Identifying optimal locations for First Nation shellfish aquaculture on Canada's North Pacific Coast

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Objectives

The objective of this project is to identify optimal locations for new shellfish aquaculture development along Canada's North Pacific Coast. This project will build on previous spatial planning efforts by the Marine Plan Partnership for the North Pacific Coast (MaPP) and guide Scoot Science (Scoot) in their effort to work with stakeholders in regions identified as ideal for shellfish aquaculture development. Scoot aims to emphasize engagement with First Nations groups in western Canada who are now gaining more sovereignty over economic development on their traditional land. To accomplish this, students will:

1. Identify districts along Canada's North Pacific Coast which exhibit ideal sea surface temperature, turbidity, and chlorophyll conditions for native shellfish species. Within these districts, develop a local-scale site suitability index for shellfish aquaculture which will reveal optimal locations for future operations.
2. Conduct a stakeholder analysis to identify barriers that First Nations groups face when considering shellfish aquaculture development in optimal, yet underutilized locations.
3. Develop an interactive web-map that displays the index and competing marine stakeholders in the area. Combining the results from the suitability index and insights from the stakeholder analysis, fine-tune the recommendation for optimal farm locations.

Significance

In 1998, the British Columbia (BC) Provincial Government initiated the Shellfish Development Initiative (SDI), its primary goal was to increase the total area under private tenure for shellfish aquaculture from 2300 to 4230 ha and achieve a $100 million wholesale sector in one decade (1). Government representatives and sector advocates saw shellfish aquaculture as an efficient and uncomplicated fix to declining fish stocks, unemployment in rural coastline communities, and a seamless path for First Nations to preserve shellfish harvesting traditions while creating new economic opportunities for their communities. By 2010, the wholesale value of the shellfish aquaculture sector had reached only $32.5 million, falling far short of the BC government's ambitions (2). Further, only 27 of the 480 tenured shellfish aquaculture sites in BC (approximately 6%) were located on the North Pacific Coast; all others were along the southern BC coast or Vancouver Island (3). Failure to achieve these goals was attributed to the BC government's failure to adequately engage and facilitate conversations between regional governing agencies, political leaders, non-governmental organizations, and public stakeholders.

Seeking to build a forum to engage stakeholders and create a more equal distribution of shellfish aquaculture sites between the north and south coasts, the Marine Plan Partnership for the North Pacific Coast (MaPP) was formed in 2011. This co-led partnership between 18 First Nations' and the Province of British Columbia governments was tasked to develop and implement marine plans for 102,000 square kilometers of coastal and offshore water in northern British Columbia (4). After 5 years of assembling stakeholders, compiling data, and conducting stakeholder negotiations (assisted with SeaSketch) sub-regional marine and implementation plans were completed in 2016. These plans set boundaries for conservation, economic development, and ecosystem-based management objectives along Canada's North Pacific Coast.

While the spatial plans succeeded at engaging many stakeholders to agree on broad boundaries zoned for aquaculture development, it fell short in providing detailed, practical guidance. Stakeholders still need to assess precise locations of optimal shellfish growing conditions and navigate competing

stakeholder interests. Areas designated for shellfish aquaculture development were expected to have lower environmental impact, but relied on coarse-scale data to inform these broadly zoned shellfish management locations (3). This project aims to conduct a local-scale analysis of sites best suited for shellfish aquaculture development that captures the complexities of oceanographic processes, environmental conditions, and local stakeholder dynamics. This analysis will enable Scoot to identify barriers preventing new shellfish aquaculture development and provide First Nation groups with tools to better evaluate and manage sites with the greatest potential for long-term success.

Background

Scoot has extensive experience managing ocean risk in aquaculture through data management, oceanographic analysis, and modeling. The team at Scoot works with farmers to identify oceanographic impacts on production and equips farms with forecasting and risk transfer tools to mitigate the effects of ocean risks like harmful algae blooms, low dissolved oxygen, and large temperature swings. Scoot is aiming to begin working with existing and new shellfish farmers and First Nations communities who manage these areas in 2022, leveraging their extensive experience with salmon farming operations. This project's deliverables would help First Nations groups on Canada's west coast identify ideal areas for new aquaculture development while also helping Scoot identify and engage with new partners who would benefit from Scoot's analytics services.

To date, First Nation entrepreneurs, communities, and other stakeholders seeking to enable new investments in shellfish aquaculture developments still rely on coarse, high-level analysis of suitable locations for scallops, clams, and oysters in the North Pacific Coast region. This data was suitable for marine and implementation plans created by MaPP, but lacks Landsat-8's temperature (100 m), turbidity (30 m), and chlorophyll a (30 m) resolutions (5). Dr. Aerin Jacob from the University of Victoria's Environmental Studies department has gathered collective habitat knowledge from aquaculture experts from the North Pacific Coast of BC and Washington, USA to inform analysis of suitable shellfish aquaculture sites throughout the North Pacific Coast of BC (6). This data will be used to inform model parameters.

Equity

The primary focus of this project is to enable First Nations groups to make more strategic and informed decisions about their coastal economic development. In recent years, these traditionally marginalized peoples have made strides in gaining sovereignty over their traditional lands throughout western Canada. Our project will serve to build on this momentum by supporting dialogue between Scoot, First Nations groups, and existing marine stakeholders about how best to develop new shellfish aquaculture operations that will benefit remote communities and their local environment.

Available Data

As a global leader in ocean analytics and forecasting for finfish aquaculture, Scoot has access to large quantities of ocean data in analysis-ready format. Scoot is committed to making the necessary datasets available to the Bren team for the completion of this project. For example, Scoot will provide students with access to formatted versions of:

- MUR Sea Surface Temperature 0.01 deg res (use for confirming surface temperature modeling accuracy)
- Global Bathymetry 15 arc sec (used to determine depth near shoreline)

- Remote Sensing Chlorophyll NASA Ocean Color MODIS-Aqua dataset (use for confirming chlorophyll modeling accuracy)

Additionally, this project would use publicly available datasets including:

- Landsat-8 Rasters
  - Sea surface temperature, turbidity, chlorophyll a
- DataBC: Publicly available database, used for strategic management of public resources in BC
  - Marine Plan Partnership for the North Pacific Coast compiles relevant stakeholder datasets in SeaSketch which can be accessed through DataBC, including: coastal administrative, boundaries, existing aquaculture tenures, forestry operations, fishery locations, public recreation sites, marine species, physical oceanography, tributary hydrology, shipping lanes
- BC Marine Conservation Analysis
- NOAA: National Data Buoy Center (14 buoys near west Canada's coastline)
  - Offshore weather buoys measuring air pressure, air temperature, sea surface temperature, wind observations, and the wave height — *in situ* data used for model validation.

Approach

- Conduct literature review of shellfish species native to western Canada's central coast and identify optimal environmental parameters influencing growth and resilience. Findings from this research will supplement Dr. Jacob's existing research with aquaculture operators in the region.
- Determine parameters used for initial coarse scale analysis of shellfish aquaculture site suitability conducted by MaPP to build off of MaPP's knowledge base.
- Assemble Landsat-8 rasters, ground-truthed environmental data from NOAA buoys and Scoot provided data, and stakeholder data from DataB
- Construct a model using methodology developed by Synder et al. in "Landsat 8-Derived Sea Surface Temperature, Turbidity, and Chlorophyll a"(7). Confirm model accuracy against ground-truthed data, reassess as needed.
- Engage Scoot stakeholder contacts via interviews and surveys to determine barriers to entry for new shellfish aquaculture development.
- Export model results to rasters to incorporate into web-map. Include stakeholder point, polygon, and raster data in web-map.

Deliverables

Beyond a final poster, and oral presentation, the group will provide:

1. Report assessing barriers for First Nation stakeholders inhibiting new aquaculture development.
2. Models used to create site suitability index with justification of regional scope selections as well as model parameters, calculations, and outputs.
3. Compiled model input and output datasets.
4. An interactive web-map displaying model and stakeholder analysis findings overlaid on relevant basemaps to provide context for management decision making.

Internship

Scoot Science commits to host and mentor one paid intern over the Summer of 2021 and will compensate the intern between $9,000-12,000 depending on student availability.

References

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3. Holden, Jessica J., et al. "Synergies on the Coast: Challenges Facing Shellfish Aquaculture Development on the Central and North Coast of British Columbia." Marine Policy, vol. 101, Mar. 2019, pp. 108–117, www.sciencedirect.com/science/article/abs/pii/S0308597X18302379?via%3Dihub, 10.1016/j.marpol.2019.01.001.

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5. "Oceans of Opportunity: A Review of Canadian Aquaculture | Emerald Insight." Marine Economics and Management, 2018, www.emerald.com/insight/content/doi/10.1108/MAEM-06-2018-002/full/html, 10.1108\/MAEM.

6. Jacobs, Aerin, et al. "Developing scallop and geoduck aquaculture on British Columbia's Central Coast: Recommendations from experts" http://www.aerinjacob.ca/uploads/1/0/5/5/10559030/lancaster__2017__recommendations_for_developing_shellfish_aquaculture_on_bc_central_coast.pdf

7. Snyder, Jordan, et al. "Oyster Aquaculture Site Selection Using Landsat 8-Derived Sea Surface Temperature, Turbidity, and Chlorophyll a." Frontiers in Marine Science, vol. 4, 29 June 2017, https://www.frontiersin.org/articles/10.3389/fmars.2017.00190/full.

Budget and Justification

We do not anticipate needing an additional budget for this project beyond $1,300 from the Bren School to cover basic operations.

Letter of Support

ScootScience

January 22th 2021

Group Project Committee
Bren School of Environmental Science and Management
University of California, Santa Barbara

Scoot Science is pleased to support Tom Wheeler and Emiliano Espinoza's proposal, "Identifying optimal locations for First Nation shellfish aquaculture on Canada's North Pacific Coast".

At Scoot Science, our mission is to bridge the gap between oceanography, finance, and environmental stewardship. The increase in the frequency and strength of extreme ocean conditions has presented aquaculture with major challenges for both day-to-day protection of existing stock and long-term planning, such as new site development or financing options. To meet these challenges, we equip marine farmers and stewards of the oceans with easily-accessible forecast modeling, oceanographic analysis, real-time monitoring, and risk management tools. Over the next 1-2 years, Scoot Science is aiming to bring our expertise in solving ocean risk challenges to shellfish aquaculture. Prior to moving into a new sector, it is essential that we assess the region's capacity for growth under changing oceans and begin initial engagement with First Nations to build a relationship with a major stakeholder.

This project will help Scoot Science evaluate opportunities for facilitating sustainable shellfish aquaculture and collaborating with First Nations in British Columbia. Our proven experience working with the British Columbia aquaculture industry and strong handle on large ocean datasets will allow us to provide the resources necessary to support the successful completion of this graduate student project. In addition, Scoot Science will offer 1 remote summer internship.

As a Bren alum, having gone through the group project process myself as a project manager and having been with Scoot Science since our very first customer, I am confident that I can help ensure a mutually beneficial project.

Sincerely,

Iwen Su

Iwen Su, MESM 2018
Senior Data Scientist

CC: Jonathan LaRiviere, CEO