Spatial-temporal changes in kelp extent in the Gulf Islands and Southern Vancouver Island: a remote sensing approach

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Spatial-temporal changes in kelp extent in the Gulf Islands and Southern Vancouver Island: a remote sensing approach

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Salish Sea conference, 26-28 April 2022

We acknowledge and respect the lək̓wəŋən peoples on whose traditional territory the university of Victoria stands and the Songhees, Esquimalt and SENĆOŦEN speaking people, the WSÁNEĆ nations whose historical relationships with the land continue to this day. Additionally, our work takes us all across the coast and we acknowledge with respect the many ongoing relationships the multiple nations have with the land and ocean along the coast of British Columbia.
Background and objectives

Goal:
To determine the long-term spatial-temporal resilience of canopy-forming kelps, in response to local and regional environmental drivers along the coastlines of the Southern Vancouver Island and the Gulf Islands.
- 137 British Admiralty (BA) charts

Historical - 1850s

Costa et al., 2020

2004-2021 - maximum kelp extent
Concepts

• Resilience
• Vulnerability

Kelp Niche - Nereocystis luetkeana
Methodology: Kelp detection with high-res imagery

High-res aerial photography
World View 2-3
Spot 6
Planet
Rapid Eye
Kompsat
Methodology: Kelp detection with high-res imagery

- Mask
  - Deep Water, Land and Soft Substrate

- Atmospheric Correction or Histogram Shift

- Band Indices (NDVI, GNDVI, Re/Y) + Stretch Input Bands

- Object Based Segmentation + Nearest Neighbor Classification

- Validation

TIME SERIES ANALYSIS
Cluster analysis

- Wind Density (W/m)
- Landsat-derived Thermal Infrared SST (°C) Spring-Summer
- Fetch (m)
- Tidal Amplitude (m/s)
- Total Suspended Matter (Mg/L) Spring-Summer
A. Victoria-Sooke

- Spring temperature
- Summer temperature
- Wind Power

Clusters
1. Purple
2. Green
3. Yellow
4. Orange

Source: Esri, HERE, Garmin, Intermap, iDerma P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri (CHN), Hong Kong GO OpenStreetMap contributors, and the OGP User Community.
Kelp extent per cluster

A. Cluster 1: Medium temperature

B. Cluster 2: Lowest temperature

C. Cluster 4: Hottest temperature

Map showing kelp extent per cluster with different colors for each cluster.
B. Gulf Islands

A. Spring temperature

B. Summer temperature

C. Wind Power

Clusters

- Cluster 1
- Cluster 2
- Cluster 4
Marine heatwaves

Oceanic Oscillations

Kelp extent per cluster

Cluster 1

Cluster 2

Cluster 4
Final comments

• Similar conditions to other regions of the Pacific North American Coastline.
• Victoria to Sooke: Most resilient is the coldest cluster
• Gulf Islands: Most resilient are the warmer clusters
• KSSS: Kelp Sentinels of the Salish Sea