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Quantifying shoreline modifications adjacent to eelgrass meadows in the Strait of Georgia Bioregion

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V9T 6N7

2022

Canadian Technical Report of Fisheries and Aquatic Sciences ####

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Canadian Technical Report of
Fisheries and Aquatic Sciences nnn

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QUANTIFYING SHORELINE MODIFICATIONS ADJACENT TO EELGRASS MEADOWS IN THE STRAIT OF GEORGIA BIOREGION

by

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Cat. No. Fs97-6/nnnE-PDF ISBN ISSN 1488-5379

Correct citation for this publication:

Cristiani, J.C., Bannar-Martin, K.H, and Rubidge, E.M. 2022. Quantifying shoreline modifications adjacent to eelgrass meadows in the Strait of Georgia Bioregion. Can. Tech. Rep. Fish. Aquat. Sci. nnn: v + 7 p.

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ABSTRACT

Cristiani, J.C., Bannar-Martin, K.H, and Rubidge, E.M. 2022. Quantifying shoreline modifications adjacent to eelgrass meadows in the Strait of Georgia Bioregion. Can. Tech. Rep. Fish. Aquat. Sci. nnn: v + 7 p.

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RÉSUMÉ

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1 Introduction

The health and functioning of coastal marine ecosystems are under threat from a variety of human activities (Halpern et al. 2019). Coastal activities such as agriculture, industrial and residential development, forestry, and shoreline hardening can create pressures on the marine environment. A modified shoreline may alter levels of sedimentation, nutrient runoff, pollution, and wave energy (Todd et al. 2019). For coastal biogenic habitat in British Columbia such as seagrass, these pressures may impact seagrass productivity and survival, and thus impact the community of species that rely on seagrass (Iacarella et al. 2018; Nahirnick et al. 2019; Murphy et al. 2021). Therefore, knowing the presence of shoreline modifications adjacent to seagrass would allow us to predict ecological impacts and understand seagrass ecosystem dynamics in a broader seascape context.

Assessing human activities for an entire coastal region is generally done at broad spatial scales. For example, impact mapping and assessments for all of BC have been done with a 2 km+ spatial resolution (Clarke Murray et al. 2015), which exceeds the size of many seagrass meadows as well as the size of the shoreline region which may be locally impacting a meadow. In addition, many spatially distinct meadows may exist close together, where only a high resolution assessment of shoreline modifications could distinguish the potential impacts between them. Fine-scale assessments of impacts to seagrass exist for the BC coast, but these are typically done in detail for only a few meadows due to logistical constraints (Iacarella et al. 2018; Nagel et al. 2020).

The objective of this study is to map and quantify the shoreline modifications adjacent to all known seagrass meadows in the Strait of Georgia Bioregion of British Columbia. Eelgrass (*Zostera marina*, the dominant habitat-forming seagrass species) is a conservation priority in British Columbia (DFO 2019), and eelgrass meadows have been designated as Ecologically and Biologically Significant Areas (EBSA) due to their productivity, sensitivity, and support for biological diversity (Rubidge et al. 2020). Therefore, it is important to acquire information on human activities to predict impacts and categorize meadows by their degree of naturalness, as areas of high naturalness may be a priority for additional management and conservation efforts (UN CBD 2008). While shoreline modifications do not represent all of the human activities potentially threatening seagrass, a high resolution dataset is currently needed and can complement other existing human impact data.

2 Methods

2.1 Seagrass spatial data

Eelgrass (*Z. marina*) is the primary subtidal and intertidal meadow-forming seagrass in British Columbia. Meadows may also consist of the non-native seagrass, *Zostera japonica*, in the intertidal zone. Seagrass occurs to depths of 10 meters and can form meadows many km^2 in size (Murphy et al. 2021). We used a spatial dataset of seagrass in the Salish Sea compiled in Cristiani et al. (2021), which consists of surveyed and modeled data from a variety of government and non-governmental sources. The dataset includes xyz meadows in the Strait of

Georgia Bioregion as well as meadows in the southern portions of the Northern Shelf Bioregion and Southern Shelf Bioregion.

2.2 Shoreline area

Remember, the methods should be the most detailed part.

- Justification (cite DFO reports, Iacarella, Nagel)
- Adjusting seagrass meadows (or just generally say we created it at the nearest shoreline)
- General geoprocessing steps

We measured shoreline modifcations within at 100m buffer onto land from a seagrass meadow.

. . . requires generating consistent buffers from onto land. The perimeter of the meadows, however, do not always abut directly to the shoreline due to different mapping accuracies and errors, thus resulting in slightly different buffer extents on to land. Aside from a few exceptions, the majority of meadows are adjacent to coastline and therefore to create consistent buffers we adjusted the perimeter of meadows to match the coastline using digitization tools in ArcGIS.

2.3 Shoreline modifications

- Modifications we are looking for and why (Emily's 2020 paper has some additional citations for impacts that I don't have)
- Also, will need to say why I'm not including docks - its categorized elsewhere because of different impacts.
- digitizing - general rules
- attributes

2.4 Postprocessing

- Roads
- General geoprocessing steps
- Calculate as percentage of buffer and associate as attribute

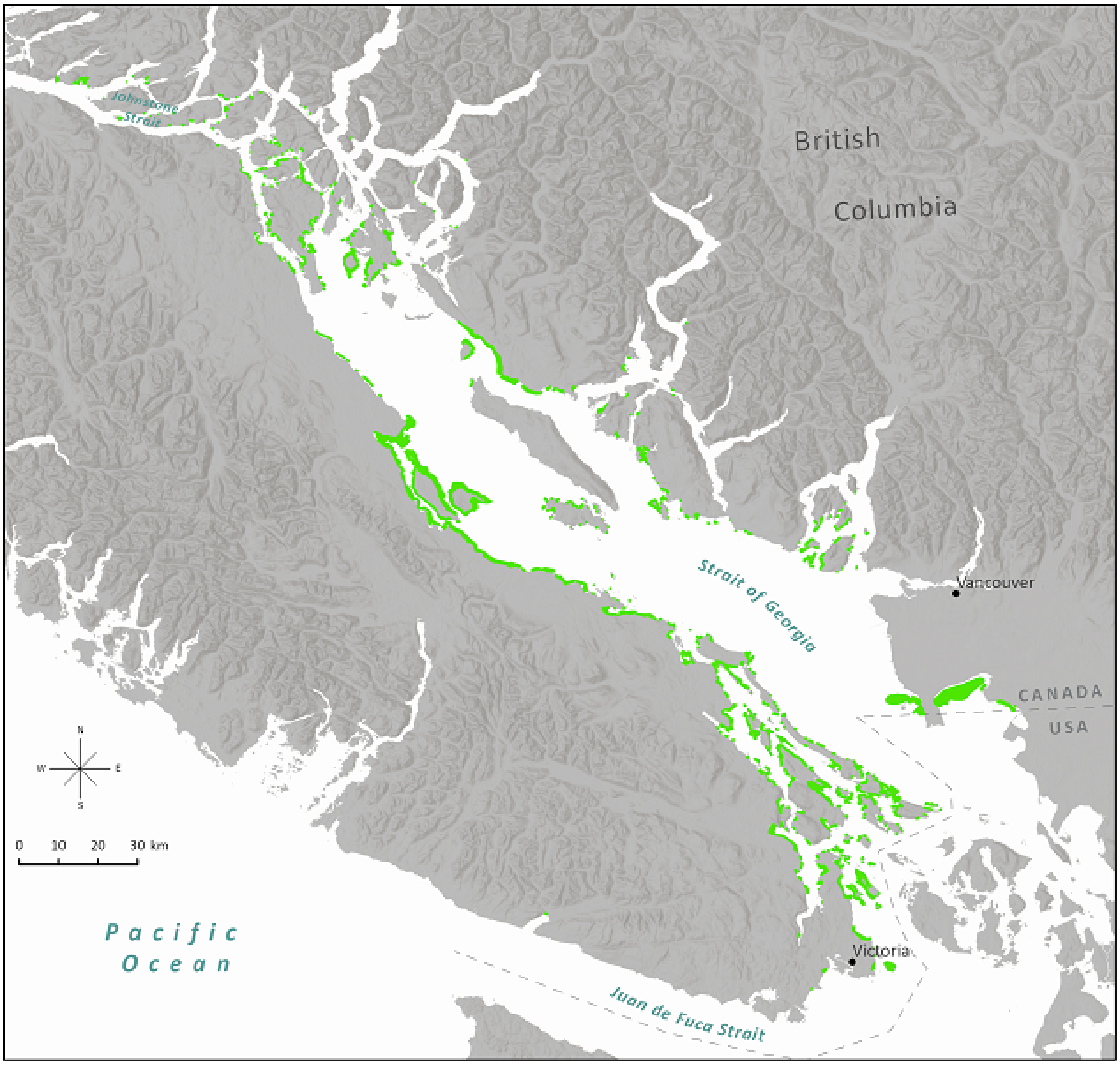

Figure 1. Study area

115 ## 3 Results

116 • A few sentences on the spatial distribution (e.g. more modifications in the south, more ag in south, more forestry in north).

Figure 2. Shoreline modifications within 100 meter buffered areas. The six selected areas are shown for example and do not imply any significance over other areas.

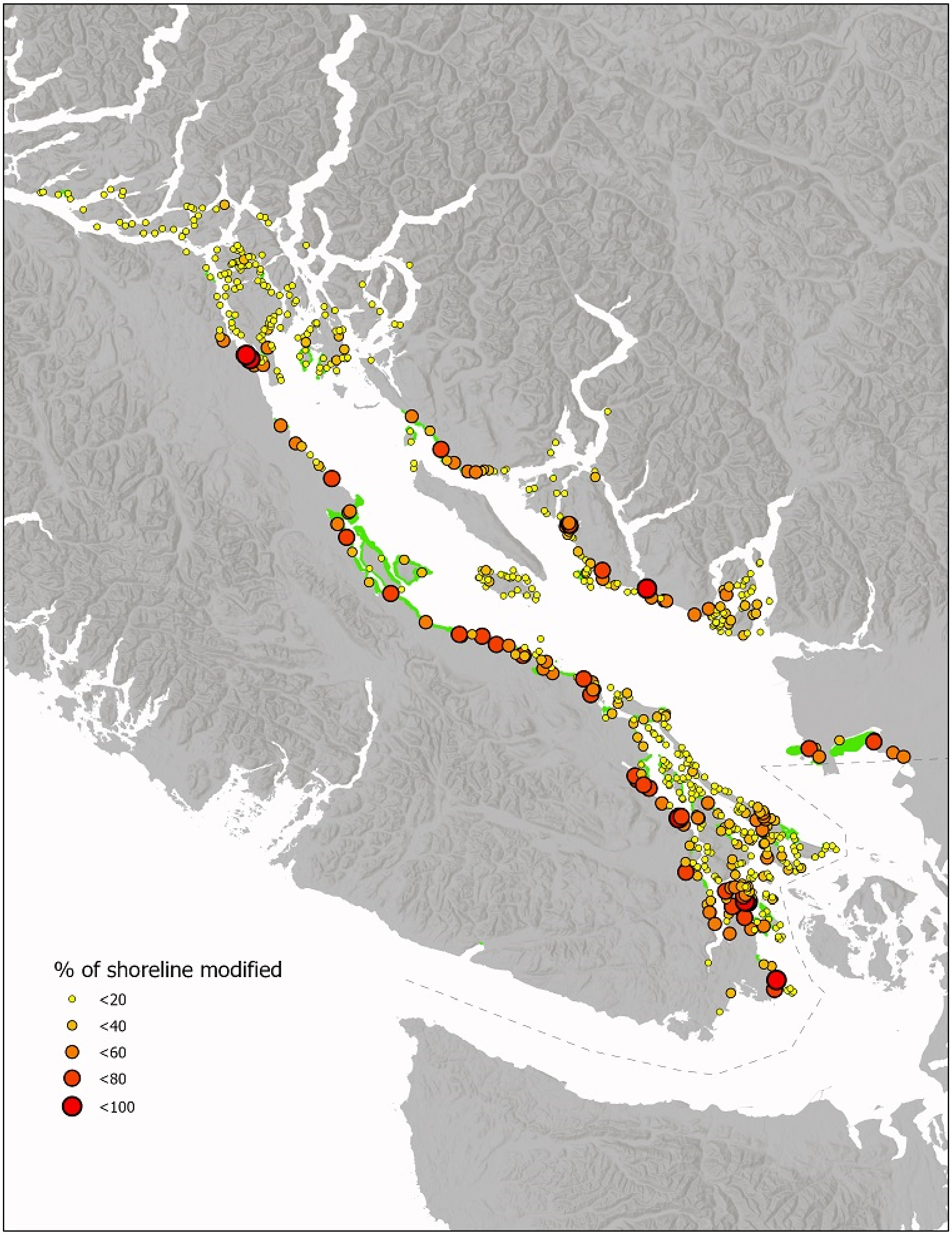

Figure 3. The percentage of the shoreline buffer modified.

4 Discussion

- summary paragraph
- spatial distribution of activities and the significance for management
- assumptions and limitations
  - No point measurements in field to confirm impacts. Some activities are well regulated in Canada, like logging, and there may be very minimal impact.
  - Meadows that aren't right on the coast may not experience any impacts
  - If the modification exists behind some vegetation then the impact may be less (cite Iacarella)
  - We use a uniform buffer, but there is a likely a distance decay for some of these activities.
- Future directions
  - incorporate vulnerability scores to specific types of modifications
  - Consider management goals of protecting the most natural meadows and how this might change given the spatial distribution of activities and other information (e.g. biodiversity in meadows, connectivity)
- some stuff from my thesis:
  - "managing seagrass habitat and associated species in a landscape context, in which patterns of distribution, dispersal, and impacts will interact to influence regional management strategies (Murphy et al. 2021b). Although eelgrass is declining globally (Dunic et al. 2021), eelgrass in nearby Puget Sound, Washington is stable and resilient overall, despite a significant increase in local human and climactic stressors (Shelton et al. 2016). Assessing the relevance of managing for human impacts in the Salish Sea will therefore require a deeper understanding of seagrass and invertebrate responses to stressors and the mechanisms (e.g., dispersal) that allow for resilience to these stressors. Ultimately, refining and validating our models will increase their utility and promote their incorporation into broader marine spatial planning efforts."

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