

British Columbia Spartina Eradication Program 2013 Progress Report



Prepared by Ducks Unlimited Canada

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Community Mapping Network

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Environment Canada – Canadian Wildlife Service

Fisheries and Oceans Canada

Friends of Semiahmoo Bay Society

Ladner Rotary Club

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Ministry of Forests, Lands & Natural Resource Operations

Port Metro Vancouver

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The representatives to the BCSWG included Kathleen Moore (Environment Canada – Canadian Wildlife Service - CWS), Markus Merkens (Metro Vancouver), Angela Danyluk (Corporation of

Delta), Liana Ayach (City of Surrey), Dan Buffett (Ducks Unlimited Canada - DUC), Rob Knight (Community Mapping Network), Margaret Cuthbert, Alison Prentice (Friends of Semiahmoo Bay), Sylvia Letay (Ministry of Forests, Lands & Natural Resource Operations), Kim Keskinen (Port Metro Vancouver), Jennifer Grenz, Tasha Murray (Invasive Species Council of Metro Vancouver), Matthias Herborg (Ministry of Environment), Rachelle McElroy (Coastal Invasive Species Committee).

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In 2013, we lost one of our Spartina warriors, Don Burkett from the Ladner Rotary Club. He epitomized the virtues of a community leader, a hard worker, a partnership builder and always had a friendly smile. We will miss Don immensely.

Over the course of summer and fall of 2013 and into early 2014, many other individuals and groups contributed to finding and removing *Spartina sp.* in BC. Many landowners provided access through their property to map and control Spartina as we thank them for their support. The BCSWG is grateful for the hard work by numerous volunteers and partner organizations that mapped and removed Spartina on the Fraser Delta and on Vancouver Island. The table below acknowledges, hopefully, all of those contributions to the BCSWG Program.

Organization	Participants
City of Surrey; SHaRP Program	City of Surrey Sharp Crew: Terry Lee, Carrie Kwok, Chelsea Nerpio, Justin Becker
Friends of Semiahmoo Bay Society	For South Surrey mapping, removals at Blackie Spit –Alison Prentice, Russell Prentice, Jessica Yu, Madison Goddyn, Kendra Moore, Ben Leyland, Marina Van Driel, Linda Easton
Ministry of Forests, Lands & Natural Resource Operations	Dave Ralph, Becky Brown
BC Ministry of Environment	Matthias Herborg
Other Volunteers on	Linda Easton, Norm Cadicott (BCIT), Iris Zhao (COHO), Joanna Niemczyk (COHO), , Port

Fraser Delta	Metro Vancouver: Crystal Lloyd, Ashley Graham, Kim Keskinen, Invasive Species Council of Metro Vancouver: Tasha Murray, Julia Alards – Tomalin, Langley Environmental Partners: Nicolas Walser, Sarah Gleboff, Taylor Robbins, Brian Clark, Deborah Clark, Sebastion Pardo, Bob Winston, Semiahmoo High school: Ingrid Woods, Kristy Harrison, Carley Senicki, Jessica Yu, Simran Gill, Hemmera: Ian Poastard, Robert Muller, Port Metro Vancouver: Kyle Robertson, Will Patterson, Jody Addah; Rod McVicar (Reed Point Marine Education Centre), Ruth Foster (Mossom Creek Hatchery), Patricia M.Banning-Lover (Wild Bird Trust Society)
Rotary Club of Ladner	Don Burkett, Roy Sakata
Comox Valley Regional District	Financial contribution to VICLMP work in Baynes Sound
MACS Oysters	Management staff in Baynes Sound provided staff and amphibious ATV to pick up and transport bags of <i>Spartina</i> plants.
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Tsawwassen First Nation	Ed Chanter, Laura Cassidy, Tia Williams Deann Jacobs for mapping and coordination
TFN Construction / Matcon Joint Venture	Nicci Bergunder for Outreach
The Nature Trust of British Columbia	Fiona Beaty, Ally Nichols, Shannon Lawrence
Port Metro Vancouver	Caroline Dorr, Crystal Lloyd, Jody Addah, Kate Schendel, Christine Rigby, Gary Olszewski, Ashley Graham, Dorota Kwasnik, Michelle Patterson, Kim Keskinen, Brent Patterson, Derek Tam

Executive Summary

In 2013, the British Columbia *Spartina* Working Group (BCSWG) continued to work toward the eradication of non-native, invasive *Spartina* species along the BC Coast. BCSWG recognizes the potential impacts of *Spartina* on local shorelines and wildlife habitat and is striving to support the Pacific Coast Collaborative goal of eradication of all non-native *Spartina* species (*S. anglica*, *S. densiflora*, and *S. patens*) by 2018 along the coasts of BC, Washington, Oregon and California.

In 2013, the BC *Spartina* Eradication Program applied \$328,042 of in-kind and direct value to deliver program components focused on Monitoring, Removal, Herbicide, Coordination, Outreach and Science/Evaluation. The monitoring program included mapping approximately 35 km of shoreline in Boundary Bay and Robert's Bank, 75 km of shoreline in Burrard Inlet and more than 110 km of shoreline in Baynes Sound.

The 2013 inventory shows that the abundance and density of *Spartina anglica* in Boundary Bay and Roberts Bank has continued to increase from 2007 and even more rapidly on Roberts Bank since 2010. *Spartina sp.* continue to in-fill the infested areas in Baynes Sound, Boundary Bay, Roberts Bank and Burrard Inlet. Since 2007 the number of larger 1m+ clones of *Spartina anglica* in the Fraser Delta has steadily increased in spite of considerable control efforts using mechanical removal by hand and machine.

On Vancouver Island, *S. densiflora* mapping and control was initiated more recently, with plant

populations showing an increase in abundance. However, the larger populations at sites that existed in 2012 and underwent mechanical removal appear to be small in size. With the extended mapping and removal coverage to Denman Island, it is anticipated that smaller populations (abundance, size) will be observed in 2014.

Spartina control in 2013 focused on manual removal until mid-August when the use of herbicide at Roberts Bank was integrated into the Spartina control program in the Lower Mainland of BC. Herbicide treatment was applied directly to over 4000 *S. anglica* clones. It is anticipated that a change in the size distribution and density trends in 2014 will be a reflection of herbicide application being introduced to the control program in 2013. In the Fraser Delta, *S. anglica* removals occurred on Roberts Bank (north and south of the Delta Port causeway) and throughout Boundary Bay. On Vancouver Island manual removal of *S. densiflora* at 159 of 189 sites throughout Baynes Sound and Denman Island.

S. patens infestations in Burrard Inlet and Baynes Sound have been re-mapped and additional trial cover plots have been established in both areas using a geo-textile fabric for a 2 year treatment.

Background

In 2003, *Spartina anglica* was found in the Fraser River Delta by Gary Williams, a consultant for the Port Metro Vancouver, while conducting habitat surveys of the intertidal areas. This was the first record of *S. anglica* in BC and raised concerns about the spread of this invasive cordgrass. The Fraser Delta has approximately 25,000 ha of tidal mud flat that is internationally recognized as important habitat for fish and migratory birds. In all of Canada, the Fraser Delta has the highest density of wintering waterfowl, shorebirds and raptors. Prior to 2003, *Spartina patens* was identified in both Burrard Inlet and Courtenay estuary (1979). In 2005 *Spartina densiflora* was confirmed in the Baynes Sound area of Vancouver Island. However based on anecdotal conversations, it is believed to have been present there for some time.

The impacts of Spartina species include: conversion of mudflats to monoculture stands, loss of habitat for waterbirds and fish, accretion of sediments, and modification of drainage patterns. Intertidal areas in Washington State dominated by Spartina have exhibited large declines in the abundance of shorebirds and waterfowl. Significant expenditures have been required to control Spartina in Washington State costing approximately one million dollars per year. Oregon and Washington states spent approximately \$50,000,000 over a ten year period in a concerted effort to eradicate *Spartina sp.* in their coastal habitats. It is only recently with sustained funding and use of herbicide that the States have significantly reduced the Spartina infestations. Controlling the spread at the early stages of species expansion is the most cost-effective approach and it is critical to control Spartina in BC as early as possible. The loss of important intertidal habitats in BC will be detrimental to a multitude of species, and will require considerably greater resources to control in the future.

The BCSWG formed in 2004 and includes members from both government and non-government organizations. The team represents a diversity of responsibilities including: environment, migratory birds, habitat restoration, and public use. In addition, the team liaisons with San Francisco Estuary Spartina Project and the Washington State Department of Agriculture, which are two U.S. agencies involved in Spartina eradication along the Pacific Coast. The focus of this group is to employ early detection and rapid response methods to eradicate Spartina. Currently, there are mapping and removal efforts taking place around the Fraser Delta, Burrard Inlet, east coast of Vancouver Island and around selected Gulf Islands. However; more work is needed to monitor other parts of the BC Coastline and expand the eradication efforts.

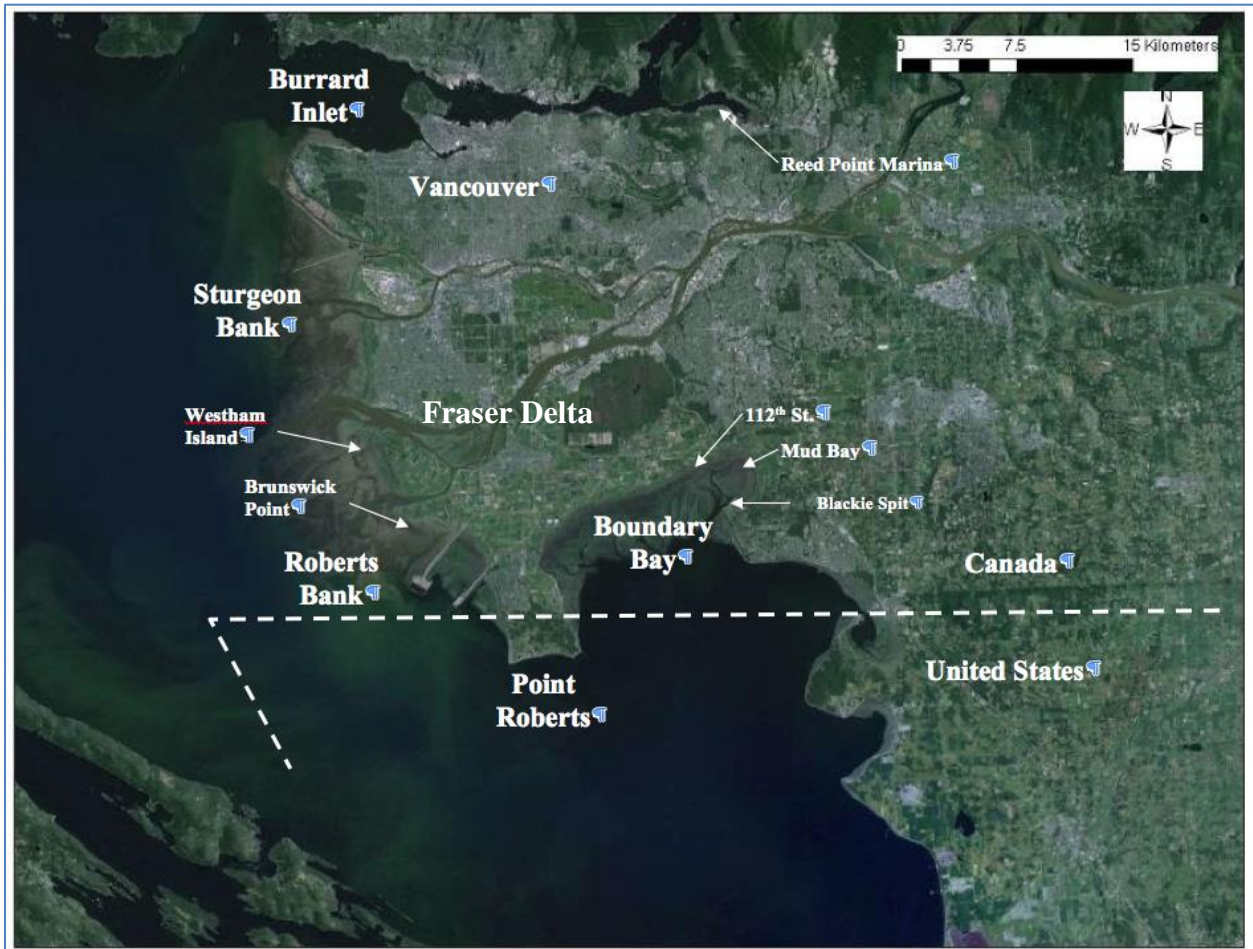
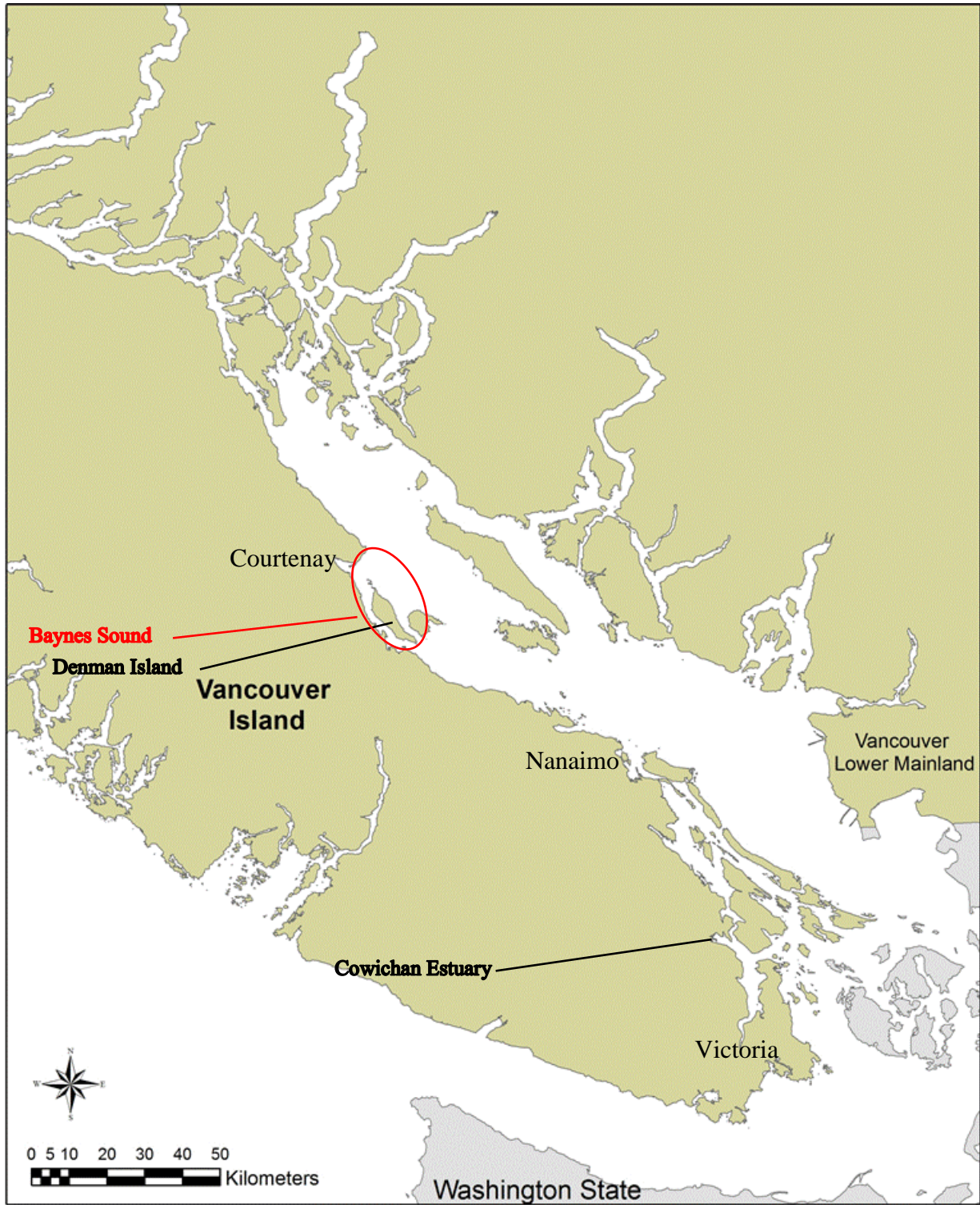


Figure 1. Areas in the Vancouver Lower Mainland

Figure 2. Areas on Vancouver Island



Detection

Data compilation and storage for *Spartina* sp. data (2004 to 2013) is provided in part by the Community Mapping Network (CMN). Species, clone size, GPS location and the extent of the area searched can be viewed at www.spartina.ca. This data is used for evaluating eradication progress, and planning future monitoring and control activities. Data for the 2006/07 Drift Card Study and Washington State Partners are also viewable at this web site. Ducks Unlimited Canada (DUC) also maintains ESRI shapefile copies of these data for GIS analysis.

Spartina data is also entered into the Invasive Alien Plant Program (IAPP) database (<http://www.for.gov.bc.ca/hra/Plants/application.htm>).

Fraser Delta and Boundary Bay

In 2013, approximately 153 person days were devoted to map and remove *Spartina* along approximately 35km of shoreline in the Fraser Delta. Mapping efforts continued to follow the same methods from 2008/09. The method of walking the intertidal habitat every June/July with hand held Global Positioning System (GPS) units (Garmin Etrex20, Garmin GPSmap76S, Garmin GPSmap60Cx/62Cs, Garmin 12XL, Garmin Dakota20, Marine Navigator Map 76/78) was used to identify the location of plants along Boundary Bay, Roberts Bank and Sturgeon Bank. *Spartina* size classes for each location were denoted as one of: single seedling, clone <0.3m, clone 0.3m - 1.0m, clone > 1.0m in diameter, or 5m area of single plants. Surveying flags were used to mark the location of the plants. The flags reduced searching time during removals and led to more effective removals by volunteers.

The extent of shoreline searched in June 2013 was the same as in June 2012 covering shores and mudflats of Mud Bay, Boundary Bay and Roberts Bank rounding Brunswick Point to the south arm of the Fraser River. The intertidal areas west of Westham Island were not surveyed in 2013 because of limited manpower. *S. anglica* was not detected beyond Brunswick Point and Blackie Spit (Crescent Beach). *Spartina anglica* was found growing in all intertidal zones and on a variety of substrates ranging from fine silt/mud, sand to cobble. It was found as seedlings, as larger isolated clones and integrated with other native marsh vegetation.

Figure 3 and Figure 4 below provide the distribution and size class of *S. anglica* in the Fraser Delta – Boundary Bay area.

Figure 3. 2013 Spartina Infestation in Roberts Bank

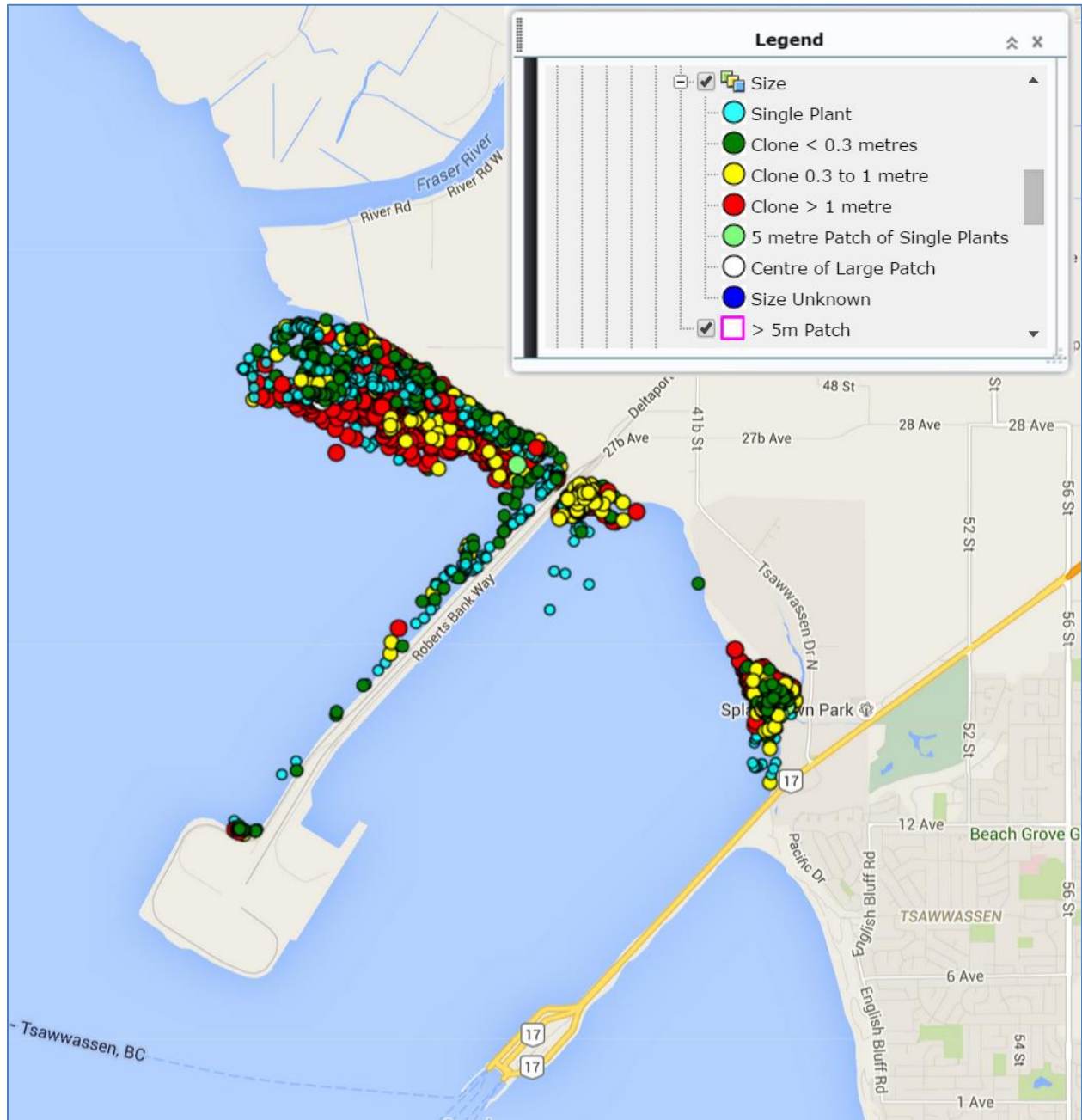
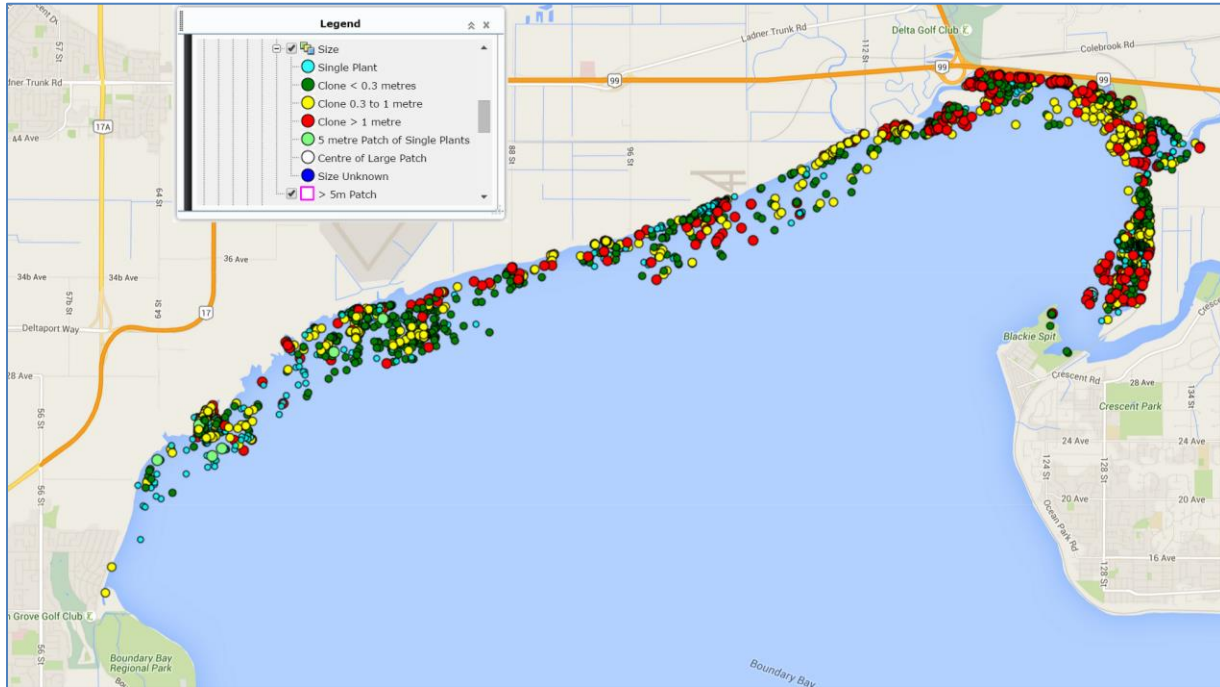


Figure 4. 2013 *Spartina* Infestation in Boundary Bay

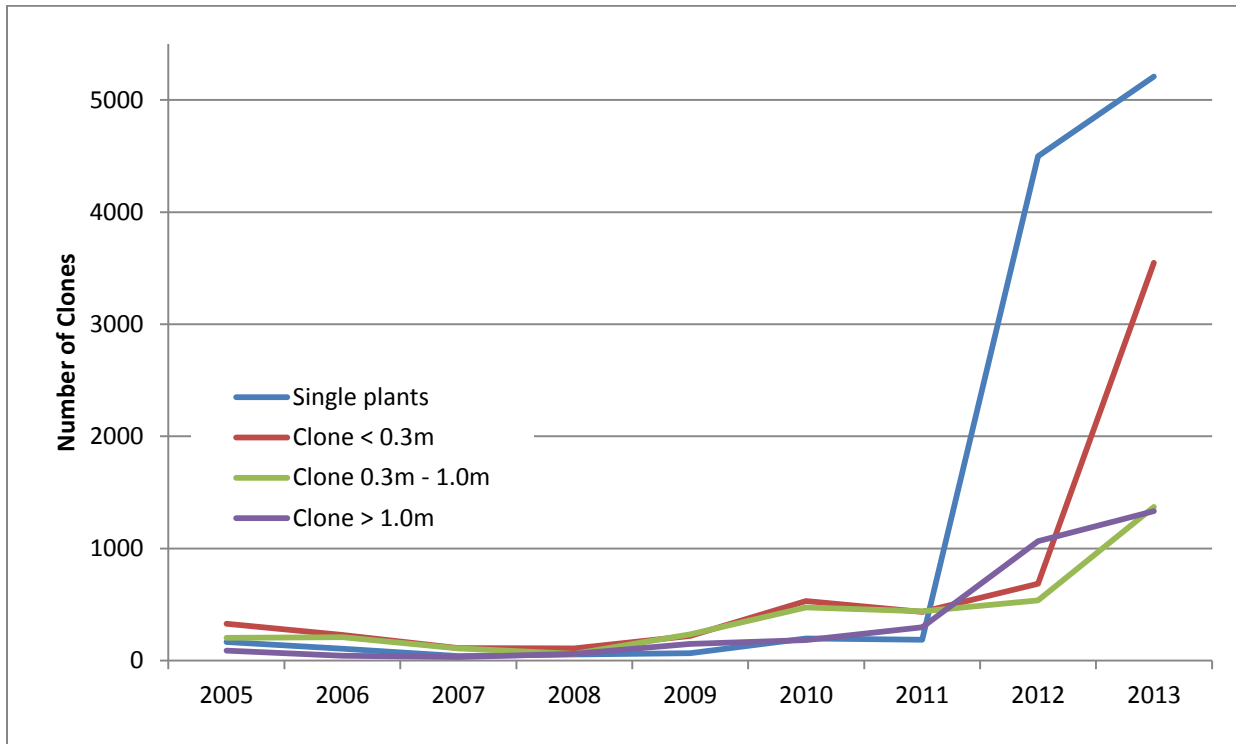


Each year since 2007, all size classes have steadily increased in spite of considerable control efforts using mechanical removal by hand and machine (Table 1). With the herbicide application in 2013, it is expected in 2014 that several of the size classes will show a reduction in 2014. Mapping efforts have been consistent since 2004 and therefore the data provides a fairly consistent assessment of trend over time. However the mapping is a conservative assessment, because while mapping is done every June and July additional plants are found later in the growing season. For example in 2012 there were 4,497 single plants mapped, yet there were over 9,200 single plants removed.

Table 1. *Spartina anglica* Detected by Size Class from 2005-2012 in Boundary Bay and Roberts Bank.

Size	2005	2006	2007	2008	2009	2010	2011	2012	2013
Single plants	167	107	41	56	67	197	185	4497	5210
Clone < 0.3m	329	229	111	110	221	532	433	685	3548
Clone 0.3m-1.0m	204	210	108	60	234	475	441	538	1371
Clone > 1.0m	90	42	33	61	149	184	296	1065	1334
Patch 5m dia.	0	97	49	47	12	78	55	7	36
Large Patch >5m	0	0	0	0	0	20	31	12	6
Total	790	685	342	334	683	1486	1441	6804	11505

Figure 5. *Spartina anglica* Size Classes Mapped from 2005-2013



Burrard Inlet

The known distribution of *S. patens* in Burrard Inlet is shown in Figure 7 below. *S. patens* is present in these six locations, the largest of which are at Maplewood Conservation Area and Reed Point. The larger locations were remapped in 2012 to determine how much they had expanded in recent years. Based on anecdotal observations, *Spartina patens* appears to be have a relatively stable distribution compared to *S. anglica*. Additional mapping work was conducted by boat and by foot in 2013 in the Port Moody arm of Burrard inlet and a few small infestations were found.

Figure 6 Boat survey search track in Burrard Inlet August 2013

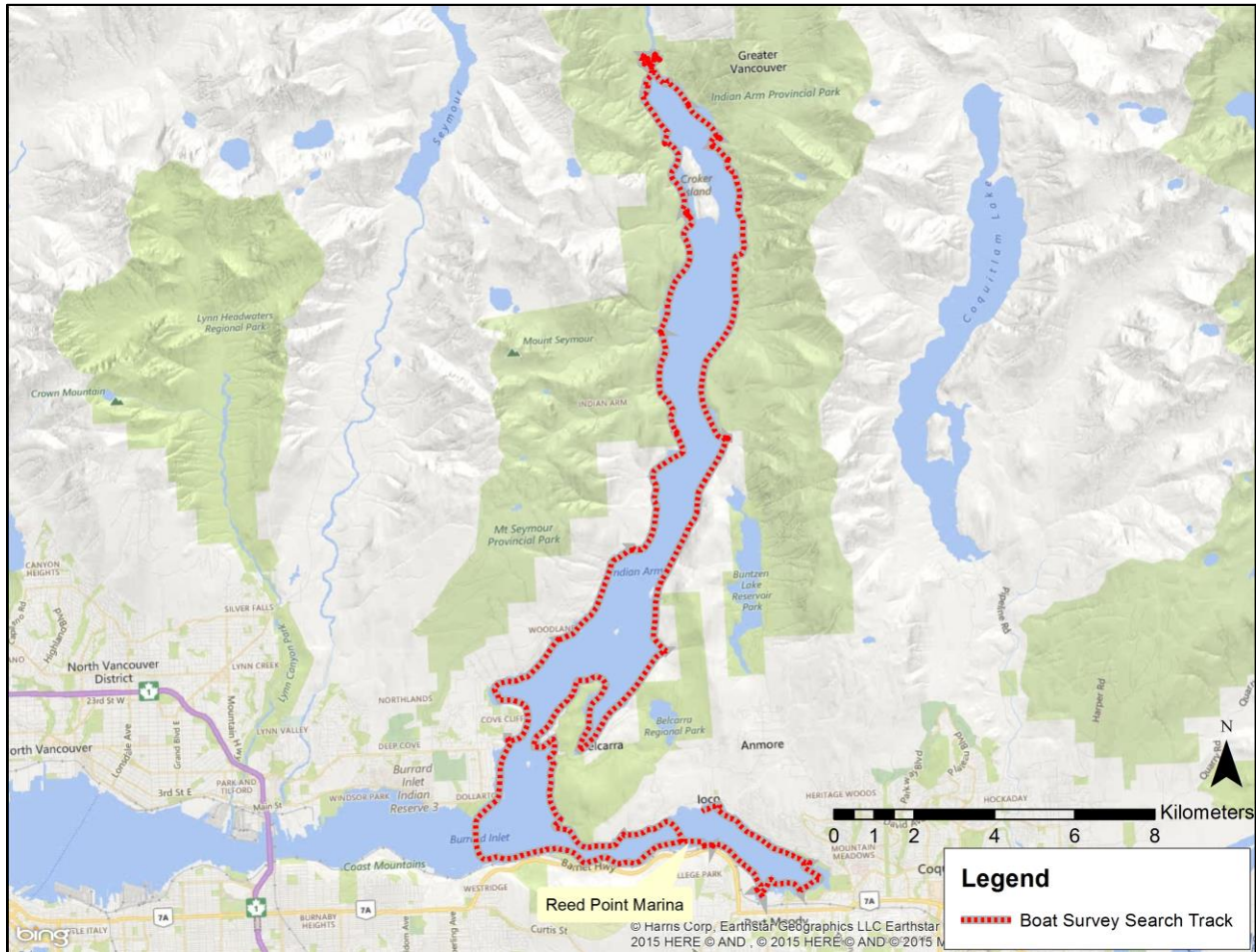


Figure 7. Current Mapped Distribution of *S. patens* in Burrard Inlet – 2013



Vancouver Island

In 2013 on the east coast of Vancouver Island a total of approximately 100 km of shoreline was mapped (roughly 5,436 Acres) using the same methodology of the Fraser Program using foot surveys on accessible inter-tidal areas supplemented by the use of a boat as required. In all, a total of 189 sites of *Spartina* infestation were identified in the Baynes Sound area (**Figure 8**). While there has been *Spartina* mapping and removal since 2008 in the Baynes Sound area, 2012 was the first there was almost complete coverage on the Vancouver Island side of Baynes Sound, and 2013 marked the first time the coverage for mapping included all of Denman Island and most of Hornby island. Key areas of *Spartina* infestation removal are Baynes Sound area including Denman Island. However, no *Spartina* was found on Hornby Island.

In recent years, specific sites outside of Baynes Sound have been checked for *Spartina*, but no *Spartina* was detected to date. This includes specific estuaries Quatse estuary, Marble Estuary, Cluxewe Estuary, Salmon estuary, Little Qualicum estuary, Englishman estuary, Nanaimo estuary, Chemainus estuary, Cowichan estuary and Tofino Mud flats 2012. In 2010 mapping surveys were carried out around Main and Prevost Islands in the Gulf Island archipelago however no *Spartina* was detected.

Figure 8. 2013 Locations of *S. densiflora* (yellow) and *S. patens* (red)



Vancouver Island Estuaries

As partners in the Spartina eradication program for Vancouver Island, the VICLMP continues to search for Spartina species in the areas that they manage and work on throughout estuaries and conservation areas on Vancouver Island. While no Spartina was found outside of Baynes Sound, (Table 8) below summarizes the effort and location of detection in 2013:

Table 8. 2013 Spartina Detection Completed in Conservation Lands of Estuaries

Estuary	Detection type	Spartina Detected	Effort (man hours)
Cowichan	Active	No	6
Chemainus	Passive	No	
Nanaimo River	Active	No	6
Englishman River	Active	No	6
Little Qualicum	Passive	No	10
Fanny Bay	Active	No	6
Coal Creek	Active	Yes – Removed	6
Salmon River	Active	No	6
Cluxewe	Passive	No	1
Quatse	Passive	No	1

Control & Removal

Fraser Delta and Boundary Bay – Manual Control

With the expected herbicide use on *S. anglica* in 2013, the integrated control plan was modified to focus manual removals (i.e. pulling and digging) to single plants and small clones and the use of herbicide for clones greater than 0.3m in diameter. The use of excavator to dig and bury plants was discontinued.

A few organizations undertook hand removals of infestations :

- Friends of Semiahmoo Bay Society: Boundary Bay - Blackie Spit and;
- City of Surrey's SHARP and SNAP summer crews: Boundary Bay in the Serpentine River Estuary and Mud Bay and;

The high priority areas for control continue to be Roberts Bank @ Brunswick Point, Boundary Bay @ 112th Street, Boundary Bay @ Mud Bay, to stop dispersal to uninfected areas.

As in previous years, participants dug up individual plants and smaller clones using hand shovels, loading them into large garbage bags. The garbage bags were pulled using snow sleds to an area accessible to the ATV or pick-up truck. At 112th Street, Brunswick Point and Mud Bay Park one or two small all-terrain vehicles gathered up the filled bags filled and transported them along the dyke to a nearby disposal bin stationed for the removal work. Using inexpensive moulded snow sleds enabled participants to bring removed plants from further out on the mud flats while keeping the lift weight in each bag smaller and reducing the bags ripping. Generally seed head clipping in September is the only control method applied to larger clones where hand removals or herbicide control was not undertaken.

A three person *Spartina* crew was hired through BCCF for July, August and September. The crew focused on hand removals, seed head clipping, additional mapping, stem plot surveys to measure clone growth rates, supervised volunteer removal activities, and provide mapping support for the herbicide use. In addition to the 2013 total quantity mapped, 2503 'S' size and 590 'A' size clones were removed.

Figure 9. Manual Control Locations at Roberts Bank & Boundary Bay



Fraser Delta and Boundary Bay – Herbicide Control

After many years of Spartina control work in BC on *Spartina anglica*, mechanical/manual control has not achieved containment of Spartina. Therefore, since 2010, a small sub-group of the BC Spartina Working Group has worked with staff from provincial and federal Canadian ministries to determine the requirements and process required to use herbicide as a control activity on Spartina. The sub-group evaluated the ecological impacts and best management information based on the success of using two herbicides to control Spartina in the states of Washington, Oregon and California after many years of limited success with mechanical control and a single herbicide. After several years, it was determined that herbicide use in BC would require registration of the herbicides with the federal Pest Management Regulatory Authority (PMRA) as well as a Pesticide Use Permit (PUP) from the BC provincial Ministry of Environment.

The BC Ministry of Environment submitted an emergency use registration to the PMRA in February 2012 for the use of use of 2 herbicides to control Spartina: Rodeo (active ingredient glyphosate) and Habitat (active ingredient imazapyr) along with supplementary documentation including the proposed methods, evaluation and monitoring process. On February 13, 2013, the PMRA granted the emergency registration of the herbicides Habitat (imazapyr) and Rodeo (glyphosate) for control of Spartina in intertidal areas of BC until December 31, 2013. As part of the approval, PMRA identified the use of the surfactant Ag-Surf II to be used with the herbicides that would bind the herbicide with the plant and reduce the amount of herbicide needed. PMRA reviewed all the potential surfactants and recommended the surfactant based on its low toxicity in the environment.

Upon the emergency use registration with PMRA, the BC Ministry of Environment subsequently submitted a Pesticide Use Permit (PUP) for both herbicides (Rodeo (active ingredient glyphosate) and Habitat (active ingredient imazapyr) to BC Ministry of Environment. Consultation was conducted prior to and after the submission of the PUP. The (PUP) No. 804-0004-2013/2015 was issued in June 2013 for a 3 year period, which was followed by public posting phase. Approval to use the approval herbicides in the Boundary Bay and Roberts Bank

Wildlife Management Area was provided by BC Ministry of Forest, Lands and Natural Resource Operation for August 2013.

Herbicide application was initiated in August 2013 with support from the Washington State Department of Agriculture. Washington State provided 2 air boats and staff to guide the BC Spartina working group in the herbicide use of Spartina given their significant expertise. In consultation with Washington State staff and to minimize overall herbicide use, we elected to only use Habitat (imazapyr) in 2013 along with the surfactant (Ag-Surf II). Therefore Rodeo (glyphosate) was not used. The treatment area was confined to Roberts Bank and the eastern portion of Boundary Bay where imazapyr was applied to approximately 5,000 individual Spartina locations. As a result most of the Spartina infestations in Roberts Bank were treated (89%, herbicide applied to approximately 4420 clones of 4959 clones mapped) but only a small portion of the infestations in Boundary Bay were treated (11%, herbicide applied to approximately 420 clones of 3652 clones mapped). Given the various delays in 2013 the herbicide treatment was not initiated until late August which left limited weather and tide conditions conducive to herbicide application in September. Below are DRAFT maps of the herbicide treated areas (Figure 10, Figure 11).

Herbicide was applied to *S. anglica* plants on Aug 20, 21, 22, 23 and Sept 4, 5, 6, 17, 18, 19, and 20. The treatment was conducted under the following conditions: at low tide during the day to allow a 6 hour drying time after application. Weather was clear to partially cloudy with temperatures between 17 C & 23 C. It is estimated that approximately 2.0 ha of Spartina plants were treated based on 500 L/ha delivery rate and 1002 litres of Habitat (24% imazapyr) combined with the surfactant of Ag-Surf II (92% alcohol ethoxylate) and water.

Figure 10. August 2013 Spartina Infestation Treated with Imazapyr (purple cross) in Roberts Bank

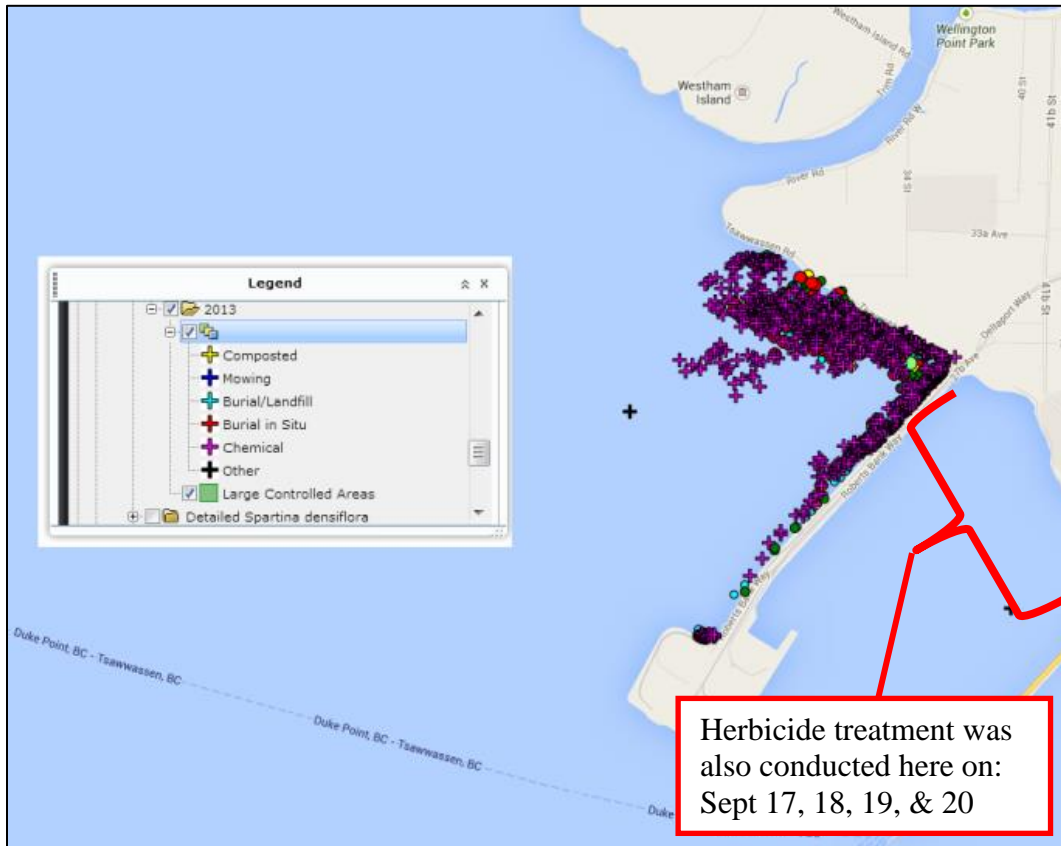
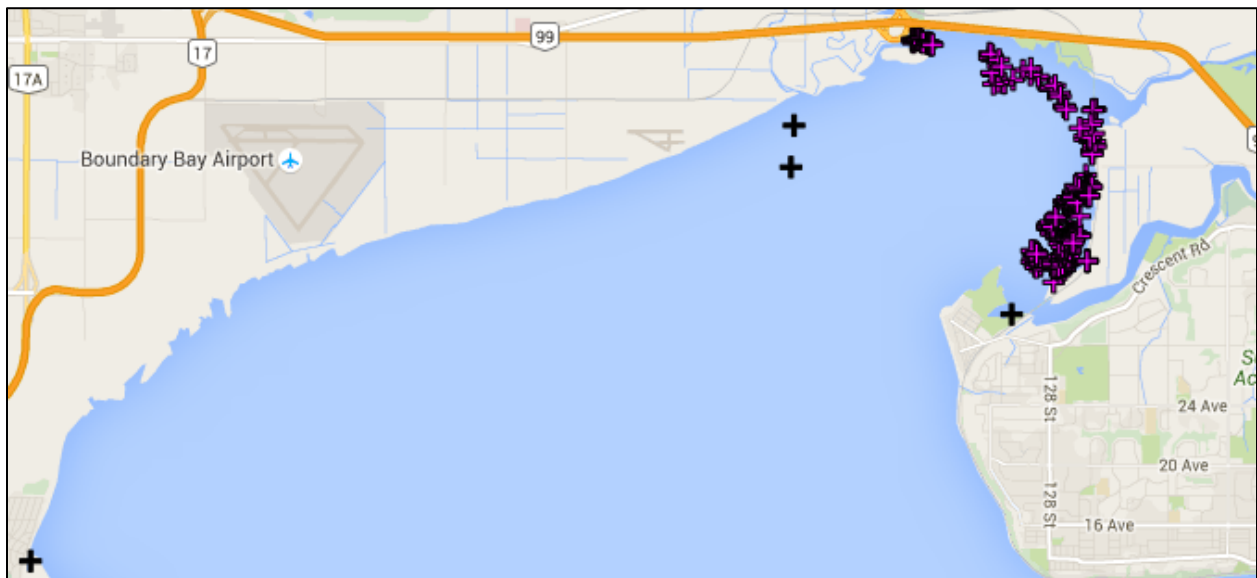


Figure 11. August and September 2013 Spartina Infestation Treated with Imazapyr (purple cross) in Boundary Bay



Burrard Inlet – Manual Control

The *Spartina patens* infestations pose a challenge to the traditional BC *Spartina* control techniques of manual digging, as *S. patens* does not grow in tufts or clones but grows in as a meadow. Therefore digging the established plant populations would significant modify the topography and likely create collateral damage by eliminating all native plant populations. Therefore, a shading technique was identified as a pilot experiment in 2012. This technique utilizes the approach used in Oregon to control *S. patens*, where the plants are covered for two years using a geotextile fabric manufactured by Nilex (geofabric). Upon removal of the geofabric the native plant populations re-established on the site rather than the non-native *Spartina*.

In 2012, a site for geofabric at Reed Point Marina, Burrard Inlet west of Port Moody, was covered by 500 square meters of a geotextile fabric designed to shade out the covered plants (Figure 12). The *S. patens* meadow is completely surrounded by rip-rap on a constructed intertidal bench and the cover is well protected from winter wave action by the adjacent marina. The cover has been stable throughout the winter/spring of 2012-13 and will be removed in the spring of 2014 to allow native intertidal vegetation to recolonize. Observations in 2013 identified that areas with only one layer of geofabric had some weak but active plants, whereas areas with two layers of geofabric were bare mud and had no plants growing.

In September 2013, Port Metro Vancouver established a second site (Pacific Coast Terminals) to evaluate geofabric technique to control *S. patens*. A total of 4 plots of *S. patens* (100 feet by approximately 10 feet each) were pre-treated with steam or cutting and subsequently covered with material (2 plots of Nilex 2002 woven geotextile and 2 plots of black polyethylene), along with a control plot (no treatment). One of each cover type plot will be removed within 6 months and the remaining 2 plots removed at 1 year. Measurements will include stem density, stem height, and percent coverage measured.

Figure 12. 2012 Pilot site of Geofabric control on *S. patens* in Burrard Inlet (Reed Point Marina)



Figure 13 a) 2013 Geofabric and Polyethylene cover material trials installed in September at Pacific Coast Terminals in Port Moody Arm. b) Applying steam (foreground) and mowing by hand (background) in plot. Photo Credit: Kim Keskinen



Vancouver Island Removals – Manual Control

The Coastal Invasive Species Committee (CISC) and J. Balke Ecofocus Environmental Consultants (Ecofocus) coordinated the control of *Spartina densiflora* and *Spartina patens* in the Baynes Sound area of the east coast of Vancouver Island, with some assistance from the Vancouver Island Conservation Land Management Program (VICLMP). Out of the 189 sites that were identified as *Spartina* infestations, a total of 159 sites were treated manually which created 17,500kg of dirt and *Spartina* plant material that was dug out and transported to Comox Valley Waste Management Center. Both CISC and Ecofocus prepared more detailed reports on mapping and removal for Vancouver Island that are provided in this report (Vancouver Island *Spartina* Eradication Program 2013 Progress Report prepared by Allison Millham, December 4, 2013 and *Spartina* Removal Project – Denman Island 2013 Final Report, prepared by J. Balke Ecofocus Environmental Consultants, November 30, 2013).

2013 CISC field work focused on treatment of known sites on the Vancouver Island coastline of Baynes Sound and Sandy Island. *S. densiflora* was removed at all sites except for one site (IAPP #290585) which was partially untreated leaving 35m² of *S. densiflora*. Based on observations, new *S. densiflora* occurrences appeared to have decreased throughout Baynes Sound and known sites have decreased in size and abundance. Those sites which received manual digging treatments in previous years have shown very little vegetative re-growth, although there is often new clones beginning to establish themselves from seed. *S. patens* remains primarily contained in the Courtenay Estuary, with isolated patches found along Sandy Island, Royston, Union Bay and Buckley Bay. However a number of "new" *S. patens* sites were identified this year, which likely were already present but detected in 2013 because crews have a better search pattern of the *S. patens* plants. Appendix 1 provides the detailed maps of *Spartina* treated. In areas where soil disturbance was high, crews collected native seeds from nearby native species e.g. *Plantago maritime*, *Triglochin maritimum* and *Grindelia integrifolia* and distributed onto the disturbed site. In areas where infestations would not be removed, crews clipped the seed heads.

Sandy Island Provincial Park was treated for *S. densiflora* infestations in 2012 and small new plants were found but dug and removed in 2013. A few large established clones are located on the easterly side of the island but were not map or removed due to limited resources. *S. patens* is also located in the park that was treated with geofabric in 2012 and another two *S. patens* sites were also found in 2013 but were not treated.

Similar to Burrard Inlet area, a geofabric pilot site to control *S. patens* was initiated in 2012. Two small plots (1.1m², 1.3m²) were covered with 2 layers of geofabric and staked. Both plots were vandalized in June 2013 and the sites were recovered with geofabric. Figure 14 shows one of the plots after one year of geofabric coverage but with the middle cut (vandalized) allowing plants to regrow. A second shade trial was installed on Sandy Island.

Figure 14. 2012 Shade Trial Site on *Spartina patens* in Courtenay Estuary where middle was cut (vandalized) in summer of 2013



The 2013 Ecofocus field work focused on treatment of known sites on Denman Island. Out of the 69 IAPP sites, all observed *Spartina* plants were removed from 41 sites along with portions on a remaining 10 sites. Seed clipping was performed at a further 5 sites. Therefore *Spartina* removal is required at the remaining 38 sites, including five sites with more than 400 plants. Removal took place from September 17 to October 21, 2013. Given the lateness of the initiation of removal (due to delayed funding), some plants were seed-clipped with hand-shears prior to digging as seeds were present. While machine cutting was tried it was abandoned and resulted in the shedding of too many additional seeds.

One of the observations during removal was longer roots were found on plants in the very high foreshore plants where it appeared that the roots might have been repeatedly buried by sand deposition.

Science – Evaluation - Monitoring

As part of the PMRA and PUP permitting for herbicide application on *S. anglica*, a series of monitoring projects were initiated in 2013:

- Impact of Imazapyr on surrounding salicornia plants
- Efficacy of different concentrations of herbicides on Spartina
- Herbicide residue persistency in water samples
- Impact of herbicide on non-target plants

While preliminary results were completed many of the monitoring projects will require a spring 2014 assessment to confirm impacts on Spartina because of the confounding effects of herbicide impact with plant senescence. The late season application of herbicide (late August) combined with the imazapyr delay in mode of action on a plant (beyond 35 days) made it difficult to assess whether changes in Spartina were due to herbicide impact or early seasonal senescence. However, based on some of the preliminary results the following recommendations for 2014:

- The impact of imazapyr on salicornia: preliminary results indicated that imazapyr residue was not detected beyond 5m of the application point immediately after applying the herbicide.
- Efficacy of different concentrations of herbicides on Spartina: ½ label rates of imazapyr and glyphosate did not provide any negative impacts on Spartina growth at 1 month after application. While the label rate of glyphosate had a larger negative effect on Spartina plant vigor than imazapyr, glyphosate does have a faster mode of action and therefore that should be expected.
- Herbicide residue persistency in water samples: glyphosate was quickly broken down in the water as it was undetected in water within 24 hrs after application. Imazapyr demonstrated a higher level of persistency in water samples.
- Impact of herbicide on non-target plants: Current results are inconclusive and therefore a spring 2014 plant assessment (repeat Braun-Blanquet) will provide more informative results

Outreach

Information and Internet Resources

- Community Mapping Network provides web mapping and other information on the distribution of *Spartina sp.* in BC. www.spartina.ca
- The BCSWG uses an email “List Serve” to communicate & coordinate with identified volunteers and partner organizations in BC. spartina-ca@vancouvercommunity.net
- Friends of Semiahmoo Bay Society uses their web site for volunteer call out, information & partner links <http://www.birdsonthebay.ca/>
- Corporation of Delta website: http://www.delta.ca/EN/main/residents/771/808/spartina_anglica.html
- Coastal Invasive Species Committee: <http://www.coastalisc.com/priority-invasive-plants>

Spartina in the media

- a. Earth Day speaker at Delta (April 22, 2013)
- b. Global News Hour on herbicide application in Roberts Bank (August 2013)
- c. The Flagstone (Denman Island monthly newspaper), November 2013
- d. Denman Conservancy Association Newsletter Article – November 2013

Spartina Presentations at Meetings and Conferences

- a. Coastal Estuary Research Federation Meeting (October 2013)
- b. Metro Vancouver Invasive Species Committee Fall Forum (October 2013)
- c. Canadian Wildlife Service Seminar (November 2013)
- d. Invasive Species Council of BC (January 2014)
- e. Public meeting on Denman Island (January 2014)
- f. Weed Society of America Annual Meeting (February 2014)

Finances

The BCSWG partners and individual volunteers contributed over \$165,000 of in-kind time and resources to the project, in addition to external funding from grants and partners. These in-kind contributions were essential to the success of the project. Figure 20 shows the percentage of contributions by component and the ratio of in-kind to direct (cash) contributions. Table 3 details the contributions by all partners for each Component of the Program and Table 4 summarizes the income and expenditures for 2013.

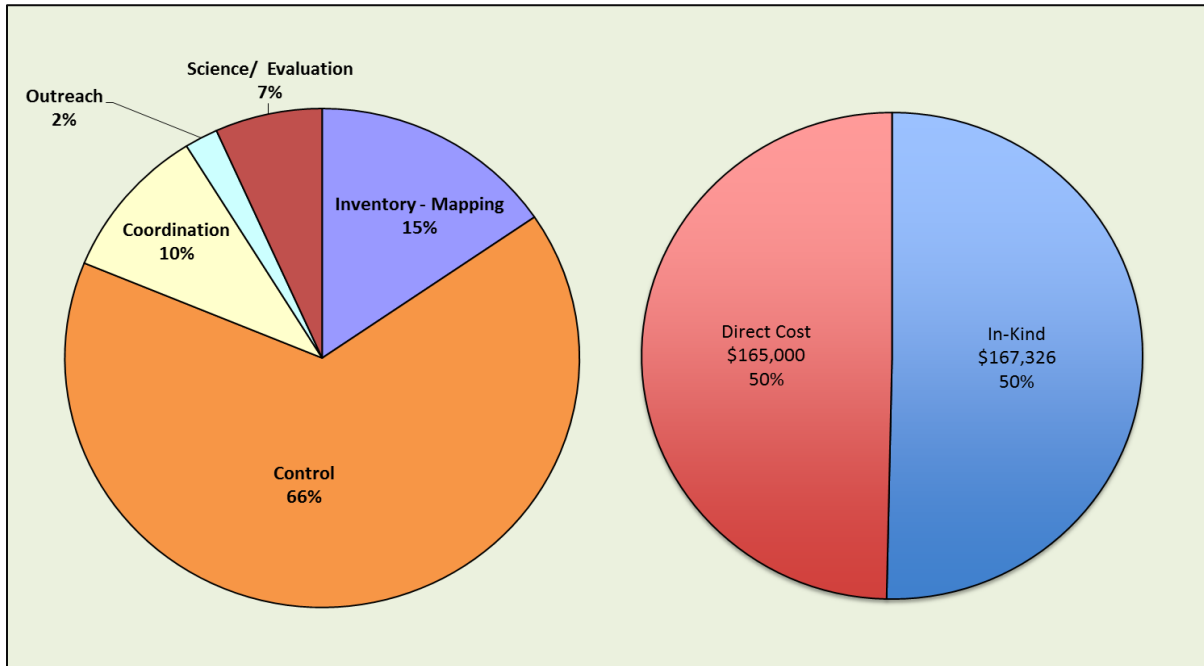


Figure 20. 2012 Spartina Program Expenditures by Component & Type/Amount

Table 3. BC Spartina Eradication Program In-Kind Contributions - BCSWG 2013

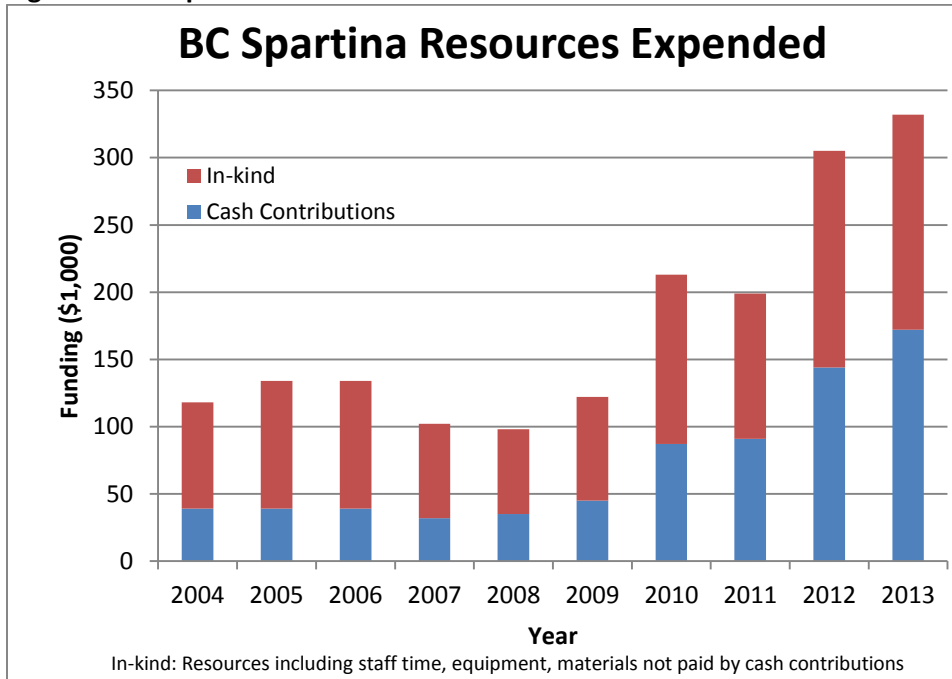
2013 Program Partners	In-Kind by Program Components					In-Kind
	Inventory - Mapping	Control	Coordination	Outreach	Science/ Evaluation	
Arocha Canada		\$1,600				\$1,600
BC Conservation Foundation		\$300				\$300
BC Ministry of Environment		\$5,000	\$8,000			\$13,000
BC Ministry of Forests, Lands, and Natural Resource Operations, Vict.		\$43,450	\$1,400		\$1,200	\$46,050
City of Surrey - SHaRP & SNAP Programs	\$4,460	\$2,060				\$6,520
Coastal Invasive Species Committee (CISC)				\$600		\$600
Vancouver Island Conservation Land Management Program (VICLMP)	\$2,550	\$6,050	\$400		\$400	\$9,400
Community Mapping Network	\$5,000		\$400			\$5,400
Comox Valley Regional District		\$1,950				
Corporation of Delta	\$4,400	\$4,694	\$922	\$800		\$10,816
Ducks Unlimited Canada		\$7,300	\$4,500			\$11,800
Environment Canada- Canadian Wildlife Service	\$4,800	\$6,400	\$1,600			\$12,800
Friends of Semiahmoo Bay Society	\$200	\$1,400	\$600	\$200		\$2,400
GL Williams & Associates	\$1,280		\$2,560	\$3,280		\$7,120
Independent Volunteers		\$20,000				\$20,000
Various Denman Island volunteers		\$3,400		\$1,200		\$4,600
Invasive Species Council of Metro Vancouver	\$400	\$800	\$400			\$1,600
MAC Oysters		\$1,600				
Port Metro Vancouver	\$800	\$4,800	\$800			\$6,400
Student Employment Programs - Federal government		\$6,946				
Tswassen First Nation, TFN Construction / Matcon Joint Venture	\$2,400		\$2,100	\$1,020		\$5,520
The Nature Trust of British Columbia		\$1,400				\$1,400
Subtotal (inkind)	\$26,290	\$119,150	\$23,682	\$7,100	\$1,600	\$167,326
* All amounts are based on \$400/day/person for inkind and direct costs						

Table 4. BC Spartina Eradication Program Direct Cost (Cash) Contributions - BCSWG 2013

Direct Costs (Cash)	Committed & Expenditures by Program Components					Total
	Inventory	Removals	Coordination	Outreach	Science/ Evaluation	
BCCF Crew	\$7,000	\$18,638				\$25,638
Corrdinator contract (R Knight, M Christensen)	\$7,000	\$18,193				\$25,193
DUC		\$7,050	\$10,000		\$8,000	\$25,050
Lab Analysis					\$13,228	\$13,228
Other Contractor-Website, transport		\$1,808				\$1,808
Materials, Supplies, misc.	\$2,000	\$6,235				\$8,235
Pesticide Use Permit - Application fee						\$0
Contract (CISC, Denman Isld)	\$10,000	\$26,564				\$36,564
Other Contractor-Website, transport						\$0
Contractor - Herbicide Application		\$25,000				Funds Spent
SubTotal	\$26,000	\$103,488	\$10,000	\$0	\$21,228	\$160,716

Over the recent history, financial contribution of the cash and in-kind of the BC Spartina Working is found below:

Figure 15. BC Spartina Resources Contributed Over Time



Partnerships

Developing partnerships are a key principle of the BC Spartina Working Group to achieve control and eradication of Spartina plants. This principle is demonstrated in the diversity of partnerships (government, non-government, community, industry) that are part of the steering committee. In 2013 new relationships were developed with Denman Island Conservancy, MACS Oysters as well as several First Nations in Burrard Inlet and agencies such as City of Port Moody, Squamish First Nations, Wild Bird Trust and BC Parks.

Given the nature that Spartina is a cross border issue, it follows that maintaining partnerships with organizations in Washington State and others states are important. The Washington State Department of Agriculture (WSDA) has been a long term partner with the BCSWG and were directly involved with BC inventory and herbicide control activities in 2013.

At a high level, the Pacific Coast Collaborative (PCC) leaders signed the “Action Plan for Ocean Conservation and Coastal Climate Change Adaptation” on February 12, 2010. One of the actions in this plan is to reduce or prevent the spread of invasive species, with Spartina being a top priority. The PCC issued a “Spartina Progress Report for the Pacific Coast Collaborative Leaders Forum November 16th, 2010” which states British Columbia, Washington, Oregon, and California have jointly committed to eradicate non-native Spartina by 2018.

This document and the Action Plan for Ocean Conservation can be viewed at <http://spartina.ca> in the “Atlas Documents” section.

Recommendations for 2014

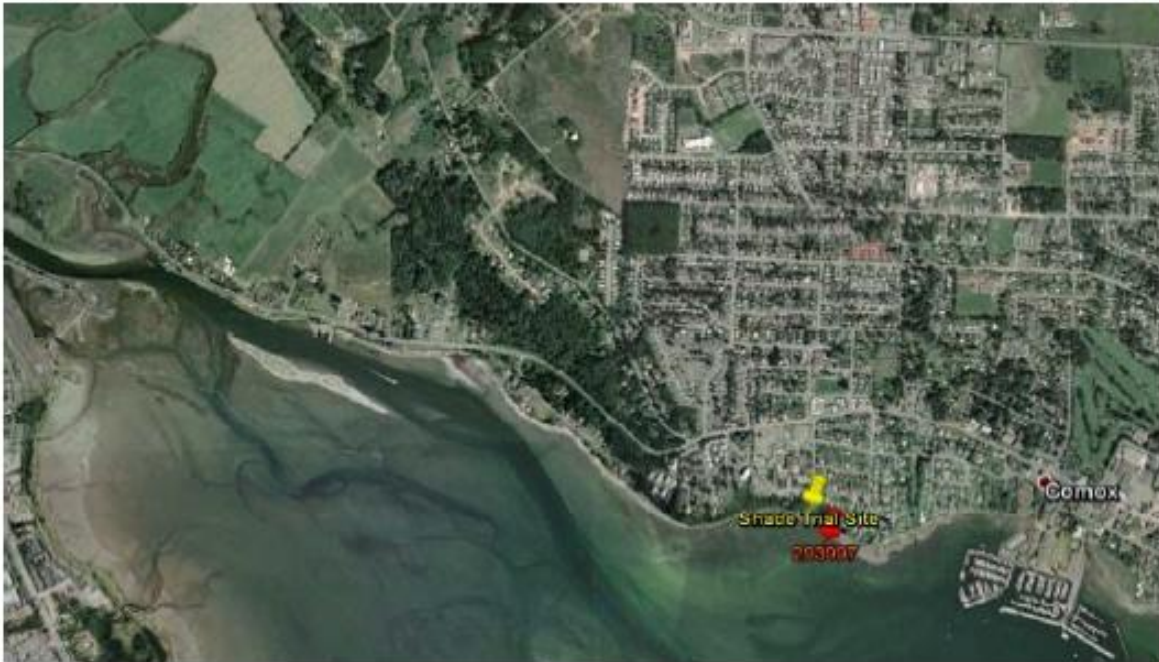
While the Spartina Project documented several successes in 2013, further resources and progress is required to achieve the Pacific Coast goal of eradication non-native Spartina by 2018. Therefore the following are recommendation from the steering committee:

1. General
 - a. Continue the partnership approach to Spartina mapping and control
 - b. Secure financial funding earlier to enable earlier mapping and removal work for *S. densiflora* and *S. patens* prior to seed setting in September
 - c. Utilize an integrated pest management approach towards eradicating *S. patens*. Explore chemical treatments, excavator treatments and hand-digging and associated restoration requirements.
2. Fraser Delta and Boundary Bay
 - a. Target herbicide application in Boundary Bay for the clones not treated in 2013 and repeat herbicide application in Roberts Bank for the missed and newly emerged plants.
 - b. Complete monitoring projects initiated in 2013

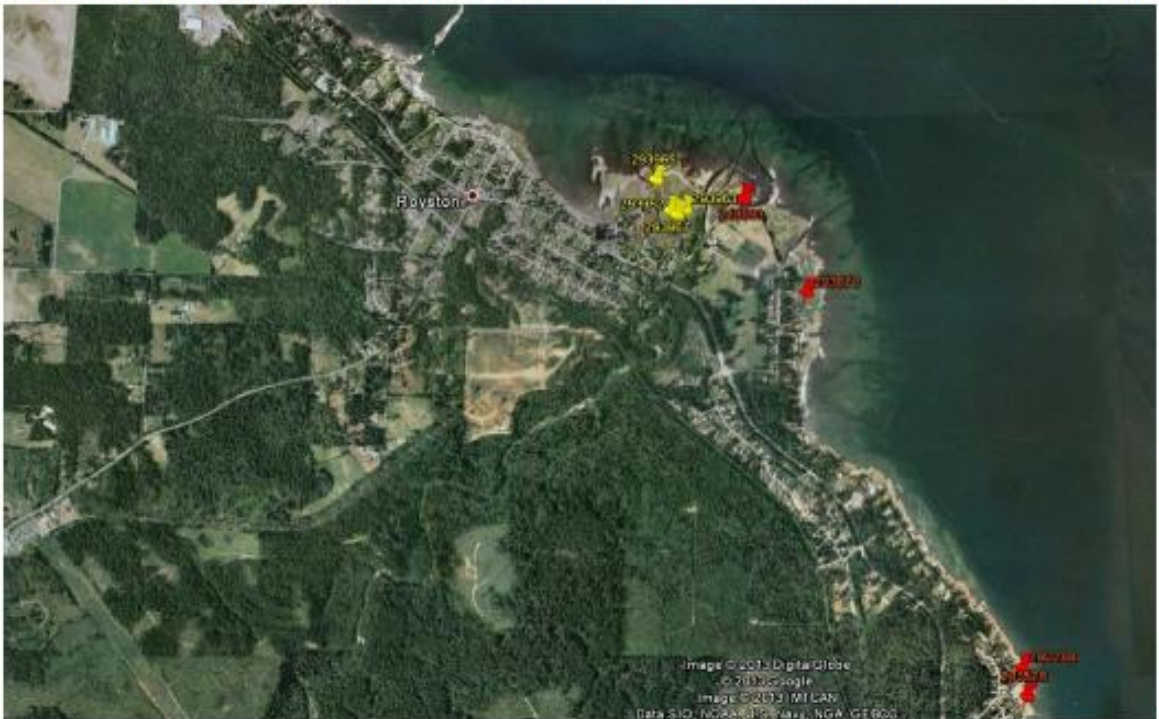
- c. Complete and evaluation of efficacy of the 2013 herbicide treated plants in Roberts Bank
- 3. Burrard Inlet
 - a. Develop a plan to address *S. patens* infestation in Burrard Inlet including proposed control techniques and associated restoration activities and expand mapping beyond areas mapped in 2013.
- 4. Vancouver Island
 - a. Initiate mapping and control in early spring 2014 (before plants begin to flower) and continue removals into winter 2014. Treatment priority should first be conducted around Provincial Parks and Conservation Areas.
 - b. Employ active, foot based surveys from Deep Bay, Bowser to Point Holmes, Comox, including a thorough search of the K'omoks Estuary.
 - c. Expand mapping and detection priorities:
 - i. Using powerboats to Texada Island, Lasqueti islands, Seal Islets and Sandy Island.
 - ii. Using canoes Widgeon Island and key estuaries on Vancouver Island.
 - iii. Royston to Point Holmes for *S. patens* for detailed information of area infested and distribution
 - iv. Continue to support the community efforts of Spartina searching and mapping in the Tofino area and in other Vancouver Island estuaries
 - d. Expand shade trial to larger *S. patens* site.
 - e. Treatment priority should first be conducted around Provincial Parks, Conservation Areas and high value areas.
- 5. Test aerial detection techniques with new technologies such as the remote controlled, electric, Quad Rotor. This device has the ability to travel up to 500m away from the user and when outfitted with high definition camera, can become a valuable tool. Real time video and pictures, with a 10 second lag, can be viewed from a laptop or smartphone. Photos and video may greatly assist on-the-ground efforts by viewing hard to access terrain from a nearby boat or access point. These activities would be most suitable to detecting large clones and large meadows of Spartina.
- 6. Outreach
 - a. Consider the use of t-shirts and hats for field workers to wear to showcase the project and its funders while giving credibility to workers as they hike beaches that are often cultivated for oysters.
 - b. Increase awareness of Spartina activities using various methods such educational Display at public events like World Oceans Day, Farmers Market or Earth Day. Contact local stewardships groups such as Project Watershed or Comox Valley Nature directly to see if they would like to participate in project - offer ID training. Publish several articles in local newspapers and post online to garner support for project.
- 7. Consider cross train crews from Lower Mainland and Vancouver Island to improve search pattern recognition of the different Spartina species.

Appendix 1 – Detailed Maps of Spartina Treated on the East Coast of Vancouver Island (Source: Vancouver Island Spartina Eradication Program 2013 Progress Report prepared by Allison Millham, December 4, 2013)

Map 1. Comox Estuary with treated sites of *S. densiflora* (red) and *S. patens* (yellow)



Map 2. Courtenay to Royston with treated sites of *S. densiflora* (red) and *S. patens* (yellow)

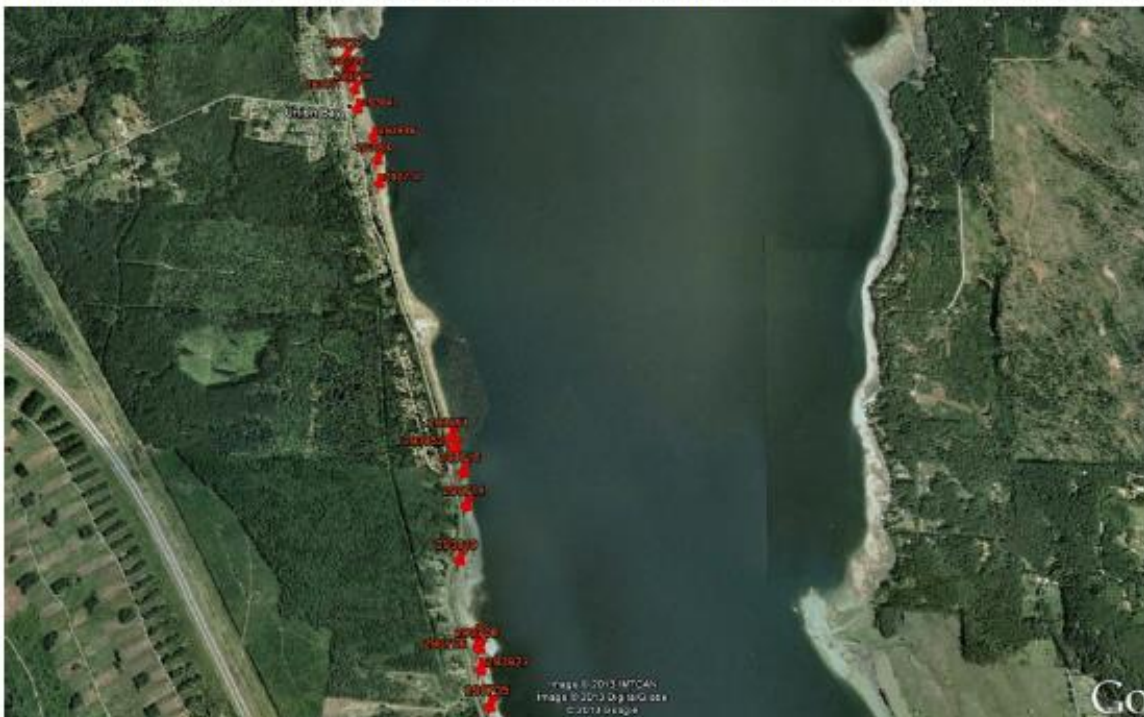


Appendix 1 – Detailed Maps of *Spartina* Treated on the East Coast of Vancouver Island (Source: Vancouver Island *Spartina* Eradication Program 2013 Progress Report prepared by Allison Millham, December 4, 2013)

Map 3. Royston area and Sandy Island with *S. densiflora* (red) and *S. patens* (yellow) treated sites



Map 4. Union Bay and the west side of Denman Island with *S. densiflora* (red) treated sites

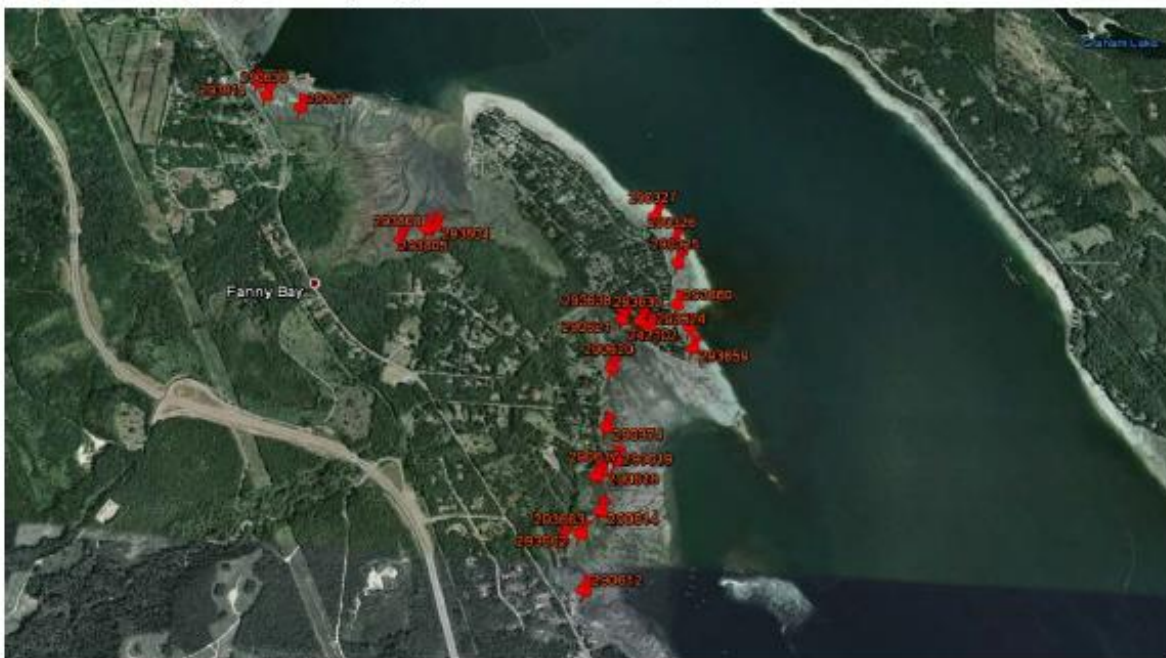


Appendix 1 – Detailed Maps of Spartina Treated on the East Coast of Vancouver Island (Source: Vancouver Island Spartina Eradication Program 2013 Progress Report prepared by Allison Millham, December 4, 2013)

Map 5. Buckley Bay and mouth of Tsable River with *S. densiflora* (red) treated sites



Map 6. Buckley Bay to Fanny Bay with *S. densiflora* (red) treated sites



Appendix 1 – Detailed Maps of Spartina Treated on the East Coast of Vancouver Island (Source: Vancouver Island Spartina Eradication Program 2013 Progress Report prepared by Allison Millham, December 4, 2013)

Map 7. Mud Bay to Deep Bay with *S. densiflora* (red) treated sites



Map 8. Location of *S. patens* shade trials, indicated by orange markers and IAPP SiteID#.

