2024

British Columbia Spartina Eradication Program Progress Report

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On Behalf of the BC Spartina Working Group

B.C. SPARTINA
Working Group
protecting our shorelines

EXECUTIVE SUMMARY

In 2024, the 20th year of the BC Spartina Eradication Program, efforts continued towards the eradication of non-native, invasive *Spartina* spp. (*S. anglica*, *S. densiflora*, and *S. patens*) along the coastline of British Columbia (BC). The BC Spartina Working Group (BC SWG) recognizes the potential impacts of *Spartina* spp. on local shorelines and wildlife habitat and strives to eradicate all non-native, invasive *Spartina* spp. along BC's coastline.

In 2024, $311,120 CAD of in-kind and direct-value contributions were applied to complete program components focused on monitoring, removal, herbicide, coordination, and outreach within the Spartina Eradication Program. Funding for the program came from both the BC Ministry of Forests, as well as the Port of Vancouver. Approximately $16,246 CAD in funding was also provided by the Federal Canada Summer Jobs program to hire summer students for survey crews.

182 km of BC's coastline was surveyed for *Spartina* spp. in 2024. Surveying efforts indicate that, in the Lower Mainland, *Spartina anglica* is limited to the South Fraser River Delta and Boundary Bay, while *Spartina patens* is limited to Burrard Inlet, False creek, and Sturgeon Bank. On the East Coast of Vancouver Island, both *Spartina patens* and *Spartina densiflora* are limited to the Baynes Sound area on the eastern side of Vancouver Island, with a small population of *S. densiflora* in the Comox Valley Region just North of the Baynes Sound area.

There was a decrease in all *Spartina anglica* metrics in 2024 following successful treatments in 2023, with plants dropping to below 1000 individuals for the first time since 2009, indicating efforts are on track towards eradication. The entire mapped population of *S. anglica* received treatment. *S. patens* metrics increased in the Lower Mainland, indicating treatments should happen earlier in subsequent years to reduce seed dispersal. Increases can be partially attributed to the discovery of a "new" population of *S. patens* at Sturgeon Bank off the coast of Richmond. The entire population of *S. patens* was treated in the Lower Mainland.

S. patens in Baynes Sound also increased, with reductions observed in the estimated leaf area of sites that were successfully treated in 2023. Treatments occurred on approximately 51.3% of the total impacted area in 2024. Metrics for *S. densiflora* show that manual removal efforts continue to be successful, with the population staying under 1000 individuals, even as some small plants continue to sprout from seed following removals. The entire population of *S. densiflora* was manually removed in 2024.

The BC SWG continues to work towards full-scale treatment of all three species. Lessons from 2024 will inform program changes in 2025 to better tackle the populations of *S. patens* in Baynes Sound.

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ACKNOWLEDGEMENTS

The work completed for the 2024 Spartina Eradication Program (SEP) could not have been undertaken without funding from:

Government of Canada | Gouvernement du Canada | British Columbia | Port of Vancouver

The British Columbia Spartina Working Group (BC SWG) is a Collaborative group that formed in 2004. It includes members from both government and non-government organizations. The SEP is primarily lead by the technical committee. However, the success of the program's early detection rapid response efforts is only possible from the entire working group (Figure 1).

Figure 1. Members of the BC SWG.

In addition, special thanks are extended to the field coordinators and many other individuals and groups who contributed to finding and removing *Spartina* spp. in British Columbia (BC). Many landowners provided access through their properties to map and control *Spartina*, and we thank them for their support. Those contributions to the BC SWG program are acknowledged in Table 1.

Table 1. List of 2024 participants who helped in the mapping and control of *Spartina* spp. in BC

Organization	Participants
City of Surrey; SHaRP Program	Emilio Yanes-Pawlowski along with 16 SHaRP crew members. The names were not recorded this year; however, the BC SWG is grateful for those that did participate in 2024 efforts.
British Columbia Conservation Foundation	Katie Calon, Allison Bachman, Yvonne Wood, Nancy Koufou, and Jack Ekholm.
Ducks Unlimited Canada	Matt Christensen, Matt Wilson, Richard Topp, Taylor Marriott
Environment Canada – Canadian Wildlife Service	Kathleen Moore
Port Metro Vancouver	Kim Keskinen, Spencer Chaisson
Little River Residents	Rick and Julie Howell
Ministry of Forests	Val Miller, Becky Brown, Derek Hogan
Nature Trust of British Columbia	Claire Ethier, Laura Holt, Keegan Wilcock and Megan Bunsko
City of Delta	Kevin Li, Greg Totaro, Elizabeth Cannell, and Matt Law
Gulf Island Surveys	Leanne Letson

BACKGROUND & ECOLOGY

Today, three different species of invasive *Spartina* are found in B.C, *Spartina anglica, Spartina densiflora,* and *Spartina patens*[1]*. S. patens* was first identified in B.C. in 1979 in both the Burrard inlet and the Courtenay River Estuary. In 2003, Gary Williams, a consultant for Port Metro Vancouver, discovered *S. anglica* growing in the Fraser River Delta while conducting habitat surveys of intertidal areas. This finding raised concerns about the spread of this invasive cordgrass as this species had not yet been discovered in BC. While *S. densiflora* was later identified in the Baynes Sound area of Vancouver Island in 2005, this species was likely present there for some time before, based on anecdotal reports.

Invasive *Spartina* spp. are detrimental to intertidal habitats. Throughout their establishment, *S. anglica* and *S. densiflora* convert important mudflat, low salt marsh, and rocky shore habitat into monoculture stands. These stands accrete sediments, modify drainage patterns and reduce habitat for waterfowl and fish. *S. patens* invades the higher salt marsh areas, outcompeting the diversity of salt marsh plants and replacing them with a dense, monoculture meadow that is very difficult to remove manually. Intertidal areas that became dominated by invasive *Spartina* in the state of Washington, USA, experienced large declines in the abundance of shorebirds and waterfowl. As a result, significant expenditures were required to control *Spartina* in the state, costing approximately $1,000,000 USD per year for more than two decades. The states of Oregon and Washington combined spent approximately $50,000,000 USD over a ten-year period in a concerted effort to eradicate *Spartina* spp. along their coastlines. It is only recently, with sustained funding and the use of herbicide, that these two states have significantly reduced their infestations of *Spartina.*

Controlling the spread of an invasive species early in its expansion is the most cost-effective approach to its eradication. The Fraser River Delta on its own contains approximately 25,000 ha of tidal mud flats that are internationally recognized as important habitat for fish and migratory birds. It hosts the highest density of wintering waterfowl, shorebirds, and raptors in all of Canada. Failing to control invasive *Spartina* in BC would result in a tremendous loss of essential habitats beyond just the Fraser River Delta and would require considerably more resources to manage in the future. It is crucial to control invasive *Spartina* spp. in BC as early as possible.

The BC SWG formed in 2004 with the intent of eradicating invasive *Spartina* spp. from BC's coastlines. The working group is comprised of members from both government and non-government organizations. The BC SWG liaises with the San Francisco Estuary Spartina Project and the Washington State Department of Agriculture, two USA agencies involved in eradicating invasive *Spartina* spp. along the Pacific Coast. The BC SWG has built upon the Pacific Coast Collaborative Agreement as well as the West Coast Governor's Agreement to eradicate *Spartina* spp. from BC's coastlines. The focus of the BC SWG is to employ early detection and rapid response methods to eradicate invasive *Spartina* spp. in BC. In 2024, these methods took the form of mapping and actively controlling for *Spartina* throughout its known range, between BC's Lower Mainland and Vancouver Island (Figure 2). Continued pressure is needed to further reduce the presence of *Spartina spp.* in BC. It is a goal of the BC SWG to expand control efforts on all *Spartina spp*. to eventually eradicate them from BC shores.

[1] Since a molecular phylogenic study was published in 2014 by Peterson, P.M. et al., there is some contention whether *Spartina* species should be re-classified into another genus *Sporobolus*. For simplicities sake, we will continue to refer to these plants by the genus *Spartina*.

DETECTION

The compilation and storage of data of *Spartina* spp. in BC has historically been a joint effort between Ducks Unlimited Canada (DUC) and the Community Mapping Network. In recent years, DUC has been responsible for the collection and storage of spatial data for all *Spartina* spp. in BC. The collected data is used for evaluating the progress of *Spartina* eradication between years, as well as for planning future monitoring and control activities. In 2024, the spatial data of *Spartina* spp. in BC was uploaded to the province's new Invasives BC platform, a replacement to the Invasive Alien Plant Program (IAPP) database. DUC also maintains a geodatabase of all the collected *Spartina* data since the beginning of the eradication program. The data is available for view through a digital web-atlas accessible through the BC SWG website. For more information on mapping methodology and spatial analyses, please visit www.spartina.ca. The location and approximate distribution of *Spartina* in BC in 2024 is shown in Figure 2.

DUC on behalf of the SWG also verifies reports from the Province of BC on new occurrences of invasive *Spartina* spp. The province of BC searches for new occurrences using the following naming conventions (Table 2).

Table 2. *Spartina* naming conventions (Jan. 2024, BC Ministry of Forests, Invasive Plant Program).

Commonly Accepted Scientific Names	Synonyms
Spartina patens	*Sporobolus pumilus*
Spartina anglica	*Sporobolus anglicus*
Spartina densiflora	*Sporobolus montevidensis*
Spartina alterniflora	*Sporobolus alterniflorus*

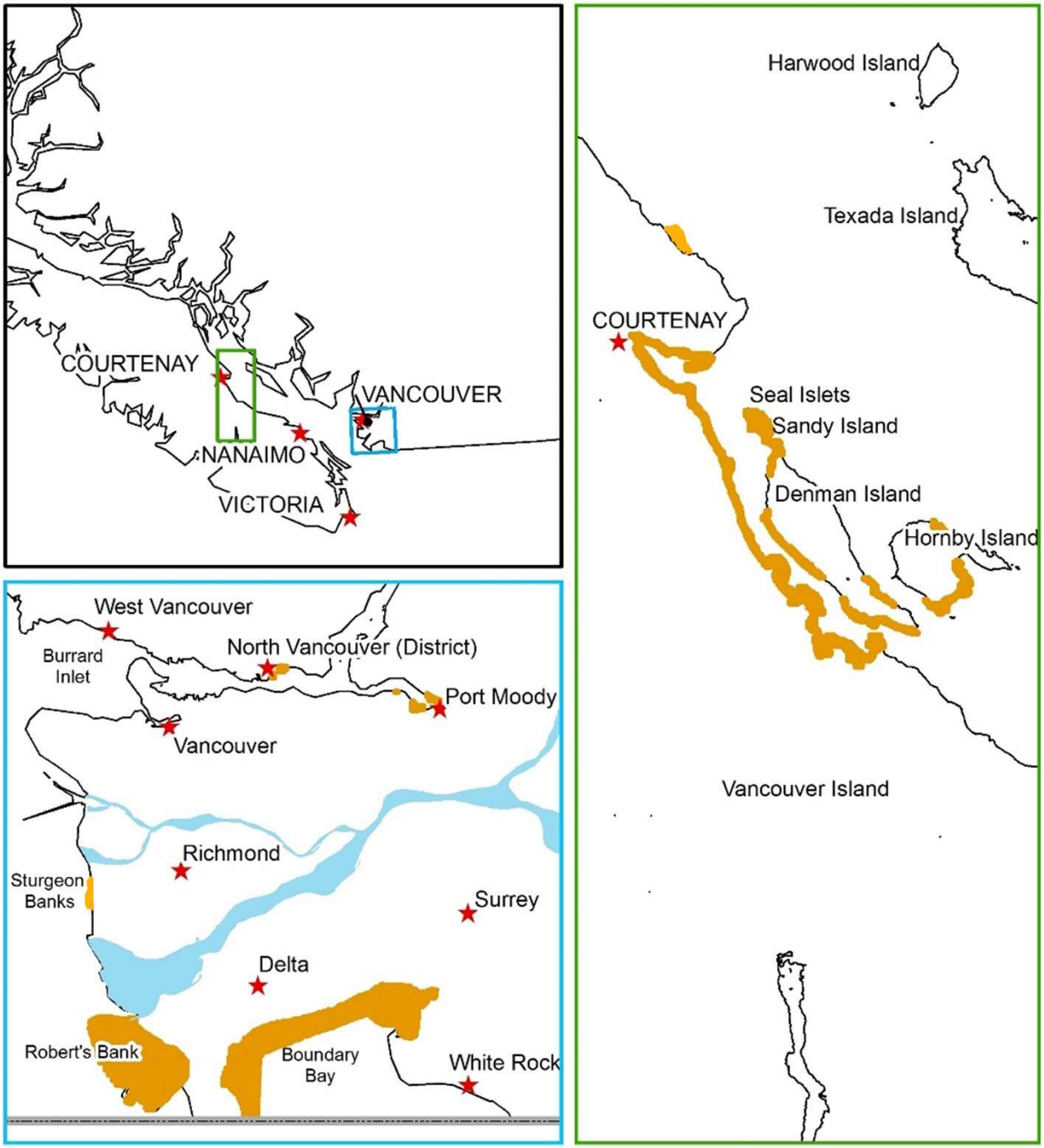


Figure 2. Known locations of invasive *Spartina* spp. in BC as of 2024.

SURVEY METHODS

Since 2017, survey data for *Spartina* spp. was collected using two ESRI[2] applications, *Collector* and *Survey123*. In 2022, *Collector* was replaced by another ESRI application, *Field Maps*. Both products are applications used on smart devices which take the place of Global Positioning System (GPS) units. *Survey123* records the location, size, and additional attributes of individual plants or clones of *Spartina* spp. and *Field Maps* provides real-time tracking of surveyors as well as pre-existing *Spartina* mapping and tracking information. Data from multiple surveyors' *Field Maps* and *Survey123* applications are routinely uploaded to shared cloud databases which surveyors can then download onto their *Field Maps* app. This process provides surveyors with accurate, updated visual representations as to what areas have already been surveyed and treated, as well as when these activities were conducted. Such information is used to determine where subsequent surveying and control efforts are to be applied. These applications allow the BC SWG to accurately and consistently track populations of *Spartina* spp. over time across multiple regions.

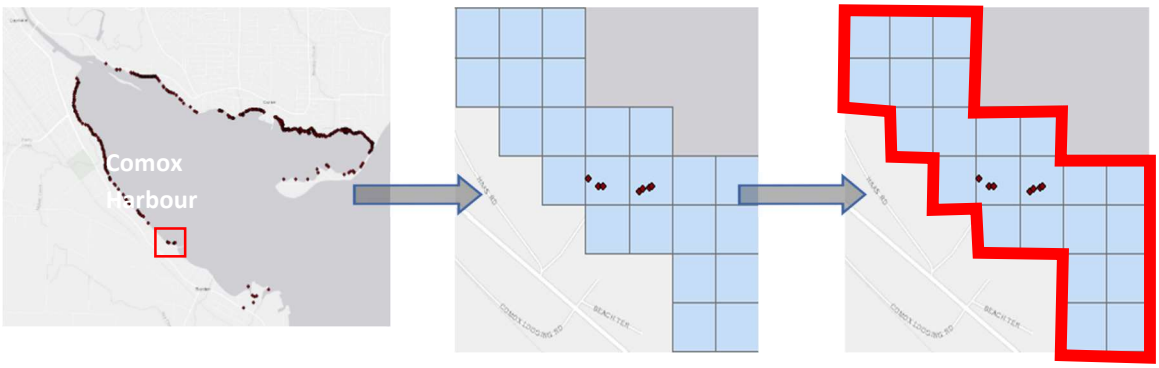
Spartina program data can be accessed through the spartina.ca website, as well as the InvasivesBC webapp.

Site boundaries were set to align with the provincial IAPP sites when it was in operation. The BC SWG analyzes the surveyed sites by using several metrics:

1. The number of plants or plant clones detected
2. The size of each plant or plant clone
    I. Size S: single plant or seedling
    II. Size A: plant with diameter less than 30 cm
    III. Size B: plant with diameter of 30 cm to 1 m
    IV. Size C: plant with diameter of 1 m to 5 m
    V. Size D: plant with diameter of approximately 5 m
    VI. Size M: plant with diameter greater than 5 m
3. The estimated leaf area (number of plants or plant clones detected x size of each plant or plant clone = number of square meters a dispersed colony would occupy if all *Spartina* plants were grouped into a single cluster, see Appendix for full equation)

4. Each site is divided into a grid of 1 ha cells. The three metrics are then summarized at a single cell level within the grid as well as an accumulation of all the cells within a site. These summaries are titled Cell Summaries and Site Summaries, respectively (Figure 3). These summaries are generated on a per-species basis each year. With these summaries, the BC SWG determines how much shoreline has been impacted by *Spartina* spp. (how many 1 ha grid cells had one or more occurrences of *Spartina*). Together, the metrics used by the BC SWG depict spatial trends over time. By analyzing these trends, the BC SWG can effectively plan and develop monitoring and control activities for the future. For more information on how these metrics and summaries are calculated, see Appendix D.

[2] ESRI (Environmental Systems Research Institute) is an international supplier of geographic information system software, web GIS and geodatabase management applications.



Map of Comox Harbour with Spartina plants represented as

Cell Summary showing the total number of plants in each cell representing total abundance

Site Summary (site boundary shown in red)

Figure 3. Cell Summaries and Site Summaries example in Comox Harbour, BC.

In 2023 the Provincial government of BC introduced InvasivesBC as the new province wide invasive species database. For the 2024 season, data collection was updated to include the necessary information for InvasivesBC and methods of collection were altered to be more aligned with InvasivesBC's formatting, such as the switch to include herbicide treatment polygons.

MAINLAND BC – SURVEY EFFORT

In 2024, approximately 172 person days were spent surveying 74.5km of shoreline in the Fraser River Delta, Boundary Bay, Sturgeon Bank, and Burrard Inlet areas for *Spartina* spp. (Figure A1). Surveying in the Fraser River Delta occurred from the tip of Brunswick Point at Robert's Bank to the Canada-USA border South of the causeway that leads to the BC Ferries Terminal in Delta. Surveying along Boundary Bay occurred from the Canada-USA border South of Beach Grove Park, Delta, to where the Campbell River joins Boundary Bay in White Rock.

Surveying in Burrard Inlet occurred in False Creek within the City of Vancouver, the Maplewood Flats Conservation Area within The District of North Vancouver, as well as in Port Moody, at the Pacific Coast Terminal property, in Old Mill Park, and in Old Orchard Park (Figure A1).

Of all the surveys that took place in mainland BC in 2024, *S. anglica* was only found in the Fraser River Delta and Boundary Bay areas (Figure A3 and Figure A4). *S. patens* was found in Burrard Inlet and a new population was discovered at Sturgeon Bank in Richmond by a DUC field crew performing vegetation surveys for another project (Figure A5 and Figure A6).

Additionally, the survey crew assisted with the manual removal of another Invasive EDRR species in Boundary Bay, perennial pepperweed (*Lepidium latifolium*).

EAST COAST VANCOUVER ISLAND & GULF ISLANDS – SURVEY EFFORT

A total of 99 person-days were spent mapping 107.5km of shoreline in the Baynes Sound area and additional surveillance sites on Vancouver Island for *S. patens* and *S. densiflora* in 2024 (Figure A2). Surveying occurred from Goose Spit Park in Comox to Deep Bay in Bowser, near Little River between the BC Ferries terminal and Seal Bay Nature Park, Nanoose Bay, Jack Point and Biggs Park, as well as on Denman, Hornby, and Sandy Island (Jáji7em and

Kw'ulh Marine Park). *S. densiflora* and *S. patens* were found within the Baynes Sound Area on Vancouver Island and some of the Gulf Islands and Seal Islets (Figure A7). *S. densiflora* was also found near Little River.

CONTROL & REMOVAL

MANUAL REMOVAL

S. DENSIFLORA

In 2024, manual removal was still the only treatment method used for *S. densiflora*. Manual removal has been effective in reducing plant numbers, and the plant's biology and habitat preference make it easier to remove by hand than the other species of invasive *Spartina*. In 2024, technicians on Vancouver Island and adjacent islands within Baynes Sound removed entire *S. densiflora* plants using pickaxes and transported them using barrel-packs (Figure 4). Most of the plant material was loaded into contractor-grade plastic bags and dropped off at a local landfill for proper disposal. In 2023, DUC trialed another form of disposal, covered burial above the high tide line, at a few of the sites with heavy infestation. This allowed crews to cut down considerably on transport time and labour to instead focus on mapping and treating a greater area.

Figure 4. Manual removal of *S. densiflora* using pickaxe and barrel-pack.

S. densiflora was controlled during the fall and winter as it is the only standing green plant in the coastal marshes during these months. The timing of control helped reduce search efforts. DUC led the operations on *S. densiflora* removals on the East Coast of Vancouver Island, which has added travel costs for crews travelling from the mainland to Vancouver Island but ensures consistency in the mapping and inventory of plants.

While on Vancouver Island, the BC SWG was able to check on the patch of *S. densiflora* reported in 2023 at Little River in the Comox Valley Region, by local residents Rick and Julie Howell. There was minimal re-growth after the entire infestation was removed in 2023. Removals in 2023 took six days in crews of 5+ people, whereas during the follow-up visit in 2024, the re-growth was removed in one day with only four people. DUC would like to extend a sincere thank you to both Rick and Julie for the accommodation, hard work, as well as the use of their land for disposal of S. *densiflora* by burial.

In 2024, crews also surveyed North of the patch at Little River up to Seal Bay Nature Park, where some standalone individuals and small patches of *S. densiflora* were discovered. Surveys will continue further North in 2025 to find any more satellite populations.

Approximately 480kg of plant material was disposed of at landfill over the 2024 season, and an estimated 160 kg was buried. This was a drastic decline compared with last year, where an estimated 1500kg was taken to landfill and an estimated 1700kg was buried. Most of the difference is from the reduction in the Little River patch, this shows the change in one year following successful removal efforts. Note that the weight reflects the combination of plant matter as well as any mud and rocks entangled in the root system of the plants and is therefore an overestimate of the actual amount of plant matter removed over the seasons.

HERBICIDE

For more than a decade, the treatment of *Spartina* spp. solely used non-herbicide control methods with limited success. Since 2010, a sub-group of the BC SWG has worked with federal and provincial Canadian agencies to determine the requirements and process of using herbicide to control *Spartina* spp. in BC. The sub-group evaluated the ecological impacts and best management practices of two herbicides used to control Spartina in the states of Washington, Oregon, and California, USA. From these evaluations, it was determined that herbicide was to be used but that the project first required the herbicides be registered with the federal Pest Management Regulatory Agency (PMRA) and that a Pesticide Use Permit (PUP) would be required from the BC provincial Ministry of Environment.

Figure 5. Herbicide (with blue dye) applied to *S. anglica*.

As members of the BC SWG, the BC Ministry of Environment and the BC Ministry of Forests submitted an emergency use registration to the PMRA in February 2012 for the use of two herbicides with different active ingredients to control *Spartina*. These were Rodeo (glyphosate) and Habitat (imazapyr). The emergency use registration also included proposed methods on using the herbicides as well as proposed evaluation and monitoring processes. The PMRA granted the emergency registration of Habitat and Rodeo on February 13, 2013, allowing for their use until December 31, 2013. The PMRA requires a new application be submitted annually for the emergency use of herbicides. In 2013, it was decided that only Habitat, mixed with the surfactant Ag Surf II, was to be used to treat *Spartina* spp. in BC. This decision was made following consultation with agencies from Washington State, USA, with the purpose of minimizing the use and impact of herbicide to treat invasive *Spartina*. By mixing Ag Surf II with Habitat, the herbicide would bind to targeted plants, reducing undesired spreading of herbicide to the adjacent environment. The decision to use Ag Surf II was made by the PMRA following a review of multiple surfactants. The review identified Ag Surf II as having a lower toxicity than the other surfactants.

In 2021, Habitat Aqua (a.i. Imazapyr) was fully registered for use in Canada thanks to the efforts of the Spartina Eradication program. This formulation is specifically designed for use in and around aquatic environments and is the product of choice for *Spartina* treatment moving forward.

Annual reports are provided to the Section Head of the Integrated Pest Management Coastal Region by January 31 as a requirement of the PUP. Full herbicide usage statistics for 2024 are provided in (Table B1-B3). Approval to use herbicides in Boundary Bay and Roberts Bank Wildlife Management Area for the 2022-2024 application seasons has been provided by the West Coast Operations Division of the BC Ministry of Forests. A new PUP application is currently in progress for 2025-2028.

S. ANGLICA

In 2024, herbicide application was the only treatment method used for *S. anglica*. Field crews also clipped and removed seed heads as they mapped to further prevent seeding events. Throughout the duration of the *Spartina* Eradication program, herbicide has shown to be most effective at controlling the spread of this species. All individuals of *S. anglica* were targeted for treatment.

In 2024, approximately 43 person-days were spent applying herbicide to *S. anglica* in the Fraser River Delta and Boundary Bay areas (Figure A3 & Figure A4). 195 hectares of the impacted area was treated in 2024 with approximately 980 plants receiving treatment, 100% of the population mapped. Second passes of herbicide treatment were conducted at the following sites: Robert's Bank, TFN Inter-causeway, Boundary Bay E of 88th st., Mud Bay, and Blackie Spit to treat any remaining plants that were missed during the first pass or any new plants. Western sections of Boundary Bay only received one pass of treatment as the first treatment occurred in late august and second treatments scheduled in the Fall were cancelled due to bad weather in the forecast.

S. PATENS

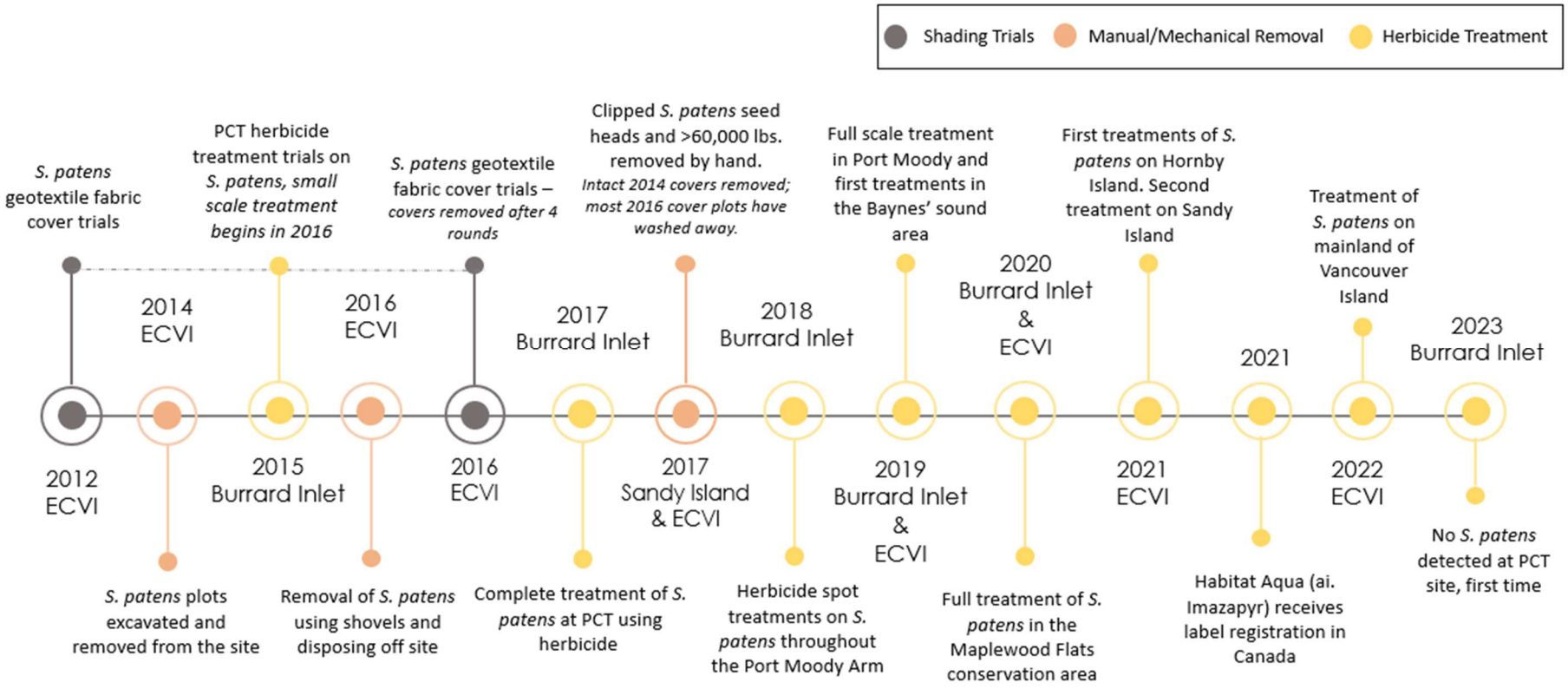
Early methods of control for *S. patens* involved covering colonies of this species with a geotextile fabric (Nilex 2002). The intent behind this was to kill the plants by shading them out over a period of multiple years. Geotextile fabric was used to shade out *S. patens* in Burrard Inlet and Baynes' Sound between 2012-2016 with limited success. Numerous locations, methods and patch sizes have been trialed using the covering method. The fabric was installed over patches of *S. patens* for a minimum of 2 years and only reduced *S. patens* biomass temporarily. The invasive plants rapidly re-established once the covers were removed, typically within 1 growing season. Baynes' Sound has a more active shoreline, subject to wind and wave action that disturbs and removes the cover fabric, which required maintenance and monitoring that is impractical. Due to the limited success with eradicating *S. patens* using covering and manual removal techniques and following a small herbicide pilot trial at PCT in 2015, operational scale herbicide treatment was employed on *S. patens* beginning in 2016. No manual removal was applied to *S. patens* in 2024. Fora full breakdown on the timeline of different treatments by the BC SWG, see Figure 6.

Five person-days were spent applying herbicide to *S. Patens* in the Lower Mainland in 2024. Fourteen hectares of impacted area containing approximately 553 plant individuals were treated in Burrard Inlet between the Maplewood Flats Conservation Area, Old Orchard Park, Old Mill Park, Pacific Coast Terminals , as well as at False Creek and Sturgeon Bank, 100% of the population mapped in 2024 (Figure A5 &Table B2). The Maplewood Flats Conservation area received second-pass treatments.

S. patens is the only *Spartina* species treated with herbicide in the Eastern Vancouver Island Region. In 2024, approximately 58 person-days were spent treating 95.4 hectares of the impacted area were treated between Union Bay and Goose Spit Park, Hornby and Sandy Island, approximately 51.3% of the total impacted area in this region. (Figure A7 and Table B3). No sites in this region received second-pass treatments. The majority of *S. patens* treatment occurred within the Courtenay River Estuary on Vancouver Island, as well as on the adjacent Gulf Islands and Seal Islets, which were prioritized to prevent spread.

Previously, special arrangements were made with the residents around Goose Spit in Comox, BC regarding treatment of plants near unregistered water wells. The special arrangements for this area include keeping a 30 metre buffer from active wells where no chemical treatment will occur, and the implementation of a treatment barrier between private properties and the herbicide applicators. This agreement was made under the expectation that the residents living in this area are responsible for manual removal of *S. patens* within the 30 metre buffer zone around any water wells. Only two water wells were identified which resulted in one contiguous area where herbicidal treatment shall not occur. Portions of the *S. patens* population in Baynes Sound around the Goose Spit area were unable to be treated due to untimely weather during scheduled treatment window. In 2025, the BC SWG is targeting treatments two and a half months earlier than in 2024, as full-scale treatment of this area is our top priority.

Figure 6. Timeline of *Spartina patens* control methods in BC.



PLANT METRICS

When reporting on mapping results from year-to-year we rely on the three metrics: plant abundance, impacted area, and leaf area. Plant abundance is defined by the sum-total of all identified plant individuals in a given area or site. Plant abundance can sometimes be over or underestimated, especially with regard to *S. patens*, as distinguishing where one plant ends, and another begins can be tricky due to their colonial nature. Abundance by size class is an important tool used to decipher this, as a decrease in larger size classes corresponding with an increase in smaller size classes indicates that the plant colonies are fragmenting due to treatment even if there are slight increases in the number of plants mapped by field crews. Impacted area is based on a grid of cells, 1 hectare in area, where an occurrence of one or more *Spartina* plants within that cell counts as the entire cell being impacted. Impacted area helps give an understanding of the extent of the population. Lastly, leaf area is an estimation based on the size of a given *Spartina* plant and its association to a leaf area coefficient (See Appendix E). Tables and figures of all plant statistics can be found in Appendix C & D.

S. ANGLICA

In 2024, *S. anglica* decreased across all metrics. We saw a large decrease in *S. anglica* abundance with a total of only 980 plants found in across all sites, a decrease of approximately 54% from 2023 (Table 3 and Figure C1). This is the first time since 2009 where there were under 1000 individuals found in BC. Additionally, the estimated total leaf area (ha) of *S. anglica* decreased by 36%, and the impacted area also decreased by approximately 21% since 2023 (Figure C2).

Table 3. Summary of *Spartina anglica* statistics following surveys by the BC SWG in 2024 in the Lower Mainland of BC.

	Current Year:	Previous Year:	Change (n)	% Change	Peak Year:	Change (n)	%Change
	2024	**2023**			**2016**		
Abundance (n)	980	2142	-1162	-54%	23260	-22280	-96%
Leaf Area (m^2)	306	478	-173	-36%	16373	-16067	-98%
Impacted Area (ha)	195	248	-53	-21%	972	-777	-80%

Using our map data, we can narrow down these changes to specific sites. The decreases held across all sites, except for TFN inter-causeway, the saltmarsh between the South side of the Deltaport Causeway and the North side of the BC Ferries causeway (Table 4). Here, only estimated leaf area increased. This appears to be solely from the detection of two “Size M” plants within the low salt marsh, the largest size class. No plants of size class M were found in 2023.

Both plants were mapped within the densest area of infestation at this site. While mapping, crews need to use discretion to class plants by size. This may be a case of differences in judgement between crews, where plants that were mapped as many more smaller plants last year were grouped together as large patches in 2024. This aligns with the decrease in the number of plants at this site, which were mainly of the smaller classes. While some variation is expected between different field crews each year, this highlights an area where the BC SWG can further standardize our data collection.

There was also a 1 ha increase in impacted area at Blackie Spit, which likely represents a plant that was missed previously or a single seeding event (Table 4).

Table 4. Summary of *Spartina anglica* statistics by site following surveys by the BC SWG in 2024 in the Lower Mainland of BC.

Site	Abundance			Estimated Leaf Area			Impacted Area		
	n	n	% Change	m^2	m^2	% Change	ha	ha	% Change
	2024	**2023**		**2024**	**2023**		**2024**	**2023**	
Robert's Bank (Brunswick Point - Deltaport Causeway)	419	679	-38%	87.76	156.97	-44%	55	59	-7%
TFN Inter-causeway (TFN Lands / Deltaport and BC Ferries Causeway)	138	323	-57%	106.83	91.93	16%	22	25	-12%
Beach Grove (S of 17A Ave Delta)	24	151	-84%	3.42	13.63	-75%	11	19	-42%
Boundary Bay (17A Ave - 112th st. Delta)	89	163	-45%	40.95	50.36	-19%	48	65	-26%
Mud Bay (E of 112th st. Delta)	279	790	-65%	64.98	153.97	-58%	48	70	-31%
Blackie Spit & Crescent Beach	31	36	-14%	1.57	11.20	-86%	11	10	10%

S. PATENS

The overall *S. patens* population saw increases in plant metrics in 2024, except for estimated leaf area which decreased by 18%. (m^2;Table 5, Figure C3 & Figure C4). Part of these increases include the discovery of previously unknown *S. patches* infestations. In 2024, *S. patens* was discovered for the first time outside of Burrard Inlet on the Lower Mainland, at Sturgeon Bank off the coast of Richmond. More thorough surveys of Deep Bay on the East Coast of Vancouver Island also revealed large patches of *S. patens* that had previously gone undetected.

Table 5. Summary of *Spartina patens* statistics following surveys by the BC SWG in 2024.

	Current Year:	Previous Year:	Change (n)	% Change	Peak Years:		Change (n)	%Change
	2024	**2023**			**2016**			
Abundance (n)	2439	1127	1312	116%	2022	1326	1113	84%
Leaf Area (m2)	21023	25778	-4755	-18%	2021	49115	-28092	-57%
Impacted Area (ha)	213	175	38	22%	2020	196	17	9%

S. patens is typically targeted later into the season (Aug-Oct) due to being significantly easier to identify once the grass begins to flower and subsequently seed. All sites were not treated in 2023, due to issues with scheduling around weather at this later time of year as the PUP has strict weather restrictions. Even at sites that were successfully treated in 2023, we still see increases due to seed dispersal and a well-established seed bank (Table 6). These increases show the need to change our practices and begin mapping and treating *S. patens* much earlier. Any plants that are missed during earlier passes without their distinct flower heads, can still be detected during second pass surveys later in the season. Treatment plans for *S. patens* in 2025 are scheduled to begin earlier, in June-July.

Table 6. Summary of *Spartina patens* statistics by site following surveys by the BC SWG in 2024.

Site	Abundance			Estimated Leaf Area			Impacted Area		
	n	n	% Change	m^2	m^2	% Change	ha	ha	% Change
	2024	**2023**		**2024**	**2023**		**2024**	**2023**	
Burrard Inlet (Lower Mainland)	553	171	223%	384.98	86.37	346%	14	9	56%
False Creek (Lower Mainland)	16	8	100%	27.62	25.20	10%	7	4	75%
Sturgeon Bank (Lower Mainland)	12	0	N/A	127.55	0.00	N/A	6	0	N/A
ECVI (East Coast Vancouver Island)	1760	916	92%	19391	25452	-24%	161	146	10%
Gulf Islands & Seal Islets (Baynes Sound)	98	32	206%	1092.32	213.48	412%	25	16	56%

Maplewood flats, which has the largest patch of *S. patens* in the Lower Mainland showed unexpected increases in 2024. Part of this increase is likely due to continued seed dispersal, given that the impacted area increased. Survey crews also re-mapped the area later into the season than normal due to the detection of *S. patens* at Sturgeon Bank taking priority, which may have led them to find more individuals as the rest of the vegetation had began to senesce for fall.

Overtime, as the dense monocultures at Maplewood Flats have been treated they have broken up into smaller sparser colonies. In 2024, the densities of *S. patens* colonies were low, sparse patches were found scattered amongst the other vegetation. As *S. patens* has typically been found in dense monoculture patches, our current survey methods rely on the obvious distinction between dense colonies to class them into different sizes. *S. patens* differs from the other two invasive *Spartina* spp. in BC, in that it is a very thin and slender grass, which makes these

distinctions even more difficult. The use of our same survey methods in 2024 likely led to overestimations of the population at this site. Interestingly, this was also found of the "new" population discovered at Sturgeon Bank, which was much less dense than other sites. This could be due to the infestation truly being a new establishment from a seed dispersal event, or because the *S. patens* at Sturgeon Bank was found growing mostly amongst an established invasive bent-grass species (*Agrostis* sp.) which it is competing with. These findings in 2024 illustrate the need to improve our survey methods to better capture new and declining populations of *S. patens*.

Unfortunately, after no plants were detected at the Pacific Coast Terminals site in Burrard inlet in 2023, two plants were discovered hidden within man-made structures in 2024. These plants were treated, and we are hoping it will be free of *S. patens* again in 2025.

Populations of *S. patens* on Vancouver Island have continued to increase as we work towards full-scale treatment in this region. The reduction in estimated leaf area of -24% from 2023 shows that successful treatments are effective at reducing colonial growth, and that larger colonies are beginning to break up (Table 6).

S. DENSIFLORA

S. densiflora decreased across almost all metrics, except for abundance, in 2024 (Table 7). A decrease in both leaf area (-72%) and impacted area (-26%), combined with an increase in abundance (+34%) is due to new small plants sprouting from existing seed banks following the removal of large plants in 2023. The large infestation at Little River accounted for 80% of the estimated leaf area of *S. densiflora* in 2023, down to only 46% in 2024.

Table 7. Summary of *Spartina densiflora* statistics following surveys by the BC SWG in 2024.

	Current Year:	**Previous Year:**	**Change** (n)	**% Change**	**Peak Years:**		**Change** (n)	**%Change**
	2024		**2023**					
Abundance (n)	982	733	249	34%	**2015**	14090	-13108	-93%
Leaf Area (m2)	70	249	-179	-72%	**2018**	4950	-4880	-99%
Impacted Area (ha)	71	96	-25	-26%	**2016**	292	-221	-76%

Decreases in *S. densiflora* occurred on both the East Coast of Vancouver Island as well as in the populations found on the Gulf Islands and Seal Islets (Denman, Hornby, and Sandy Island; Table 8).

Table 8. Summary of *Spartina densiflora* statistics by site following surveys by the BC SWG in 2024.

Site	**Abundance**			**Estimated Leaf Area**			**Impacted Area**		
	n	n	% Change	m^2	m^2	% Change	ha	ha	% Change
	2024	**2023**		**2024**	**2023**		**2024**	**2023**	
ECVI (East Coast Vancouver Island)	965	499	93%	69.68	228.13	-69%	69	77	-10%
Gulf Islands & Seal Islets (Baynes Sound)	17	234	-93%	0.00	21.11	-100%	2	19	-89%

WEATHER & OTHER DELAYS

A large factor in the success of planned mapping and treatment activities has been weather. In 2024, the BC SWG lost zero days to mapping due to extreme weather or smoke. Surveys were delayed by one week due to the discovery of a deceased person in Boundary Bay, which happened similarly in 2021. Many treatment opportunities were missed in the Fall as bad weather in the forecast prevented scheduling treatment due to restrictions of the PUP.

RESTORATION

Control and eradication efforts to date in B.C on *S. anglica* and *S. densiflora* have been successful without requiring additional restoration efforts. *S. anglica* and *S. densiflora* invade mudflats and areas of shoreline that typically have limited plant abundance and diversity. Where *S. anglica* and *S. densiflora* occur within native vegetation, it is typically in clusters surrounded by native vegetation that rapidly re-establishes after treatments.

S. patens can invade the high salt marsh where there is a higher density and abundance of native plants and turns these areas into monoculture meadows of *S. patens*. Planting of native species in the areas left barren following *S. patens* treatment can speed up native re-vegetation and increase the resilience of these habitats while reducing the ability for invasive species to monopolize them again.

Previously, the BC SWG trialed replanting after *S. patens* treatment with the City of Port Moody. Replanting was done using nursery stock of *Carex lyngbyei*, a dominant species that thrives at low- to middle-elevation tidal zones, which include high marsh elevations where *S. patens* grows. *Carex lyngbyei* was planted at the end of the 2018 program year. Goose grazing is a known pressure on marsh plants and particularly marsh restoration plantings, as such goose ex-closure fencing was installed to minimize these pressures, which required regular monitoring and maintenance to ensure the goose ex-closure fence remained intact and the plantings took root. Scaling a planting operation like this would have challenges. Often *Spartina* spp. grow in exposed habitats with high tidal and wave action, as well as interference from debris in the water column, making these structures time-intensive to check-on and maintain across a broad range of locations.

In 2023 DUC evaluated whether to focus time and effort on replanting *S. patens* treatment sites with native vegetation in Burrard inlet, which has reached a point where most monoculture patches have broken up into sparser smaller patches. Native vegetation so far has been able to re-establish itself where *S. patens* was.

Currently, the *S. patens* population on Vancouver Island more closely resembles the monoculture meadows that would typically be candidates for replanting. However, difficulties with fully treating some of these areas have prevented the need for replanting. With treatments on *S. patens* scheduled earlier in 2025, a full-scale treatment is expected to occur. Additional monitoring is planned for 2025 on the large monoculture patches in Deep Bay, which will inform our needs for replanting and give us a better understanding of how local salt marshes respond to the removal of large colonies of invasive plants.

FINANCES

The Spartina Eradication Program has generated over $4,025,000 CAD of direct cash funding since its creation in 2004 with an additional $1,555,000 CAD of In-Kind contributions to the program. $2,400,000 CAD of this funding has been provided by the province of BC through the Ministries of Environment, FLNRORD, Forestry, and Agriculture over the life of the program. The total program revenue in 2024 was approximately $378,500 CAD through various

donors, of which $362,275 CAD was raised for the program directly through DUC. Another $6,200 CAD of in-kind contributions were put towards the program by various organizations in 2024.

$10,000 of the funding granted by the Port of Vancouver was given to the Friends of Semiahmoo Society for European Green Crab monitoring in Boundary Bay.

Approximately $73,600 CAD was unspent on the program in 2024 and will be carried forward into the next program season. Underspending was due to treatments in the Lower Mainland taking fewer applicator days than expected with the low populations of *S. anglica,* incomplete treatment of *S. patens* on Vancouver Island due to incompatible weather, and manual removals of *S. densiflora* at Little River taking considerably less effort than in 2023. For a breakdown of the revenue and expenditures for 2024, see Table 9 and Table 10. The recent history of financial contributions (cash and in-kind) of the BC Spartina Working Group is found in Figure 7, below. The in-kind contributions were provided by the following agencies:

- BC Conservation Foundation
- BC Ministry of Environment
- BC Ministry of Forests
- City of Surrey – ShaRP & SNAP Programs
- City of Delta
- City of Port Moody
- Environment Canada- Canadian Wildlife Service
- Port of Vancouver
- West Coast Conservation Land Management Program
- South Coast Conservation Land Management Program
- Friends of Semiahmoo Bay Society
- The Tsleil-Waututh Nation
- Raincoast Conservation Foundation & Tsawwassen First Nation
- The Nature Trust of BC

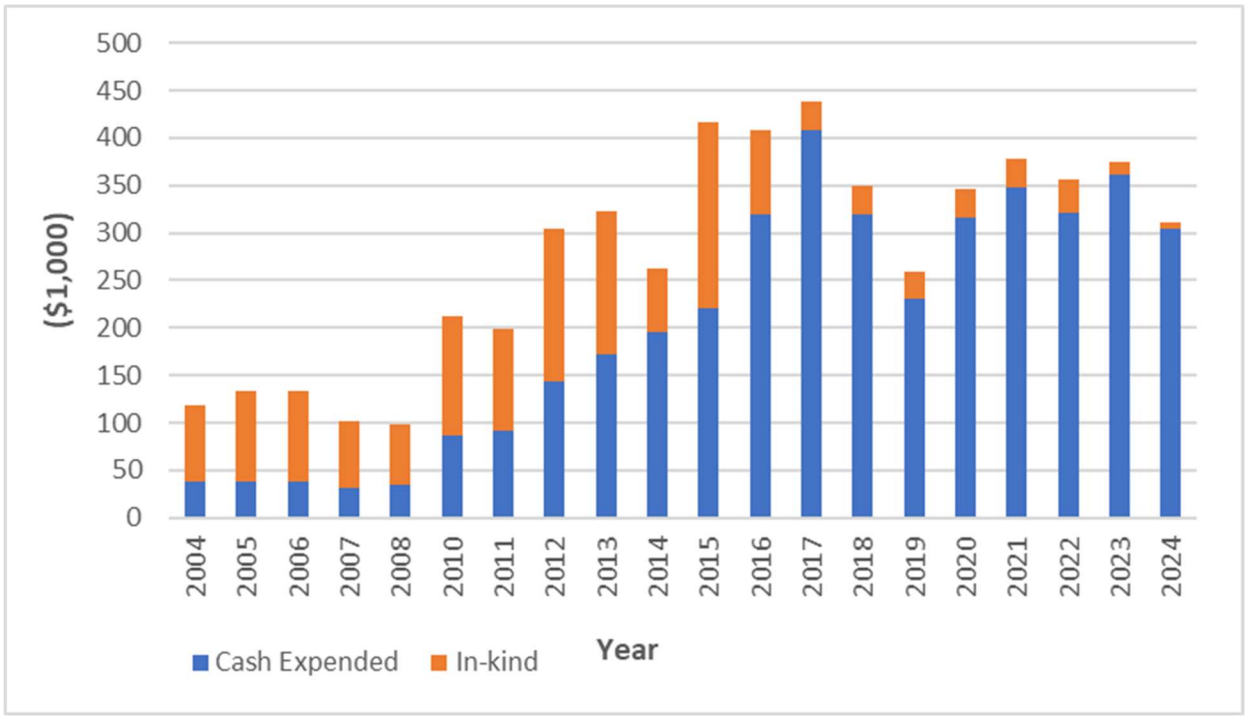


Figure 7. Funding history of the Spartina Eradication Program comparing in-kind donations to total cash expenditures each year since 2004.

Table 9. Total revenue from all funders towards the Spartina Eradication Program in 2024.

Revenue		
Source	**Through DUC**	**Through BC SWG Member**
Province of BC	$300,000	-
Province of BC – Carry Over FY24	$32,275	
Port of Vancouver	$30,000	-
Government of Canada – Canada Summer Jobs	-	$16,246
Subtotal	***$362,275***	***$16,246***
Grand Total	**$378,521**	

Table 10. Expenditures related to the Spartina Eradication Program in 2024.

Expenditures		
Category	**Mainland BC**	**Vancouver Island & Gulf Islands**
Treatment Contractors	$25,487	$44,469
Personnel - Field Crew	$45,424	$0
Personnel - DUC Staff	$3,400	$27,835
Travel	$10,141	$7,251
Subtotal	***$84,452***	***$79,555***
Gas, Mileage, Truck Rental	$16,698	
Tools, Supplies, PPE, etc.	$11,283	
Herbicide	$6,607	
Green Crab Monitoring Boundary Bay	$10,000	
Coordination	$68,605	
Administration/Overhead	$27,720	
Subtotal	***$140,913***	
Grand Total:	**$304,920**	

INFORMATION AND INTERNET RESOURCES

- The spartina.ca website provides information on the Spartina Eradication Program and houses the historical distribution of *Spartina* spp. in BC: www.spartina.ca .
- Coastal Invasive Species Committee website: http://www.coastalisc.com/priority-invasive-plants

RECOMMENDATIONS FOR 2025

COORDINATION

- Continue engaging with the BC SWG members to build volunteer capacity.
- Host two identification workshops (one for each region) for BC SWG members and interested members of the public.

SURVEYS

- Re-evaluate survey metrics to ensure we are accurately capturing less dense populations of *S. patens.*
- Identify opportunities to collect additional data as crews perform regular surveys.
- Provide all survey personnel with portable size references or measuring tools to ensure they are accurately classing plants by size.
- Further standardize survey methods by providing written protocols in addition to the regular training.

TREATMENTS

- Start herbicide treatments earlier on *S. patens* in Baynes' Sound, increasing treatment coverage to the largest extent feasible without compromising any progress made on *S. anglica* eradication to date.
- Continue to identify opportunities to improve herbicide treatment program delivery efficiency between regions given limited treatment season and treatment condition windows (tides and weather).
- Work with Tsawwassen, K'omoks, and Tsleil-Waututh First Nations to map and treat *Spartina* spp.

SCIENCE AND EVALUATION

- Expand herbicide treatment efficacy monitoring to include a higher number of duplicates.
- Conduct additional monitoring on vegetation community response as large monoculture patches of *S. patens* are treated on Vancouver Island.
- Set a reasonable target of mapping areas adjacent to existing infestations or at risk of invasion to catch new infestations, alternating areas between years.
- Test aerial detection techniques with new technologies such as remote-controlled, electric, unmanned aerial vehicles (UAVs) or satellite imagery. These activities would be used to detect large clones and large meadows of *S. patens* in particular. This could also reduce survey time for *S. anglica* in large mudflat areas that are slow to survey due to the muddy conditions and long distance to cover, but often have few plants present.

RESTORATION

- Identify opportunities for restoration at *Spartina* sites without compromising on treatment efforts.
- Continue to monitor for scenarios where re-planting could be beneficial (erosion, adjacent invasive species, etc.)

CONCLUSION

2024 marked the 20th year of the BC SWG's efforts to control invasive *Spartina* spp. in BC. The population of *S. anglica*, the species which kicked off the program, dropped to below 1000 individuals for the first time this year since 2009! While there have been small fluctuations year-to-year, efforts have reduced the abundance in the Lower Mainland of *S. anglica* by 96% since its peak in 2016.

The 20th anniversary marks a chance to re-evaluate our program delivery. DUC on behalf of the BC SWG has planned some changes for the 2025 season including targeting *S. patens* treatments earlier into the summer season, retaining field crews into the Fall to increase our capacity, adding additional ecological monitoring into the program, increasing surveillance of new sites, as well as leading identification workshops. With limited time and capacity over the summer season, the program's success entirely comes down to how time and effort are prioritized for mapping and treatment. Scheduling around seasonal tide schedules, remote access sites, and balancing the various factors such as permit, and commercial harvest restrictions has its challenges. As the population continues to decline in the Lower Mainland, the BC SWG has an opportunity to adapt and pivot efforts to furthering treatment efforts on Vancouver Island.

One of the wins this year included treating a new population of *S. patens* at Sturgeon Bank only two weeks after discovery, this was the first population found outside of in Burrard inlet or False Creek in the Lower Mainland. Crews were also able to remove 100% of the mapped *S. densiflora* and are expecting large reductions during 2025 surveys. The "new" patch of *S. densiflora*, which took a huge effort over two weeks to remove in 2023, was so much smaller in 2024 that it took only one day to manually remove. Crews were also able to survey areas North of the patch and remove some scattered individuals.

With the end of the current PUP for 2022-2025, and a new PUP application in the works for 2025-2028, the BC SWG held its first meeting in many years, bringing back together the groups and stakeholders who played a larger role during the early years of the program. Since the BC SWG meeting in February of 2025, various groups and stakeholders have sent messages offering to help with the program. The BC SWG will continue to re-engage with its members, as well as re-connect with those leading *Spartina* eradication efforts to the South, in Washington State.

The Spartina eradication program has continually evolved its methods to match the changes in technology and best practices since the start of the program. The program has seen massive strides towards eradication of *Spartina* spp. in BC since 2016. With more years of intense treatment pressure, the BC SWG can continue to significantly reduce the presence of *Spartina* spp. in BC and eventually move into the monitoring stage until *Spartina* spp. can be declared as eradicated from our sites. The BC SWG will continue with its partnership approach in striving to protect BC's shores and eradicate invasive *Spartina* spp.. DUC, on behalf of the BC SWG, would like to thank all of those who have helped with the program over the last twenty years!

REFERENCES

Peterson, P., Romaschenko, K., Arrieta, Y., & Saarela, J. (2014). Proposal to conserve the name *Sporobolu*s against *Spartina, Crypsis, Ponceletia*, and *Heleochloa* (*Poaceae: Chloridoideae: Sporobolinae*). Taxon. 63. 10.12705/636.23.

APPENDIX A – MAPS

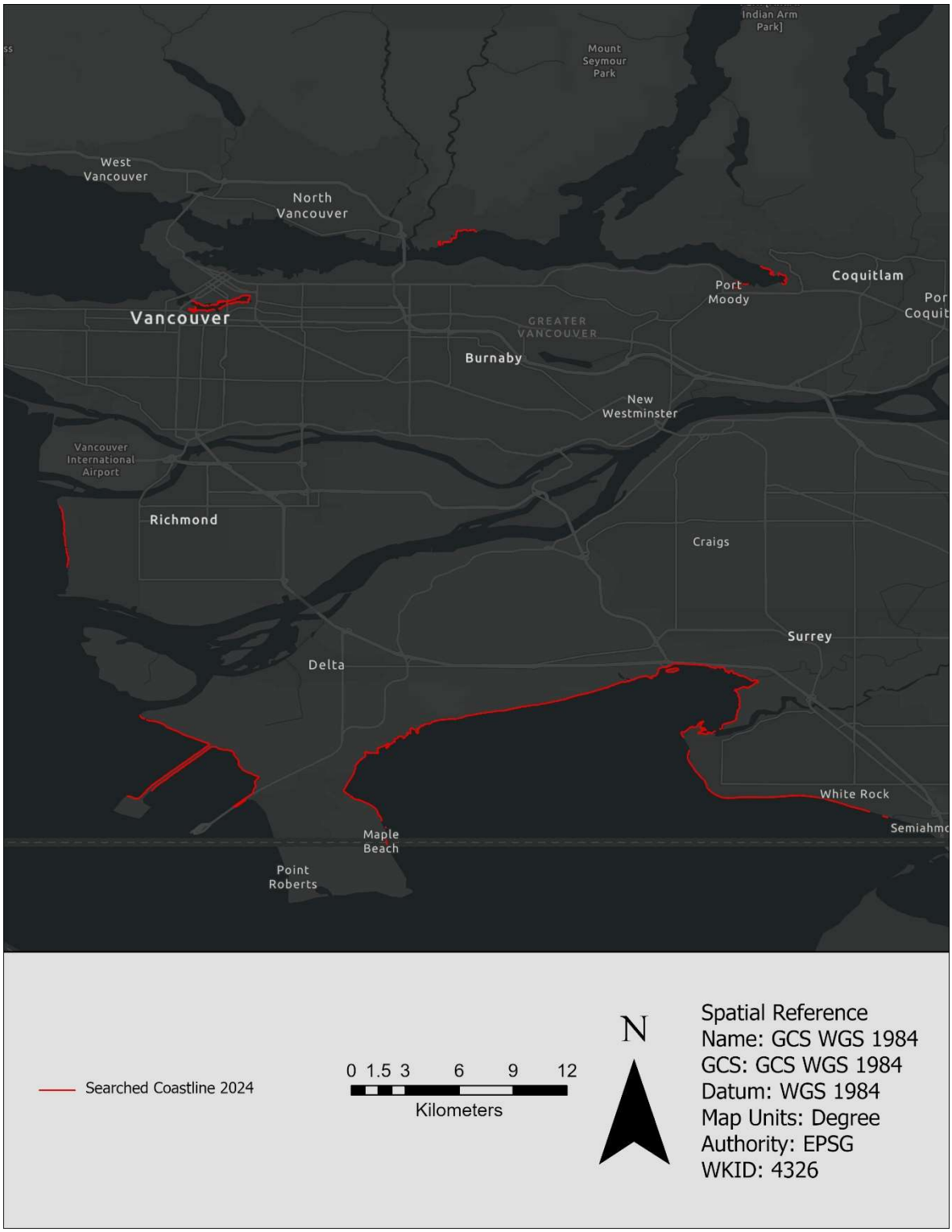


Figure A1. Fraser River Delta, Boundary Bay, Sturgeon Bank, and Burrard Inlet areas surveyed for *Spartina* spp. in 2024. A total of 74.5 km was searched.

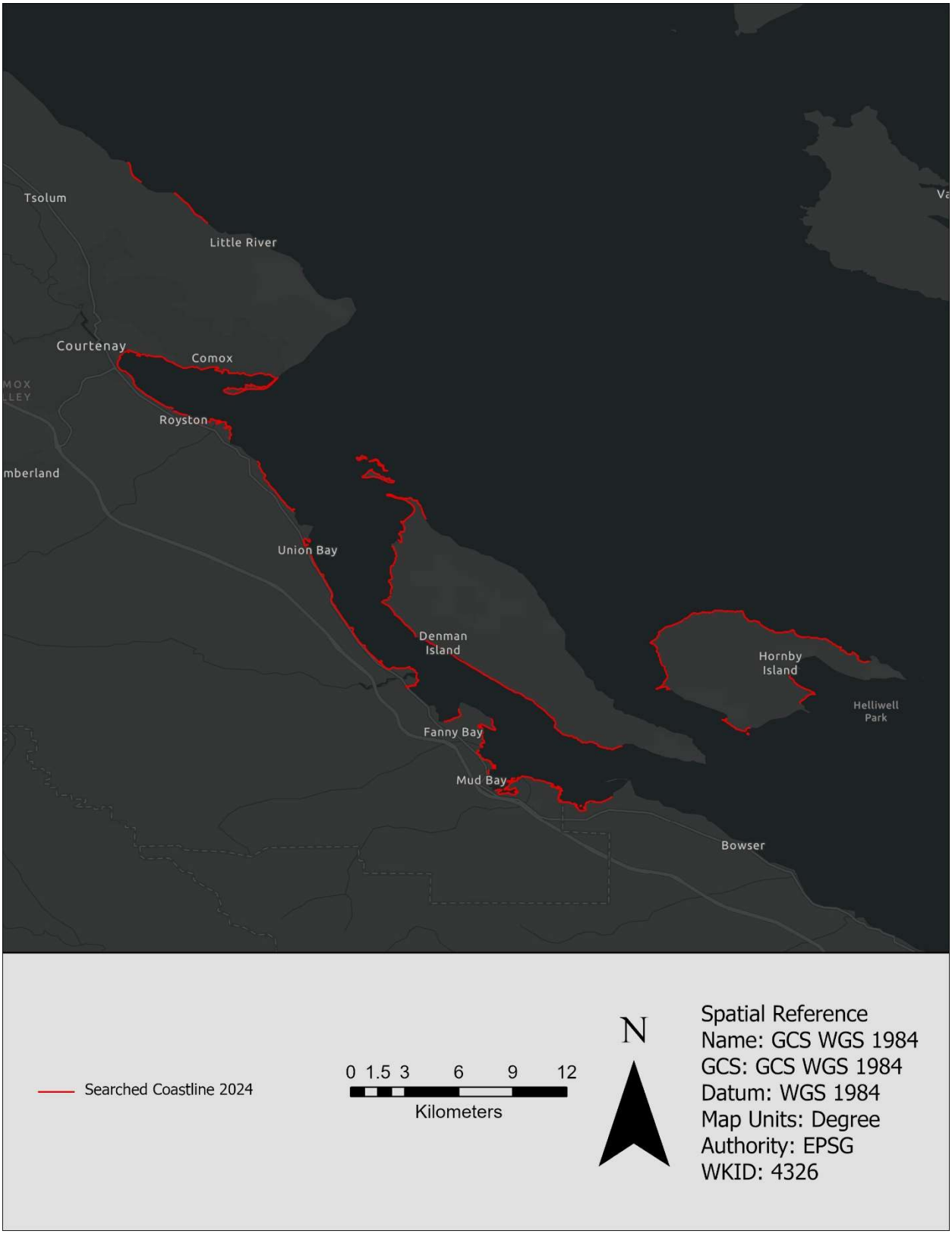


Figure A2. Baynes' Sound area surveyed for *Spartina* spp. in 2024. A total of 107.5 km was searched. Some surveillance surveys that took place in 2024 are not pictured: Nanoose Bay and Jack Point and Biggs Park.

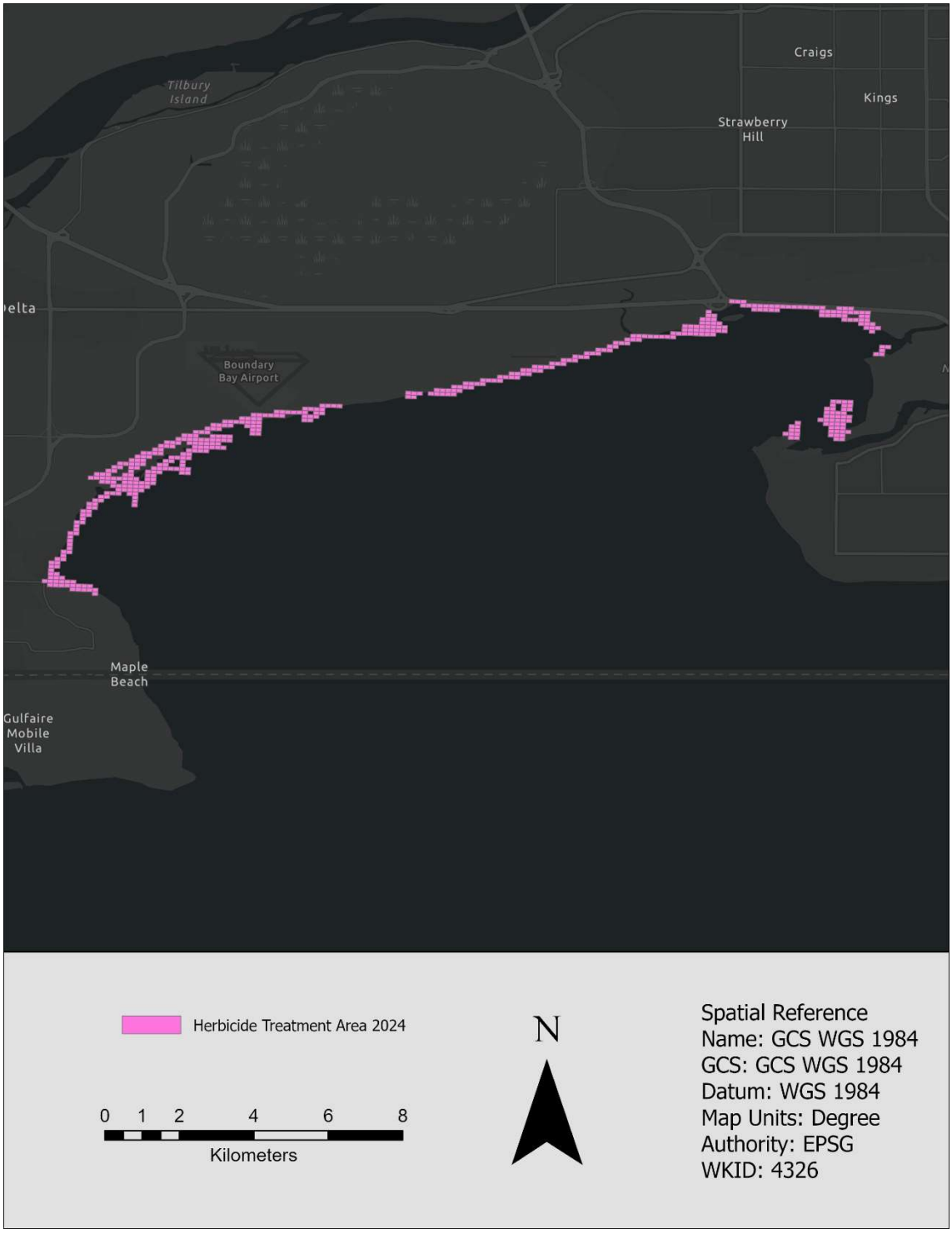


Figure A3. 2024 *Spartina anglica* treatment areas in Boundary Bay. Each pink square represents a 1 ha cell where one or more *Spartina anglica* plants were treated.

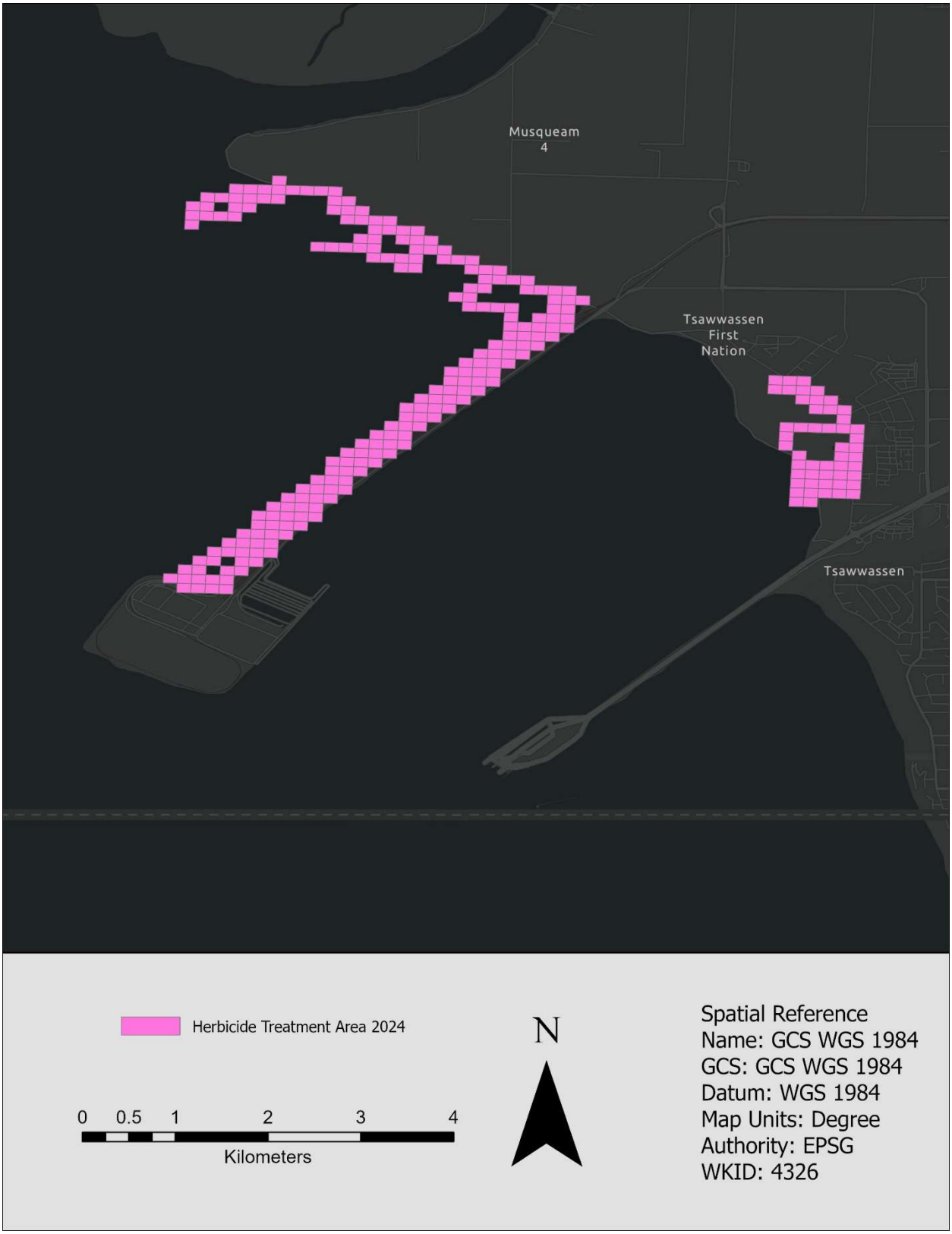


Figure A4. 2024 *Spartina anglica* treatment areas in the Roberts Bank Wildlife Management Area and Tsawwassen First Nation. Each pink square represents a 1 ha cell where one or more *Spartina anglica* plants were treated.

Figure A5. Herbicide treatment locations for *Spartina patens* in Burrard Inlet in 2024. Each pink square represents 1ha cell where one or more plants were treated.

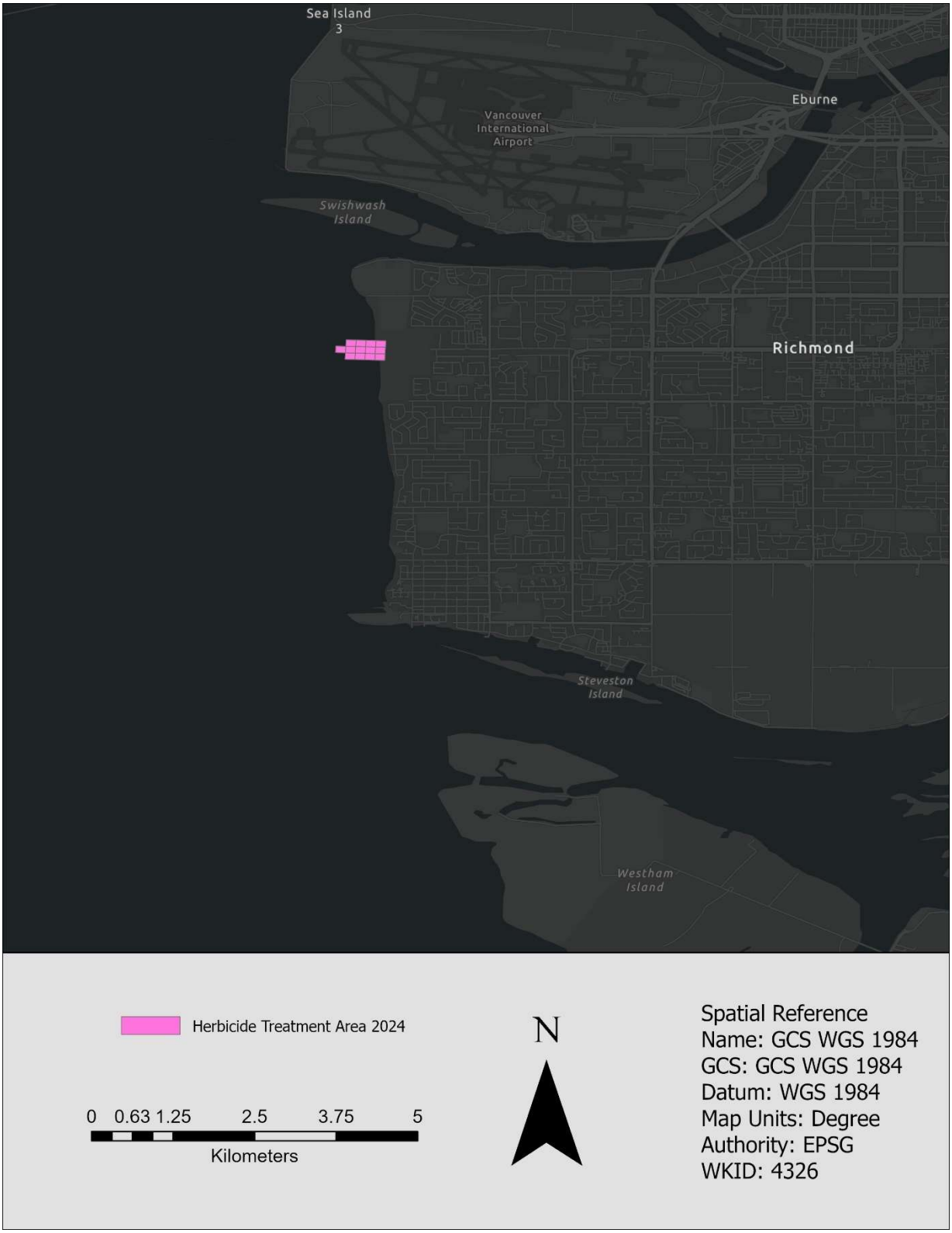


Figure A6. Herbicide treatment locations for *Spartina patens* at Sturgeon Bank in 2024. Each pink square represents 1ha cell where one or more plants were treated.

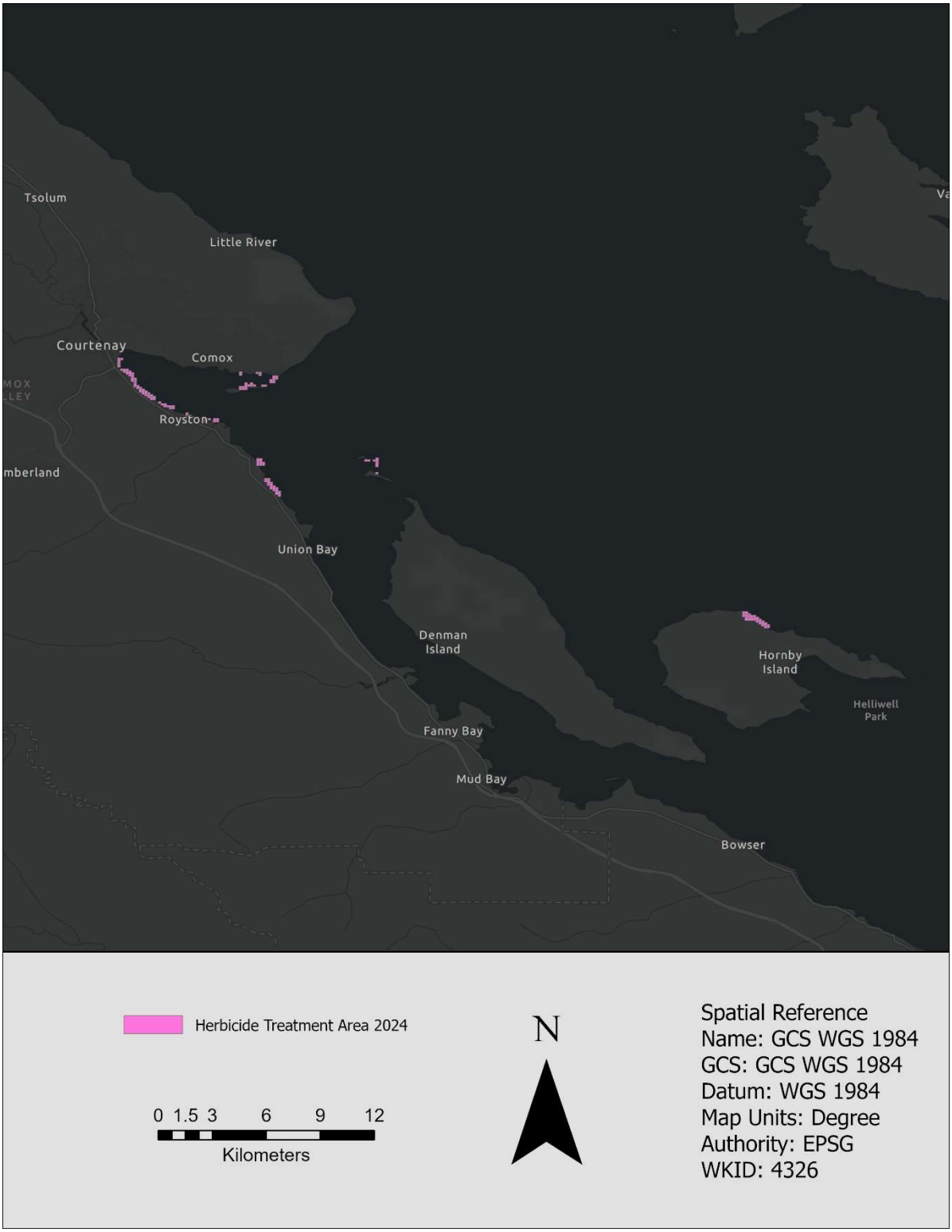


Figure A7. 2024 *Spartina patens* treatment areas in the Baynes' Sound area. Each pink square represents a 1 ha cell where one or more *Spartina patens* plants were treated.

APPENDIX B – HERBICIDE USAGE

Table B1. Amount of herbicide used to treat *Spartina anglica* since 2013.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Volume of herbicide mix used (L)	1090	2595	1950	3744	2412	1109	566	178	492	164	188	136
Volume of Habitat used (L)	8.17	19.46	14.62	28.08	18.09	8.32	4.25	1.33	3.69	1.23	1.41	1.02
Amount of active ingredient (Imazapyr) **used** (kg)	1.96	4.67	3.51	6.74	4.34	2.00	1.02	0.32	0.89	0.30	0.34	0.24
Volume of surfactant Viterra Ag Surf II used (L)	5.44	12.97	9.75	18.72	12.06	5.55	2.83	0.89	2.46	0.82	0.94	0.68
Amount of active ingredient (alcohol ethoxylate**)** (kg)	5.01	11.94	8.97	17.22	11.10	5.10	2.60	0.79	2.20	0.73	0.84	0.61
Estimated area of Habitat Aqua coverage (ha)	1.75	4.17	3.90	6.01	3.87	1.78	0.91	0.29	0.79	0.26	0.30	0.22

Table B2. Amount of herbicide used to treat *Spartina patens* in the Lower Mainland since 2016.

	2016	2017	2018	2019	2020	2021	2022	2023	2024
Volume of herbicide mix used (L)	216	583	17	25	782	48	67	35	88
Volume of Habitat used (L)	1.62	4.37	0.13	0.19	5.87	0.36	0.50	0.26	0.66
Amount active Ingredient (Imazapyr) used (kg)	0.39	1.05	0.03	0.05	1.41	0.09	0.12	0.06	0.16
Volume of surfactant Viterra Ag Surf II used (L)	1.08	2.92	0.09	0.13	3.91	0.24	0.33	0.17	0.44
Amount active ingredient (alcohol ethoxylate) used (kg)	1.17	3.17	0.09	0.14	3.60	0.22	0.31	0.16	0.40
Estimated area of Habitat Aqua coverage (ha)	0.35	0.94	0.03	0.04	1.26	0.08	0.11	0.06	0.14

Table B3. Amount of herbicide used to treat *Spartina patens* in the Bayne's Sound area since 2019.

	2019	2020	2021	2022	2023	2024
Volume of herbicide mix used (L)	567	345	298	531	456	424
Volume of Habitat used (L)	4.25	2.59	2.24	3.98	3.42	3.18
Amount active Ingredient (Imazapyr) used (kg)	1.02	0.62	0.54	0.96	0.82	0.76
Volume of surfactant Viterra Ag Surf II used (L)	2.84	1.73	1.49	2.66	2.28	2.12
Amount active ingredient (alcohol ethoxylate) used (kg)	2.61	1.54	1.33	2.37	2.04	1.89
Estimated area of Habitat Aqua coverage (ha)	0.91	0.55	0.48	0.85	0.73	0.68

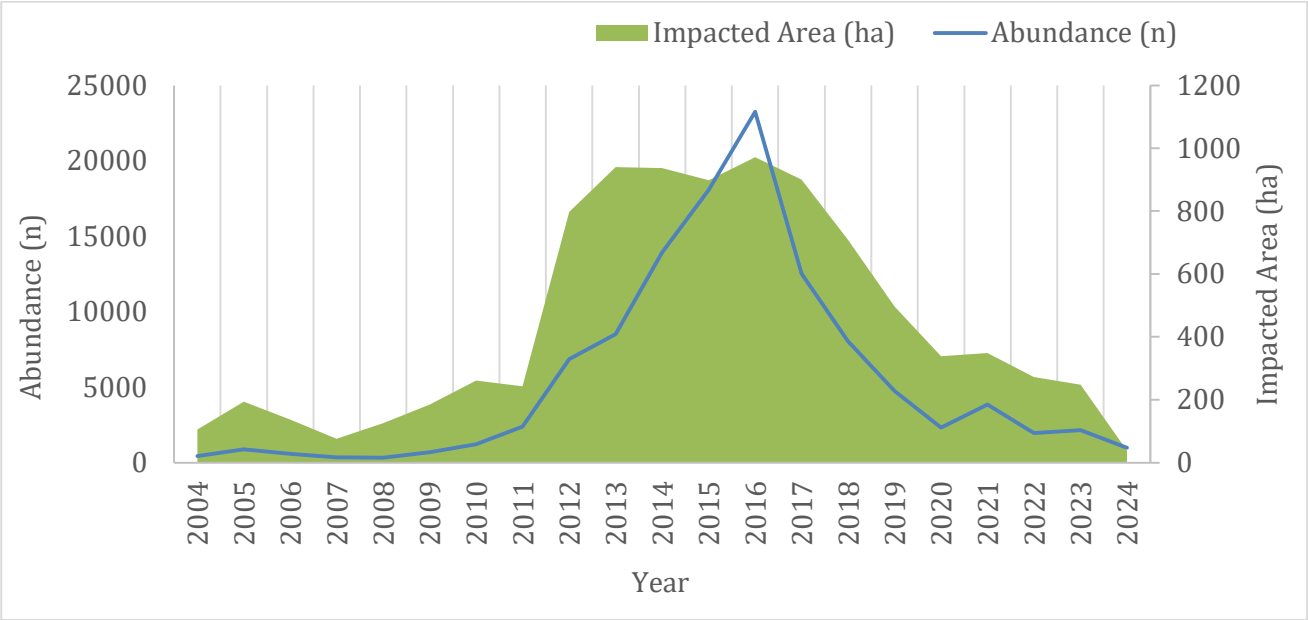


Figure C1. Plant abundance (n) and impacted area (ha) of *Spartina anglica* from 2004 – 2024.

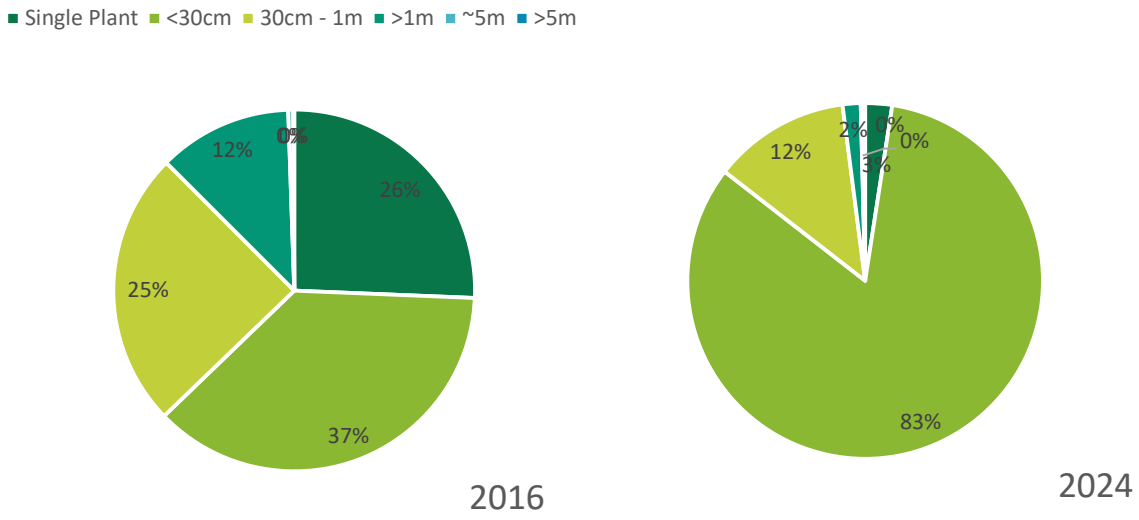


Figure C2. Proportions of *Spartina anglica* plants found in BC of different size classes, in 2016 and 2024.

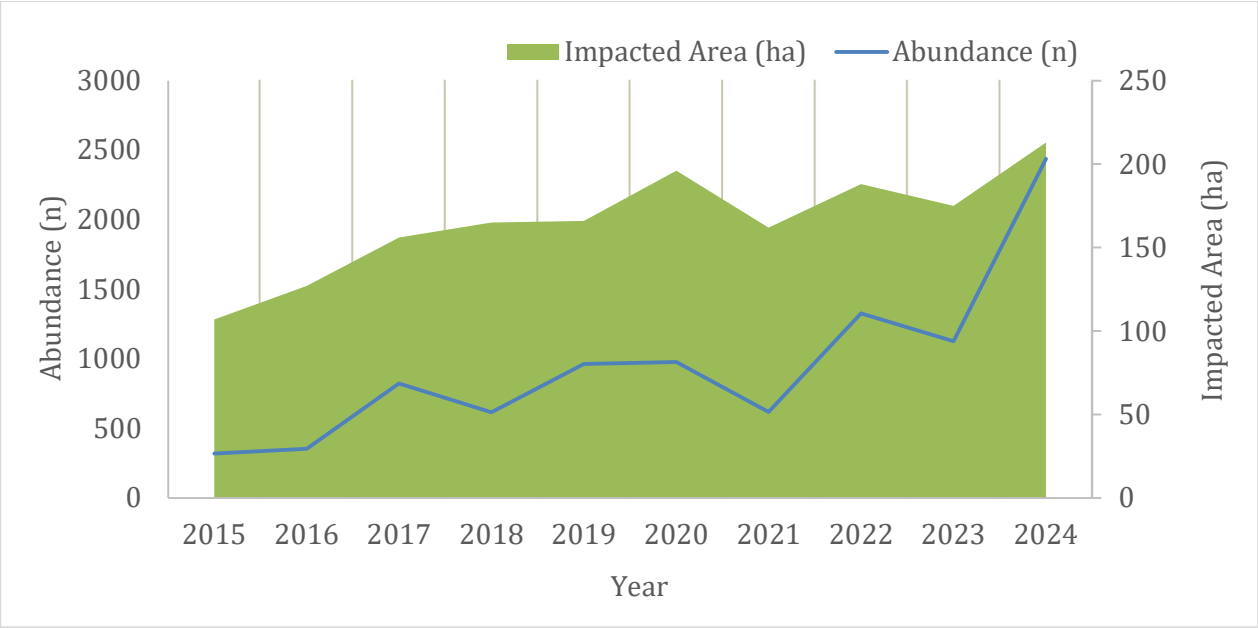


Figure C3. Overall plant abundance (n) and impacted area (ha) of *Spartina patens* from 2015 – 2024.

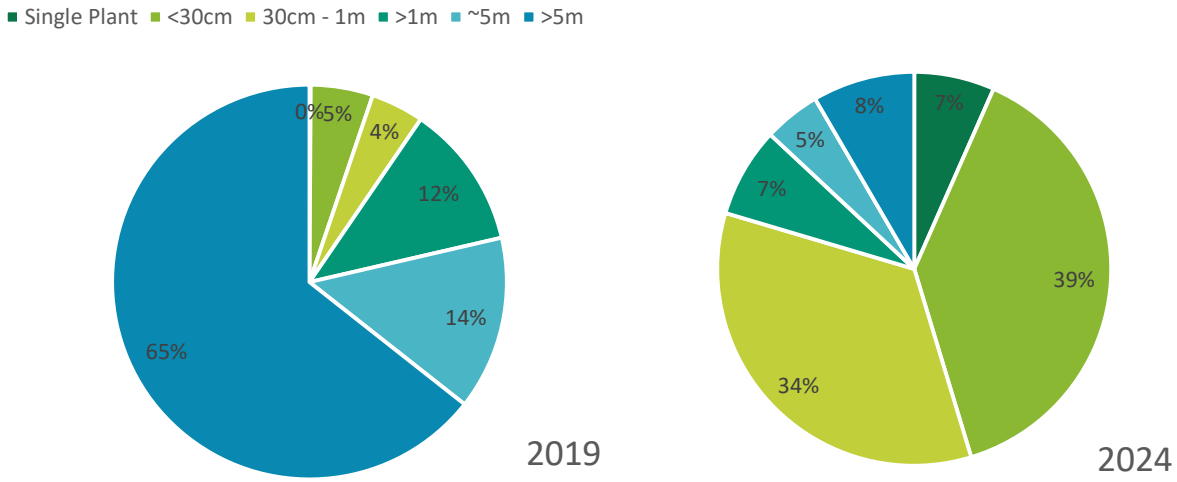


Figure C4. Proportions of *Spartina patens* plants found in BC of different size classes, in 2019 and 2024.

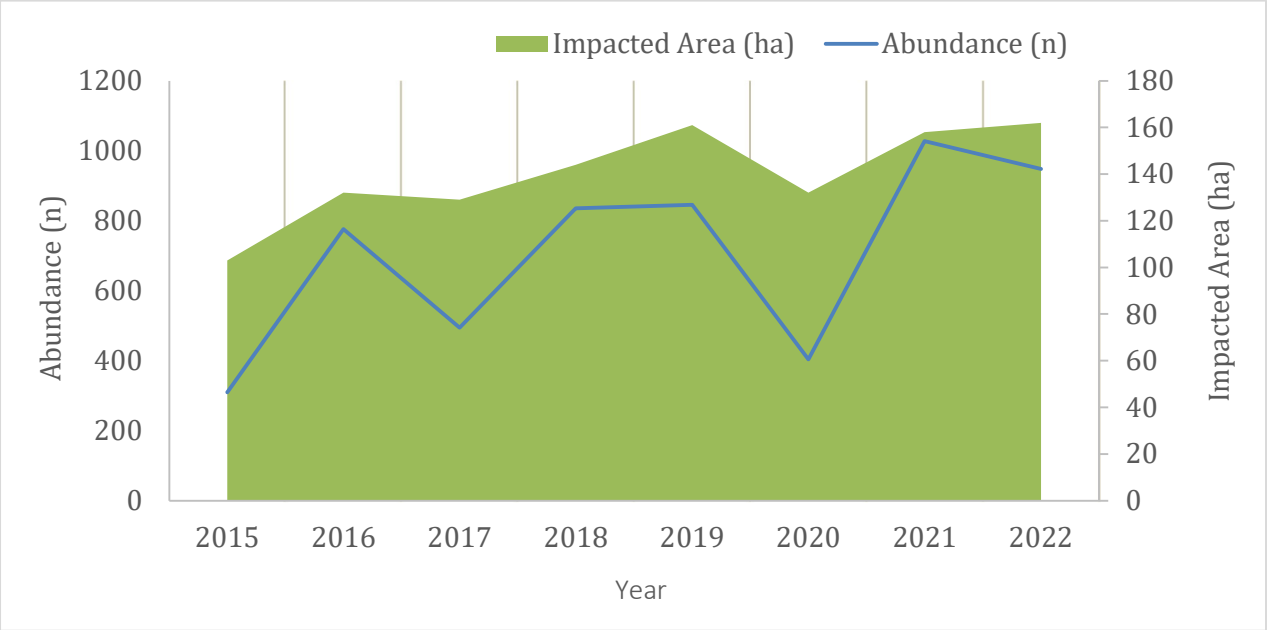


Figure C5. Plant abundance (n) and impacted area (ha) of *Spartina patens* in the Baynes Sounds area from 2015 – 2024.

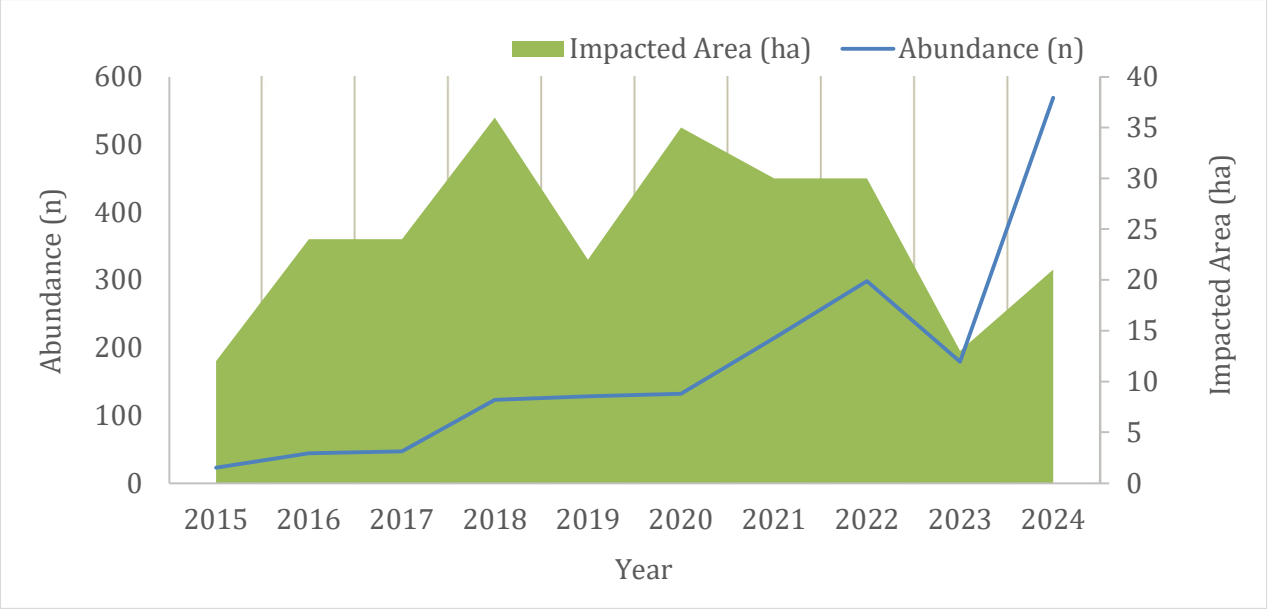


Figure C6. Plant abundance (n) and impacted area (ha) of *Spartina patens* in the Burrard Inlet area from 2015 – 2024.

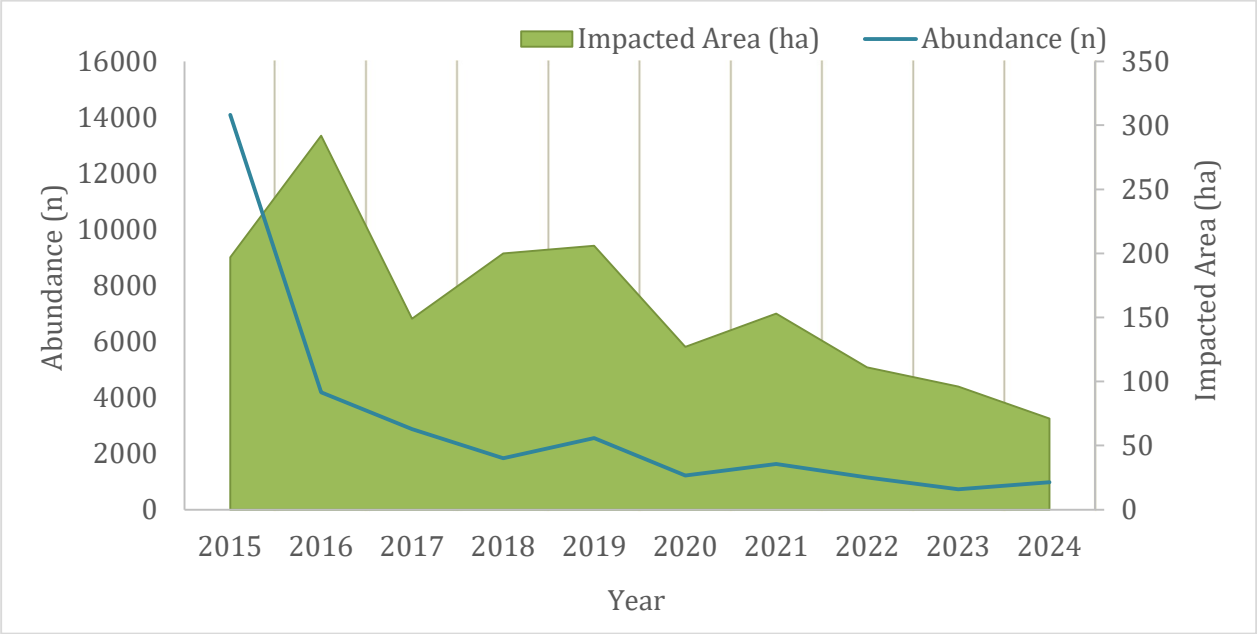


Figure C7. Plant abundance (n) and impacted area (ha) of *Spartina densiflora* from 2015 – 2024.

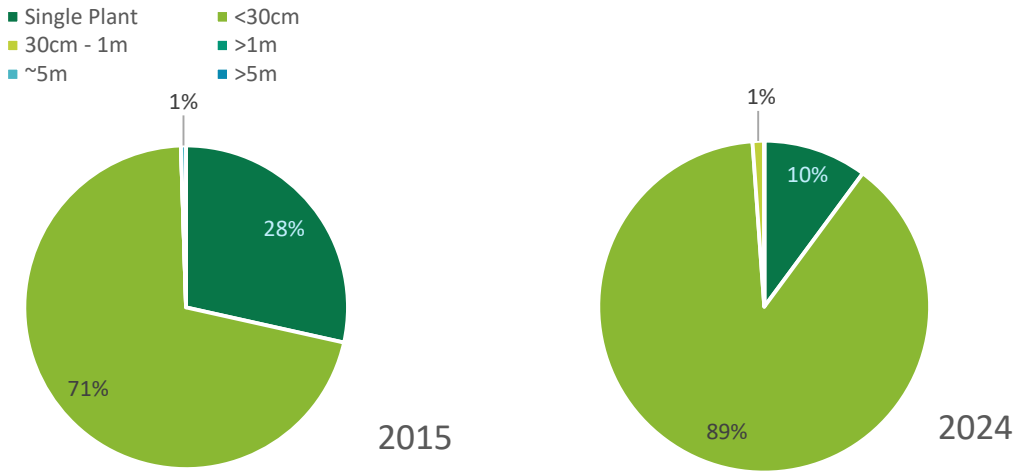


Figure C8. Proportions of *Spartina densiflora* plants found in BC of different size classes, in 2015 and 2024.

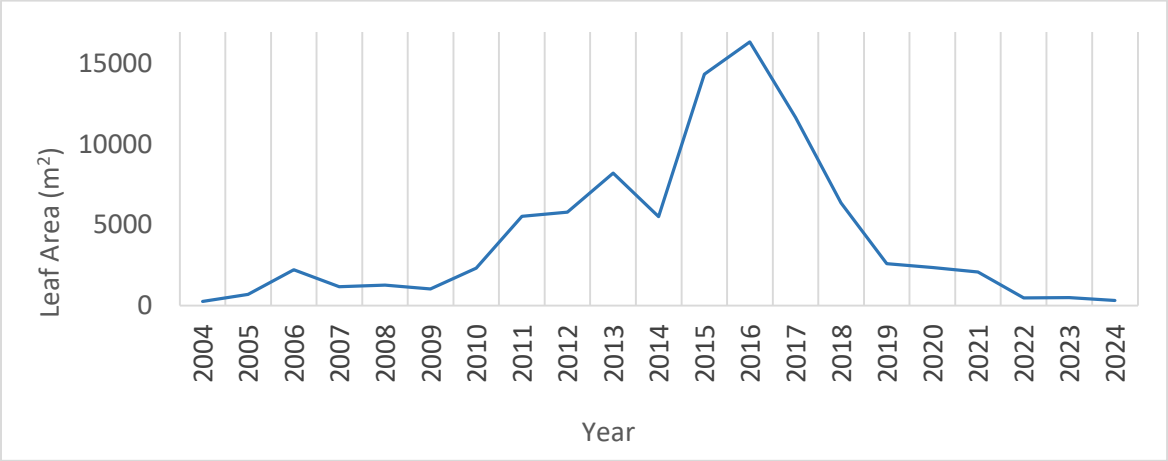


Figure C9. Estimated leaf area (m2) of *Spartina anglica* from 2004 - 2024.

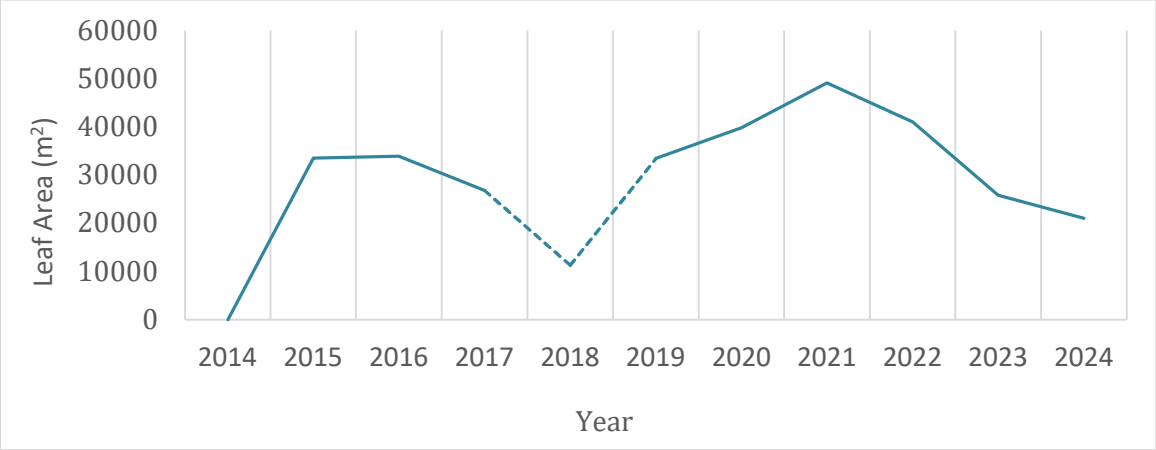


Figure C10. Estimated leaf area (m2) of *Spartina patens* 2015 - 2024[3].

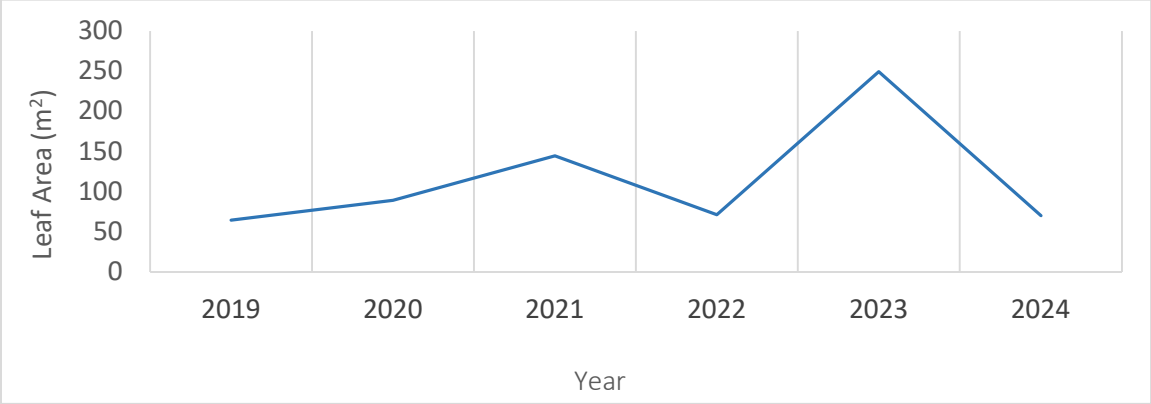


Figure C11. Estimated leaf area (m2) of *Spartina densiflora* from 2019 - 2024.

[3] Note that the dotted line represents a period where there was inconsistency in how size classes were measured and reported in these species during the switchover to digital data collection methods, leaf area (m^2) data from this time may be inaccurate.

APPENDIX D – PLANT DATA

Table D1. Summary of *Spartina* spp. invasion since 2004. Note that leaf area (m^2) data for *S. patens* and *S. densiflora* in italics from before 2019 may not be accurate, as there were inconsistencies in how size classes were measured and reported during the switchover to digital data collection methods.

	S. anglica			*S. patens*			*S. densiflora*		
Year	Estimated Leaf Area (ha)	Impacted Area (ha)	Number of Plants Detected	Estimated Leaf Area (ha)	Impacted Area (ha)	Number of Plants Detected	Estimated Leaf Area (ha)	Impacted Area (ha)	Number of Plants Detected
2004	0.0250	105	433	-	-	-	-	-	-
2005	0.0681	194	864	-	-	-	-	-	-
2006	0.2202	137	584	-	-	-	-	-	-
2007	0.1158	75	342	-	-	-	-	-	-
2008	0.1263	125	334	-	-	-	-	-	-
2009	0.1020	184	691	-	-	-	-	-	-
2010	0.2312	261	1217	-	-	-	-	-	-
2011	0.5525	242	2387	-	-	-	-	-	-
2012	0.5785	797	6846	-	-	-	-	-	-
2013	0.8209	940	8511	-	-	-	-	-	-
2014	0.5502	937	13921	-	-	-	-	-	-
2015	1.4353	898	18074	3.3502	107	320	*0.2133*	197	14090
2016	1.6373	973	23260	3.3892	127	354	*0.3992*	292	4181
2017	1.1676	900	12512	*2.6770*	156	823	*0.0151*	149	2872
2018	0.6362	709	8051	*1.1295*	165	617	*0.4950*	200	1836
2019	0.2578	496	4742	3.3382	167	963	0.0065	206	2557
2020	0.2352	338	2317	3.9784	196	977	0.0089	127	1222
2021	0.2073	348	3844	4.9115	162	618	0.0144	153	1633
2022	0.0466	272	1954	4.0969	188	1326	0.0071	111	1153
2023	0.0478	248	2142	2.5778	175	1127	0.0249	113	733
2024	0.0306	195	980	2.1023	213	2439	0.0070	71	982

The methods of collecting, analyzing, and reporting of *Spartina* data has changed significantly since the start of the program. The method of calculating leaf area, as described in Appendix A, was first introduced in the 2015 season and several IAPP sites were standardized between 2011-2013. We are now at a stage where our methods of collection, analysis, and reporting are consistent between years. As such, references made to previous years' data, regarding impacted area, should be taken from the most recent *Spartina* report or from the online *Spartina* web-atlas.

APPENDIX E – METRIC & SUMMARY CALCULATIONS

The point data for each species of spartina is collated into a spatial database for subsequent analysis using three different metrics:

1. The number of plants or plant clones detected
2. The size of each plant or plant clone (single plant or seedling; patch with diameter less than 30 cm; patch with diameter of 30 cm to 1 m; patch with diameter of 1 m to 5 m; patch with diameter of approximately 5 m; patch with diameter greater than 5 m)
3. The estimated leaf area (number of plants or plant clones detected x size of each plant or plant clone = number of square meters a dispersed colony would occupy if all Spartina plants were grouped into a single cluster)

Each IAPP site is divided into a grid of 1 ha cells which is used to summarize the data that has been analyzed through the metrics above. These summaries occur at a single cell level as well as an accumulation of all the cells within the site. They are titled Cell Summaries and Site Summaries, respectively. Summaries occur on a per-species basis. Moreover, with these summaries, the BC SWG determines how much shoreline has been impacted by *Spartina* spp. (how many 1 ha grid cells had one or more occurrences of Spartina).

Cell Summaries: The total number of observations for each size class is calculated for each cell on a per species basis. The estimated leaf area of a species in a cell is calculated by multiplying the total number of observations for each size class by the size class's Areal Coefficient (Table 7) and summing the values for each size class.

Site Summaries: The summing of the metrics of all of the cells within an IAPP site.

Table E1. Size classes and their areal coefficients.

Size Class	Description	Areal Coefficient (m^2)
S	Single Plant or Seedling	0.002
A	Patch with diameter less than 30 cm	0.071
B	Patch with diameter of 30 cm to 1 m	0.785
C	Patch with diameter of 1 m to 5 m	3.14
D	Patch with diameter of approximately 5 m	19.625
M	Patch with diameter greater than 5 m	38.465

The resulting equation for the estimated leaf area of a Spartina species in a cell is:

Estimated Leaf Area =(**Σ**S*0.002)+(**Σ**A*0.071)+(**Σ**B* 0.785)+(**Σ**C*3.14)+(**Σ**D* 19.625)+(**Σ**M*38.465)

For example, a cell with multiple *S. anglica* observations of 10 seedlings (Size S), 3 patches of a diameter of 30 cm to 1 m (Size A), 5 patches with a diameter of 1 m to 5 m) Size C, and 1 patch greater than 5 m (Size M) would have an area of $54.398\ m^2$.

$$\text{Area} = (10*0.002\ m^2)+(3*0.071\ m^2)+(5*3.14\ m^2)+(1*38.465\ m^2)$$
$$\text{Area} = 0.020\ m^2 + 0.213\ m^2 + 15.7\ m^2 + 38.465\ m^2$$
$$\text{Area} = 54.398\ m^2$$