

Spatiotemporal characterization and evaluation of petroleum hydrocarbons in small craft harbour sediments in Nova Scotia, Canada

Myriam Mora¹, Tony R. Walker¹, Rob Willis²

¹School for Resource and Environmental Studies, Dalhousie University, 6100 University Phone: +52-(55)-4043-9436 Ave, PO Box 15000, Halifax, B3H 4R2, Canada

E-mail: myriam.mora@dal.ca

²Dillon Consulting Limited, 137 Chain Lake Drive, Suite 100, Halifax, B3S 1B3, Canada

Introduction: Small craft harbours (SCHs) in Nova Scotia, Canada are vital for the fishing industry, economy and have high socioeconomic and cultural importance for surrounding communities. Several pollution sources impact SCH sediments, including petroleum hydrocarbons (PHCs). Ecological impacts in marine sediments can have significant impacts in biota and humans, including fishing activities and the local economy. PHCs are one of the most widely used compounds on a global scale, with two-thirds of total crude oil being refined for fuel use [1]. Such an extensive use leads to a portion of these compounds being released into the environment every year, creating an increasing number of contaminated sites. It is estimated that approximately 60% of Canada's contaminated sites involve PHCs. Atlantic Risk-Based Corrective Action (Atlantic RBCA) is a tool used to assess and manage the remediation of sites impacted by PHCs in Atlantic Canada, while also being used as a point of reference for other Canadian provinces. It provides both environmental quality standards and a technical toolkit used to carry out risk assessments and remediation processes [2].

Methods: This study characterized the spatiotemporal distribution of over 500 PHC samples in 31 SCH sediments in Nova Scotia between 2000 and 2017. Historical data was acquired from the marine sediment sampling programs reported by Fisheries and Oceans Canada (DFO). The project used ecological screening levels established in Atlantic RBCA to determine PHC exceedances across all 31 SCHs. An ecological risk evaluation for multiple contaminants in sediments was also conducted. These contaminants were chosen based on the previous characterization and prior studies in the area, particularly related to polycyclic aromatic hydrocarbons and metals. While single contaminants can be below sediment quality guidelines, interaction of multiple contaminants can exacerbate ecological risk. Two lines of evidence were implemented to conduct this comprehensive analysis.

Results: This research showed that 49% of samples have exceedances for lube oil-resembling hydrocarbons across SCHs and 38% show exceedances of diesel-resembling hydrocarbons. Additionally, 7% of them exceed modified TPH. For the ecological risk evaluation, most SCHs show low or no risk of impact to biota. Only 2 SCHs present moderate to high risk. Maps showing the

spatiotemporal distribution of PHCs and relevant ecological risks are presented in the study as well.

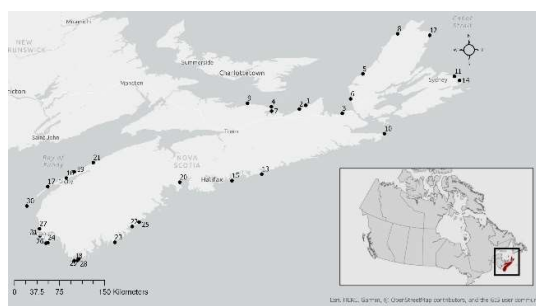


Fig. 1: Selected SCH locations in Nova Scotia.

Discussion: Comprehensive studies in SCHs are important to determine sediment quality and potential sources of harbour pollution. Integrated results like those obtained from this research inform harbour authorities about historical and current state of SCHs, so future risk-management options can be developed and prioritized to comply with established environmental quality standards. Since these SCHs are federally managed by DFO, risk evaluations are also useful to determine any environmental liability present in the SCHs in case divestment is being considered.

Acknowledgements: This study was funded by the Natural Sciences and Engineering Research Council of Canada (NSERC), Grant/Award Number: RGPIN-2018-04119 to Tony R. Walker, a NSERC CREATE: ASPIRE student scholarship and a Mitacs Globalink Graduate Fellowship to Myriam Mora.

References: [1] Batelle (2007) *Sediment Toxicity of Petroleum Hydrocarbon Fractions*; [2] Atlantic PIRI (2012) *Atlantic RBCA*.