Climate-Resilient Coastal Nature-Based Infrastructure Workshop 2022

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COASTAL ZONE CANADA ASSOCIATION
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TransCoastal Adaptations
Centre for Nature-Based Solutions

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National Research Council Canada
Conseil national de recherches Canada

Eric Balke

Ducks Unlimited Canada

BENEFICIAL RE-USE OF DREDGED SEDIMENT TO SUPPORT ECOLOGICAL RESILIENCE AND COASTAL FLOOD PROTECTION AT STURGEON BANK

Abstract

The Fraser River estuary is one of the largest and most important ecosystems on the Pacific coast of North America. Since the 1980s, approximately 260 hectares of low elevation bulrush marshes have been lost throughout the delta front, including at least 160 hectares at Sturgeon Bank. Several factors likely contribute to the large marsh recession at Sturgeon Bank, including relative sea-level rise, foraging by Snow Geese and Canada Geese, and changes in salinity and sediment regimes due to river training jetties, dredging, and dikes. Although large areas of tidal marsh have already been lost, sea-level rise poses a potentially greater threat to these important ecosystems in the coming decades since the capacity of marsh vegetation to respond to sea-level rise is inhibited by ongoing river maintenance dredging and river training infrastructure. Led by Ducks Unlimited Canada, the Sturgeon Bank Sediment Enhancement Pilot Project is a 2-year collaborative effort to observe the biophysical response of the foreshore to sediment addition aimed at restoring tidal marsh resilience and supporting coastal flood protection. If successful, the design and lessons learned from such a pilot project could be scaled up to the rest of Sturgeon Bank and applied to other areas of the Fraser delta front and other estuaries throughout British Columbia.

Allen Beck

Clean Foundation

LESSONS LEARNED FROM A HYBRID LIVING SHORELINE PROJECT ON SALT MARSH RESTORATION

Abstract

Clean Foundation is in the midst of completing a hybrid living shoreline project at Sitmuk to remove waste material, restore salt marsh habitat, and involve the local community. Sitmuk is a tidally flooded cove, also known as Moodie's Cove, within Pictou Landing First Nations. It was a historical wetland complex that was infilled in the 1970s for development. The wetland habitat that remains in place is a fringe salt marsh along the shore of the cove. This marsh helps to reduce wave energy and stabilize the shoreline (i.e., the dense growth of the grass in the marsh baffles the water, attenuating the waves). However, the marsh is narrow, which limits its baffling capabilities, and the shoreline is steep, restricting the migration capabilities of this marsh. To help improve conditions at this site, we have removed rock waste material left on the marsh surface, planted native salt marsh grasses on the site to speed recovery, and deployed shoreline reef balls to encourage the expansion of salt marsh away from shore. This is a hybrid living shoreline project as the reef balls are permanent concrete structures, though the rest of the project is being completed with natural, biodegradable materials. A key factor in the project's completion and long-term success has been the community involvement (e.g., community volunteers planting grass plugs). All restoration works have been completed but management of the site is ongoing, informed by our many lessons learned.

Amaury Camarena

CBCL

MANAGING NATURAL ASSETS TO INCREASE COASTAL RESILIENCE

Abstract

Since 2019, CBCL has worked together with the Municipal Natural Assets Initiative to quantify the value of natural assets, particularly those that provide protection against coastal flooding and erosion. Jointly we have developed a simple, yet reliable, modelling tool that coastal communities can use to understand and compare alternative natural asset management solutions. The Coastal Toolbox was developed in collaboration with two coastal communities that were used as case studies: Gibsons, in British Columbia, and Pointe-du-Chêne, in New Brunswick. The unique characteristics of these sites generated an input matrix of coastal conditions, assets, and climate change related impacts that were used throughout the development of the toolbox. This allowed us to evaluate the merits of natural assets (e.g., coastal vegetation or beach sediments) alongside grey infrastructure. As we continue to bring to light the value — not just monetary, but intrinsic — of natural assets, we also look to see how management of coastal ecosystems can mitigate the risks of flooding and erosion. Our deep dive into these two communities showed us how important natural assets are to coastal communities and illustrated the need for continued assessments of nature-based solutions for climate adaptation.

Michelle Côté[1], Gwyn Lintern[1], Pauline Martens[1], and Phil Clement[2]

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FIELD MONITORING IN SUPPORT OF NATURE-BASED COASTAL INFRASTRUCTURE IN PARTNERSHIP WITH FIRST NATIONS COMMUNITIES IN BC

Abstract

The Geological Survey of Canada is leading field data collection at the two west coast study sites for the Nature-based Infrastructure for Coastal Risk and Reduction Project. This project was co-proposed by federal science agencies, universities, and two municipalities, and uniquely as well included Indigenous Services Canada with a role to ensure that the scientists are meeting the needs of the involved coastal First Nations communities. The first year of the project has focused on relationship-building with Metlakatla First Nation (Metlakatla site) and Semiahmoo First Nation (Boundary Bay site) through online and in-person meetings and articles in community newsletters. Knowledge and information were exchanged to develop field plans that met the unique needs of both community partners, while also meeting the science objectives. Instrumentation including wave sensors, current meters, and interval cameras, were deployed in autumn 2021 and spring 2022. The science team is working to directly involve community members in field activities to document pre- and post-storm conditions and regular download of instruments. Data will be collected through March 2023 to support laboratory and numerical modelling activities at the National Research Council, Queen's University, and the University of Ottawa.

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PIPING PLOVERS AND SAND ENGINES: NEW PARTNERSHIPS ON THE ACADIAN PENINSULA

Abstract

Piping Plovers (*Charadrius melodus melodus*) are an icon of endangered species habitat conservation in Atlantic Canada. Could they also be the flagship for habitat creation and holistic coastal restoration through nature-based approaches in the region? Habitat restoration and creation for Piping Plovers is underway on the Acadian Peninsula of New Brunswick using nature-based techniques. This project features: Atlantic Canada's first "Sand Engine"; the most northern marsh with sill living shoreline built to date; beneficial reuse of dredge material; dune and marsh restoration techniques to restore critical barrier spit habitats; a 15-year post construction monitoring program; and a 5-year expanded scientific monitoring program. Exciting results of year 1 post-construction monitoring of the Sand Engine and lessons learned through the planning, design, and construction of this multi-stakeholder project, as well as challenges and successes in implementing long-term monitoring plans for these nature-based solutions, will be presented.

Adam Fenech, Andy MacDonald, and Luke Meloche

Climate Lab, University of Prince Edward Island

INITIAL EVALUATION OF COASTAL PROTECTION USING NATURE'S FORCES AT EIGHT PROVINCIAL INFRASTRUCTURE SITES ON PRINCE EDWARD ISLAND, CANADA, USING DRONES

Abstract

Coastal erosion remains a constant threat to the fragile shores of Prince Edward Island, Canada. Rates of coastal erosion have been increasing across the Island as a result of climate change – a rising sea level, increasing storm events, and changing phenology of sea ice – resulting in threats to the provincial infrastructure of parks, causeways, lighthouses, and golf courses. On direction and funding from the PEI Ministry of Environment, Energy and Climate Action, the Climate Lab at the University of Prince Edward Island has undertaken drone flights to monitor the vulnerability of the provincial infrastructure from coastal erosion due to climate change. Drone flights using a DJI Phantom 4 RTK RPAS (Remotely Piloted Aircraft System) were conducted at eight (8) provincial infrastructure sites over two years (twice a year) to understand the End Point Rate (EPR or annual rate of change at metres per year calculated by dividing the distance between coastlines by the time elapsed between aerial imagery), and the Net Shoreline Movement (NSM or the distance in meters between the two coastlines examined). Interim results from the first years of the study suggest that coastal armouring approaches using nature's forces to protect provincial infrastructure is successful in half of the cases, allowing for accretion of coastlines rather than erosion. This presentation will describe the provincial efforts at coastal protection, and their initial success.

Negin Ficzkowski

Walter Booth School of Engineering Practice, McMaster University, Hamilton, Ont.

LIVING SHORELINES: A STRATEGIC APPROACH TO CLIMATE ADAPTATION FOR CANADA

Abstract

The accelerated impacts of climate change in coastal areas and the proven inefficacy of resource-heavy aging grey infrastructure have driven shoreline management practices to evolve towards restoration of ecosystem services at the land-water interface. Gaining momentum as an adaptive approach in restoration projects, living shorelines are comprised of natural ecosystem components used in combination or in place of traditional methods to provide coastal protective services and erosion mitigation. The success of living shorelines in protecting coastal property and infrastructure as well as delivering other ecosystem services varies based on the geomorphology, hydrology, and biology of a waterfront region. It is also heavily reliant on social acceptance of the approach and best implementation practices. The relatively lower lifecycle cost and the range of associated co-benefits of living shorelines such as carbon sequestration and water purification have well positioned them as a promising alternative approach in theory. There are, however, gaps in regional long-term datasets and evidence-based guidelines.

This research investigates the underlying geopolitical readiness and opportunities for integrating natural and nature-based solutions in climate adaptation strategy within Canadian shoreline municipalities. The comprehensive review of existing literature complimented with expert interviews in this field aims to identify the barriers within Canadian municipal jurisdiction and inform decisions for minimizing the destructive effects of traditional shoreline protection approaches in the face of climate change. The data synthesized in this study presents applicable insights from other locations to encourage successful implementation of these solutions relative to their ecological, social, and economic benefits.

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DEVELOPMENT AND APPLICATION OF A DECISION TOOL FOR MANAGED REALIGNMENT AND TIDAL WETLAND RESTORATION FOR NOVA SCOTIA'S AGRICULTURAL DYKELANDS

Abstract

The Nova Scotia Department of Agriculture (NSDA) is responsible for 241 kms of dyke and 252 aboiteaux throughout the province. With a mandate to protect agricultural land, management decisions in the past have been focused on traditional hard infrastructure solutions to reinforce existing dykes and infrastructure, or "hold the line." However, in recent years, NSDA has begun the process of managing dykelands differently, and has recently undertaken an initiative that will have proponents assessing not only traditional engineering solutions but potential nature-based solutions as well when determining feasible design options for dykeland system upgrades. As part of this approach, NSDA commissioned TransCoastal Adaptations: Centre for Nature-Based Solutions to develop a Tidal Wetland Restoration and Dyke Realignment Decision Tool as part of a larger *Dykeland Decision Tool (DDT).* Dyke realignment, the process of removing or relocating agricultural dykes, can result in the restoration of tidal wetland habitat, increased coastal protection by way of natural processes, and reduced maintenance costs for infrastructure. Determining the feasibility of managed realignment at a given location requires a wholistic view of the landscape – including geotechnical, biological, hydrological, and ecological parameters. This new approach will ensure that the design option that is chosen will have the greatest impact on the landscape as a whole and that decisions are being made based on the best available science and engineering and factor in climate adaptation options where feasible.

Frédéric Haché and Marion Tétégan Simon

VALORĒS, Coastal Zones Research Institute Inc., Shippagan, NB

SEDIMENTARY DYNAMICS OF BEACH AND DUNES TO ASSESS A COASTAL RESTORATION

Abstract

The village of Le Goulet (New Brunswick) is threatened by coastal flooding due to the degradation of its sand dunes. The impact of climate change in this Atlantic region is increasingly visible and marked; and the communities living in this region are more and more aware of the need of coastal restoration, especially in recent years. In order to restore its dunes, (1) *Ammophila breviligulata* was planted; (2) from 2013, the village built structures from fir trees and lobster cages to capture the sand transported by the wind; (3) and the village made siltings from sediments extracted from dredging works. The village plans to continue silting up with additional sediment from major work planned in its harbor.

In 2014, Valorēs developed a protocol to monitor the sedimentary dynamics of the beach and dunes of Le Goulet in order to assess the effectiveness of restorative structures by carrying out topographic surveys. Another objective of the study is to identify the sectors to prioritize for potential future silting up interventions.

On 5 years monitoring, the majority of transects have experienced seasonal (spring–fall) accumulations of sediment. In addition, it has been observed that some structures seem to contribute to the accumulation of sediment, especially towards the top of the beach. Net gains in sediment volume are measured in areas where it has structures and silting up, while net losses in sediment are measured in areas where it has no structures.

Sade Hanley, Danika van Proosdij, and Min-Jung Kwak

Department of Geography and Environmental Studies, Saint Mary's University, Halifax, NS

PERCEPTION OF FLOOD-RISK AS A COASTAL HAZARD, AND NATURE-BASED SOLUTIONS IN ST. KITTS AND NEVIS

Abstract

The small island developing states (SIDS) of St. Kitts and Nevis has an increased risk to inland and coastal flooding due to sea level rise, and storm surge, exacerbated by weather-related events and erosion. Hard-engineered responses are often favoured to protect these coastal communities but are also associated with many physical, socio-economic, and political barriers. Preservation of coastal ecosystems and implementing nature-based solutions (NbS) are increasingly being applied in SIDS. Considering the under-representation of public perception of climate change risks in SIDS, this research explores local perceptions of flood-risk as a coastal hazard and the application of NbS to mitigate the hazard. A total of 247 Kittitian and Nevisian residents participated in an online survey and 2 civil servants were individually interviewed on Zoom. Participants were asked about their location within flood zones, the impact, and the perceptions of risk to a list of coastal hazards. Kittitians perceived flood-risk as being moderate to storm where Nevisians perceived their risk as being low. Residents believed that hybrid solutions, combining NbS and hard-engineered approaches are viable alternatives in reducing flood-risk in St. Kitts and Nevis. However, they also highlighted a number of barriers to the implementation of these solutions in the Federation which are categorized under five themes. The informational theme, described as the awareness or knowledge of coastal issues and adaptation practices, was the most common theme receiving a total of 39% of the responses. Finally, the recurring themes between the perceptions of flood-risk and adaptions were the (i) Informational, (ii) Socio-political, and (iii) Experience themes.

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NUMERICAL MODELLING OF WAVE-VEGETATION INTERACTIONS VALIDATED USING EXPERIMENTAL DATA

Abstract

Living shorelines having been increasingly used for coastal protection. In Canada, they are typically constructed or restored saltmarshes that may be built alongside other infrastructure on the coast, such as dykes or breakwaters. However, there are still a range of unknowns regarding how they attenuate waves and reduce erosion. Numerical tools provide a critical tool to investigate the behaviour of these systems and examine multi-scale processes that influence their performance. Numerical modelling is a uniquely flexible tool for studying coastal hazards and infrastructure. It offers a level of control not feasible in field studies, and often at a fraction of the cost of flume experiments.

The work presented here is a numerical investigation of the behaviour of individual marsh plants, validated using a novel physical modelling study using plant surrogates. The work of Paul et al. (2016), wherein plastic strips attached to force meters were subjected to waves, was modelled using the computational fluid dynamics software, REEF3D. The model will be further extended to look at the behaviour of real plants, studied in the large wave flume at INRS. The results of this study enable a more complete understanding of how small-scale processes related to plant motion contribute to the performance of the salt marsh as a whole.

Phil Hill

National Resources Canada-Geological Survey of Canada

PALEOGEOMORPHOLOGY OF BOUNDARY BAY, BRITISH COLUMBIA, AND IMPLICATIONS FOR THE LIVING DYKE

Abstract

Boundary Bay is located on the margins of the Fraser Delta, which has built out since the retreat of late Wisconsin glaciers. The Fraser Valley was deglaciated approximately 12,000 years before present. Isostatic depression of the crust under the ice load led to invasion of the entire region by the sea, including the bedrock and Quaternary uplands in the vicinity of Boundary Bay. As the crust rebounded, these uplands, including Point Roberts, emerged from the sea as islands. At the same time, the Fraser Delta began prograding down the Fraser Valley. By 8000 years before present, a large delta channel system had built into Boundary Bay. Delta progradation continued until 4500 years before present, at which time there is evidence that the salt marsh in Boundary Bay extended at least 1 km offshore of the present-day coast. It is likely, from geomorphological evidence, that the tidal flats in Boundary Bay also extended several kilometres further offshore. This suggests that the shoreline in Boundary Bay is in a state of marine transgression (likely due to compaction subsidence of the delta) and is therefore not in equilibrium with the present wave conditions. Therefore, the Living Dyke will not be naturally stable and will need protection against wave attack along its seaward edge. Rising sea level due to climate change will be an order of magnitude faster than relative sea level rise due to subsidence. Continuous replenishment of bed material will likely be needed to sustain the marsh.

Amy Hunt[1], King, Jeffrey[2], and John Jack Wood[3]

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PRESERVING HISTORY: ENGINEERING WITH NATURE AND THE NATIONAL PARK SERVCICE AT ST. CROIX ISLAND, CALAIS, MAINE

Abstract

St. Croix Island, located in Passamaquoddy Bay, just on the United States (US) side of the US/Canada border, experiences some of the highest tides in the world. The island is managed by the National Park Service (NPS) as St. Croix International Historic Site (SACR) under formal agreement between Parks Canada and in consultation with the Passamaquoddy Tribe.
The Passamaquoddy people originally used the site to store food to protect it from mainland animals. In 1604, the island was the site of an early attempt at French colonization; however, due to the severity of the first winter, 35 members of the expedition died and were buried at SACR.

Today, coastal erosion processes combined with tidal currents and a 20+ foot tide range have caused significant erosion, threatening burial sites and archaeological features. Erosion of the island is expected to be exacerbated by accelerated sea level rise (SLR) as well as changes to storm intensity and frequency as indicated by climate change.

Key to the wider application of Natural and Nature-Based Solutions (NNBS) is an understanding of advantages they may offer relative to conventual, “hardened” approaches. To help create this understanding, a complete picture of the project, including its ecologic and economic dimensions is needed. Understanding costs and benefits also include project efficacy (how well does the completed project provide desired outcomes and for how long). EA Engineering, Science, and Technology, Inc., PBC, with support from USACE ERDC, plans to explore the applicability of NNBS approaches for addressing natural and built infrastructure needs at SACR.

Danker Kolijn[1], Phil Osborne[2], and Enda Murphy[3]

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ESTABLISHING REGIONAL CHAPTERS: COLD REGIONS LIVING SHORELINES COMMUNITY OF PRACTICE

Abstract

During the 2021 Coastal Zone Canada Association (CZCA) Conference, a poll conducted by the Cold Regions Living Shorelines Community of Practice (CRLS CoP) identified increasing demand and interest in Nature-Based-Solution (NBS) and living shoreline solutions here in Canada. Conference participants and CZCA members expressed a clear desire for more engagement and knowledge-sharing within the CRLS CoP. To respond to this feedback, the CRLS CoP has established regional knowledge hubs within Canada in the Atlantic, Great Lakes, Pacific, and the Arctic, that are independently organized under a national CRLS CoP umbrella. The intent of these regional hubs is to:

- Organize more frequent gatherings of like-minded professionals to share NBS best practices and experiences within Canada on a quarterly or bi-annual basis.
- Contribute to national initiatives and to facilitate knowledge transfer between practitioners.
- Create regional resources and networks for practitioners.
- Provide the opportunity for the regional hubs to come together into a larger conference setting at the biennial CZCA conference.

In this presentation an update is provided on the CRLS CoP national initiative, the regional leads are introduced, and a framework is presented to move the CRLS CoP forward. Short-, medium-, and long-term priorities for the CRLS CoP are identified. An open discussion and dialogue will be facilitated to receive input on what it will take to keep these regional knowledge hubs active and engaged, while providing meaningful contributions to the professional community and implementing nature-based solutions such as living shorelines concepts in Canada and North America as a whole.

Danker Kolijn[1], Jessica Wilson [1], Lauren Roy[2], Nicole Goñi[2], and Lucie Robidoux[2]

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SYNOPSIS OF NORTH AMERICAN WORKSHOP SERIES ON NATURE-BASED SOLUTIONS TO ADDRESS FLOODING IN COASTAL CITIES

Abstract

In May 2022, the CEC and DHI hosted seven (7) intersectoral workshops with Canadian, American, and Mexican experts from across North America to develop an interdisciplinary community of practice devoted to nature-based solutions to address flooding in coastal cities. The workshop series hosted over eighteen (18) speakers and ten (10) interactive exercises and brainstorming sessions to fill knowledge gaps and barriers to broader implementation of nature-based solutions in coastal cities in North America. The workshop series initiated a 30-month CEC project. The main themes discussed during the workshop series included the co-benefits of nature-based solutions, retrofitting existing infrastructure using nature-based solutions, and monitoring the efficacy of nature-based solutions.

This presentation will summarize the key findings of these workshops and will present an overview of some of the outcomes from the interactive sessions completed by participants. The various gaps and barriers to broader implementation of nature-based solutions will be discussed, along with solutions generated by participants. Lessons learnt which were shared by the multi-disciplinary experts who participated in the workshop series will be summarized and presented within the context of planning, implementing, and monitoring nature-based solutions to address flooding in coastal cities.

Charlotte Large

PEI Watershed Alliance

LIVING SHORELINES: POPULARIZING NATURE-BASED INFRASTRUCTURE ON PEI

Abstract

Living shorelines represent a form of soft shoreline protection that has largely not been implemented on PEI. Three living shoreline demonstration sites were installed along the Hillsborough River as a first step towards making these nature-based solutions more visible and viable on our coastlines. The Alliance used these sites as training opportunities for watershed groups on PEI, through the GreenShores training offered via Saint Mary's University, so that watershed groups can integrate nature-based infrastructure in their own work within the community. As these sites represent some of the first major living shoreline projects on PEI, there were a number of challenges. These included:

1. coordination of many contractors on a technically complex site within a short period of time
2. incorporating intuitive indicators to direct the public away from vulnerable areas of the installation and towards intended public pathways
3. advising private landowners who are interested in pursuing living shorelines on their own property, but for which there are currently no programs on PEI to assist
4. coordinating division of responsibilities between stakeholders within publicly facing areas that are municipally or provincially owned

There are many lessons learned as a result of confronting these challenges, from the planning stage to management post-construction. With regards to project success, watershed groups have reported interest from many private stakeholders in nature-based solutions on their coastal properties. The positive response to these demonstration sites bodes well for the future of living shorelines and nature-based infrastructure on PEI.

Rosmarie Lohnes

Helping Nature Heal Inc.

NATURE-BASED INFRASTRUCTURE FOR STEEP SLOPES IN COLD CLIMATES

Abstract

Climate change is accelerating erosion from increasing storm intensity and flooding. Large sediment losses affect properties, habitat and waterways in various ways. At Helping Nature Heal Inc, we have been testing nature-based erosion mitigation techniques for over 20 years in Atlantic Canada. While we have had many successes, we have also had many opportunities to learn. The reality is, when working with Mother Nature, and learning to mimic what we observe, some of our hard work will fail. When we look through a new lens to allow for trial and error, every failure is an opportunity. Through these actions we are building resilience, protecting biodiversity and slowing erosion. In this session, President and CEO Rosmarie Lohnes will discuss how she has been challenged to adapt as climate change intensifies and has learned more about her own resilience and ability to learn from nature.

Jeremy Lundholm[1], Danika van Proosdij[2], Tony Bowron[3], Jennie Graham[3], Emma Poirier[1], Kirsten Ellis[3], Samantha Lewis[3], and Megan Elliott[2]

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MANAGED REALIGNMENT IN TWO UPPER BAY OF FUNDY DYKELANDS: SYNTHESIS AND LESSONS LEARNED

Abstract

The Making Room for Wetlands project involved dyke managed realignment (MR) and tidal hydrological restoration at two sites in the Upper Bay of Fundy. While both projects can be considered highly successful in terms of tidal marsh restoration, the experience has emphasized the need for clear leadership and project manager oversight during construction and careful attention to cultural/archaeological resource components prior to implementation. The projects have demonstrated that construction activities can leave a legacy of geomorphological effects that need to be anticipated and mitigated. New instrumentation techniques yielded enhanced capacity to understand key processes at MR sites and monitor progress. Nature-based techniques including Living Shorelines were implemented successfully at both Converse and Belcher MR sites and can serve as exemplars in the region.

Sediment accumulated more rapidly at Belcher compared with Converse, likely due to higher sediment concentrations associated with Belcher's location relatively high up in the estuary. Erosion and deposition resulting in changes to site configuration occurred during a relatively small proportion of tides. This study also showed the importance of pre-restoration legacies of vegetation and agricultural drainage networks. Sites that have substantial vegetation remaining from prior land use would likely benefit from mowing prior to tidal restoration. Active planting at both sites with field transplants and propagated plugs was successful. Active planting may prove useful at sites where vegetation recovery is slow. The role of site differences speaks to the importance of pre-restoration data collection and monitoring post-restoration. In addition, the timing of inner dyke construction and re-introduction of tidal flow likely impacted the rate of vegetation establishment and adaptive management required on new dyke infrastructure. The Belcher site was breached in June allowing time for annual plants to establish within the restoration site and newly constructed inner dyke. Full tidal exchange at Converse didn't occur until December and seeding of the new dyke in late fall had minimal success. The timeline for recovery can be fast, as in the case of Belcher, but the slow-but-sure progress at Converse emphasizes the need for long-term monitoring to allow for adaptive management.

Enda Murphy[1], Brent Baron[2], Andrew Cornett[1], Danika van Proosdij[3], Ioan Nistor[4], Ryan Mulligan[5], Tom Duncan[6], Jacob Stolle[7], Paul Knox[1], and Scott Baker[1]

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APPLIED RESEARCH TO INFORM CANADIAN DESIGN GUIDANCE FOR NATURE-BASED COASTAL INFRASTRUCTURE

Abstract

Nature-based solutions (NbS), including hybrid solutions combining green and grey infrastructure, are internationally proven to support coastal flood and erosion risk management. However, they remain underutilized in Canada, owing to uncertainty surrounding performance across diverse coastal settings and the lack of authoritative design guidance tailored to Canadian regional settings. The Nature-based Infrastructure for Coastal Resilience and Risk Reduction project, supported by the Canadian Safety and Security Program and led by the National Research Council of Canada, was launched in 2020. The project has brought together a diverse team of Canadian researchers, practitioners, and community leaders to develop an improved understanding of the performance of NbS in varied Canadian coastal environments. The project involves applying laboratory experiments, field monitoring, and numerical modelling to multiple pilot sites ("living laboratories"). The objectives are to develop: a unique knowledge base concerning the performance of NbS in Canadian coastal settings; new and improved analytical tools to predict and assess the performance of coastal NbS; and design guidance for coastal NbS in Canada. Research plans have been co-developed with local government, Indigenous community partners, and practitioners. The collaboration has generated new knowledge to guide NbS implementation on Canada's coasts, including: species- and site-specific influences on wave attenuation by native salt marsh vegetation under varying tidal regimes; the response of immature (newly planted) marsh plants to waves; interactions between hybrid system components; and new considerations for the design of cobble beaches (dynamic revetments).

Emma Poirier[1], Makadunyiswe Ngulube[1], and Danika van Proosdij[2]

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COMPARISON OF PROTECTION FUNCTION OF A NATURAL *SPARTINA ALTERNIFLORA* MARSH VERSUS FORESHORE CREATED THROUGH MANAGED DYKE REALIGNMENT IN THE BAY OF FUNDY

Abstract

Salt marshes are increasingly being accepted as a form of natural coastal defence by providing erosion protection and flood risk reduction. A natural marsh and a marsh restored through managed dyke realignment were examined and their wave attenuation capacity were compared. Wave heights and vegetation characteristics were examined at these two *Spartina alterniflora* dominated sites in the Bay of Fundy, a hypertidal estuary on the east coast of Canada. Clifton, in the Minas Basin, is the natural marsh, and Aulac, in the Cumberland Basin of Chignecto Bay, is the marsh that was established following managed realignment 11 years prior. RBR wave loggers were installed in a transect of 4 or 5 instruments, starting in the mudflat and extending into the marsh. Significant wave heights were examined for the amount of wave attenuation across the transect. Vegetation surveys were carried out every 4 weeks to measure stem height, density, and above-ground biomass. Both sites mostly experienced a decrease in significant wave height across the transect, with topography playing a large role in the pattern of wave heights. When categorizing waves by wave height at the beginning of the transect, waves in the managed realignment site had similar attenuation trends in the marsh, while in the natural marsh larger waves (>20 cm) were attenuated quicker than smaller waves. Results from these experiments can be used to inform future design and decision making for nature-based infrastructure.

Amanj Rahman, Behnaz, Ghoodoosipour, Paul Knox, Andrew Cornett, and Enda Murphy

National Research Council Canada

EXPERIMENTAL INVESTIGATION OF WAVE AND CURRENT INTERACTIONS WITH IMMATURE *SPARTINA ALTERNIFLORA* SALT MARSH CANOPIES

Abstract

Restored or constructed marsh systems can provide ecosystem services in support of coastal resilience objectives, acting as buffers against waves and erosion. However, most studies of wave attenuation and sediment stabilization by salt marsh vegetation have focused on mature or dense canopies, which may not be representative of conditions in the early stages of a marsh restoration or construction. In this study, experiments were conducted involving immature *Spartina alterniflora* vegetation, installed in NRC's Large Wave and Current Flume (LWCF) in configurations representative of newly constructed or establishing marsh canopies. The response of the vegetation to regular waves (H = 0.1-0.6, T = 1.5-3.25), irregular waves (Hm0 = 0.1-0.6, Tp = 2.25-3.25), and combined waves and currents, was evaluated for a range of water depths resulting in fully emergent to deeply submerged canopy conditions. Wave attenuation was assessed by measuring wave heights at intervals along the vegetation canopy. Two different canopy densities were tested, corresponding to 36 stems/m2 and 81 stems/m2. The results showed that wave attenuation is sensitive to canopy density, water depth, and relative submergence. For the range of test conditions, wave attenuation was relatively insensitive to currents. The results suggest that sparse, immature *Spartina alterniflora* canopies only provide effective wave attenuation in situations where relative submergence is low, with implications for site selection and marsh design. The study findings provide new insight to wave attenuation by immature marsh vegetation native to Atlantic Canada, and threshold hydrodynamic conditions for survival of young *Spartina alterniflora* plants.

Fred Scott, Qimiao Lu, Robert Nairn, and Yarzar Tun

Baird & Associates Ltd.

MID BRETON SEDIMENT DIVERSION FOR DELTA DEVELOPMENT

Abstract

Sediment deprivation, hydrologic alteration, subsidence, sea level rise, and saltwater intrusion have been causing significant land loss in coastal Louisiana. The Breton Sound, Barataria Bay, and Mississippi River Delta have lost approximately 447,000 acres of land, representing one of the highest land loss rates in the world since the 1930s when the Mississippi River was leveed. The levees have successfully provided flood control; however, they have also deprived the coastal ecosystem of the fresh water and sediment supply it needs to survive. To address this problem, a sediment diversion is proposed. The diversion will "reconnect the river" and restore natural processes, which can strategically re-establish hydrologic flows, carry land-building sediments, nourish marshes, and sustain land.

Baird is involved with the numerical modeling and hydraulic design for the Mid-Breton Sediment Diversion (MBrSD) Project which is intended to divert sediment-laden water from the river into Breton Sound to build and sustain land. This presentation will focus on the challenges and successes of the engineering design with specific focus on the delta development model, which is a coupled modeling framework consisting of hydrodynamic, morphologic, and vegetation/wetland growth models (named the OM-LV model). Inclusion of vegetation in the model is necessary to appropriately evaluate the delta development in the receiving basin since it impacts hydrodynamics, sediment transport, and morphologic evolution. The objective of the OM-LV model is to evaluate the long-term morphologic development in Breton Sound (over 50 years) with the inclusion of vegetation growth and wetland morphology.

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PHYSICAL MODELLING OF COBBLE BEACHES FOR SHORELINE PROTECTION: EVALUATION OF EXISTING DESIGN FORMULAE

The potential drawbacks associated with traditional "hard" engineering approaches to shore protection in certain circumstances are widely demonstrated. Grey coastal infrastructure has a limited capacity to adapt to changes in the coastal system, and can contribute to compression or loss of subtidal habitat under rising sea-level conditions ("coastal squeeze"). Increasing attention is therefore being given to softer engineering solutions to coastal erosion and flood risk challenges, such as dynamic revetments.

Dynamic revetments, also known as "cobble berms," use placed gravel- or cobble-sized stones to mimic natural cobble beaches, dissipating waves and providing a degree of protection against coastal erosion. Unlike hard structures (e.g. seawalls), dynamic revetments allow for redistribution of materials and reshaping of the profile when exposed to waves. However, comprehensive design guidance for dynamic revetments is absent, and existing guidance notably lacks recommendations for material particle size selection. Designers must therefore rely on knowledge of local, natural analogues for material selection and profile design, which leads to inconsistent design practices and performance.

This presentation describes experiments in a wave flume at the National Research Council's laboratories in Ottawa, designed to verify existing design formulae for dynamic revetments and explore potential improvements. The response and performance of dynamic revetments with various initial configurations and material characteristics was linked to hydrodynamic conditions. The findings will support the development of improved design guidance, enabling more ready adoption of dynamic revetments as nature-based solutions for coastal flood and erosion risk management in Canada.

Marion Tétégan Simon, Frédéric Haché and Andréa Lebel

VALORĒS, Coastal Zones Research Institute Inc., Shippagan, NB

COASTAL EROSION CONTROL BY RE-VEGETATION OF THE BANKS FROM NATIVE PLANTS AND ECO-FRIENDLY BIOLOGICAL SUBSTRATES

Abstract

In the Acadian Peninsula, one of the major damages linked to the effects of climate change is erosion (by water and by wind). This mechanical process of removing particles is mainly caused by the impact of waves during storm surges. Conventional methods of substrate retention generally consist of making a mechanical modification at the coastline or installing artificial structures (breakwaters or riprap). These types of works, although effective, involve significant monetary expenses which are not always accessible to the public and are not without harmful effects. Several municipalities and citizens from the Acadian Peninsula are already showing concern about this and are looking for solutions to solve this problem, which has grown in recent years.

Valorēs is working on a new project to propose an innovative method of controlling coastal erosion by re-vegetation of the banks. This method consists in creating a natural barrier against water erosion using a cover of native plants and the use of biological substrates (sphagnum-peat mixtures, etc.) capable of promoting their growth in coastal areas. Thus, Valorēs will offer an environmental intervention to the problem of erosion of the Acadian banks. The results of this 5-year project will have ecological and socio-economic benefits: restoration of coastal biodiversity, development of tourism in coastal areas, lower insurance premiums for title deeds, etc.

Marion Tétégan Simon, Frédéric Haché, Marie Pirlet, and Thomas Grandprez

VALORĒS, Coastal Zones Research Institute Inc., Shippagan, NB

PROJECT ADAPTATION PA: A PROJECT TO BUILD AWARENESS TO COASTAL RESTORATION AND CLIMATE CHANGE ADAPTATION

Abstract

Project Adaptation PA is a regional project aimed at identifying and implementing measures to reduce current and future impacts of coastal erosion and flooding in communities at risk along the Acadian Peninsula. The effects of climate change have already been observed in the Acadian Peninsula, as is the case elsewhere across the country. Flooding has occurred in some communities during major storms, particularly in 2000 and in 2010, whereas in other communities, erosion has forced people to move or is currently posing a threat to homes or roads.

Some examples here after. On Miscou Island, the road leading to the famous lighthouse has been damaged twice in recent years. On Lamèque Island, erosion has been worrying the residents of Sainte-Marie-Saint-Raphael, Cap-Bateau, and Pigeon Hill for several years now. Some residents have resigned themselves to moving. Other residents would like to do so but can't afford to and therefore experience stress every time a storm hits. In Maisonnette, the "Chemin des chalets" was threatened by erosion and the wooden boardwalk on the Maisonnette dune was damaged. In Grande-Anse, cliff erosion is a source of concern.

Since 2011, Valorēs works alongside communities in their efforts to adapt to climate change. Its role is to couch scientific information in layperson's terms for communities, and to help communities on strategic planning exercises, cost-benefit analyses of strategies, technical studies, evaluation of strategy feasibility, public consultations, communication and awareness, and implementing adaptation solutions.

Danika van Proosdij[1], Jennie Graham[2], Tony Bowron[2], Julie Purcell[1], Emma Poirier[3], Chris Ross[4], Ryan Mulligan[5], Kevin Bekkers[4], and Bob Pett[6]

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COMPARISON OF MODELLED VERSUS MEASURED HYDRODYNAMICS AT THE ONSLOW-NORTH RIVER MANAGED REALIGNMENT AND TIDAL WETLAND RESTORATION SITE

Abstract

The Onslow-North River managed dyke realignment and tidal wetland restoration project has been a collaborative, innovative initiative between the Departments of NS Public Works, NS Department of Agriculture, NS Environment, CBWES Inc., and Saint Mary's University. After more than 5 years of planning and preparation, full tidal exchange was restored in early November 2021 during the highest tides of the year setting the stage for the restoration of 90 Ha of tidal wetland habitat. Hydrodynamic modelling using Delft 3D was an integral component for design adjustments and selection of final implementation plan. Spatial patterns of sedimentation, sediment flux and water levels were measured throughout the site during the first five spring tides to flood the platform, including low altitude aerial imagery and video. Landforming had a significant impact on spatial patterns of sedimentation and drainage of the marsh surface with very high deposition in flooded dale areas (~4 cm per tide) and less on the crests. As expected, the inlet channel openings responded very strongly to the forces of the tidal bore, re-working material and setting the stage for establishment of an equilibrium form. Velocities and water levels measured in the field will be compared to modelled results using Delft3D. In light of all findings and experience at other sites in the region, the anticipated restoration trajectory will be discussed.

Ivana Vouk[1], Amanj Rahman[1], Rachel Burns[2], Laura Swatridge[2], Enda Murphy[1], and Ryan Mulligan[2]

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NUMERICAL INVESTIGATION OF STORM- AND TIDE-DRIVEN FLOODING ON THE CHIGNECTO ISTHMUS TO ASSESS NATURE-BASED SOLUTIONS POTENTIAL

Abstract

The National Research Council's Ocean, Coastal, River Engineering Centre, with other research partners, is undergoing a number of studies to assess the role of Natural and Nature-based Solutions in managing flood and erosion risk along Canada's coastlines. This presentation focuses on the development of a 2D hydrodynamic flood inundation model along the Chignecto Isthmus, complementing research activities already taking place in the area. Once completed, the model will be used to assess flood mitigating effects of various managed dyke realignment and marsh restoration options including the addition of future sea level rise and storm surges coinciding with high tide. Lessons learned from this exercise will feed into a future guidance document. Current state of development will be presented, along with potential examples of how the model may be used to investigate future potential scenarios.

Dan Walker, Taber Midgley, Ellen Jessup McDermott, and Christopher Small

EA Engineering, Science, and Technology, Inc. (PBC)

INNOVATIVE INTEGRATION OF NATURAL AND NATURE-BASED APPROACHES AND TRADITIONAL KNOWLEDGE TO INCREASE COASTAL RESILIENCY OF POINT HOPE, ALASKA

Abstract

Point Hope is a community of roughly 750 native Alaskans, and sits on a triangular, gravel spit extending into the Chukchi Sea from the coast of western Alaska. For over 2,000 years, Iñupiat people and their ancestors have lived a subsistence lifestyle here, making it one of the longest continually inhabited areas in North America. Due to its location north of the Arctic Circle, Point Hope is experiencing significant impacts associated with the changing climate. Increasingly exposed to coastal storms, due both to sea level rise and changes in seasonal sea ice extent, Point Hope is being adversely impacted by significant coastal erosion and the loss of function of the natural infrastructure its citizens have relied upon for centuries.

Observational evidence indicates the northern end of the spit is eroding at a rate of just under 8 feet per year. In addition to exacerbating coastal erosion, the reduction of sea ice extent negatively impacts the subsistence lifestyle of the local Iñupiat, which is largely based on bowhead whale hunting from the ice. Permafrost degradation, caused by increasing air and ground temperatures, is adversely impacting natural ice cellars (siġluaqs) used for generations to store whale meat and other food stuffs. Work in the area is advancing to address both challenges simultaneously, through the unique integration of traditional knowledge and nature-based engineering approaches. Specifically, conceptual designs for a dynamic revetment and a restored primary dune, including a pilot siġluaq stabilized by thermosyphons, are being advanced.

Paula Whitfield

National Oceanic and Atmospheric Association

ISLAND RESTORATION FOR ENHANCED COASTAL RESILIENCE: A CASE STUDY FROM THE CHESAPEAKE BAY, MARYLAND, USA

Abstract

Coastal habitats, like marshes, reefs, and islands have an inherent ability to reduce waves, and slow the inland transfer of water during storm events, reducing flood risks to coastal communities and under the right conditions are adaptable to a changing environment. Despite these advantages, the uncertainties associated with performance and maintenance of natural infrastructure compared to static conventional infrastructure, is an obstacle to wide-spread acceptance and use of nature-based solutions.

In 2019, the US Army Corps of Engineers, Baltimore District restored the 12-acre footprint of Swan Island in the Chesapeake Bay, presenting an opportunity for partners from NOAA, US Army Corps of Engineers (USACE), US Fish and Wildlife Service, Maryland Department of Natural Resources and USACE Engineering With Nature® Program to monitor and evaluate the performance of the restored Island and to document the process that will serve as a guide for similar projects.

Three years post-restoration, scientists have collected hydrodynamic, vegetation, and elevation data, both on-the-ground and using drones, to gauge project success. This information is critical to informing adaptive management actions for the island and the design and construction of other sediment placement projects in the region and beyond.

Tony Wong[1], Debbie Miller[1], Gary Williams[2], Eric Morris[3], and Enda Murphy[4]

[1]Semiahmoo First Nation
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[4]National Research Council Canada

THE LIVING DYKE: INNOVATION AND COLLABORATION TO MANAGE COASTAL FLOOD RISK AND ADAPT TO CHANGING CONDITIONS IN BOUNDARY BAY

Abstract

The Living Dike Pilot Project is one of several coastal adaptation projects being undertaken collaboratively by the City of Surrey, West Coast Environmental Law, Semiahmoo First Nation, and the City of Delta, which received funding from Infrastructure Canada's Disaster Mitigation and Adaptation Fund. The project is situated in Boundary Bay on Semiahmoo First Nation's traditional territory, where landforms and natural systems have experienced disturbance and change over a variety of timescales in response to natural drivers and human activities (e.g., dyking, population growth). The goal of this innovative project is to pilot a novel approach to adaptation, which involves promoting and encouraging the growth of existing salt marsh habitat seaward of existing sea dikes. The preliminary design for the Living Dike incorporates dike improvements, a constructed marsh bench, thin-layer placement of sediment, stabilizing edge treatments, and experimentation with different marsh planting techniques. The design allows for adaptive management of the system by raising the marsh bench over time to accommodate projected future sea-level rise. Construction of the pilots is scheduled to begin in 2023, with monitoring and adaptive management to continue to 2025. The Living Dike is one of several pilot sites incorporated in a parallel research project led by the National Research Council, which aims to generate new knowledge to inform the design of the pilots, while drawing on lessons learned to support the development of a new Canadian design guide for coastal nature-based solutions.

Emily Baker

Saint Mary's University, Halifax, NS

NATURE-BASED RESTORATION TECHNIQUES IN COLD CIMATE REGIONS

Abstract

Coastal ecosystems are shaped by ecomorphodynamic processes that influence their capacity to protect the mainland against erosion and flooding, and provide habitat for species of conservation and/or commercial value. However, climate change and habitat loss threaten these ecosystems and their functionality. "Building with Nature" solutions, including the construction of sand engines and marsh sills with living shorelines, have been used to restore coastal ecosystems, but neither has been trialed in areas subject to harsh winter conditions. A Piping Plover habitat compensation project currently underway at a barrier spit near Shippagan, New Brunswick, is piloting both techniques in Atlantic Canada, with the intent of restoring degraded sandy beach, sand dune, and salt marsh habitats. The proposed research seeks to address knowledge gaps surrounding a) the feasibility of employing these restoration techniques in cold climate regions and their ecomorphodynamic and ecological impacts, and b) whether habitats restored using such techniques are ecologically comparable to their natural counterparts. A longitudinal study will analyze how restored habitats change seasonally and over time, while two comparative studies will assess how the restored beach-dune system and the restored marsh compare with nearby naturally occurring ones. Geospatial, environmental, and ecological data, collected seasonally, will be examined through an ecological integrity lens: Analyses of biodiversity, geomorphology, and food web dynamics will be used to assess the composition, structure, and function, respectively, of the restored habitats. These results will improve our understanding of how restoration methods influence barrier spit ecosystems in cold climates, and how cold climates influence restoration outcomes.

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ONSLOW-NORTH RIVER MANAGED DYKE REALIGNMENT AND TIDAL WETLAND RESTORATION PROJECT

Abstract

The Onslow-North River managed dyke realignment and tidal wetland restoration project is a collaboration between the Nova Scotia government, researchers, and industry. It has two main goals: to increase local flood resilience and to restore an important tidal wetland ecosystem. This poster will document the stages of project implementation since 2015 including marsh body consultation, design, modelling, earthworks, breach, and public education. In October 2021, the existing dyke along the Salmon and North Rivers was breached with an excavator during neap tides at several key locations, allowing tidal waters from the river to return to the floodplain. In early November 2021, the first high Perigean Spring Tides flooded the entire site up to the modelled boundary, setting the stage of ultimate restoration of 90 ha of tidal wetland habitat. Ultimately, this project will create fish and wildlife habitat and contribute to reducing flood risk in Truro, therefore enhancing local biodiversity and climate resilience. In addition, it provides an important case study and public demonstration site for additional large, complex dyke managed realignment projects in the Bay of Fundy.

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CHARACTERIZING THE EVOLUTION OF A RESTORING SALT MARSH LANDSCAPE WITH LOW ALTITUDE AERIAL IMAGERY AND PHOTOGRAMMETRIC TECHNIQUES

Abstract

In Nova Scotia, Canada, managed realignment, a form of nature-based adaptation to the effects of climate change, is being used to restore natural salt marsh systems which provide many benefits including coastal erosion protection and vital habitat. This study utilized remotely piloted aircraft systems equipped with real-time kinematic (RTK) positioning corrections to monitor and measure morphodynamic changes at a managed realignment site in the Bay of Fundy with resolutions and accuracies not achievable with traditional methods. Sedimentation patterns and channel network evolution were analyzed using remote sensing and GIS techniques. Results show strong seasonal signals in the morphological evolution of the site, and variations in sedimentation patterns and channel characteristics between areas with and without relic agricultural features. RTK positioning functionality improved achievable product accuracies and increased the magnitude of measurable change in sedimentation analyses, and hyperspatial resolutions allowed for the mapping of embryonic channel features.

Rosmarie Lohnes

Helping Nature Heal, Inc.

HYBRID STRATEGIES TO INCREASE LIFESPAN OF TRADITIONAL METHODS

Abstract

Collaboration by utilizing traditional and Nature-based systems to preserve our coastline may be the most effective strategy in many cases. Nature-based systems can extend the life of pre-existing rock walls and engineered structures, and re-establish ecosystem services lost in traditional methods.

Patricia Manuel[1], Kate Sherren[2], Danika van Proosdij[3], and Eric Rapaport[1]

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MAKING ROOM FOR MOVEMENT: A FRAMEWORK FOR IMPLEMENTING NATURE-BASED COASTAL ADAPTATION IN NOVA SCOTIA

Abstract

Making Room for Movement: A Framework for Implementing Nature-based Coastal Adaptation in Nova Scotia supports decision-makers and coastal practitioners in selecting natural approaches over hard engineering for managing coastal impacts of climate change. Funded by Natural Resources Canada between 2018 and 2020, a multidisciplinary team of researchers and practitioners, through the TransCoastal Adaptations Centre for Nature-Based Solutions, studied scholarship and best practices, and explored the geomorphic, socio-demographic, cultural, jurisdictional, governance, planning, and regulatory context of Nova Scotia to form guidance and strategies for implementing nature-based adaptation. This poster presents the Framework structure, and key findings of the research that informed its development. Nova Scotia's coastal geology and geomorphology, tidal range, and settlement history create a diverse coastal landscape. This diversity ensured the opportunity to explore a variety of NbCA options within the same planning and governance context. The framework can also be adapted for other coastal jurisdictions, particularly in Atlantic Canada given the similarities in coastal environments, settlement patterns, jurisdiction, and governance across the four Atlantic provinces. The guiding principles are universal and therefore widely applicable: working with nature increases resilience to climate change impacts along Canada's Atlantic coast.

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ASSESSING THE SUITABILITY OF NATURE-BASED ADAPTATION TECHNIQUES FOR COASTAL EROSION IN PRINCE EDWARD ISLAND

Abstract

Coastal erosion rates on Prince Edward Island (PEI) are increasing due to climate change. Wave action continuously works on the unconsolidated till and sandstone banks, eroding and receding coastlines, while nourishing beaches and estuaries. This causes intensified risk to properties, infrastructure, and humans. Hard structures disrupt the natural land-water interaction as wave energy is deflected at the structure and dispersed to adjacent areas, increasing erosion. Nature-based solutions (NbS) are used as alternatives to hard structures by incorporating natural materials, such as vegetation, to provide coastal protection. Certain characteristics and baseline conditions such as vegetation, geology, geomorphology, sediment, and differing exposure types are required for NbS to reap their intended benefits. Tools to assess site suitability for NbS, available online or through documents, are critiqued based on how well the tool characterizes PEI. A multicriteria analysis (MCA) was conducted in ArcGIS Pro to identify segments of the shoreline that were suitable, moderately suitable, unsuitable, and unnecessary for implementing NbS. The analysis resulted in 37.9% of PEI's coastline to be suitable for NbS, while 34.1% was moderately suitable. Implementation of NbS cannot be determined solely by the land owner. Permits and applications are required to modify a coastline, wetland, or buffer zone in PEI. Depending where the NbS is to be installed, there are different requirements by varying levels of government. A guidance document and chart are created to help maneuver the steps of implementation of NbS on PEI. With these resources, the NbS implementation process becomes straightforward.

Makadunyiswe Ngulube[1] and Danika van Proosdij[2]

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COMPARING THE PROVISION OF PROTECTIVE (WAVE ENERGY DISSIPATION, EROSION PREVENTION) AND ECOSYSTEM SERVICES (HABITAT, PRIMARY PRODUCTIVITY, BLUE CARBON) OF A NEWLY CONSTRUCTED MARSH SILL TO A NATURAL MARSH

Abstract

A field-based study was carried out at Clifton Marsh, Nova Scotia, in the Bay of Fundy. The aim was to determine the wave dissipation potential of salt marsh vegetation in a temperate, hypertidal estuary. A transect was set up with 4 RBRduet3 T.D|wave16 — temperature & pressure loggers extending from the mudflat to the vegetated section dominated by *Spartina alterniflora*. Data were collected from mid-June to early December 2020. For each two-week dataset, the data was sorted to include only that with a depth greater than 0.1 m, and events were selected to have a significant wave height that is greater than 0.05 m. Vegetation surveys were carried out bi-weekly to measure the various parameters such as the stem height, stem diameter and the width of the middle top parts of the leaves. The results of the study showed that over 60% of the wave energy is dissipated within the first 10 m of the transect, and by 50 m, complete wave attenuation had occurred (Ngulube, 2021).

This research demonstrates that the presence of vegetation on salt marshes plays an important role in wave dissipation and attenuation. To further investigate this finding, a field study will be conducted on the Chiasson Spit, adjacent to the Shippagan Gully, located in New Brunswick. This is a habitat offsetting, or a conservation allowance, proposed to mitigate the unavoidable alteration of Piping Plover Critical Habitat at the site. The purpose of this research is to quantify and compare the protective and ecosystem services of a natural marsh in the Acadian Peninsula, to those of a newly constructed marsh sill (created using beneficial re-use of dredge material). Wave energy dissipation will be measured using RBRduet³ T.D|wave16 — temperature and pressure sensors. Erosion reduction will be quantified upon carrying out repeat Remotely Piloted Aircraft System (RPAS) and measuring the erosion rate at the marsh edges. Field cameras will be mounted to record habitat use at both sites. Heat motion maps will be generated using a Python script to show where habitat use is optimum. The primary productivity will be calculated upon collecting aboveground biomass samples. Sediment cores will be taken by each vegetation plot. The results from the study are expected to indicate that the marsh sill with living shoreline may equal natural marshes in most aspects. This research will provide empirical data which will be included in formulating engineering design standards for living shorelines.

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FOUR SALT MARSH RESTORATION PROJECTS IN NEW BRUNSWICK

Abstract

Salt marsh restoration accesses ecosystem services in coastal areas where they have been lost or reduced due to anthropogenic activities. Our objective is to present four ongoing salt marsh restoration projects in New Brunswick, which are occurring in different water bodies and with different starting conditions. Ultimately, we are interested in defining critical phases of restoration that are specific to a project's location and site history, as well as those that can apply regardless of these. The four restoration projects are as follows. (i) Aulac is in its 12th year of a managed realignment, located at the head of the upper Bay of Fundy with relatively high wind and wave exposure, megatidal, and a former pastureland. (ii) Rockland is 2 y old, located along the Memramcook River in the upper Bay of Fundy, protected, megatidal, and a former freshwater impoundment. (iii) Musquash is 4 y old, located in the Musquash Estuary and adjacent to a Marine Protected Area in the outer Bay of Fundy, macrotidal, and a former freshwater impoundment. (iv) Rivière-du-Nord is 2 y old, located at the head of Caraquet Bay in the southern Gulf of St. Lawrence, influenced by much freshwater input, microtidal, and a former freshwater impoundment. We conduct various monitoring activities, including sediment deposition, on-the-ground and remote vegetation dynamics, invertebrate dynamics, salt pool establishment, hydroperiod, and use by fish. Our work contributes to best practices for salt marsh restoration in the diversity of soft-sediment shorelines, tidal regimes, and site histories in Maritime Canada.

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MODELLING CULTURAL ECOSYSTEM SERVICES IN AGRICULTURAL DYKELANDS AND COASTAL WETLANDS TO INFORM CLIMATE ADAPTATION DECISIONS: A SOCIAL MEDIA DATA APPROACH

Abstract

The management of agricultural dykelands and coastal wetlands around Canada's Bay of Fundy faces challenges to address rising sea levels under the influence of climate change. Today, the 242 km system of dykes on the Nova Scotia side of the Bay protect 17,364 ha of increasingly diverse land uses. Managers will have to decide which dykes to reinforce, which to realign or remove, and where to restore wetlands. These decisions will have important impacts on the ecosystem services provided by different landscapes and therefore information from ecosystem services needs to be taken into account to support decision-making. Cultural ecosystem services (CES) are non-material benefits that play a significant role in human-nature relationships and human well-being. Previous work indicated strong local dykeland attachments and CES but provided little insight about tidal wetlands. We take the Ji'juktu'kwejk/Cornwallis River as a study area, identify the CES provided by the area through text analysis of Instagram data, and map the CES in the study area through the SolVES model combined with environmental data, revealing the difference in the delivery of agricultural dykelands and coastal wetlands. The results show that agricultural dykelands have a higher supply capacity for cultural heritage/diversity, education and knowledge systems, recreation and tourism, social relations and relational values, and spiritual CES. Coastal wetlands have a higher supply capacity for aesthetics, inspiration and art, and sense of place and terroir. Both agricultural dykelands and coastal wetlands show multifunctionality, with an average of 1.5 services provided by a given area of agricultural dykeland and 2.6 services provided by coastal wetlands.