

# British Columbia Spartina Eradication Program 2012 Progress Report



**Prepared for: Ducks Unlimited Canada (March 2013)**

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**On Behalf of: The BC Spartina Working Group (BCSWG)**

City of Surrey

Coastal Invasive Species Committee

Community Mapping Network

Corporation of Delta

Invasive Species Council of Metro Vancouver

Ducks Unlimited Canada

Environment Canada – Canadian Wildlife Service

Fisheries and Oceans Canada

Friends of Semiahmoo Bay

Ladner Rotary Club

Metro Vancouver

Ministry of Environment

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, Jeanine Bond, Justin Quong, Courtenay Lahue, James Logan(Ducks Unlimited Canada - DUC), Rob Knight (Community Mapping Network), Margaret Cuthbert, Alison Prentice (Friends of Semiahmoo Bay), Becky Brown and Sylvia Letay (Ministry of Forests, Lands & Natural Resource Operations), Crystal Lloyd (Port Metro Vancouver), Jennifer Grenz, Tasha Murray (Invasive Species Council of Metro Vancouver), Matthias Herborg (Ministry of Environment), Rachelle McElroy, (Coastal Invasive Species Committee), Joanne Neilson (BC Conservation Foundation). A special thanks to the two summer crews of **BCCF** (James Logan, Kaliegh Kissack, Lisa Dekleer, Marc Edwards, Matthew Christensen, Toby Schmitt, Yonathan Uriel) and the summer crews of **CWS** (Danielle Piezas, Kasey Moran, Robyn Pirie) and **Delta** (Cindy Ederis, Jordan Royer Mike )

Over the course of summer and fall of 2012, many other individuals and groups contributed to finding and removing *Spartina sp.* in BC. 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/SNAP Programs	For Mud Bay hand removals: Coordinator Brittany McKinnon & SHaRP/SNAP Crews: Ashley Myrvold, Liam McKay, Zach Morris, Grace Choi, Stephanie Blain, Amraaz Mangat, Ali Hussain, Sterling Testini, Satwinder Gil, Chelsea, Cody, Rimi & Mark.
Friends of Semiahmoo Bay Society	For South Surrey mapping and Balckie Spit – Pat’s Patch removals/clipping: Alison Prentice, Leona & Joanne Breckonridge, Keith Sorensen, Sharon Jones, Mai Clark, Russell Prentice, Sarah Brookes, Justin Boehringer, Maria Cuthbert, Russell Prentice, Peter Zhang, Bob Winston
Ministry of Forests, Lands & Natural Resource Operations	Brianne Smith
Other Volunteers on Fraser Delta	Peter & Phelan Harris, Linda Easton, Trevor & Hughie Jones, Morgan Umpletay, Jackie Woodruff, Nicci Bergunder, Julie Boswell, Duncan McDonald, Chris Chan, Pamela Zevit, Brock Ramshaw

Rotary Club of Ladner	Don Burkett, Dan Burkett, Dan Treend, Patty Rosten, Sandra O’Keefe, Linda Ottho, Chris Offer, Art Birk, Jeff Peters, Linda Cran, Barry Irvine, Ray Moschuk, Diana Nimsick, Roy Sakata, Tom Siba, Mike Storey
Coastal Invasive Species Committee*	Alison Millham, Mike Reid and Jennifer Manuel
Vancouver Island Conservation Lands Management Program (VICLMP): Baynes Sound mapping and <i>S. densiflora</i> removals	Thomas Reid, Steven Godfrey and Clayton Billett (The Nature Trust)
Comox Valley Regional District	Financial contribution to VICLMP work in Baynes Sound
Vancouver Island University	Brian Kingzett (Vancouver Is. University) for outreach to aquaculture industry re <i>Spartina sp.</i>

\*Coast Invasive Plan Committee (CIPC) renamed Coast Invasive Species Committee (CISC) in 2012

## Executive Summary

In 2012, 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 2012, the BC *Spartina* Eradication Program applied \$285,387 of in-kind and direct value to deliver program components focused on Monitoring, Removal, Coordination, Outreach and Science/Evaluation. The monitoring program included mapping approximately 35km of shoreline in the Fraser Delta, more than 18km of shoreline in Baynes Sound and nine at risk estuaries on the East Coast of Vancouver Island. The 2012 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 (figures 1 & 11).

Since 2007 the number of larger 1m+ clones of *Spartina anglica* in the Fraser Delta has steadily increase in spite of considerable control efforts using mechanical removal by hand and machine. From 2011 to 2012 there was a **260% increase** in the number of 1m+ size clones and a **22% increase** in clones size class 0.3m-1.0m. This is a continuation of increasing numbers of larger clones as seen each year. In addition, there was a very large increase in the number of *S. anglica* seedlings in 2012 that required a sustained effort by volunteers and summer crews to remove. Many established clones were not seed head clipped in 2011 and their viable seed germinated during the mild spring and summer throughout Boundary Bay and Roberts Bank.

If *S. anglica* infestations in BC are left unchecked they will grow rapidly into thousands of acres of salt grass meadows, exponentially increasing the future costs of eradication as previously experienced in Washington, Oregon and California.

Spartina removals in 2012 continued to use hand digging, and mechanical excavating in locations at highrisk infestations sites. In the Fraser Delta, *S. anglica* removals occurred on Roberts Bank (north of and beside the Delta Port causeway) and throughout Boundary Bay. On Vancouver Island, some of the *S. densiflora* was manually removed from Baynes Sound.

*S. patens* infestations in Burrard Inlet and Baynes Sound have been re-mapped and trial cover plots have been established in both areas using a geo-textile fabric for a 2 year treatment and evaluation in 2014.

The BC Ministry of Environment submitted an emergency registration permit to the Pest Management Regulatory Authority (PMRA) in 2012 and hope to receive approval in 2013. Further permitting will be required if herbicides are used as part of the Spartina control program. The working group is working with all federal and provincial agencies to ensure herbicide use is in accordance with regulations and guidelines, integrating the herbicides in the Spartina control program.

Outcomes of the 2012 program continue to confirm the conclusion of the *BC Spartina Response Plan 2010* (Dresen et al, 2009) that indicated mechanical control efforts alone have met with limited success.

## 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. Two other *Spartina* species have since been discovered in BC: *S. densiflora* (Vancouver Is., Baynes Sound) and *S. patens* (Burrard Inlet, Baynes Sound). These other two species tend to establish on shorelines with coarser materials in higher inter-tidal zone.

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 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, 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.

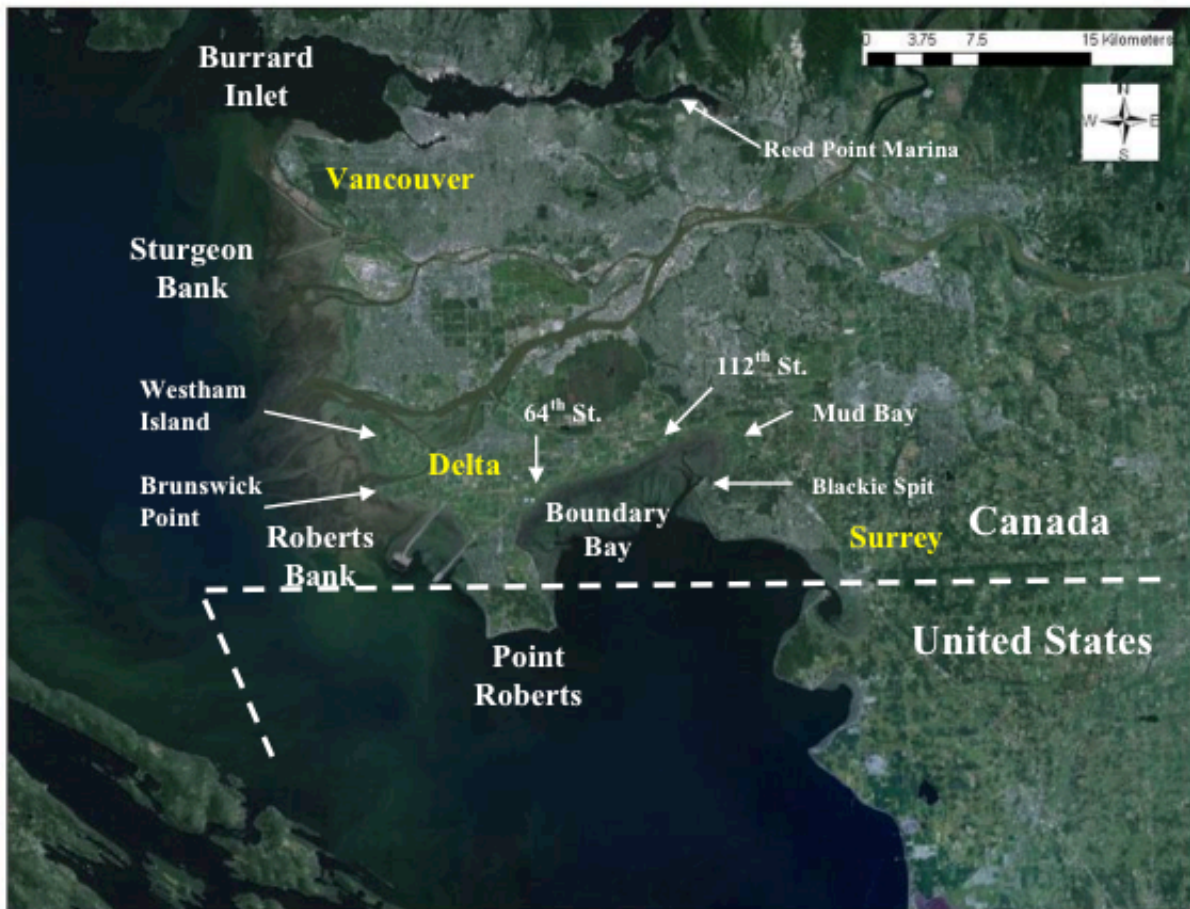


Figure 1. Areas in the Fraser River Delta

## Detection

### South Fraser

In 2012, approximately 166 person days were devoted to monitor and map about 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. Locations were denoted as one of: single seedling, clone <0.3m, clone 0.3m - 1.0m, clone > 1.0m in diameter, and 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.



**Figure 2. *Spartina anglica* Extent of Search Area (yellow line) and Distribution in the Fraser Delta Area – 2012**

The extent of shoreline searched in June 2012 was the same as in June 2011 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 2012 because of limited manpower but south of Crescent Beach to the Canada/US boarder was surveyed in 2012. *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.

Each year since 2007 the number of larger 1m+ clones has steadily increase in spite of considerable control efforts using mechanical removal by hand and machine. Between 2011 and 2012 there was a 260 % increase in the number of 1m+ size clones and more than a 2,300

% increase in single plants. The dramatic increase in the number of single plants in Table 1 (4497) is an underestimate because by Sept. 2012 approximately 7,500 single plants were removed. The mapping effort in 2012 was similar to previous years but seed germination appears to have increased significantly and continued throughout the summer.

Mapping is done every June and July as a constant measure of the effects of control measures in the previous year. This tends to underestimate the number of smaller clones in the infested areas because these sizes are found more easily later in the growing season. For example single plants mapped in 2012 was 4,497 but there were over 9,200 single plants removed. For size <0.3m: 685 mapped vs 1,883 removed. This bias in estimating numbers is also size dependant because hand removals are not applied to large clones and removal effort varies across the infested area.

**Table 1. *Spartina anglica* Size Classes Mapped from 2005-2012 in Boundary Bay and Roberts Bank.**

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



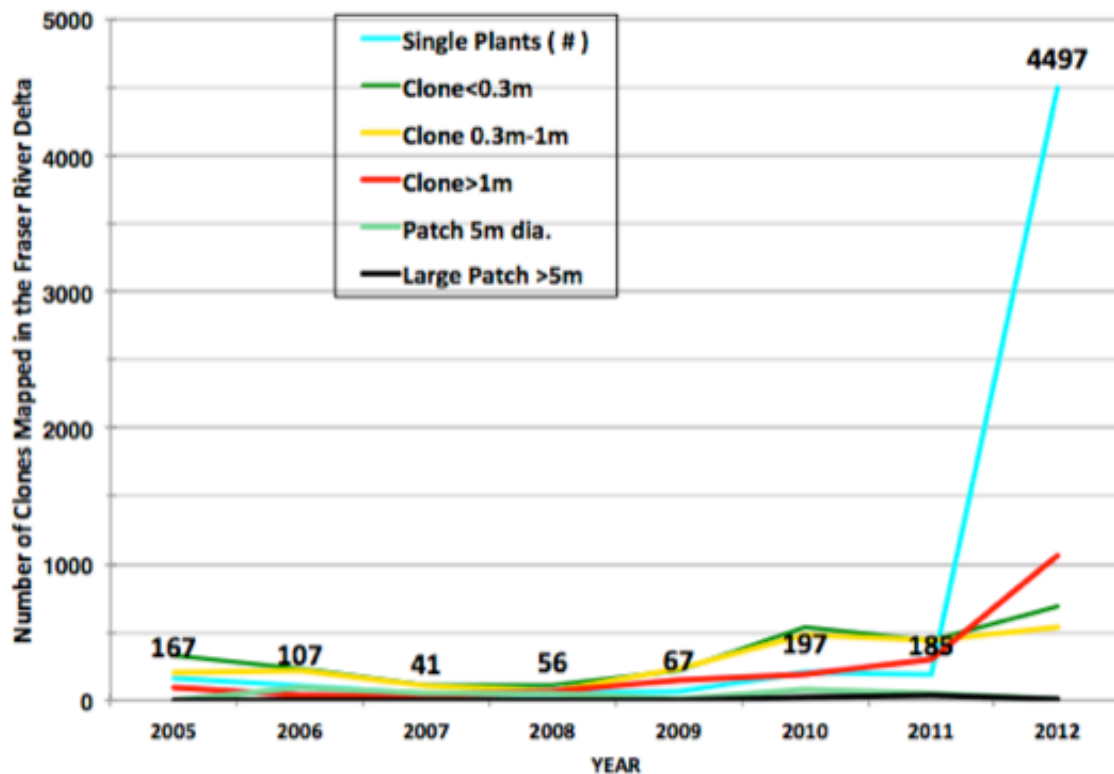
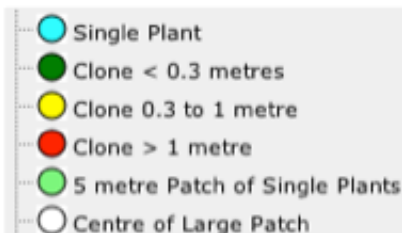


Figure 3. *Spartina anglica* Size Classes Mapped from 2005-2012 preliminary stats

The following three areas remain of greatest concern because of the relatively high infestation and ecological values for migratory fish and birds.

The size categories for mapped *Spartina* clones in the following Figures 4 to 9, are represented by these dot colours:

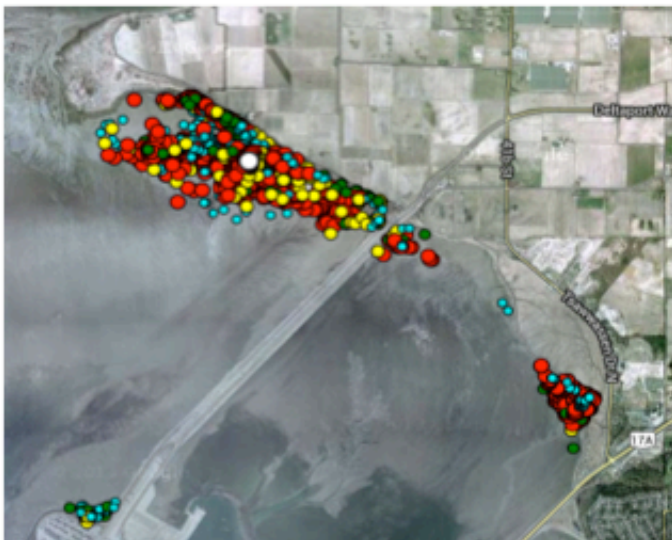


### **Brunswick Point:**



This area has very high ecological values for avian and fish species, and as the only confirmed, significant source of bio-film that Western sandpiper utilize as an essential food source in the spring migration north. The *S. anglica* infestation in this area has spread considerably over the past several years. A large infestation of all clone sizes continues to expanded on the mudflats between Brunswick Point and the Delta Port causeway in spite of considerable effort to remove all sizes by hand and with an excavator.

**Figure 4. Distribution of *S. anglica* at Brunswick Point – 2011**

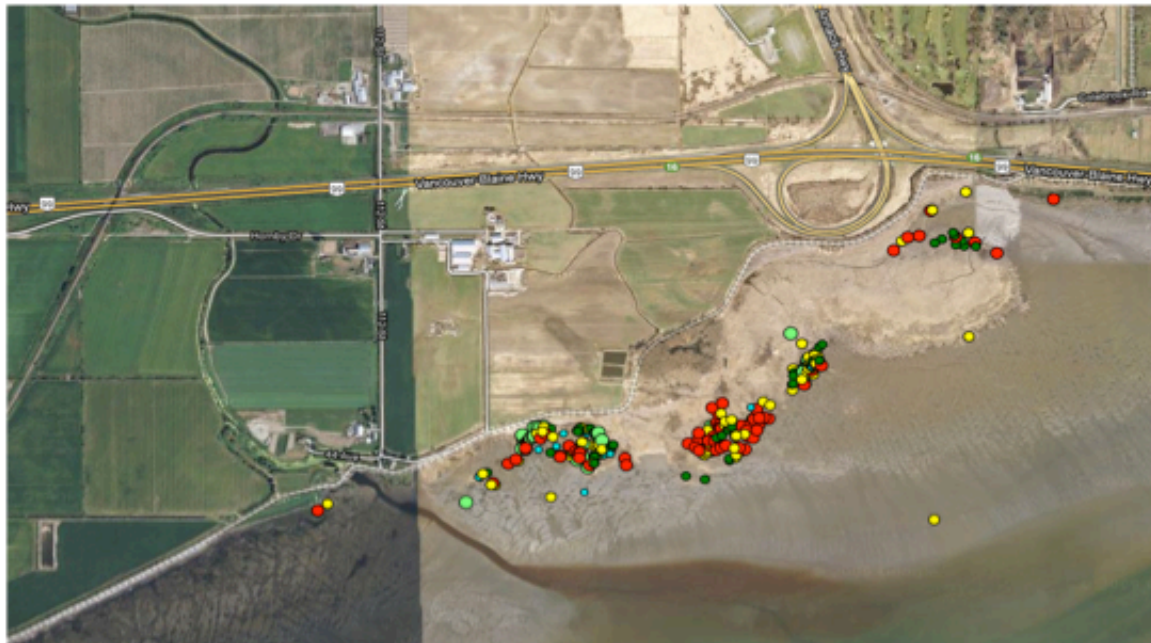


Many 1m and larger clones were removed in the intertidal marsh area between Brunswick Point and the Delta Port Causeway in 2010 and 2011 but the rapid expansion has continued beyond the resources currently available to control this infestation. In addition, a new infestation was mapped and removed in 2011, at the southern end of the causeway (Figure 4). In spite of those 2011 removals at the causeway south end, several clones were found in 2012 (Figure 5).

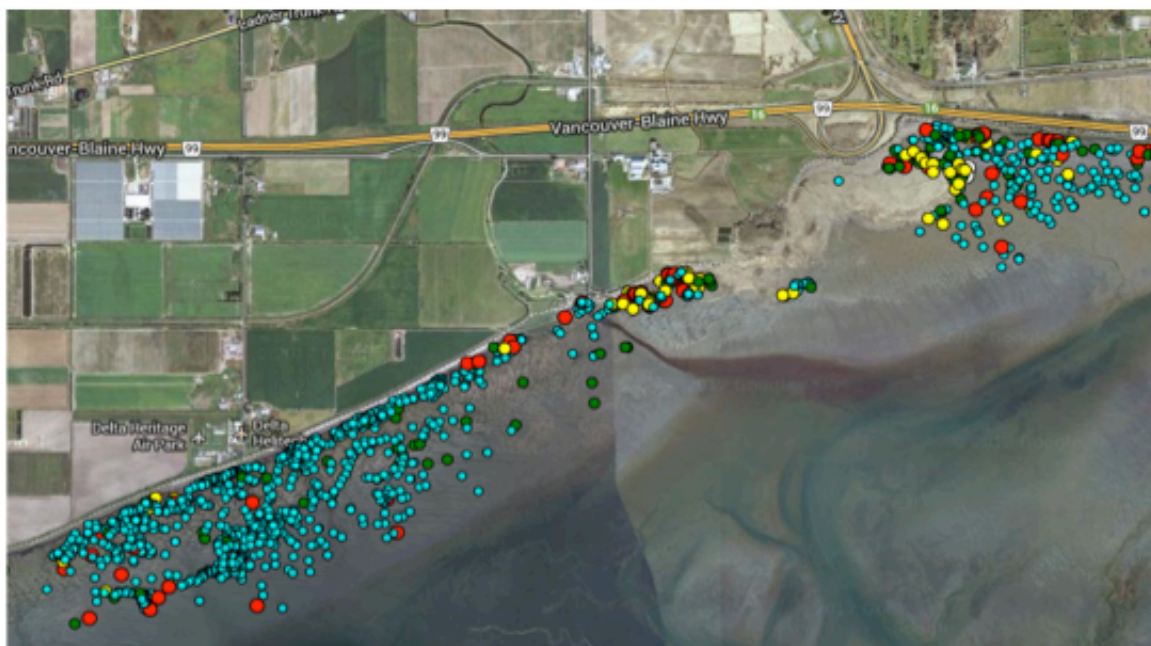
**Figure 5. Distribution of *S. anglica* at Brunswick Point – 2012**

### **112th Street:**

In 2010 this area was the largest and densest infestation in Boundary Bay but repeated excavator removals in 2010 and 2011 reduced the number of large, 1m+ clones (Figure 6) In 2012, the large number of clones in this area are smaller than the 1m+ size class but have expanded significantly east and west since 2011 (Figure 7). The limited resources currently available to control this expansion cannot cope with the numerous smaller clones that will expand to 1m+ diameter in a couple of years.



**Figure 6. Distribution of *S. anglica* at 112th Street – 2011**



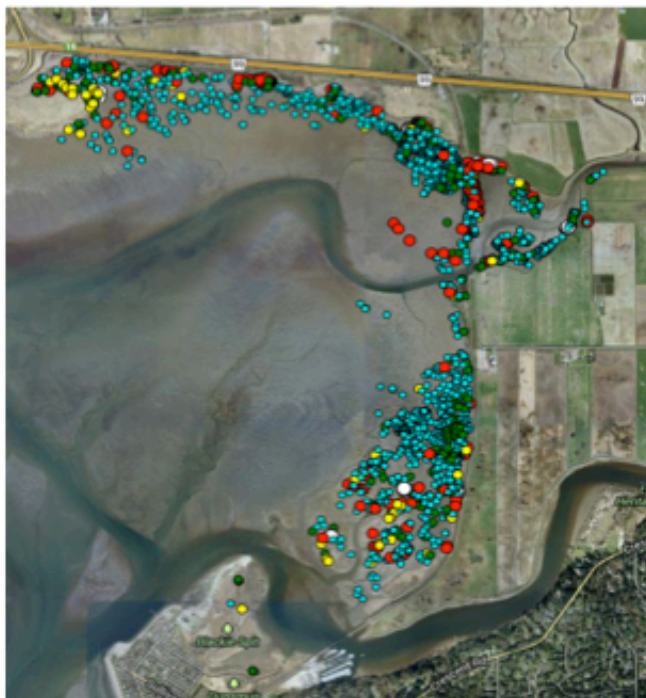
**Figure 7. Distribution of *S. anglica* at 112th Street – 2012**

## Mud Bay:



The Mud Bay area continues to be of concern because river outflows from the Serpentine and Nicomekl Rivers could spread *S. anglica* seeds to new locations west and south towards mudflats in Washington State but the 2012 mapping shows expansion west and south is minimal. The mud flat between the two rivers is very difficult to access and removals have only occurred north and south of the rivers. The 2012 mapping shows smaller clones throughout this area have grown much larger and new, small clones are much more numerous (Figure 9), similar to the 112<sup>th</sup> St. area, compared to the 2011 inventory (Figure 8).

Figure 8. Distribution of *S. anglica* at Mud Bay – 2011



This area, between the Serpentine and Nicomekl Rivers, was explored by kayak in 2012 to reevaluate the kayak method for mapping and small clone removals. As in a 2010 pilot kayak program, we confirmed it is not a practical approach to working in these habitats. The tidal range and timing over the wide mudflats leaves ample time for searching by foot but travel by kayak on a rising or falling tide greatly reduces the search/mapping time. It would take many days more to properly search the Mud Bay area by kayak or canoe. Some of the islands of intertidal vegetation could be more easily accessed but the mudflats between the islands requires a foot survey method.

Figure 9. Distribution of *S. anglica* at Mud Bay – 2012

## Burrard Inlet

Spartina distribution throughout Burrard Inlet was not completed in 2012 given resource limitations and recent observations that *Spartina patens* has remained relatively stable in distribution. The known distribution of *S. patens* in Burrard Inlet is shown in Figure 10.

*S. patens* is present in these five locations, the largest of which are at Park Dr., Maplewood Flats and Reed Point. Those three, larger locations were remapped in 2012 to determine how much they had expanded in recent years. Polygons showing the extent of 2012 mapping can be viewed at the <http://Spartina.ca>.



Source: Dan Buffett, Ducks Unlimited Canada, 2008

**Figure 103. Distribution of *S. patens* in Burrard Inlet – 2012**

## Vancouver Island

In 2005, *Spartina patens* was confirmed in the Comox estuary and was believed to have been present there for sometime. *Spartina densiflora* was also reported in and around Baynes Sound in 2005. Although much of East Vancouver Island and the Gulf Islands shorelines are at risk for invasion, only some of those shores have been surveyed for *Spartina sp.*

The Coastal Invasive Species Committee (CISC) developed an Island *Spartina* Working Group in 2008, to coordinate inventory and management beginning in 2009. In 2010 mapping surveys were carried out around Main and Prevost Islands in the Gulf Island archipelago and in parts of

Baynes Sound using both land and boat monitoring techniques. The 2010 Gulf Islands surveys were negative for *Spartina* presence but the presence of *Spartina* in Baynes Sound surveys prompted more surveys in 2011 and 2012. Those shoreline surveys and mapping followed the same on-shore method as the established Fraser Program using foot surveys on accessible inter-tidal areas and investigating suspected plants on shore when seen from a boat travelling along the shore. Figure 11 shows the locations of all surveys for 2011-2012. The 2012 surveys included several estuaries north and south of Baynes Sound not previously surveyed – no *Spartina sp.* were found outside of Baynes Sound.

A detailed description of the estuaries surveyed in 2012 is available at <http://spartina.ca> in the Atlas Documents section: “Vancouver Island *Spartina* Eradication Program 2012 Progress”.



**Figure 11. Combined *Spartina* Shoreline Search Areas on Vancouver Island – 2011, 2012**

As in previous years The Vancouver Island Conservation Lands Management Program (VICLMP) worked closely with the Coast Invasive Species Committee (CISC) and the Vancouver Island Conservation Corps summer crew in Baynes Sound, to map and remove or clip seed heads from *S. densiflora* and to map *S. patens*. Mapped locations, search tracks and some of the removal locations for *Spartina sp.* can be found on the interactive web mapping for the BCSWG, <http://cmnmaps.ca/invsp/>

# Control & Removals

## South Fraser Manual Removals

Many more clones/seedlings (9212 in 2012 vs 1140 in 2011) were removed by hand in the infested areas of the Fraser Delta. Three volunteer organizations undertook hand removals of infestations (Figure 18):

- along the Boundary Bay shore from Beach Grove to 112<sup>th</sup> St. (Ladner Rotary Club)
- at Blackie Spit (Friends of Semiahmoo Bay Society) and
- City of Surrey's SHARP and SNAP summer crews in the Serpentine River Estuary and Mud Bay

The high priority areas continue to be 112th Street, Mud Bay, and Brunswick Point to stop dispersal to uninfested areas.

The 2012 tally on hand removals is: 7,409 Single plants, 1692 <0.3m (A) clones, 100 0.3m-1m (B) clones, 11 >1m (C) clones. Note that excavation of a 1m+ clone by hand is extremely hard work and only undertaken in a few locations not suitable for an excavator. Generally seed head clipping in August is the only control method applied to larger clones when excavator or hand removals were not undertaken.

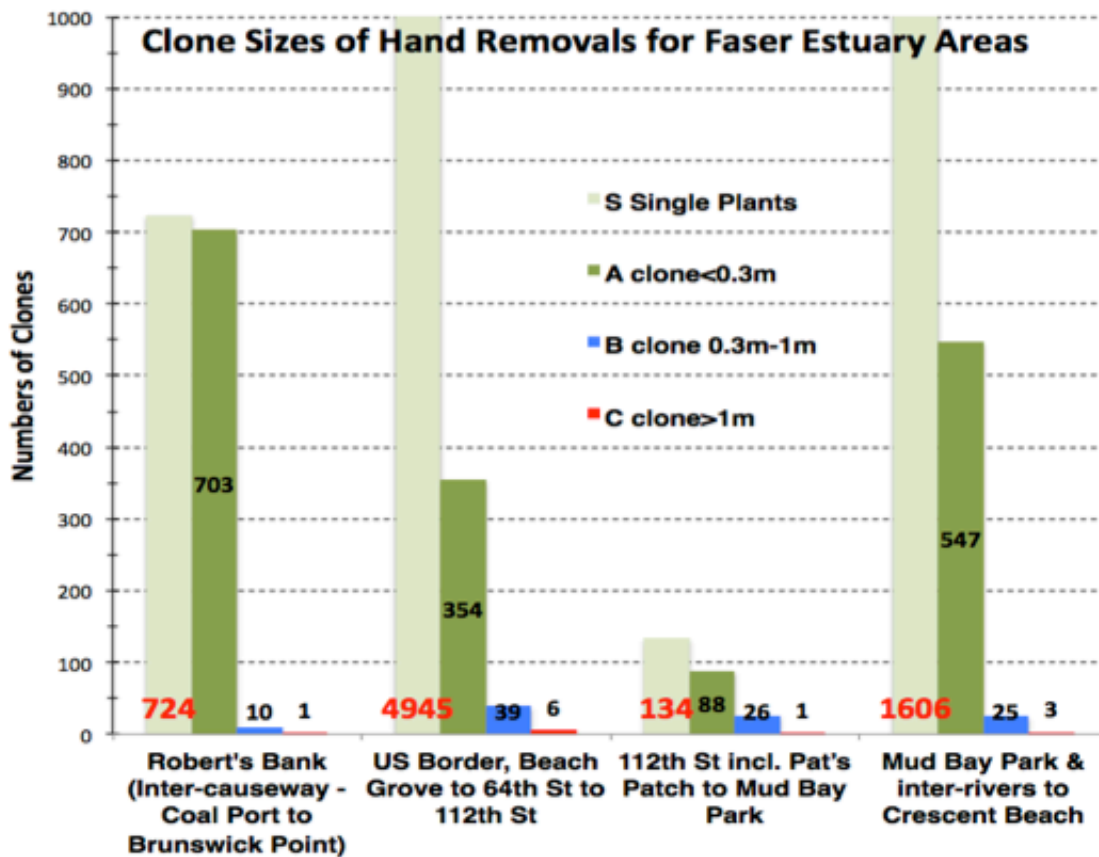


Figure 12. Clone Sizes Removed in Fraser Estuary Areas (Fig.1) – 2012

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 to the dyke or to a near by disposal bin stationed for the removal work. Using inexpensive moulded snow sleds (a technique introduced in 2010) 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. New for 2012 was an in-kind use of an 8 wheel “Argo” ATV that extended the ability of small crews to carry out hand removals further from shore. In August, after the removal season, the bins were taken to Metro Vancouver’s sanitary landfill.

2012 program funding was available to hire a four person Spartina crew through BCCF for July, August and part of 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 worked closely with the excavator.

In 2012, the program objectives were to gain control on Spartina species through removal (hand, excavator) or seed head clipping. Given the very high seed germination numbers observed in June 2012 this strategy is hoped to reduced the number of single plants in 2013. Figures 13 & 14 illustrate the Control Effort and Control Results for 2012.

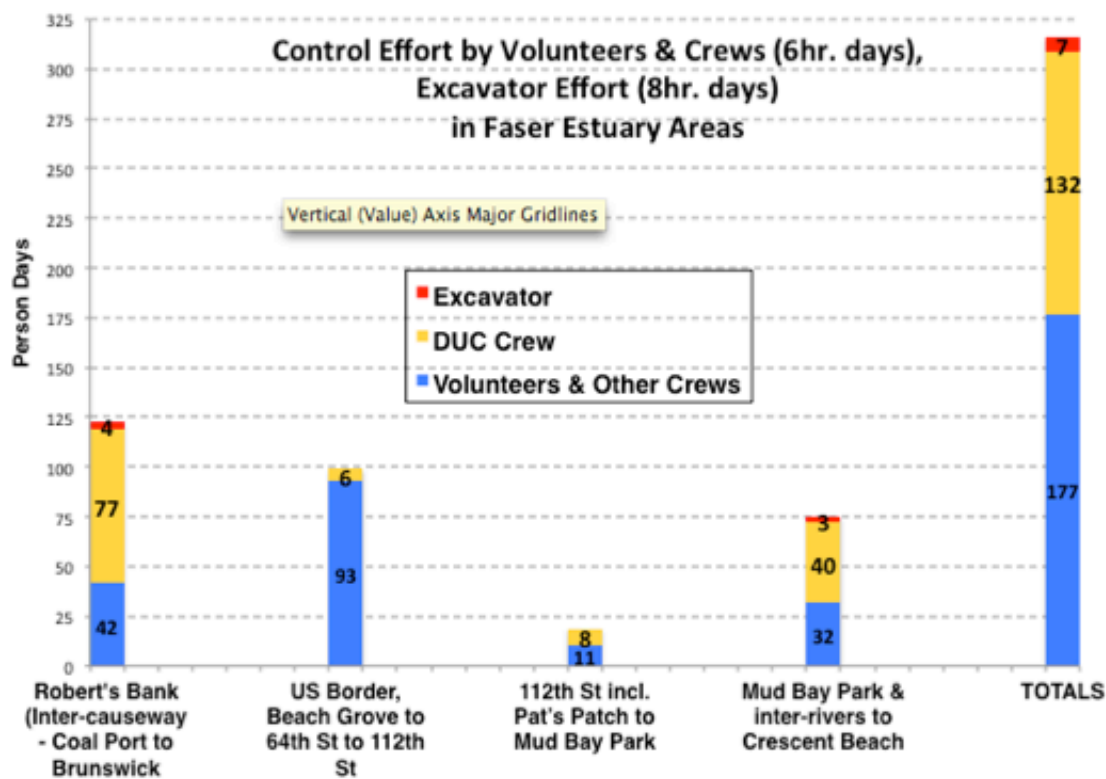


Figure 13. *S. anglica* Control Effort for Fraser Estuary – 2012



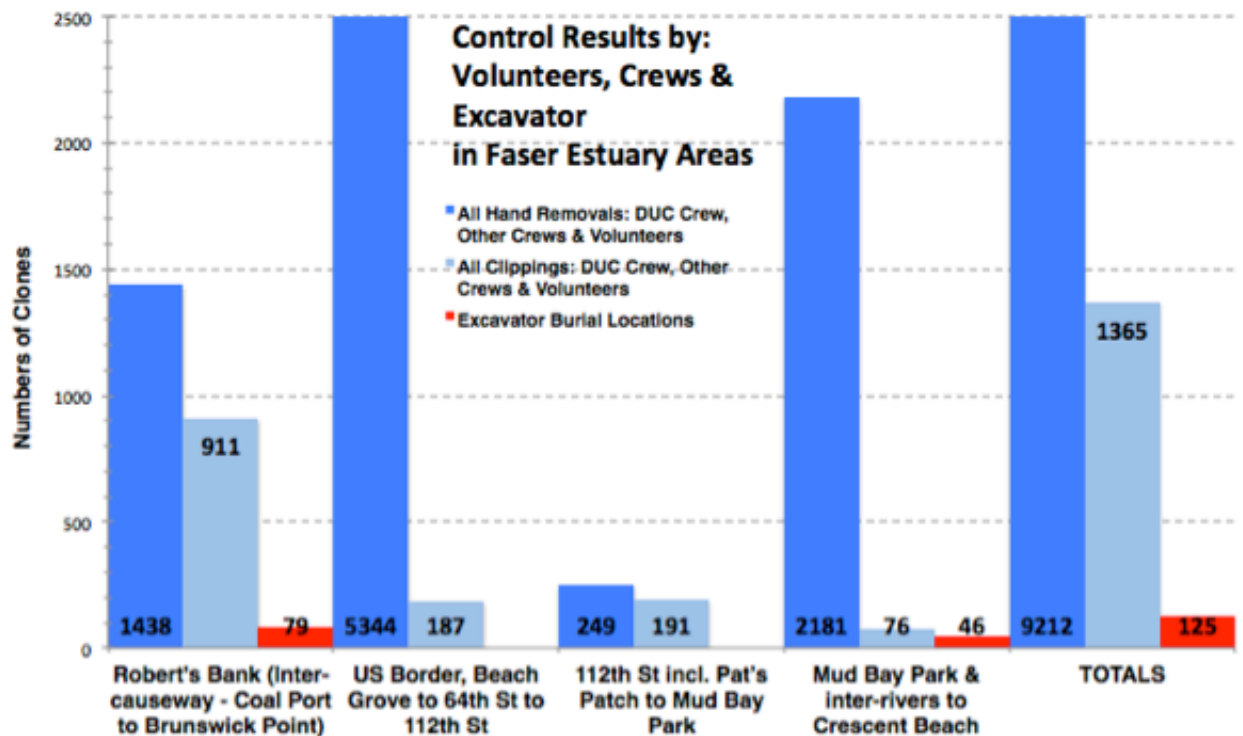


Figure 14. *S. anglica* Control Results for Fraser Estuary – 2012. Excavator Burial Locations contain multiple clones as per Figures 16 & 17.

### South Fraser Excavator Removals

Concord Excavating and Contracting Ltd. was hired again to conduct mechanical removals of *S. anglica* adjacent to Brunswick Point dike, to the Delta Port Causeway then moved to Mud Bay in the Serpentine R. estuary. Approvals were granted by Fraser River Estuary Management Program (FREMP), Corporation of Delta, Canadian Wildlife Service, Tsawwassen First Nations, and the Ministry of Forests, Lands & Natural Resource Operations.

As in 2011 a smaller amphibious excavator (Figure 15) with very low ground pressure was used to remove and bury larger clones (>0.3m dia.) in 125 locations (GPS recorded) on the intertidal marsh areas of Roberts Bank and in Mud Bay (Figure 18). The excavator dug 3m deep holes and buried clones with a minimum cap of 1.5m to 2m of mud/sand. A record of the clone sizes buried at each location is summarized in Figures 16 and 17.



**Figure 15. Amphibious Excavator Removing *S. anglica*, Mud Bay, 2012**

The smaller excavator used in 2011/2012 has many advantages over the larger machine used in previous years. Smaller means much lower mobilizations costs, lower hourly rate, more rapid travelling over intertidal areas and considerable less track damage to native vegetation. The smaller machine is somewhat underpowered for digging in some ground conditions but overall the smaller excavator is more cost effective and less disruptive to the intertidal habitat.

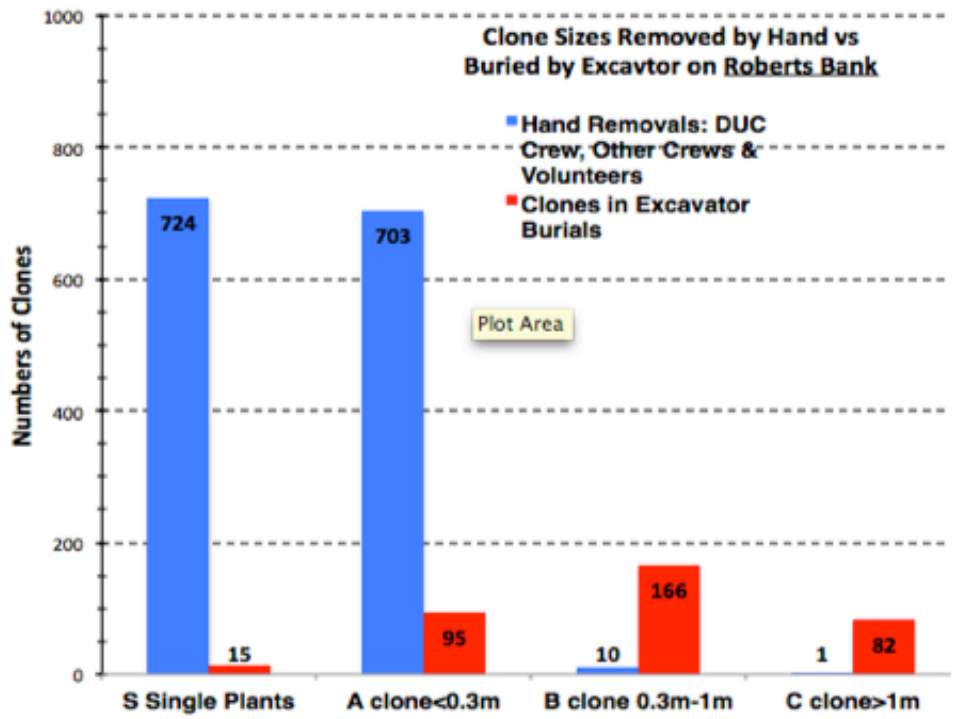


Figure 16. Clone Sizes Removed by Hand vs Buried by Excavator on Roberts Bank

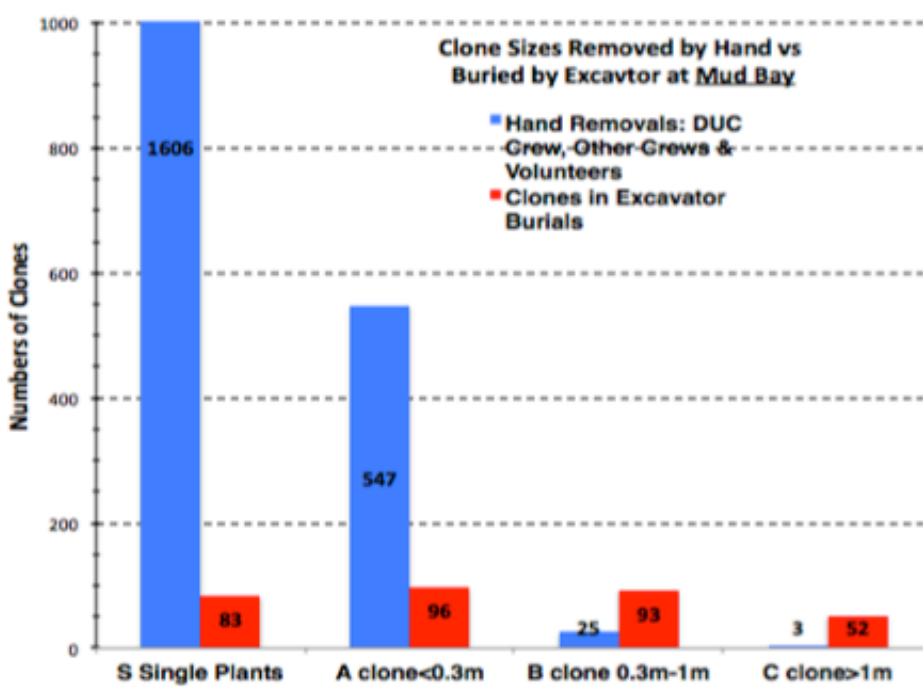


Figure 17. Clone Sizes Removed by Hand vs Buried by Excavator at Mud Bay



Figure 18. 2012 Burial and Hand Removal Locations on Roberts Bank in Boundary Bay

## Vancouver Island Removals

### *Spartina densiflora*

2012 removals and control activities in Baynes Sound have been recorded in the BC IAPP database as 33 sites “mowed” (i.e. seed heads clipped) comprising of 2.96 hectares and another 70 sites as removed comprising 0.6832 hectares. From all of the removals 1070kg of plant material was taken to the Comox Valley Waste Management Center. Another approximately 300kg of plant material was removed and placed above high tide. 190kg of seeds were also taken to landfill and an estimated 120kg of seed was placed above high tide and buried in a forest.

The Vancouver Island field crews also observed Canada Geese eating inflorescence of *S. densiflora* at the Deep Bay Marina, with video footage taken by Steven Godfrey. This particular vector of spread may not have previously been recognized.

## Science/Evaluation

The province of British Columbia has committed to eradicate *Spartina* from BC marine environments by 2018, under the *West Coast Governors’ Agreement on Ocean Health*, the *Pacific Coast Collaborative Agreement* and in action plans of B.C.’s *Oceans and Coastal Strategy*.

But the outcomes of this years program continue to confirm the conclusions of the BC *Spartina* Response Plan 2010 (Dresen et al, 2009) which indicated that mechanical control efforts have met with limited success and suggests that herbicide is necessary for eradication of *Spartina* in BC. Herbicide treatment has been extremely efficient in achieving control of infestations in Washington, Oregon and California.

## Herbicide Evaluation

In June 2010, a technical working group formed to investigate the options for herbicide application and research for future *Spartina* control in BC. The working group has undertaken extensive consultation with provincial, federal and US partners, as well as industry, to determine regulatory requirements, optimal treatment efficacy and methodology, and benefits and drawbacks. Use of herbicide would reduce mudflat compaction and disturbance by reducing the number of people and equipment entering the estuarine environment and would be more cost effective. The following principles guide the technical working group:

- Utilize the most effective products with the least impacts to non-target species;
- Review the impacts of herbicide on fish and other aquatic organisms
- Develop techniques to minimize amount of require herbicide and maximize application efficacy;
- Ensure consistent treatments to achieve optimal results, and;
- Maintain public education and awareness about invasive species and associated risks.

With the support of the technical working group, the BC Ministry of Environment in February 2012, submitted an emergency registration of two herbicides “Rodeo” (active ingredient glyphosate) and “Habitat” (active ingredient imazapyr) for the control of *Spartina* in intertidal areas of coastal BC. It is anticipated that approval may be received in early 2013. If herbicide is approved, then herbicide would be part of an integrated approach in the *Spartina* control program

## Spartina Cover Plots

### Cover Plot – Burrard Inlet

A perfectly contained *S. patens* meadow 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 19). 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 2015 to allow native intertidal vegetation to recolonize.



Figure 19. Covered *S. patens* in Burrard Inlet (Reed Point Marina), September 2012

### Cover Plot – Courtenay Estuary

A “shade trial” was installed along the Comox foreshore on Nov 16, 2012 to cover the *Spartina patens* for 2 years. This method has been used successfully in Oregon State. Sixteen *S. patens* sites were evaluated and two small patches measuring 3.5ft x 3.5ft and 4ft x 3.5ft were prepared for installation. Each patch was covered with 2 layers of geotextile staked down with large plastic pegs, then covered with rocks. The geotextile used is the same as used on *S. patens* at Reed Point Marina in Burrard Inlet, Nilex’s “Woven 2002”. This site will be monitored regularly for two years and then a strategy for re-vegetation applied.

### Cover Plot – Boundary Bay

The cover plots on *Spartina anglica* previously established in Boundary Bay at 64<sup>th</sup> St, Mud Bay Park and Brunswick Point were re-examined in 2012. The geo-textile cover fabric was re-fastened as needed using 16 inch plastic stakes and *S. anglica* was not found growing under or through the cover fabric at any of the cover plots. The older uncovered (in 2011) plots at Brunswick Point (previously covered for 2 years) were re-marked using the orange plastic stakes. On these exposed plots *Triglochin maritime* (seaside arrowgrass) and *Salicornia virginica* (pickleweed) were observed beginning to recolonize the plots.

### *Spartina anglica* Growth Monitoring

In 2010, 15 clones were selected and measured as a baseline to determine growth rates. Table 2 summarises changes in average diameters and areas for the remaining clones in 2011 (10) and 2012 (9). There was an overall average increase of 0.3m in diameter and 90% increase in area from 2011 to 2012. On average the monitored clones doubled in area between 2011 and 2012.

**Table 2. *Spartina anglica* Clone Diameter and Area Change 2010-2012 in the Fraser River Delta**

Summary	Average Diameter			Change in Avg. Diameter Over Previous Year		Change in Average Area Over Previous Year	
	2010	2011	2012	m	%	m <sup>2</sup>	%
Plot	0.6	2.2	2.9	0.8	<b>35.0%</b>	3.0	82.3%
7	1.7	1.5	1.9	0.4	<b>26.8%</b>	1.1	60.7%
8	0.6	1.6	1.5	-0.1	<b>-4.7%</b>	-0.2	-9.1%
9	1.7	2.3	3.0	0.7	<b>28.3%</b>	2.8	64.6%
10	1.5	2.0	1.8	-0.2	<b>-10.5%</b>	-0.6	-20.0%
11	0.8	0.8	0.8	0.0	<b>0.7%</b>	0.0	1.5%
12	1.1	0.3	0.8	0.5	<b>165.4%</b>	0.5	604.3%
13	2.8	3.2	3.5	0.3	<b>10.3%</b>	1.7	21.7%
14	4.2	4.7	4.8	0.2	<b>3.3%</b>	1.2	6.8%
15*	0.4	0.6	NA*	0.2*	67.6%*	0.1*	119.0%*
<b>Overall Averages for Plots 1-14, Plot 15 excluded</b>				<b>0.3</b>	<b>28.3%</b>	<b>1.0</b>	<b>90.3%</b>

## Data Management

Data compilation and storage for *Spartina sp.* data (2004 to 2012) is provided 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](http://www.spartina.ca). These data are used for measuring 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 shp file copies of these data for GIS analysis.

## 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](http://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](mailto:spartina-ca@vancouvercommunity.net)
- Friends of Semiahmoo Bay Society uses their web site for volunteer call out, information & partner links <http://www.birdsonthebay.ca/>
- The BCSWG reprinted 250 additional "2009 *Spartina* ID Card" sets which include info on the GPS mapping method and native marsh plants – distributed to volunteers and partners.
- The BCSWG published a 2 page "Prohibited Weed Bulletin" on *Spartina* in 2011 for distribution <http://spartina.ca/> (attached file section)
- The Delta Optimist carried three articles about Ladner Rotary's activities to find and control local *Spartina sp.* infestations in Boundary Bay:
  1. "Spartina battle waged at 'Bay, Rotarians continue efforts to rid shoreline of invasive weed that's choking eco-system" by Jessica Kerr, The Delta Optimist, August 10, 2012
  2. "Ladner Rotarians help to rid 'Bay of invasive weed" by Jessica Kerr, The Delta Optimist, October 21, 2012
  3. "Invasive plant battle continues, Ladner Rotarians pulling *Spartina anglica* in bid to save sensitive foreshore ecosystems" by Sandat Gyarmati, The Delta Optimist, November 2, 2012
- Presentations regarding the status of *Spartina* in BC were presented to:
  1. California Estuarine Research Society (September 2012)
  2. Corporation of Delta (October 2012)
  3. Coastal Estuary Research Federation (November 2012)

## Finances

The BCSWG partners and individual volunteers contributed over \$161,000 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 2012.

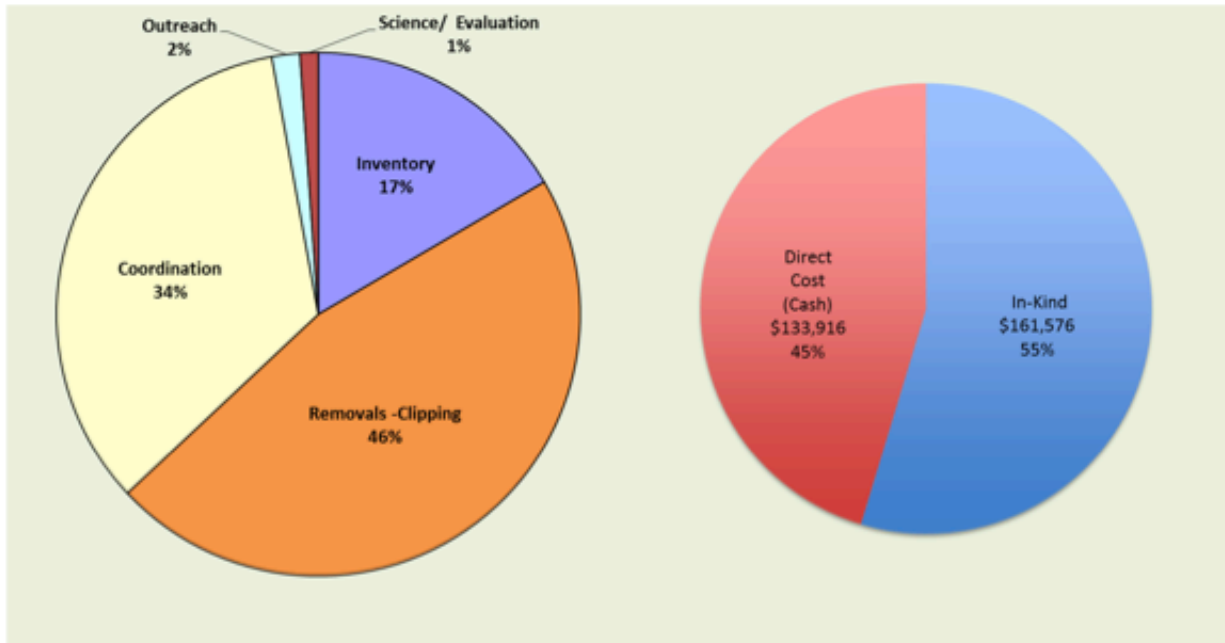


Figure 20. 2012 Spartina Program Expenditures by Component & Type/Amount



Table 3. BC Spartina Eradication Program In-Kind Contributions - BCSWG 2012

2012 Program Partners	In-Kind by Program Components					In-Kind
	Inventory	Removals - Clipping	Coordination	Outreach	Science/ Evaluation	
BC Conservation Foundation			\$1,600			\$1,600
BC Ministry of Environment			\$10,000			\$10,000
BC Ministry of Forests, Lands, and Natural Resource Operations, Vict.	\$800		\$30,000			\$30,800
BC Ministry of Forests, Lands, and Natural Resource Operations, Surrey			\$600			\$600
BC Ministry of Forests, Lands, and Natural Resource Operations, Nanaimo	\$750					\$750
City of Surrey - SHaRP & SNAP Programs		\$9,060	\$800	\$1,000		\$10,860
Coastal Invasive Species Committee (CISC)	\$3,058	\$9,174	\$2,988		\$1,536	\$16,756
Vancouver Island Conservation Land Management Program (VICLMP)	\$3,250	\$0	\$750	\$0	\$600	\$4,600
Community Mapping Network	\$4,000			\$1,600	\$400	\$6,000
Corporation of Delta	\$5,016	\$9,094	\$1,200			\$15,310
DFO Fisheries & Oceans			\$400			\$400
Ducks Unlimited Canada		\$1,700	\$9,600			\$11,300
Environment Canada- Canadian Wildlife Service	\$2,400		\$2,000			\$4,400
Friends of Semiahmoo Bay Society	\$3,400	\$2,400	\$800	\$900		\$7,500
GL Williams & Associates				\$400	\$800	\$1,200
Hemmera Consulting	\$200					\$200
Independent Volunteers	\$3,600					\$3,600
Invasive Species Council of Metro Vancouver	\$800		\$800			\$1,600
Ladner Rotary Club	\$1,000	\$22,700	\$1,200	\$800		\$25,700
Port Metro Vancouver	\$1,200	\$400	\$400			\$2,000
Tswassen First Nation		\$6,000				\$6,000
Vancouver Island University				\$400		\$400
						<b>In-Kind</b>
<b>Subtotal (inkind)</b>	<b>\$29,474</b>	<b>\$60,528</b>	<b>\$63,138</b>	<b>\$5,100</b>	<b>\$3,336</b>	<b>\$161,576</b>

**Table 4. BC Spartina Eradication Program Direct Cost (Cash) Contributions - BCSWG 2012**

Direct Costs (Cash)	Committed & Expenditures by Program Components					Total
	Inventory	Removals	Coordination	Outreach	Science/ Evaluation	
BCCF Crew	\$4,000	\$33,465				\$37,465
Corrdinator contract (R Knight)			\$11,222			\$11,222
DUC			\$26,500			\$26,500
Disposal Fee		\$2,933				\$2,933
Excavator		\$17,108				\$17,108
Materials, Supplies, misc.		\$3,307				\$3,307
Pesticide Use Permit - Application fee		\$1,000				\$1,000
Vanc Island Crew (CISC, TNT)	\$3,406	\$18,000				\$21,406
Other Contractor-Website, transport	\$12,075	\$900				\$12,975
						<b>Funds Spent</b>
<b>SubTotal</b>	<b>\$19,481</b>	<b>\$76,713</b>	<b>\$37,722</b>	<b>\$0</b>	<b>\$0</b>	<b>\$133,916</b>
<b>Income for BCSWG</b>	Federal Summer student program	Invasive Alien Species Partnership Program (IASPP)	DUC	Province of BC	Comox Valley Regional District (CVRD)	<b>Total Income</b>
	\$6,986	\$10,000	\$14,930	\$100,000	\$2,000	\$133,916

## Cross Border Partnerships

The Washington State Department of Agriculture (WSDA) was not directly involved with BC inventory activities in 2012 but the BCSWG continues to have regular communications with their staff on Spartina EDRR and the WSDA provided assistance to the working group assessing the role of herbicide. The WSDA and People for Puget Sound have added their Spartina mapping data (2009 & 2010) to the web mapping at <http://spartina.ca> and 2011/2012 data has been requested to illustrate that Spartina is a common threat and needs cross border cooperation to eradicate.

At a higher 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.

The Feb. 12, 2010 Action Plan for Ocean Conservation states, regarding the spread of invasive species:

“Cooperate to prevent or reduce the spread of invasive species by:

- a) refining and coordinating capacity to recognize, identify, report, and rapidly respond to both newly discovered and existing invasive infestations;
- b) addressing pathways of introduction such as ballast water, vessel hulls of commercial ships and recreational boats, and boat trailers traveling across state and provincial boundaries; and
- c) supporting the efforts of the Pacific Ballast Water Group and coordinating ballast water policies.

As priorities for initial coast-wide efforts, focus rapid detection, early response and eradication efforts on non-native cordgrasses (genus *Spartina*), tunicates, and green crab, which may expand their range along the west coast via ocean currents or human activities.”

## Concluding Remarks

The success of the 2012 *Spartina* Project could not have been completed without the commitment of the BCSWG partners and the financial contributions from the Province of BC, the Federal Summer Student Program and Ducks Unlimited Canada.

The value of the *Spartina* program in 2012 was \$295,492 compared to 2011 at \$178,434. The in-kind contributions in 2012 were valued at \$161,576 vs. \$90,800 in 2011 and direct costs in 2011 were \$133,916 vs. \$97,634 in 2011.

Since 2007 the number of larger 1m+ clones has steadily increase in spite of considerable control efforts using mechanical removal by hand and machine. From 2011 to 2012 there was a **260% increase** in the number of 1m+ size clones and a **22% increase** in clones os size class 0.3m-1.0m. This is a continuation of increasing numbers of larger clones as seen each year.

Overall in 2012, hand and excavator removals probably slowed the in-fill rate but the numbers of A, B and C size classes (any clone 0.3m to 1+m) increased since 2008 at an average rate of 280 clones per year.

Year over year mapping of the same intertidal habitat seems to indicate that the deep burial method is an effective control technique because we do not find re-emergent growth at the burial locations. Monitoring of the 2010, 2011 and 2012 burial sites would be useful now that the number of located burial sites represents a very large sample size for an evaluation study.

In response to the dramatic increase in mid sized and larger clones on Roberts Bank near Brunswick Point (Figure 1) the majority of summer crew effort was focused on hand removals and seed head clipping of clones out on the mud flats (Figure 13).

Similarly the excavator was applied to the intertidal vegetation along the Delta Port Causeway and Brunswick Point Dike (Figure 16). This area has very high ecological values for avian and fish species, specifically as the only confirmed, significant source of bio-film that Western Sandpiper utilize as an essential food source in the spring migration north.

The trial cover plot on *S. patens* in Burrard Inlet (Figure 19) will require occasional monitoring in 2013 and evaluation in 2014. We anticipate this technique can be effectively applied to other *S. patens* at Maplewood Flats in coming years.

The detection and control work on Vancouver Island continued to make progress in 2012 by completing the mapping in Baynes Sound and searching other east coast (of Van Is.) estuaries for *Spartina sp.* (Figure 11). *Spartina* was not detected outside of Baynes Sound. Almost 1700 Kg of *S. densiflora* plant material was removed this year from Baynes Sound and two trial cover plots for *S. patens* were established in the Comox Estuary.

The cross-border partnerships that have been developed over the years have been extremely valuable to the BCSWG. Continued collaborative work will facilitate information sharing and will improve and expand control techniques associated with *Spartina* in both BC and Washington, especially with the anticipated approval to use herbicide in 2013.

Recommendations for 2013 include:

1. Implement mechanical removal control techniques for *S. densiflora* and *S. patens* in Baynes Sound that could include: use of a compact, tracked excavator (e.g. Kubota KX ) transportable by barge, the use of brush saws as used in San Francisco and shading
2. Develop a plan to address *S. patens* infestation in Burrard Inlet and complete the detailed mapping of infestations not mapped in 2012.
3. Continue to support the community efforts of *Spartina* searching and mapping in the Tofino area and in other Vancouver Island estuaries at risk.
4. If herbicide is approved for use in 2013 for *S. anglica* in the Vancouver Lower Mainland, continue an integrated use of herbicide and mechanical approach.
5. If herbicide is not approved for use in 2013 for *S. anglica* in the Vancouver Lower Mainland, then significant more resources will be required to just hold the line and control *Spartina anglica*.