

Hydro-ecological Riparian Zone



An innovative approach combining environmental variables using LiDAR, Satellite Imagery, and GIS Lavanya Gopal | Masters In GIS Applications | Vancouver Island University | Iavanya.gopal@my.viu.ca

Background

Riparian ecosystems are found near the shores of lakes & streams. They fulfil ecological functions such as regulating water quality, water temperature, filtering pollutants etc. However, they are threatened by land-use modifications and climate change. To preserve these areas, we need to define and protect riparian zones.

Did You Know?

Over 75% of BC's animal species use riparian zones

Research Problem

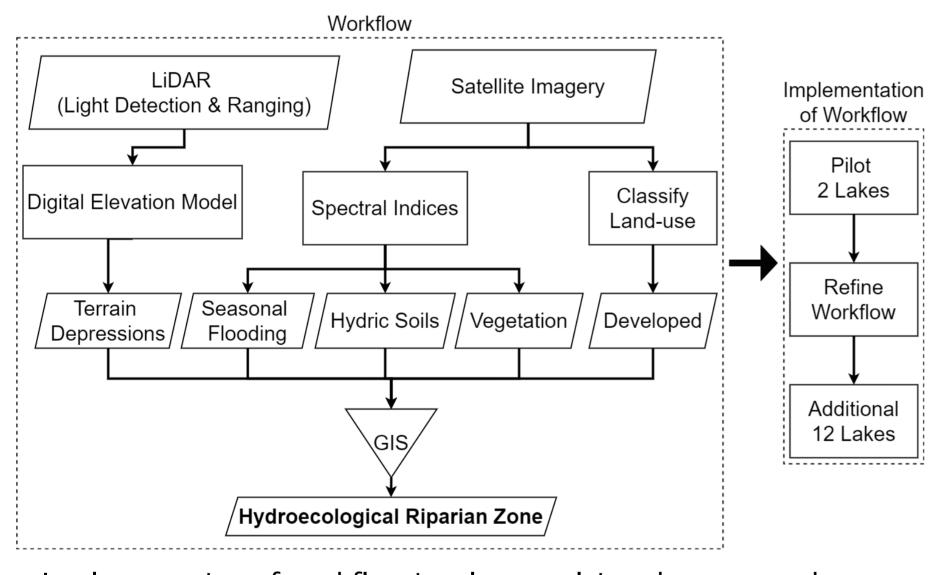
Lack of riparian vegetation is linked to water temperature fluctuations, poor water quality, and decline in fish population. Traditional 10m fixed-width buffers do not consider surrounding environmental conditions and may be inadequate to fulfill ecological functions. There is a need for innovative strategies combining environmental conditions to define riparian zones.

Objective

Develop a workflow to analyze topographical, hydrological, and ecological variables influencing riparian zones and delineate variable-width Hydroecological Riparian Zone.

Methodology

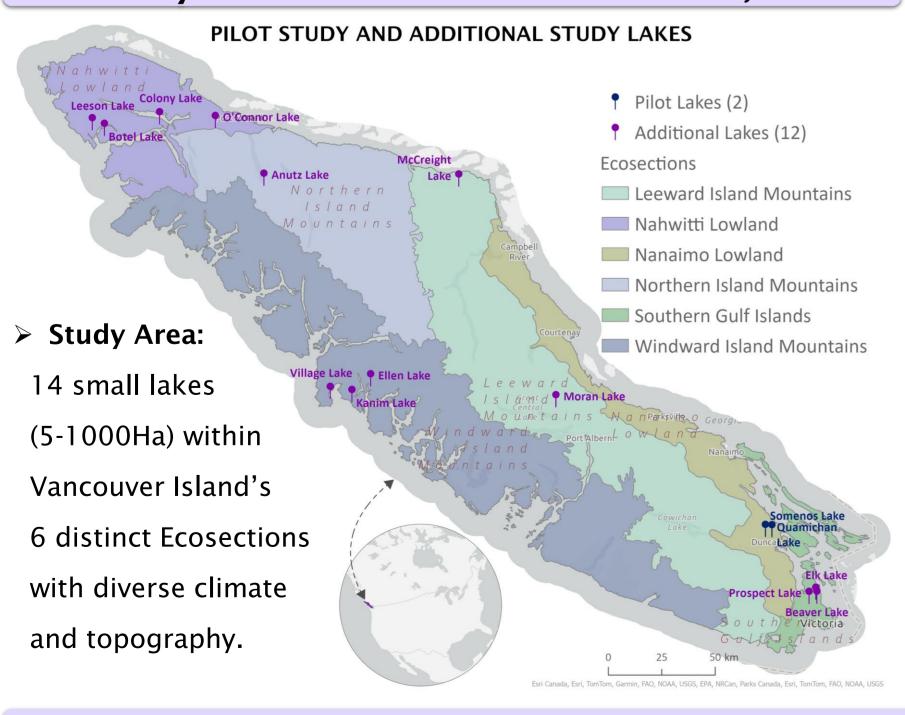
Riparian ecosystems are influenced by water accumulation, flooding, high moisture, hydric soil, dense vegetation etc. Below is the workflow that integrates multiple environmental factors to delineate a riparian zone:



Implementation of workflow involves applying the proposed workflow to pilot study area, identifying issues, refining, and applying the refined workflow to additional study areas.

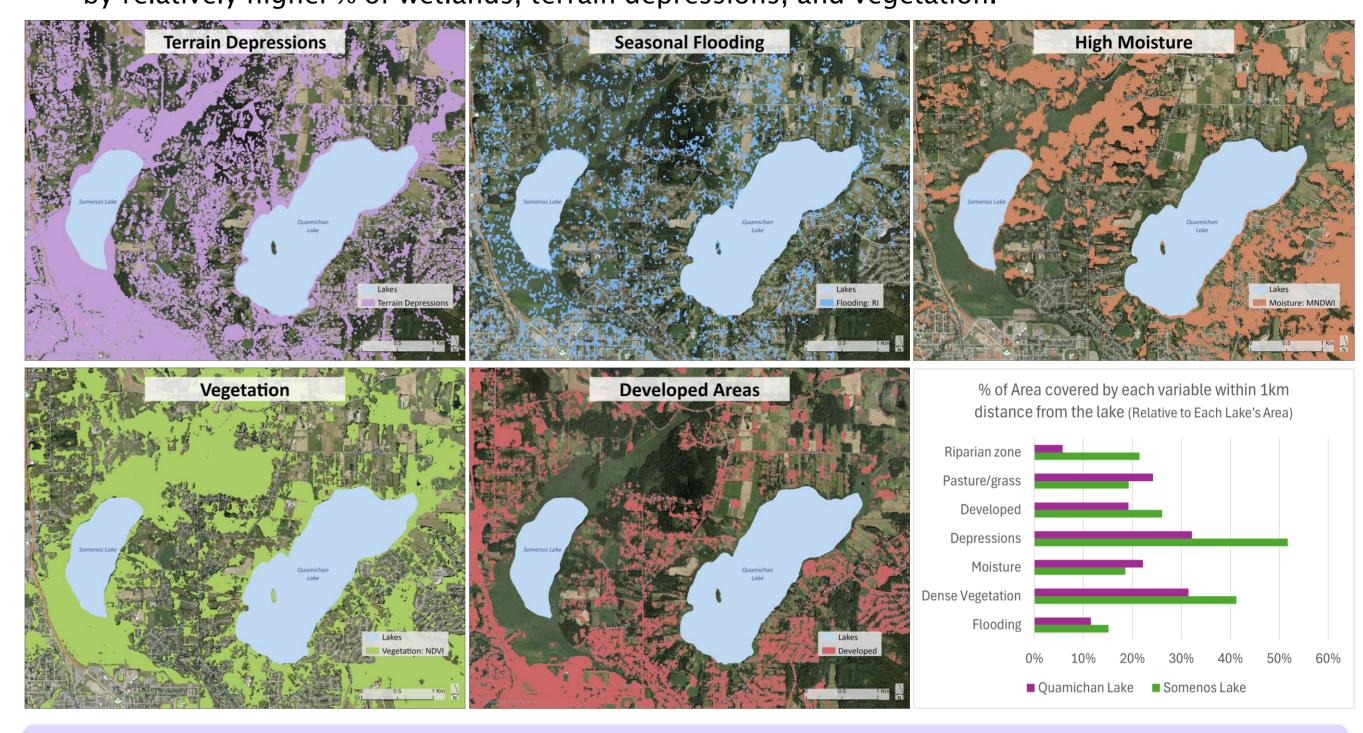
- Tools: ArcGIS Pro, Arc Hydro, Google Earth Engine (JavaScript).
- **Data Sources**: BC LiDAR, Sentinel-1 SAR, Sentinel-2 imagery.

Study Area: Vancouver Island, BC

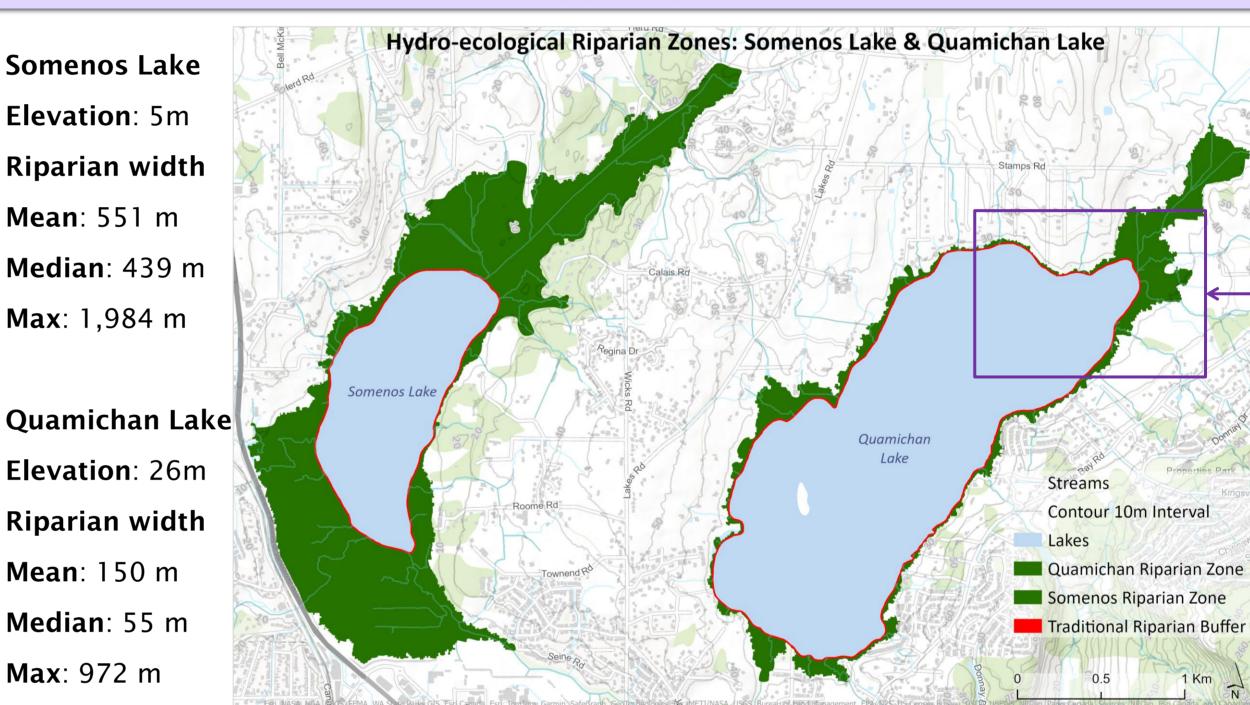


Environmental Variables

- **Environmental variables**: Depressions, seasonal flooding, vegetation, high moisture, land-use
- Quamichan Lake is surrounded by high % of urban areas whereas Somenos Lake is surrounded by relatively higher % of wetlands, terrain depressions, and vegetation.



Results



> Findings:

Mean: 150 m

Median: 55 m

Max: 972 m

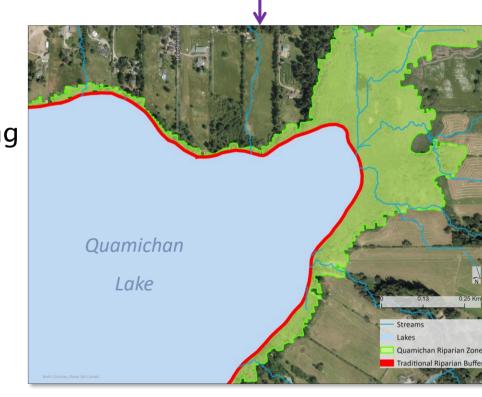
Somenos Lake

Elevation: 5m

Mean: 551 m

Max: 1,984 m

- · Influential variables include terrain depressions, vegetation, and moisture, with seasonal flooding playing a secondary role in the riparian zone delineation.
- Different land-use types and steep slopes constrain riparian zone delineation emphasizing the complexity of integrating diverse variables into the workflow.
- Wetlands, stream inflows, and flood-prone areas exhibit relatively wider riparian zones.



10m Traditional Buffer (red) vs. Delineated Riparian Zone (green)

Key Takeaways:

- Even within same Ecosections, riparian widths can vary significantly due to local differences in environmental variables, including topography, hydrology, ecology, and land-use types, highlighting the necessity of integrating environmental variables into the delineation.
- By leveraging the capabilities of LiDAR, satellite imagery, and GIS tools, this research developed an innovative workflow to map variable-width riparian zones that are relevant to latest environmental conditions.

> Outcomes:

Analytical framework for identifying riparian ecosystems and valuable insights for conserving lakes ecosystems, terrestrial, and aquatic biodiversity.

> Future Work:

Further evaluation of riparian zone delineation workflow to enhance its applicability across diverse ecological contexts and development of targeted conservation strategies to safeguard these critical ecosystems.

Acknowledgements

Story map:



I am deeply grateful for the advice and support of my supervisors Dr. Paul Zandbergen (VIU Faculty) and Tracy Michalski (Research Fish Biologist at BC Ministry of Forests). This study was made possible through Esri tools including ArcGIS Pro, Arc Hydro for Pro, and ArcGIS StoryMaps References: [1] Abood, S. A., Maclean, A. L., & Mason, L. A. (2012). Modeling Riparian Zones Utilizing DEMS and Flood Height Data. Photogrammetric Engineering & Remote Sensing, 78(3), 259-269. https://doi.org/10.14358/pers.78.3.259 [2] Dindaroğlu, T., Reis, M., Akay, A. E., & Tonguç, F. (2014). Hydroecological approach for determining the width of riparian buffer zones for providing soil conservation and water quality. International Journal of Environmental Science and Technology, 12(1), 275-284 https://doi.org/10.1007/s13762-013-0444-4