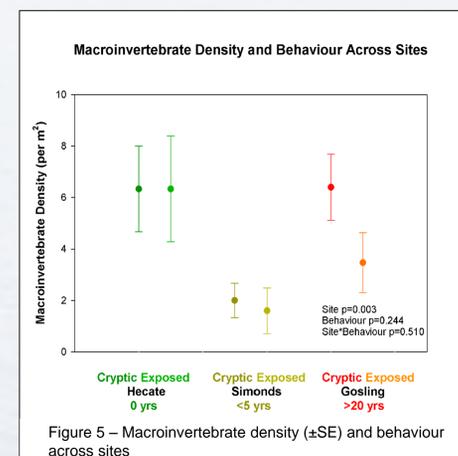


Figure 5 – Macroinvertebrate density (±SE) and behaviour across sites

Acknowledgements

This work was made possible both by an NSERC USRA to B.D. and a grant from the Tula Foundation as part of the Hakai Network for Coastal People, Ecosystems and Management. Thanks to Linda Nichol for sharing her knowledge of sea otter history, to the Heiltsuk Integrated Resource Management Department (HIRMD) and to the staff of Hakai Beach Institute for supporting this research.

Works Cited

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