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# RESTORING ECOLOGICAL FUNCTION IN THE CAMPBELL RIVER ESTUARY

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FWCP Project COA-F24-W-3900 – FINAL Report



Figure 1. Greenways volunteers taking a break while working hard at the Annual Broom Bash at Myrt Thompson Trail, May 2023.

Prepared with financial support from the Fish & Wildlife Compensation Program, on behalf of its program partners BC Hydro, the Province of B.C., Fisheries and Oceans Canada, First Nations and Public Stakeholders.

Camille Andrews, BIT  
Habitat Management Coordinator  
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## Executive Summary

The Campbell River Estuary is an iconic sensitive ecosystem that is recovering from over a century of degradation through industrial use. The estuary provides habitat to many wildlife species, including great blue herons, bald eagles, waterfowl, and four species of Pacific salmon, including the iconic “Tyee” chinook. It also contains remnants of diverse wildflower meadows in upper intertidal marsh habitat. Healthy estuarine ecosystems are key to supporting this rich biodiversity. While most industrial uses have ceased in the estuary, ecological scars from decades of impacts are still healing. Disturbance from activities such as log milling, log booming and log storage offered an unparalleled opportunity for invasive species to spread, and impacts must continue to be addressed to recover the ecological integrity of the estuary.

*Restoring Ecological Function in the Campbell River Estuary* has completed its eighth year providing tangible and measurable conservation benefits to the ecology of the estuary. From April 1, 2023 to March 31, 2024, the project has continued to make an important impact on the ecological integrity of the Campbell River Estuary by ensuring that native plants continue to be the dominant species in the sensitive marsh and riparian habitats, maintaining biodiversity in these species-rich habitats.

The priority of this project has continued to be the conservation of the sensitive salt marsh plant ecology through the management of the most prevalent invasive plants to threaten these habitats; yellow flag iris and purple loosestrife. To a lesser extent, the project also addresses Scotch broom and Himalayan blackberry management in riparian forests and meadows within the estuary. Another important focus of this project has been the revegetation of habitats following removals in areas where replanting with native species is necessary to prevent regrowth of invasive species.

Invasive species were first inventoried in the Campbell River Estuary for the Management Plan for Baikie Island Nature Reserve in 2002. Yellow flag iris was not treated until 2012 and was able to invade several hectares of sensitive marsh habitat. Invasive management is a priority 1 action of the Campbell River Watershed Action Plan’s Wetland and Riparian Ecosystem chapter (action CBR.WAR.HB.31.01 – Implement Wetland and Riparian Restoration Projects); and a priority 2 action of the Campbell River Watershed Action Plan’s Rivers, Lakes and Reservoirs Ecosystem chapter (action CBR.RLR.HB.11.06 – Implement habitat restoration, enhancement measures – Campbell River Watershed).

Greenways Land Trust has been managing invasive species in the estuary for 15 years, with the most intensive progress being made with the *Restoring Ecological Function in the Campbell River Estuary* project since 2016. In 2023/2024, 1010 kg of yellow flag iris, almost 400 kg of purple loosestrife and 110 kg of common tansy was removed from marsh habitat. In upland and riparian habitats, an estimated 740 kg of Himalayan blackberry and 375 kg of Scotch broom was removed. We also removed 325 kg of less prevalent invasive plant species from the Campbell River Estuary.

Japanese knotweed infestations were monitored with no significant change within the Baikie Island Nature Reserve. The Wei Wai Kum Guardians assisted the Invasive Species Council of BC with some removals of 10 Japanese knotweed plants from the shores of the Myrt Thompson Trail using hand removal methods in 2022/2023 and we noticed the plants were more robust in 2023/2024 but we did not find any additional locations of new Japanese knotweed infestations.

A big highlight of the 2024 season was seeing the results after the removal of an additional 10 benthic barriers that had been in place to manage yellow flag iris in an area of dense infestation, followed by a variety of treatments including native planting in spring, native planting in fall, and leaving areas to revegetate on their own so we can track any benefit of replanting over time. The results after one year point to revegetation being only marginally slower to return to native vegetation than replanting, informing us that for this scale of treatment area, there is enough nearby native vegetation available to recolonize. We also found that spring plantings were more successful than fall ones due to winter king tides taking some plants away as roots did not have as long to establish. This was a very important finding for informing the timing of our marsh plantings for our Mill Pond Restoration Project. We have also not seen any regrowth of the yellow flag iris in areas where the barriers were lifted which is very promising.

We also replanted some riparian areas with over 100 trees and shrubs planted on Baikie Island and 30 wildflowers planted into a riparian meadow at Ocean Blue. Greenways has continued to share our appreciation and learnings about the estuary within the larger community. Our volunteers contributed almost 200 volunteer hours in 2023/2024, including invasive removals, plantings, trail maintenance and cleanups.

Continued invasive species management in the estuary is vital for the benefit of the estuary's wildlife and its biodiversity. FWCP funding for 2024/25 will help maintain our momentum controlling invasive species and revegetating habitats, engaging more and more volunteers and community members as we return to larger volunteer events, and supporting Wei Wai Kum Guardian Watchmen as they work towards the management of invasive species and revegetation within their lands and waters.

## Introduction

In 2023/2024, *Restoring Ecological Function in the Campbell River Estuary* completed its eighth year focusing on providing tangible and measurable conservation benefits to the ecology of the Campbell River Estuary, particularly targeting restoration of wetland and riparian habitats through invasive species management. The 2023/2024 year refers to April 1, 2023 to March 31, 2024.

Invasive species were first noted in the estuary in an inventory completed for the Management Plan for Baikie Island Reserve in 2002 when, it was recommended that “immediate management efforts should be taken against yellow-flag iris before it establishes larger populations, as it is currently restricted to small, scattered clumps (District of Campbell River and Nature Conservancy of Canada, 2002).” As yellow flag iris treatments did not start in the estuary until 2012, this species was able to invade several hectares of sensitive marsh habitat in the estuary over the intervening 10 years. We have prioritised the control of this invasive species to prevent further infestation, and as in most years, much of the funding requested of FWCP has been allocated to treating the invasive plants in sensitive marsh habitats.

The Campbell River Estuary is an iconic sensitive ecosystem that is currently recovering from over a century of degradation through industrial use. The estuary provides habitat to many wildlife species, including great blue herons, bald eagles, waterfowl, and four species of Pacific salmon, including the iconic “Tyee” chinook. It also still contains remnants of amazingly diverse wildflower meadows in upper intertidal marsh habitat. Healthy estuarine ecosystems are key to supporting this rich biodiversity.

While most industrial uses have now ceased in the estuary, the ecological scars from decades of impacts are still healing. The disturbance caused by activities such as log milling, log booming, and log storage offered the opportunity for invasive species to spread, and they are one of the primary impacts that remain to be addressed for the estuary to recover its ecological integrity.

This project builds on over 15 years of restoration projects by many agencies to restore ecological function in the estuary. The City of Campbell River estimates that over \$1 million has already been spent on restoring the estuary, and the City continues to fund ongoing restoration of its Baikie Island Nature Reserve, which is currently managed by Greenways Land Trust under an annual maintenance contract. The Nature Conservancy of Canada holds a conservation covenant on the Baikie Island Nature Reserve.

Invasive species are impacting the ecosystem functioning of the entire estuary, particularly the provincially red-listed Henderson's checkermallow-Tufted Hairgrass marsh ecological community. Both the Vancouver Island beggarticks (a species of Special Concern under the Species at Risk Act) and the Henderson's checkermallow (a blue-listed species), are found in these marsh habitats (BC Species and Ecosystems Explorer, 2023). Mitigating threats from invasive species is a management objective under the SARA Management Plan for the Vancouver Island beggarticks in British Columbia (Environment Canada, 2015). One of the greatest threats to the functioning of the Campbell River Estuary is the impacts of invasive species in natural and created wetland habitats. The goal of this project is to reduce

and eventually eradicate all invasive species from sensitive habitats in the estuary over the long term. This project focuses on protecting investments already made towards restoring the estuary to a well-functioning, productive, and ecologically diverse wetland which supports numerous wildlife species.



Figure 2. Greenways Land Trust's summer Conservation Crew kayak to the small estuary islands to ensure all purple loosestrife has been removed from these diverse salt marsh habitats that make up a provincially red-listed ecological community.

Greenways Land Trust is keen to continue to address the threat of invasive species in order to restore the rare ecological communities present in the estuary, ensuring their continued ecological health and continuing to work towards the goal in the Campbell River Estuary Management Plan of “establishing a mix of rehabilitated, revegetated and natural upland, shoreline setbacks and foreshore that will support improved fish and wildlife habitat” (Penfold, 2002). As a locally based environmental non-governmental organization, Greenways can work with all the landowners in the estuary to restore and enhance the estuary's ecological functions. Greenways has a long-term interest in restoring our estuary and we are committed to eradicating all invasive species from the estuary over time.

This project has been long-term majority funded by the City of Campbell River and the Fish and Wildlife Compensation Program, with significant support from Wei Wai Kum First Nation, Greenways Land Trust, the Nature Conservancy of Canada, and TD Friends of the Environment Foundation.

## Greenways Land Trust

The mission of Greenways Land Trust is to restore, sustain and protect natural areas and critical habitats, particularly ecological and recreational greenways, for the benefit of our community. Since we were established in 1996, our volunteer board has been active in championing environmental projects and collaborating with partners.

Greenways has been actively involved with management of invasive species in Campbell River, including developing and implementing programs to control yellow flag iris, purple loosestrife, Himalayan blackberry, Scotch broom, and Japanese knotweed with our partners. Greenways has an excellent track record in facilitating volunteering and stewardship among community members and school students. Volunteers contributed over 6900 hours towards our community stewardship projects in 2022/2023.

## Goals and Objectives & Linkage of FWCP Action Plans and Specific Actions

One of the greatest threats to the functioning of the Campbell River Estuary is the impacts of invasive species in sensitive wetland habitats. The goal of this project is to contribute towards reducing the area of invasive species infestation and preventing their spread; eventually eradicating all invasive plants from sensitive habitats in the estuary over the long term. This project focuses on protecting the investments already made in the Campbell River Estuary and restoring the estuary to a well-functioning, productive, and ecologically diverse wetland which supports numerous wildlife species.

The project approach focuses on continuing invasive species management programs already undertaken by Greenways Land Trust, the City of Campbell River, and the Nature Conservancy of Canada, alongside partners including the Wei Wai Kum Guardian Watchmen. Activities include the physical removal of yellow flag iris and purple loosestrife by digging and/or seed removal. Areas of very dense yellow flag iris infestation have been treated using the installation of benthic barriers to kill the entire plant, including rhizomes and seeds in the soil. Areas where previous invasive species removals have already taken place, or areas that have remained free of invasive plants, continue to be monitored.

FWCP Action Plan Alignment:

Primary Action:

Coastal Watershed Action Plan: Campbell River Watershed Action Plan

Ecosystem Chapter: Wetland and Riparian

Action Type: Habitat-based Actions

Priority Action Short Description: CBR.WAR.HB.31.01 Implement Wetland and Riparian Restoration Projects – P1

This project manages invasive plants in the Campbell River Estuary, identified as a high priority restoration activity by both estuary stakeholders and through assessment and mapping (Campbell River Estuary Vegetation Community Mapping and Assessment, Mimulus Biological Consultants, 2017). This project directly addresses Priority Action CBR.WAR.HB.31.01 which states "Implement wetland and riparian restoration projects that are identified as high priorities through inventory, mapping or assessment... This can include managing invasive plants as needed."

*Secondary Action:*

Coastal Watershed Action Plan: Campbell River Watershed Action Plan

Ecosystem Chapter: Rivers, Lakes and Reservoirs

Action Type: Habitat-based Actions

Priority Action Short Description: CBR.RLR.HB.11.06 Implement habitat restoration, enhancement measures – Campbell River Watershed – P2

Estuarine habitat restoration is a priority 2 action for anadromous and resident salmonids. Removal of invasive species and restoration of native vegetation, especially intertidal and riparian species, will provide the habitats and prey productivity essential for rearing juvenile salmonids, as well as improving substrate stability and reducing erosion, along with preventing infill of small tidal channels through marsh habitats by invasives are capable of impeding fish passage in such areas if left unchecked.

## Study Area

The study area is the Campbell River Estuary from the highway bridges and Highway 19 to Discovery Passage at Tyee Spit. The area includes the main channel of the Campbell River; mudflats, tidal marshes, riparian areas and upland forests of Baikie Island, Tyee Spit and several peninsulas and small islands; finally outflowing into the Discovery Passage.

# 2017 Campbell River Estuary Vegetation Survey



-  Forest (F)
-  Terrestrial-herbaceous (TH)
-  Riparian (R)
-  Marsh (MS)
-  Swamp (SW)
-  Mudflat (MF)
-  Cobble shore (CS)
-  River/Channel (RC)
-  Ocean (O)
-  Study Area

0 100 200 300M



 Mimus Biological Consultants  
GIS Applications by Redtail Environmental Services

Figure 3. Our study area, the Campbell River Estuary.

## Methods

Invasive species removal and treatments followed best practices to ensure that efficient and effective control measures were used, and long-term impacts were maximized. The targets of our invasive species management during the 2023/2024 season were yellow flag iris and purple loosestrife in marsh habitat, and Himalayan blackberry and Scotch broom from upland riparian habitat; focusing treatment efforts on ensuring more pristine areas are free of invasives, as well as targeting several very dense areas of invasive plant infestation to prevent their spread. New to 2023/2024 was an increased effort to spot and remove incidental invasive species while removing target invasives of greater concern.

The area of tidal marsh with the highest density of yellow flag iris in the estuary was treated using a multi-pronged approach of digging rhizomes in the areas that previously had extensive digging done and repairing benthic barriers covering adjacent areas of dense infestation. As with the previous year, the yellow flag iris dug out at this time was primarily new growth from seeds from missed flowers in previous years so while many thousands of small plants were removed, the size of each plant was very small compared to earlier project years. The benthic barrier technique used is effective for dense well-established areas as it prevents light infiltration and gas exchange killing the entire plant including the rhizomes and seeds existing in the soil (Tarasoff, 2016). All of the areas possible to treat with benthic barriers were treated in previous years so no new benthic barriers were added in 2023/2024.

In 2023/2024 season an additional 10 benthic barriers that had been in place for 2-3 years were removed (with another 10 having been removed the previous year). As we found in the previous year, some intact yellow flag iris rhizomes remained under the barriers, but they had an uncharacteristic mushy feeling. While we were under the assumption the mushy rhizomes were no longer viable, we wanted to confirm that, so we added removal/non-removal of those mushy rhizomes to our trials to inform future treatment following benthic barrier removals.



Figure 4. Greenways Land Trust's Executive Director, Katie, labelling yellow flag iris benthic barrier removal areas with the revegetation treatment trialed so we could compare results of revegetation methods over time.

Our “experimental trial” conducted in 2022/2023 used four revegetation treatments on these areas to determine the best method to follow for the remaining barriers:

1. Removal of any rhizomes still intact followed by planting with nursery stock in Spring.
2. Removal of any rhizomes still intact followed by planting with nursery stock in Fall.
3. Removal of any YFI rhizomes still intact, followed by leaving to naturally revegetate.
4. Leaving YFI rhizomes in place and planting with nursery stock in Spring.
5. Leaving YFI rhizomes in place and leaving to naturally revegetate.

In areas that were planted using nursery stock, we planted 1-gallon pots of silverweed (*Potentilla anserina*), common rush (*Juncus effusus*), lady fern (*Athyrium filix femina*), and Douglas’ aster (*Aster douglasii*).

Purple loosestrife removals were focused on two areas of marsh habitat in the Baikie Island Nature Reserve: in Fred’s Slough and on the shores of the Mill Pond. This was a priority to help reduce the prevalence of invasives in the area to prevent the recently constructed marsh habitats in the Mill Pond from becoming dominated. The other sites where targeted purple loosestrife removals took place were along Myrt Thompson, in the Nunns Estuary (which flows into the Campbell River Estuary) and on the outermost islands within the estuary. Wherever possible, plants were removed along with their roots (by digging larger mature plants, or by pulling small seedlings). In some areas where the purple loosestrife was growing through shrubs such as sweet gale and hardhack, the flower heads were removed to prevent seeds spreading. This plant is primarily removed by Wei Wai Kum Guardian Watchmen, contractors and staff as we have found that it requires a specific technique to be successful and not leave portions roots which cause the plants to grow back stronger and with more flower heads.

Himalayan blackberry was cut, and roots were dug out of the soil. As we were working in very dense areas of Himalayan blackberry, the majority of blackberry removed was taken to the landfill to make the



Figure 5. A yellow flag iris plot photographed in the spring of 2023, following two years of cover with a benthic barrier, followed by barrier removal and replanting of native vegetation in the fall of 2022.

areas more accessible for volunteers and contractors to plant. In less dense areas, canes were cut small and left on site, adding much needed organics to the soil. Scotch broom were cut at the base of the plant and young plants were pulled whenever possible. As broom was all removed at the beginning of flowering and no seeds were present, we were able to dispose of broom plants on site by tucking them under established native vegetation as mulch to return organics to the soil.

We increased our removals of the incidental invasive species encountered while doing other removals of target species, while travelling to and from different areas within the estuary, and while completing other maintenance tasks such as trail pruning. The species that were removed in this way include Bull thistle, Canada thistle, Western dock, and small areas of canary reed grass from marsh habitats. In riparian and upland areas, the incidental species removed included new seedlings English holly and new patches of English ivy.

Treatment data will be compiled and will be recorded into the provincial Invasive Alien Plant Program (IAPP) database to ensure that all stakeholders are aware of the works. Treated areas will continue to be monitored for regrowth in future years.

Effective invasive species management should also include revegetation of treated areas where there is a high likelihood of regrowth of invasive species. Replanting this funding year occurred in a previously planted riparian area that was formerly dominated by Himalayan blackberry. This area experienced the loss of some larger conifers after a windstorm which opened additional planting opportunity. We also planted a mix of wildflowers in a meadow area following the removal of invasive common tansy. Planting prescriptions were determined based on native species were present and thriving in nearby natural areas with similar conditions. As mentioned previously, we did not continue replanting of yellow flag iris treatment areas as it was determined to not be required as natural revegetation was nearly as effective within a two-year trial. All of our upland and riparian plantings are mulched, watered and weeded for their first three years.



Figure 6. Greenways' summer Conservation Crew watering the 2022 TD Tree Days Planting site during the summer of 2023.

## Results and Outcomes

In 2023/2024, approximately 2950 kg of invasive plant material was removed from habitats in the Campbell River Estuary. The breakdown of the amounts of each species removed can be seen in Table 1. Approximately 1010 kg of yellow flag iris plants were removed from one area just over 0.25 ha of previously densely infested marsh habitat on Baikie Island by hand-digging and then taking to the landfill. As the yellow flag iris removed was primarily seedlings within previously dug areas and under marsh shrubs, the volume removed adds up to many hours of searching for and digging out thousands of very small plants. A very similar effort in 2022/2023 amounted to 3440 kg which shows that we are continuing to have a great leap in momentum towards removing this area of yellow flag iris infestation. We are now at a point where all mature plants have been removed and we are just continuing to deplete the seed bank in the marsh which we estimate will be exhausted in the next year or two. As we have been focussed on this section of the estuary for each year of the project, this is a very exciting success story for us.

Another exciting development for us in 2023/2024 was being able to compare the results of four revegetation treatments used following the lifting of benthic barriers that had been in place for two or more years (outlined in the Methods section of this report with results summarized in the Table 2 below). Thankfully, the results of the trials were that there was no regrowth of the intact but mushy yellow flag iris rhizomes that remained after years of cover with benthic barriers. The results also showed that the replanting, while effective, resulted in plots that had only marginally more dense growth of native vegetation after two full seasons. We also added an additional trial by planting one plot in the fall and most in the spring. This showed us that if we do want to plant, we should only do so in the spring as fall king tides were able to displace some plantings that had not had a long enough growing season to establish a sufficient root system to remain in place at high tides. The last finding is important for informing the planting plan for our Mill Pond Restoration Project.

Please note that due to low sample size we were not able to do any statistic analysis of the significance of these results, but we feel that they were effective enough to inform how we move forward. These results are very positive as they mean that our resources can be more effectively spent on removals of invasives and that revegetation on smaller scales such as this can be left to nature. We were also able to lift ten more benthic bringing us to 20 barriers lifted and only three more remaining to be lifted in 2024/2025. We did not plant any of these plots as we are now confident that native vegetation will recolonize these treatment areas.

Table 1. Results from revegetation treatment trials following the removal of benthic barriers that had been in place 2-3 years covering dense yellow flag iris infestations.

Treatment	Result
Removal of any rhizomes still intact followed by planting with nursery stock in Spring.	Great results: <ul style="list-style-type: none"> <li>- no regrowth of yellow flag iris</li> <li>- plots looking almost completely covered with vegetation in one year</li> <li>- plots indistinguishable from adjacent habitat in two years</li> </ul>
Removal of any rhizomes still intact followed by planting with nursery stock in Fall.	Good results: <ul style="list-style-type: none"> <li>- no regrowth of yellow flag iris</li> <li>- plots looking almost completely covered with vegetation in one year but with some gaps due to plants being removed by king tides</li> <li>- plots indistinguishable from adjacent habitat in two years</li> </ul>
Removal of any YFI rhizomes still intact, followed by leaving to naturally revegetate.	Good results: <ul style="list-style-type: none"> <li>- no regrowth of yellow flag iris</li> <li>- plots looking partially covered with vegetation in one year</li> <li>- plots almost completely covered in two years</li> </ul>
Leaving YFI rhizomes in place and planting with nursery stock in Spring.	Great results: <ul style="list-style-type: none"> <li>- no regrowth of yellow flag iris</li> <li>- plots looking almost completely covered with vegetation in one year</li> <li>- plots indistinguishable from adjacent habitat in two years</li> </ul>
Leaving YFI rhizomes in place and leaving to naturally revegetate.	Good results: <ul style="list-style-type: none"> <li>- no regrowth of yellow flag iris</li> <li>- plots looking partially covered with vegetation in one year</li> <li>- plots almost completely covered in two years</li> </ul>

This year also saw an estimated 390 kg of purple loosestrife removed from 2 ha of marsh habitat. This included four main areas: along Myrt Thompson Trail, on the small islands at the outside edge of the estuary, and at two locations within Baikie Island Nature Reserve: Fred's Slough, and an area on the shores of the Mill Pond. In all areas except where loosestrife growing under sweet gale and hardhack shrubs, the whole plant was removed including the roots, and disposed of at the landfill. As in prior years, we shift from full plant removal to the removal of flower heads once the loosestrife begins to show signs of shifting from flowering to developing seeds to ensure that we do not allow any new seeds to spread in marsh habitats.



Figure 7. Greenways' summer crew removing purple loosestrife from a small island in the Campbell River Estuary.

All other marsh habitat was monitored twice over the season and any purple loosestrife and yellow flag iris found was removed. This includes the small islands in the estuary, all of the shoreline around Baikie Island Nature Reserve, and the adjacent shorelines at Myrt Thompson. In 2022/23 and 2023/2024 we brushed a small area (~50m<sup>2</sup>) of canary reed grass to prevent seeds from spreading. We will cover that area with benthic barriers in May of 2024. It is an area of higher elevation in the marsh on Baikie Island that should respond well to treatment with the benthic barrier technique as it is rarely influenced by tides.

In upland riparian habitats totaling over 3 ha, an estimated 740 kg of Himalayan blackberry and an estimated 375 kg of Scotch broom was removed and left as mulch on site. New to this year was the removal of 110 kg of common tansy in a riparian meadow.

We increased our removals of the incidental invasive species encountered while doing removals of target species, while travelling to and from different areas within the estuary, and while completing other maintenance tasks such as trail pruning. The species that were removed in this way include approximately 25 kg Bull thistle, 25 kg of Canada thistle, and 100 kg canary reed grass from high marsh habitats. In riparian and upland areas, the incidental species removed included 50 kg of English holly seedlings, 25 kg of English laurel, 50 kg Western dock, and 50 kg of small patches of English ivy.

Staff and volunteers also revegetated upland riparian areas with over 100 native trees and shrubs in an area that was previously planted after Himalayan blackberry removal and had since lost several mature trees in a windstorm. In addition, 30 flowering plants (including yarrow, entire-leaved gumweed and Canada goldenrod) were planted in a riparian meadow after removing common tansy.

Japanese knotweed infestations were monitored with no significant change within the Baikie Island Nature Reserve. The Wei Wai Kum Guardians assisted the Invasive Species Council of BC with some removals of Japanese knotweed from the shores of the Myrt Thompson Trail using hand removal methods in 2022/2023 and this was observed to grow back with increased vigor in 2023/2024 but we did not notice any spreading to new or adjacent locations. All treatment data will be recorded in the provincial Invasive Alien Plant Program (IAPP) database to ensure that all stakeholders are aware of the invasive treatments completed.

Table 1. The invasive plant species and relative quantities removed from sensitive habitats in the Campbell River Estuary.

Habitat Type	Invasive plant species	Amount removed (kg) *
Salt marsh	Yellow flag iris	1010
Salt marsh	Purple loosestrife	390
Salt marsh	Canary reed grass	100
Riparian/Upland	Himalayan blackberry	740
Riparian/Upland	Scotch broom	375
Riparian/Upland	Common tansy	110
Riparian/Upland	English holly	50
Riparian/Upland	Western dock	50
Riparian/Upland	English ivy	50
Riparian/Upland	English laurel	25
High marsh/low riparian	Canada thistle	25
High marsh/low riparian	Bull thistle	25
<b>Total</b>		<b>2950</b>

## Discussion

The Campbell River Estuary is an iconic sensitive ecosystem that is currently recovering from over a century of degradation through industrial use. The estuary provides habitat to many wildlife species, and contains remnants of incredibly diverse wildflower meadows in upper intertidal marsh habitat. Healthy estuarine ecosystems are key to supporting this rich biodiversity.

While most industrial uses have now ceased in the estuary, the ecological scars from decades of impacts are still healing. The disturbance caused by activities such as log milling, log booming, and log storage provided the opportunity for invasive species to spread. The goal of this project is to reduce the area of

invasive species infestation and eventually eradicate all invasive species from sensitive habitats in the estuary over the long term, particularly in both natural and created wetlands.

Invasive plants are a threat to the sensitive, provincially red-listed Henderson's checker-mallow-Tufted Hairgrass marsh ecological community, and habitat for the Vancouver Island beggarticks, a species of Special Concern under the Species at Risk Act (BC Species and Ecosystems Explorer, 2018). This project focuses on protecting the investments already made in the Campbell River Estuary and restoring the estuary to a well-functioning, productive, and ecologically diverse wetland which supports numerous wildlife species. In Year 8 of the project, invasive species removal and treatments continued to follow best practices to ensure that efficient and effective control measures were undertaken, and long-term impacts were maximized.

Treatment for yellow flag iris followed the technique started in 2020/2021 of early spring removal of very small seedlings in areas previously dug, and we expanded this in subsequent years to include areas between benthic barriers, and areas under hardhack and sweet gale shrubs. This method was very effective as it allowed us to remove many thousands of plants at much smaller volumes than if they were removed later in the growing season. This is also possible because we are building upon prior years and most of the areas of thick rhizomes have already been removed.

The benthic barrier method following the technique developed for controlling yellow flag iris (Tarasoff, 2016), piloted in 2018/2019 and continued in 2019/2020 and 2020/2021, was found to have been a great success, killing the rhizomes and seeds it was covering. We attempted a smaller, 40m<sup>2</sup> area, in 2020/2021 that was not successful as it was lower elevation and more exposed to winter storm surges. The reason for this is likely that the increased tidal activity and exposure would have allowed for more oxygen transfer and more damage to the barrier's seal, allowing for the gas exchange required by the rhizomes to stay alive. These barriers were removed in 2022/2023 and 2023/2024 and followed up with a variety of treatments to help guide future best practices for marsh revegetation. Treatments included leaving vegetation to come in on its own, and planting with nursery stock, as well as trialling removal of mushy yellow flag iris rhizomes and leaving the rhizomes in place, as well as treatment in the spring compared to that in the fall. So far, we have found that we do not need to remove rhizomes as they are in fact not viable, that we do not need to plant the plots as they revegetate well naturally, and that spring is the best time to remove the barriers as new vegetation has a better chance of establishing roots needed to hold plants in place during the winter king tides. These are all favourable findings as they mean that the best use of resources is the removal of young plants, rather than the purchase and labour of replanting marsh vegetation. The few remaining barriers will be assessed and likely removed in late May of 2024, and left to revegetate on their own if removed. Using transplants has been ruled out as it ended up being very labour intensive and we were concerned about bringing less obvious invasive plants into an area that has seen so much effort to restore.

In 2023/2024 we also added more removal of incidental lower concern invasives that we were encountering while focusing on target species. This included removing inflorescences from small clumps of canary reed grass and pulling scattered Western dock. A larger area of canary reed grass was brushed to prevent seeds from spreading. In upland and riparian areas, we have been making more efforts to remove young holly seedlings by pulling the entire plant. These early removal methods are important for eliminating a problem before it has a chance to spread and take hold in the estuary in a larger way and future project years will place more and more emphasis on the early detection and removal of invasive plants before new species and new locations are able to become established.

Replanting in upland areas saw over 100 native trees and shrubs fill-planted into previously planted areas of riparian habitat that had been dominated by Himalayan blackberry. An additional 30 wildflowers were planted in meadow habitat following a common tansy removal.

Management of invasive species in the format that Greenways champions provides a limited risk profile. While manual removal of invasive species can also disturb valuable native species, the long-term benefit of preventing infestations from growing will negate the harm to native species. Infestations located on the Baikie Island Nature Reserve will continue to be monitored and treated if necessary, using annual maintenance funds provided by the City of Campbell River. While Greenways has been successful in finding additional funding for treating and maintaining areas outside of the Baikie Island Nature Reserve to date, we will mitigate the risk of reduced funding using our large volunteer labour pool, which can maintain treated areas in future. However, without additional funding, we will not be able to treat new areas. Removing yellow-flag iris rhizomes is slow but effective for controlling the plant. Most areas where we have removed rhizomes in the past only need minimal maintenance for continued control. The use of the benthic barrier method has increased efficiency of treatment over time by reducing labour cost in the long-term as the seed bank in the soil is also killed. Unfortunately that method is somewhat limited in where it is a viable option as we have seen reduced success in lower elevations with greater tidal influence.

Greenways has continued working closely with the Wei Wai Kum Guardian Watchmen on ongoing management of the Campbell River Estuary. We have also been meeting regularly with them, as well as with the Guardians of our Salish Estuaries (formerly Guardians of Mid-Island Estuaries) to ensure that our projects are not getting in each other's way and to find opportunities for collaborations and sharing of learning. These estuary meetings are also attended by the City of Campbell River, and more recently, the more recently established We Wai Kai Guardians group have also begun to attend and started participating more in the stewardship of the Campbell River Estuary. We also assist the Nature Conservancy of Canada with their covenant monitoring within the Baikie Island Nature Reserve. Over the past two years, Greenways Land Trust and Wei Wai Kum have also starting working together with We Wai Kai Guardians to manage invasives higher in the watershed, in both Nunns and Kingfisher Creeks through a collaborative Indigenous Watersheds Initiative project. Another important collaboration we have been working on since the spring of 2023 is a large-scale restoration of the Mill

Pond area within the Campbell River Estuary alongside the Wei Wai Kum First Nation. This three-year project funded through British Columbia Salmon Restoration and Innovation Fund aims to restore 22,000 m<sup>2</sup> of eelgrass, saltmarsh and riparian habitat and increase connectivity to side channel habitat in an area that was previously altered for log-boom storage and log sorting operations.

## Community Engagement, Education and Outreach

Greenways Land Trust is committed to providing meaningful opportunities to the community to participate in the conservation of natural areas within our community. We engage with our community through activities such as work parties where individuals, families, and school groups can participate in invasive species management and habitat restoration. Greenways staff ended up engaging 47 volunteers in 17 events, totaling 191.5 volunteer hours (see Table 1). This year saw a slight reduction in direct FWCP volunteer hours as we also had two new projects that also provided opportunities to engage volunteers with our work in the Campbell River Estuary. With our large-scale Mill Pond Restoration Project funded by BC Salmon Restoration and Innovation Fund, we invited volunteers to join us for eelgrass transplanting in February.



Figure 8. A Greenways Conservation Team Member assisting with installing bark mulch and browse guards following our 2023 TD Tree Days Planting Event.

In partnership with both We Wai Kai and Wei Wai Kum Guardians groups, our watershed stewardship and education project funded by the Indigenous Watersheds Initiative allowed us to host hundreds of students doing work in adjacent habitats including Nunns Creek Estuary and Kingfisher Creek.

We were also able to do some in-person education and outreach by leading several outings in the Estuary. One example was an August 29th interpretative walk at Baike Island Nature Reserve in the Campbell River estuary for our Nature Club participants to learn more about the flora and fauna of the estuary, and how our efforts to manage invasive plant species help maintain this biodiversity of life.

Table 3. Summary of activities completed by Greenways Land Trust volunteers in 2023/2024 towards the stewardship of the Campbell River Estuary.

<b>Date</b>	<b>Number of Volunteers</b>	<b>Volunteer Hours</b>	<b>Activity</b>
3-Feb-23	2 Conservation Team	3	Rabbit proofing planting at Baikie Island
26-Apr-23	3 Conservation Team	4.5	Common tansy removal and wildflower planting at Ocean Blue
2-May-23	1 Freelance Volunteer	1.5	Himalayan blackberry removal on Baikie Island
5-May-23	1 Freelance Volunteer	3	Removing Broom and Blackberry at Baikie Island
25-May-23	4 Conservation Team	2	Scotch broom and Himalayan blackberry removal at Myrt Thompson
26-May-23	1 Freelance Volunteer	7	Scotch broom and Himalayan blackberry removal at Tye Spite
27-May-23	3 Conservation Team	34	Greenways Annual Broom Bash at Myrt Thompson
31-May-23	1 Freelance Volunteer	4	Himalayan blackberry removal at Baikie Island
2-Jun-23	1 Conservation Team	1	Scotch broom and Himalayan blackberry removal at Tye Spite
4-Jun-23	1 Conservation Team	5	Scotch broom removal at Tye Spite
23-Jun-23	2 Conservation Team	5	Watering 2022/2023 TD Tree Days Planting
14-Feb-23	4 Seniors Centre Volunteers	5	Garbage Cleanup along the Raven Trail
23-Jun-23	2 Conservation Team	5	Watering 2022/2023 TD Tree Days Planting
27-Jul-23	6 Conservation Team	9	Marsh Invasive Plant Removal at Ocean Blue
0-Jan-00	13 Community Members	26	TD Tree Days Planting on Baikie Island
9-Nov-23	1 Conservation Team	1.5	Mulching TD Tree Day Planting at Baikie Island
Ongoing	1 Freelance volunteer	75	Trail Maintenance in Baikie Island Nature Reserve
<b>17 Events</b>	<b>47 Volunteers</b>	<b>191.5 Volunteer Hours</b>	<b>Various activities including invasive removals, plantings, cleanups and trail maintenance</b>

# Project Communications

Greenways Land Trust tries to be varied in our reach to our community, using communications methods including social media, presentations within the community and to program partners, and attempts to gain media attention. We usually highlight the restoration of the estuary in the later spring and summer months when we are directly engaging volunteers in Scotch broom removals in upland habitats or purple loosestrife removals within marsh habitats.

We published several e-news articles during this funding period including [May 2023](#) "Campbell River Estuary Invasive Species", featuring an our activities planned for the season's invasive plant management efforts, with acknowledgement of FWCPs ongoing support and funding. The [June 2023](#) e-news included two articles about our work in the Estuary: "Broom Bash 2023: Volunteers teamed up for a great day of invasive species removal along Campbell River Estuary" and an "Campbell River Estuary Invasive Species" update focussed on yellow flag iris and volunteer efforts to remove Himalayan blackberry. Again, the Fish and Wildlife Compensation Fund and other funders were acknowledged for their support.



## Campbell River Estuary Invasive Species

We are getting geared up for another exciting season of taking us closer to our vision of an invasive free estuary.

We are lifting more of the benthic barriers that have been in place choking out invasive Yellow flag iris for a couple of years. **These areas are ready to return to marsh meadows full of native sedges, rushes and wildflowers.**

The season will also include scouring the marsh habitats for **Purple loosestrife**, and surveying habitats for new invasive species to catch them before they become a problem.

**Himalayan blackberry and Scotch broom** are also on our most wanted list for upland areas within the estuary.

For several years in a row, we have partnered with the **Wei Wai Kum Guardian Watchmen** to complete our invasive management goals. We are looking forward to another great year of estuary stewardship through partnership.

Our thanks to our long-term funders, the **City of Campbell River** and the **Fish and Wildlife Compensation Program**, for making this important invasive removal possible!

## Conservation Team Who's ready to get back outside?!

We've missed you Conservation Team members!

Join Camille to remove some of the large blackberry canes sneaking onto our many plantings, plant some native trees and shrubs to replace losses after bunny feasting, and redistribute the remaining mulch to combat weeds from outcompeting our most recent plantings. Meet at the [Baikie Island parking lot](#) at the end of Robinson Rd, east off Hwy 19.

**Tuesday, May 2nd**  
10:00 to 11:30am

**Baikie Island Tending**

Join Camille to help Willow Creek Super-Stewards, Tom and Reta, to remove some invasive plants from Millenium Park. Meet at the [Ken Forde Boat Ramp parking lot](#) (just south of Erickson Rd on Hwy 19A in Willow Point).

**Wednesday, May 17th**  
10:00 to 11:30am

**Willow Creek/Millenium Park Invasives**

For more information about the Conservation Team or to join the email list for events, contact Camille at [camille@greenwaystrust.ca](mailto:camille@greenwaystrust.ca)



Figure 9: Our May 2024 e-news newsletter article, "Campbell River Estuary Invasive Species" as well as an invitation to our May volunteer events, including one on Baikie Island to assist with fencing our 2022/2023 planting.

The Campbell River Mirror published an article “Greenways Land Trust gets boots muddy in battle against Campbell River Estuary invasive species” on [May 10, 2023](#) article about the efforts made towards the management of yellow flag iris on Baikie Island.

Additional communications in this timeframe have included a number of Instagram and Facebook celebrating the invasive plant removals and revegetation efforts made possible by Fish and Wildlife Compensation Program, as well as out other funders, the City of Campbell River and TD Friends of the Environment Foundation.

## Recommendations

Greenways is proud to be a part of the ongoing restoration of this iconic estuary and enthusiastically recommends the continuation of this intensive invasive species management and revegetation project in the Campbell River Estuary to benefit the biodiversity of the entire estuary. Much progress is being made, and we believe that our goal of eradication of many of these species from the estuary is possible in time. We recommend an increased emphasis on revegetation over time, and that Wei Wai Kum Guardians continue to be supported by partners and funders, allowing them to continue their efforts to restore these areas that include both their traditional territories and their reserve lands. We look forward to continuing to work closely with them and other program partners in 2024/2025 and years to come.

## Acknowledgements

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In addition, Greenways would like to acknowledge the support of our dozens of volunteers, the Wei Wai Kum First Nation, the Wei Wai Kum Guardian Watchmen, the Nature Conservancy of Canada, A’tlegay Fisheries Society, and Fisheries and Oceans Canada towards our work in the estuary this year. Thank you to all of these partners for helping to heal the diverse habitats within the Campbell River Estuary.

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