

Eco-Cultural Restoration of the K'omoks Estuary



2021 Final Report

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Executive Summary

'Eco-Cultural Restoration of the K'omoks Estuary' is a project developed by the Guardians of Mid Island Estuaries Society (GoMIES) in partnership with the K'omoks First Nations (KFN) Guardian Watchmen. The goal of this project is to protect and restore *Carex* sedge habitat within the brackish high marsh zones of the K'omoks estuary at risk due to overgrazing by locally overabundant Canada Goose (CAGO) populations. The Eco-Cultural restoration prescriptions implemented by this project address priority one actions identified in the 2017 FWCP Puntledge River Watershed Action Plan (PUN.RLR.HB.14.01 Implement habitat restoration of the K'omoks estuaryP1) and the 2011 Comox Valley Project Watershed Society K'omoks estuary restoration plan.

Eco-Cultural estuary restoration involves the modification of traditional fish weir techniques to a more modern purpose to restore and protect productive *Carex* marsh habitat to increase salmon survival at the K'omoks estuary. *Carex* sedge habitats and other marsh vegetation will be protected from further Canada Goose herbivory by the construction of a series of wooden fences made from alder poles and willow branches to construct natural restoration exclosures.

In 2018, the project focus was to exclude critical sedge marsh habitats in Comox/Dyke slough locally known as the Hollyhock flats where extensive Canada Goose herbivory had severely degraded *Carex* channel edge habitats in this part of the K'omoks estuary. Alder poles were used to support green snow fenced sites to exclude Canada Geese. A large exclosure was erected within a portion of the estuary that was totally denuded of all marsh vegetation and *Carex* plugs were transplanted within this exclosure. Approximately 4,160 m² of prime high marsh channel edge habitat was protected in 2018.

In 2019/20, exclosure techniques evolved to what we refer to as Eco-Cultural Estuary Restoration (100% all-natural wood and hemp rope with no plastics) as we created several more restoration sites and expanded the original exclosures. All the green fencing was removed and replaced with willow. We also started the process to speed up recovery by transplanting *Carex* plugs to suitable habitat sites devoid of any marsh vegetation. We completed a five-year restoration plan in 2020 thanks to seed funding from the Habitat Conservation Trust Foundation that now guides our work.

Considerable expansion of Eco-Cultural Restoration exclosures were made through FWCP support in 2020/21 which now protects *Carex* dominated estuarine habitat exceeding 18,200 m². KFN and GoMIES transplanted 8,572 individual *Carex* sedge plants into denuded mudflats within these habitat exclosures during the spring of 2020 and 2021.

GoMIES also worked with community stewardship leader Project Watershed to ensure the public was aware of this project. Three local media stories provided the Courtenay/Cumberland/Comox communities information on this project. Four interpretive signs were also installed off public walkways and estuary viewpoints in partnership with the City of Courtenay, Project Watershed, KFN, and the Comox Valley Regional District. The public and members of KFN and Project Watershed have continued to be very supportive of this project especially now that all habitat exclosures are made from all-natural wood and implemented by our unique hands on Eco-Cultural Estuary Restoration approach.

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Background

Estuaries are known to be the most productive ecosystems in North America. They provide critical fish and wildlife habitat, and therefore their protection and rehabilitation are of the utmost importance (Gaboury, M. *et al.* 2012). Over 30 Conservation organizations, stewards, and partners have spent over \$20 million to secure, maintain, and restore east coast Vancouver Island estuaries since the 1980's. The K'omoks (Courtenay River) estuary is ranked as a class 1 estuary and among the top 8 in BC (Pacific Coast Joint Venture 2007). This estuary has been impacted by urban development which has hardened most of its floodplain due to road and dyke systems and a variety of industrial users over the past 100+ years. The watershed has a diverse group of users. Industry uses other than hydro-electric generation include forestry, agriculture, and mineral exploration. Hydroelectric facilities were built in 1912 and include a storage dam at the outlet of Comox Lake and a diversion dam 3.7 km downstream. Water is carried 5 km by an overland penstock to a powerhouse on the lower Puntledge River. From 1953-56, shortly after BC Hydro acquired the assets, the dams and powerhouse were redeveloped, and Comox Lake storage was increased. Both Comox Dam and the Diversion Dam have fishways to facilitate upstream fish passage. The loss of intertidal estuary habitat during this time severely impacted the river and estuaries ability to support juvenile salmon during critical life-cycle stages.

During the past 20 years efforts to restore the estuary have gained widespread public acceptance along with a transition away from industrial activities. Stewardship groups, conservation organizations, K'omoks First Nations, and local governments have acquired land adjacent to the estuary along with riparian floodplains and farmland within the lower Puntledge River/K'omoks estuary floodplain. The enhanced awareness of these efforts has highlighted the importance of the K'omoks estuary for fish and wildlife, flood control, and public recreation and has placed a greater urgency to conserve and restore modified habitats within the estuary. The K'omoks First Nation (KFN) supports the recent efforts of Project Watershed, Ducks Unlimited Canada, the Nature Trust of BC, Comox Valley Land Trust, and the on-going funding support of BC Hydro's - Fish and Wildlife Compensation programs and the Habitat Conservation Trust Foundation, DFO, and many other organizations who have contributed to the protection, monitoring, and restoration of the K'omoks Estuary and its watershed. The KFN have partnered with the City of Courtenay, the Comox Valley Land Trust, and Project Watershed to acquire the former Fields Sawmill site adjacent to Comox Slough for the purpose of restoring natural habitats to benefit, salmon, wildlife, and the community. The implementation of this estuary marsh restoration plan will significantly improve *Carex* sedge marsh habitats adjacent to this site which will help facilitate quicker recovery of the restored former industrial lands and the Comox Slough provincial conservation lands.

Estuary Restoration Issues and Recent Progress

Since 2015, the KFN Guardian Watchmen have worked with the Guardians of Mid Island Estuaries Society (GoMIES) to address a new emerging issue that is severely impacting estuaries within the KFN traditional territories. Overabundant resident Canada Geese (CAGO) have over-grazed estuarine marshes in the K'omoks estuary over the past 5-10 years which has caused significant erosion of the marsh platform in the estuary and a loss of *Carex* channel edge communities in places like the "Dyke Slough" off Comox Road (among several other locations). In 2018 GoMIES and the KFN Guardians started a pilot *Carex* sedge marsh protection and restoration project to stop CAGO herbivory in these important salmon fry and migration habitats. Eco-Cultural restoration techniques involving all-natural wood enclosures were implemented in 2019, and the total area of protected habitat has nearly tripled since our inaugural year to over 18,000 m². The KFN is taking a lead role in the protection of the estuary and a key step has been to prevent further estuary destruction by resident geese and to work with GoMIES, Project Watershed, and other groups working to restore estuarine habitat.

Introduction

Year-round resident CAGO and a variety of “visiting” sub-populations (Clermont, H. 2015), have been directly linked to over-grazing and grubbing of channel edge vegetation dominated by species such as the highly productive Lyngbye’s Sedge (*Carex lyngbyei*), leading to the erosion of productive sediment/soils and the collapse of marsh benches on most estuaries found along the east coast of Vancouver Island (Figure 1). Since 2015, the Guardians of Mid Island Estuaries Society (GoMIES) have worked closely with the K’omoks First Nation (KFN) Guardians to address a new emerging issue that is severely impacting estuaries within the KFN traditional territories. Overabundant resident Canada Geese (CAGO) have over-grazed estuarine marshes in the K’omoks estuary which has caused erosion of significant marsh and beach structure in the estuary. The greatest loss of *Carex* channel edge communities in the K’omoks Estuary occurs in the provincial conservation lands called the Dyke/Comox Slough off Comox Road. Several other locations are at risk with over 1000 resident Canada Geese observed feeding on the K’omoks estuary in September 2021.



Figure 1. Canada Geese grubbing *Carex* rhizomes, which lead to marsh platform erosion at the K’omoks Estuary, January 2018.

The scientists, fisheries, and wildlife biologists involved with GoMIES believe there is a direct link towards declining Chinook salmon stocks (and other salmonids) and loss of estuarine cover and productivity due to Canada Goose herbivory at several estuaries along the East coast of Vancouver Island including the K’omoks estuary. In 2010, GoMIES implemented a pilot project which included the installation of 16 exclosures on the Little Qualicum and Englishman River estuaries. Over the next three years during peak growing seasons, vegetation surveys were conducted along transects within each exclosure which were 50-100m² in size and compared to equivalent adjacent non exclosed plots. Since 2014, the Guardians have begun to restore *Carex* sedge channel edge communities at the Little Qualicum and Englishman River estuaries by both transplanting healthy *Carex* plugs and installing temporary fencing to prevent CAGO herbivory. This project builds on techniques that have been tested and proven effective in other estuaries.

Goals and Objectives, Measurables, and Linkage to FWCP Action Plans

The primary goal of Eco-Cultural estuary restoration is to generate high quality forage and rearing habitat for juvenile salmon and significantly increase the primary productivity of the K'omoks estuary by protecting vulnerable sites and by re-vegetating denuded and degraded areas with *Carex* dominated estuarine marshes.

The Dyke/Comox Slough were found to have the most fish use during the formulation of the Comox Valley Project Watershed Societies' 2011 estuary restoration plan. This zone has recently suffered the greatest degradation by Canada Goose herbivory and has the most potential for immediate protection and enhancement through our proposed habitat-based actions. Creating expanded intact sedge marshes will be critical for the successful restoration of the adjacent former Fields sawmill site (once acquired) as potential *Carex* donor sites and for natural *Carex* colonization.

Our project helps to implement priority one habitat-based actions identified in the 2017 FWCP Puntledge River Watershed Action Plan and specifically PUN.RLR.HB.14, 15, and 16.01 to Implement habitat restoration or habitat-based actions in the Comox Slough/Dyke Slough...K'ómoks estuary-P1.

The following objectives were outlined:

1. Construct Eco-Cultural estuary exclosures to protect vulnerable *Carex* channel edge habitat and to facilitate *Carex* restoration success and transplant *Carex* plugs into denuded mudflats.

Measurables: *Carex* habitat protected and restored in m²/hectares, numbers of *Carex* plants transplanted leading to improved fish use from enhanced habitat structure and resiliency of the estuary.

2. Train K'omoks First Nation Guardians to become skilled at Eco-Cultural restoration, Canada Goose mitigation and site monitoring.

Measurables: Numbers of Guardians skilled to carry out all aspects of project monitoring, data collection, and to sustain restoration sites over the long-term. Indigenous Guardians proficient in Canada Goose nest searches and egg addling.

3. Promote research and awareness of Eco-Cultural restoration techniques to improve fish and wildlife habitats in the K'omoks estuary.

Measurables: Quality of interpretive outreach information and signage which highlights the role and contributions of KFN Guardians and community stewards. Information bulletins, local media updates, and information sharing with Project Watershed regarding how our work complements their efforts to protect other habitats within the estuary and watershed.

4. Update the comprehensive habitat map to show locations of healthy *Carex* channel edge communities, degraded or at-risk *Carex* marsh habitat, and denuded mud flats suitable for restoration.

Measurable: Updated habitat polygons showing progress to protect and restore key habitats in the K'omoks Estuary.

Study Area and Restoration Map

The priority habitat representing the project study area involves high marsh, brackish channel edge vegetative communities found along the lower Courtenay River, Comox Slough, Courtenay Airpark lagoon, and confluence of Millard Creek with the K'omoks Estuary, all of which contain high value fish and wildlife habitat that is vulnerable to CAGO over-grazing within the K'omoks Estuary (Figure 2).

Methods

Starting in the spring of 2018, GoMIES used GIS software to create georeferenced polygons and photos that identified healthy *Carex* donor sites, priority sites requiring immediate protection from Canada Goose herbivory, and fully denuded sites requiring long-term restoration. These maps have been continuously updated to show areas currently protected, and areas targeted for future restoration as identified in the FWCP Action Plan and 2011 Estuary Restoration Plan. (Figure 2).

Eco-Cultural estuary restoration is a modification of traditional fish weir techniques to a modern use to restore vital estuary habitat to enhance salmon survival. Habitat exclosures to prevent CAGO herbivory and degradation to the marsh platform are built by using 100% natural materials from locally sourced alder, willow, and hemp twine. Large 3.5"-5" diameter 2m to 2.4 m high alder poles will be "hand cut and sharpened on one end" and installed in the estuary by using a 6" diameter post pounder. Long slender willow and alder branches (2-3m long) will be woven through the larger alder poles to create all wood exclosures stronger and more natural than previously constructed snow fence and rebar structures which required regular cleaning/maintenance. GoMIES have recently obtained a permit from the Ministry of Transportation and Infrastructure (MOTI) that allows our Society with First Nations partners to harvest young alder and willow from highway right of ways from Qualicum Beach to Campbell River. The cost to make the Eco-Cultural restoration wooden structures is lower than purchasing fence posts, rebar, and plastic snow fencing from big box hardware stores. The wood source is donated by MOTI and the cost to manufacture the alder poles and willow stakes is mostly First Nations and Guardians labour, tools, and transportation costs. This work is best achieved in the late winter to late spring which is typically a slow period for the KFN Guardians.

Carex plugs will also be transplanted into fully denuded substrates within the main exclosure system and into exclosures completely devoid of any vegetation. A large custom-made all metal extractor tool designed by GoMIES will collect cone shaped plugs from healthy sedge marsh donor sites. Each *Carex* plug typically contains the roots and rhizomes of 3-5 *Carex* plants. *Carex* plugs are then transported to restoration sites using blue fish totes and our tool is used to remove a similar sediment plug where we then inserted the transplanted plug. We have learned that *Carex* can be successfully transplanted in late February to mid-May using this technique. We made new *Carex* plug extractor tools that were stronger than our original design in 2019 which proved very effective in collecting and transplanting plugs to the restoration sites.

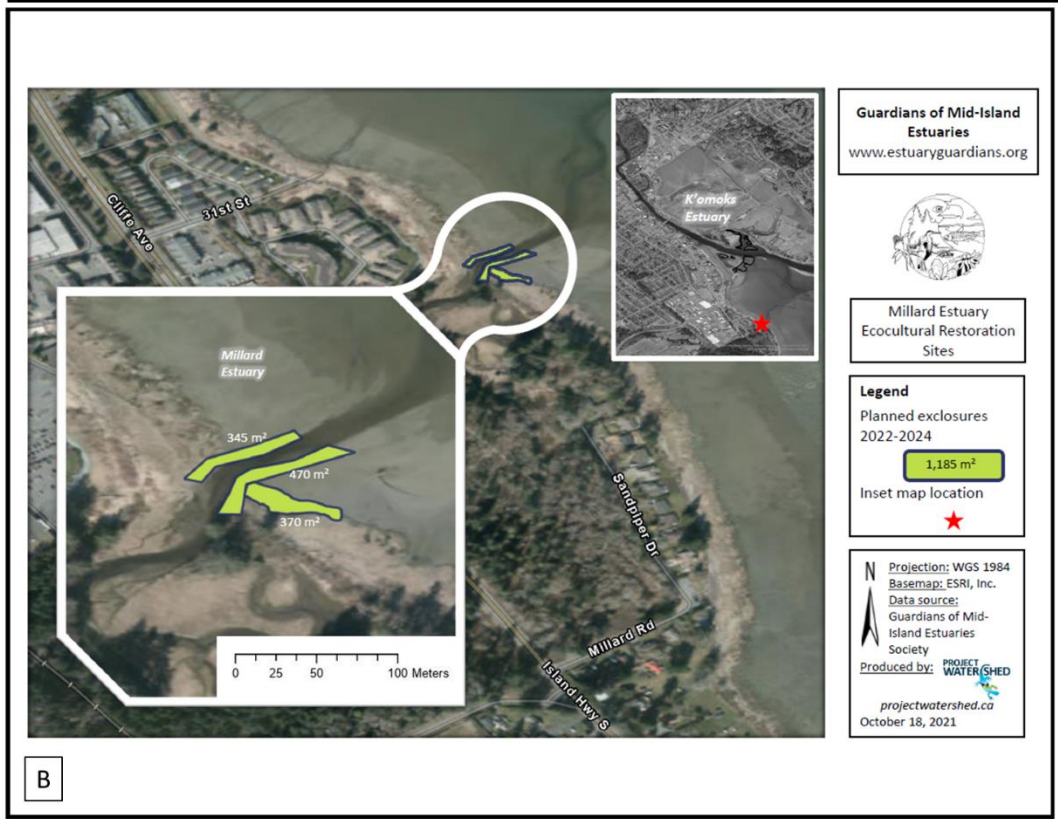
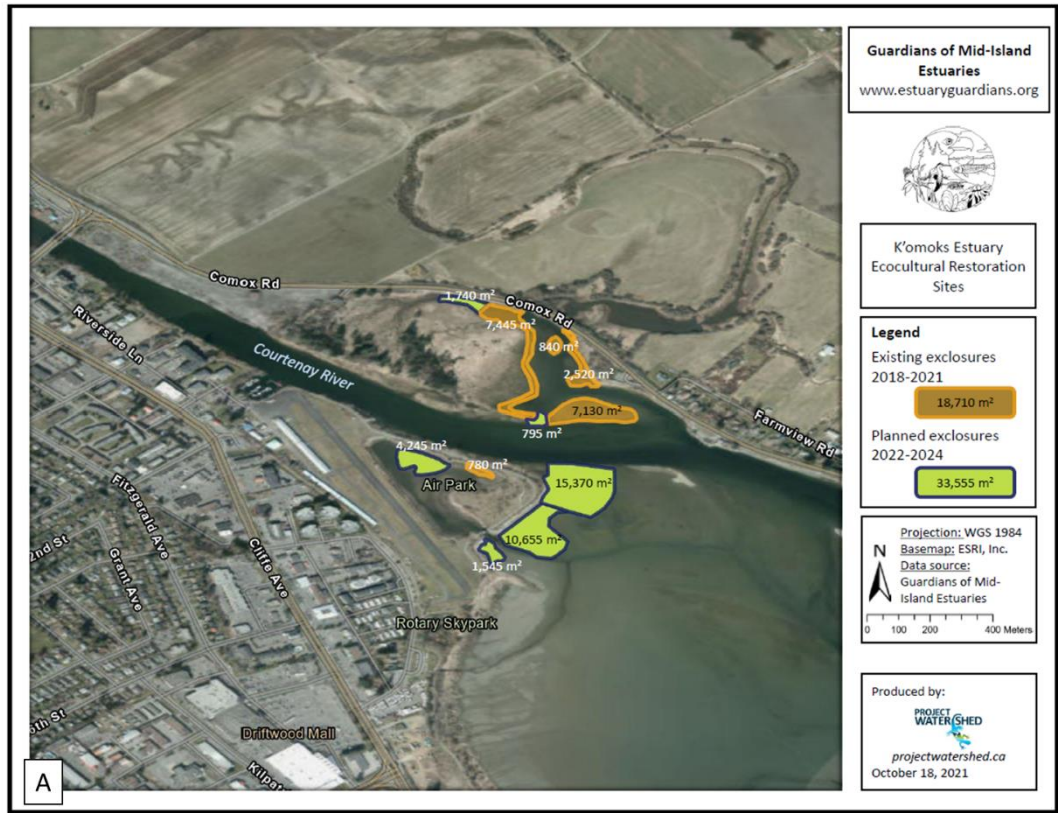


Figure 2. A) Eco-cultural restoration sites established 2018-2021, and proposed restoration sites for 2022-2024 at K'omoks Estuary. B) Proposed eco-cultural restoration sites at nearby Millard Creek.

Results and Discussion

Each of our objectives achieved measurable successes:

1. Objective: construct Eco-Cultural estuary exclosures to protect vulnerable *Carex* channel edge habitat and to facilitate *Carex* restoration success, and transplant *Carex* into denuded mudflats.
 - Measurables: *Carex* habitat protected and restored in m²/hectares, numbers of *Carex* plugs transplanted leading to improved fish use from enhanced habitat structure and resiliency of the estuary.

During the funding period we more than doubled protected habitat area by constructing over 18,200 m² of new eco-cultural fence to protect remnant habitat and transplanted 8,572 *Carex* shoots. In preparation for the 2022 field season, we have identified the highest priority areas to extend eco-culturally fenced habitat to protect at least another 9,000 m² (Table 1).

Table 1. Summary achievements in the K'omoks Estuary

Year	Exclosure Area Established (m ²)	Number <i>Carex</i> Shoots Transplanted
2018-2020	7,100	1,000
2020-2021 (completed)	11,100	8,572
Total completed	18,200	9,572
2022-2023 (targeted)	8,000	15,000
Expected total (2023)	26,200	24,572

2. Objective: Train K'omoks First Nation Guardians to become skilled at eco-cultural restoration Canada Goose population control and monitoring.
 - Measurables: Numbers of Guardians skilled to carry out all aspects of project monitoring, data collection, and to sustain restoration sites over the long-term.

Over the 2020/21 field seasons 6 full-time KFN Guardians worked on this project and 4 junior Guardians and half were new to this project. We did train 6 KFN Guardians to find goose nests and addle their eggs at three nearby estuaries (Tsable River, Fanny Bay Nature Trust, and Rosewall Creek Federal lands). We hope to expand this work in 2022 to help reduce CAGO juvenile recruitment from the estimated 100+ nests throughout Baynes Sound and Denman Island.

3. Promote research and awareness of Eco-Cultural restoration techniques to improve fish and wildlife habitats in the K'omoks estuary.
 - Measurables: Quality of interpretive outreach information and signage which highlights the role and contributions of KFN Guardians and community stewards.

In 2019, two Signs were installed along the Courtenay Air Park estuary viewpoints and in 2020/21 one each at the Comox Road Rotary Park and off the Oyster River trail near former UBC Farm and Woodhus slough conservation area. Project Watershed continues to share project information on their web site.

In recognition of the expanding application of our restoration actions, we are recruiting additional academic support to quantify the ecological success of our work in the K'omoks and other regional estuaries. With the support of a PhD student and a post-doctoral researcher starting in 2022, we will be able to assess rates of *Carex* recovery to build a model of anticipated timelines toward a stable *Carex* habitat that does not require restoration intervention. Establishment of long-term monitoring plots at the time of transplant will facilitate a 'Before-After-Control-Impact' design to quantify transplant success rates, and rates of above- and below-ground sedge biomass expansion compared to biomass recovery of remnant sedge vegetation impacted by goose grazing. This monitoring will be used to comparatively assess cost-benefit of using nursery stock plants or locally sourced transplants, and optimal transplanting design strategies across elevation and salinity gradients to facilitate recovery of remnant vegetation.

4. Update the comprehensive habitat map to show locations of healthy *Carex* channel edge communities, degraded or at-risk *Carex* marsh habitat, and denuded mud flats suitable for restoration.
 - Measurable: Updated habitat polygons showing progress to protect and restore key habitats in the K'omoks Estuary.

Maps have been updated as of October 15, 2021, to reflect completed work through the summer of 2021, and future restoration objectives that will encompass the 2022 and 2023 field seasons (Figure 2.).

Project Milestones - Task/Completion Dates

October 2019: Updated habitat restoration map illustrating 2018/2019 restoration sites and proposed future restoration sites (Figure 2 A & B).

March 2020: Obtained renewed BC Permit from FLNORD after they approved our annual report and proposed restoration expansion plans through 2021. We will request a 3–5-year permit in 2022 for expanded restoration activities.

Ongoing: Photo monitoring and a regularly updated photo library to document all phases of our restoration project.

March/April 2020: Transplanted over 5,000 *Carex* shoots into protected denuded mudflats.

April to August 2020: Built several new eco-cultural restoration enclosures to protect and restore an additional 11,000 m² of *Carex* sedge marsh habitat for a total of 18,200 m² now protected from CAGO herbivory.

September 2020: Restoration plan mapping updated and HCTF K’omoks Estuary Restoration Plan completed outlining a strategy to protect and restore 35,000 m² of *Carex* channel edge habitat to 2024.

March/April 2021 - Transplanted 4572 *Carex* plants from healthy donor sites along the Courtenay River to a completely denuded mudflats in the large habitat enclosure out from the Rotary Park Estuary Viewing platform off Comox/Dike Road.

April to October 2021: Added willow to complete large enclosure and retied and added willow throughout the network of enclosures. In late September we added vertical willow to the large enclosure to prevent CAGO from landing and KFN Guardians added alder to subdivide this enclosure into smaller partitions.

Lessons Learned and Recommendations

With the estuary restoration sites adjacent to public trails in the City of Courtenay and the main access road to Comox, the public was very inquisitive of our project. Once additional grants were awarded there was urgency to get started to protect as much vulnerable habitat as we could and to transplant *Carex* during the optimal window. We developed a Press Release after the first year and by 2020 three local media articles were written about our project. Interpretive signs installed in 2019, 2020, and 2021 along with community presentations helped to garner support and awareness from the community, stewardship leaders, and local governments. Provincial and Federal Fisheries biologists have also been complimentary of our Eco-Cultural estuary restoration approach.

The KFN and GoMIES work very well together and over the past 5 years have built a solid partnership to tackle the overabundant resident CAGO populations and to develop effective estuary restoration techniques. The transition to all wood enclosures and evolution to Eco-Cultural restoration techniques was a testament of our collaboration. The larger openings created by the alder and willow fencing allows easy access for fish of all sizes to utilize the immediate habitat structure of Eco-Cultural restoration. Maintenance has been reduced by using these methods which allows our resources to focus on restoring additional key salmon and wildlife habitat in the K’omoks Estuary. Through adaptive management we have learned to add vertical willow to beef up the habitat fencing and to add vertical 3 m+ willow to break up the flight path of CAGO within the large enclosure fronting the Rotary – Estuary Viewing Platform.

More sites still require enclosures and the next phase should ramp up *Carex* transplants to help speed up recovery. This project will take 5 years to reach recovery targets of over 35,000 m² of prime *Carex* sedge marsh habitat in the K’omoks Estuary.

Building on lessons learned from past years, we contributed to public awareness through local journalism, including a publication of our project efforts in the Watershed Sentinel (Auger, 2021).

Primary objectives for the funding period were successfully achieved. Photo monitoring continues, which will require ongoing resources to maintain photo-documentation of all phases of our restoration project (Appendix A)

Acknowledgements

Guardians of Mid Island Estuaries Society gratefully acknowledges the financial support of the Fish and Wildlife Compensation Program for its contribution to the Restoration of *Carex* marsh habitat in the K'omoks Estuary. www.fwcp.ca

We want to thank the KFN Guardian's, especially Cory and Randy Frank, Krissy Brown, Kaylan Mclean, Cedar Frank, Jesse Everson, and Candace Newman who contributed so much hard work and expertise to make this work enjoyable and rewarding. Special thanks to Jay Miles Baker-French for updating our Estuary Restoration maps and volunteering to help us transplant *Carex*. Also, to Stefanie Lane for contributing to this report and developing future monitoring strategies. Garreth Ashley also led several field days involving the KFN Guardians and trained 6 members to become proficient in finding goose nests and how to addle their eggs effectively and safely at nearby estuaries within Baynes Sound.

We want to also acknowledge the Pacific Salmon Foundation for their ongoing support of cost-effective manufacturing and transport of KFN and MOTI wood materials used for restoration and their funding greatly supported overall project material, supplies, and signage costs. The Habitat Conservation Trust Foundation supported the development of the 2019 K'omoks Estuary Eco-Cultural Restoration Plan (2018-2023) and to the 2020/21 implementation of habitat exclosures.

We also want to acknowledge the continued support of the Ministry of Highways and Transportation Infrastructure for allowing us a steady nearby wood source for all our Vancouver Island Eco-Cultural Estuary Restoration projects, especially Brendan Kelley and Sean Wong.

We hope to continue to work closely with all partners associated with helping to conserve and restore the K'omoks estuary.

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Project Web Links

<https://projectwatershed.ca/guardians-building-resiliency-in-the-komoks-estuary/>

<https://tidechange.ca/2018/08/08/guardians-building-resiliency-in-the-komoks-estuary/>

<https://www.estuaryguardians.org/>

Appendix A



Sept. 1, 2020 Project Watershed assessing recovery at exclosures in K'omoks Estuary



Mar. 12, 2021. *Left:* Sedge plugs transported from donor sites in crates. *Center:* New sedge plugs planted at low tide within protected habitat. *Right:* Tim Clermont tallies sedge shoots as they are transplanted



Left: Mar. 12, 2021, newly transplanted sedge plugs within protected habitat. *Right:* Mar. 30, 2021, new growth emerging with warmer temperatures



Left: Mar. 12, 2021, newly transplanted sedge plugs within protected habitat. *Right:* Mar. 30, 2021, new growth emerging with warmer temperatures



Left: Apr. 12, 2021, GoMIES staff and K'omoks trainees addling goose eggs. *Right:* Sept. 16, 2021, large populations of Canada geese returning for the winter breeding season



Sept. 1, 2021. *Left:* Eco-cultural enclosure by the Airpark constructed in 2019 with recovering sedge establishing into fence line (red outline). *Right:* Educational signage installed during the 2020-2021 field season.



Sept. 16, 2021: *Left*: leftover willow whips are used to mark out an eco-cultural extension targeted for 2022, building off existing successful restoration (background). *Right*., large populations of Canada geese returning for the winter breeding season above protected habitat.