Ecological effects of shoreline development on King County's swimming beaches

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Introduction

Freshwater shorelines have undergone little analysis on the effects of development on macroinvertebrate biodiversity (1). Such information is crucial because it is a direct indicator of the productivity of an ecosystem as they belong to the bottom of the food chain, so this introductory study proves useful in gathering information by which to forward conservation efforts in the future. The study was conducted at the 12 sites labeled in the figure below. It has also been shown that across the nation public agencies' Environmental Impact Statements fail to account for effects on biodiversity, so this study sought to determine King County's consideration for biodiversity conservation (2).

Objectives

The objective of this project was to answer the following two questions:

1. How has freshwater shoreline development effected macroinvertebrate diversity?
2. How effective are Environmental Impact Statements at recognizing and mitigating potential threats to beach communities?

Methods

The study method for this project was broken into three components, each yielding its own data set:

- Spatial analysis was performed using GIS to classify shoreline development and surrounding land use in terms of presence of engineered surfaces and urban density (A descriptive key is shown in the "Results" section.
- Field sampling was performed to characterize the biodiversity of each site by macroinvertebrate identification to family.
- A case study of public documents was performed to determine the level to which Environmental Impact Statements for King County's developmental projects seek to prevent or mitigate negative effects on biodiversity in shoreline communities.

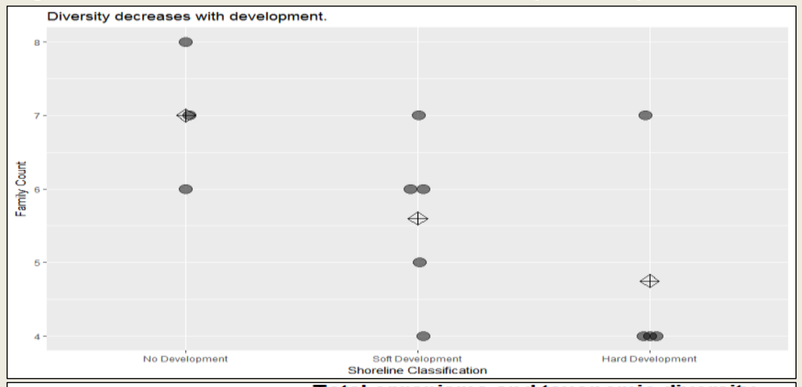
Results

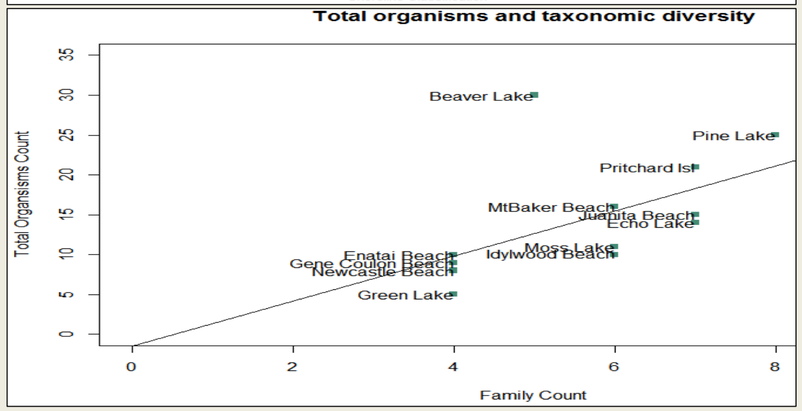
Beach Biodiversity

After performing the study at 12 swimming beaches in King County (33% of those in the beach monitoring program) it was found that there is a strong correlation between shoreline development and taxonomic diversity. The criteria for the developmental levels is shown below, as is the p-value for the comparison of shoreline development and taxonomic diversity.

Level	Description	Criteria
1	No Development	Natural shoreline, less than 20% coverage by engineered surfaces
2	Soft Development	Change in flora/soil, less than 50% coverage by engineered surfaces
3	Hard Development	Change in flora/soil, more than 50% coverage by engineered surfaces

A non-significant but highly suggestive negative relationship was found for development and biodiversity (p=0.11), with increasing development associated with lower biodiversity. Total number of organisms is also associated with increased family diversity





The most common macroinvertebrates found were scud (amphipoda), water mites, and aquatic worms (planaria, nematode) in that order. Pictured in the right-most column (3).

EIS Review

The case study of public documents surrounding freshwater shoreline development encompassed 10 documents from 1983 to 2017, and the results are as follows: 60% mentioned biodiversity, 30% did not, and 10% were Declarations of Non-Significance.

Conclusions

1. Freshwater shoreline development negatively impacts biodiversity, and in turn species abundance.
2. King County has actually attempted to prevent and mitigate the negative effects discussed here at a higher frequency (60%) than the national average, where only 44% (2) of developmental projects touch on the topic of biodiversity conservation.

References

(1) Twardochleb, Laura A., and Julian D. Olden. "Human Development Modifies the Functional Composition of Lake Littoral Invertebrate Communities." *Hydrobiologia*, vol. 775, no. 1, Oct. 2016, pp. 167–184
(2) Samuel F. Atkinson (2000) Treatment of biodiversity impacts in a sample of US environmental impact statements, Impact Assessment and Project Appraisal, 18:4, 271-282
(3) www.stroudcenter.org/research/projects/schuylkillriverproject

Acknowledgements

Thank you to Leo Pham and Ramses Angulo for being invaluable teammates, thank you Tim Clarke, Daniel Nidzgorski, and Debra Bouchard for mentoring our team, and a special thanks to the Doris Duke Conservation Scholars Program at the University of Washington for providing our team the opportunity to do this project.

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