

British Columbia *Spartina* Eradication Program 2010 Progress Report



Prepared by: Ducks Unlimited Canada (February 2011)

Contact: Claire de la Salle

Address: 511 – 13370 78th Ave Surrey BC V3W 0H6

Phone: (604) 315-7449

Fax: (604) 592-0930

Email: c_delasalle@ducks.ca

On Behalf of: The BC Spartina Working Group

City of Surrey

Community Mapping Network

Corporation of Delta

Ducks Unlimited Canada

Environment Canada – Canadian Wildlife Service

Friends of Semiahmoo Bay

Greater Vancouver and Coastal Invasive Plant Committees

Metro Vancouver

Ministry of Agriculture and Lands

Ministry of Environment

Port Metro Vancouver

The Nature Trust of BC

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Over the course of summer and fall of 2010, *Spartina* removal events required a significant amount of effort. Appreciation is extended to the numerous volunteers and partners who mapped and removed *Spartina* such as the BC Conservation Foundation, Parks Canada, University of Vancouver Island, and the Washington State Department of Agriculture.

Executive Summary

In 2010, the British Columbia *Spartina* Working Group (BCSWG) continued to work toward the eradication of non-native, invasive *Spartina* species from the BC Coast. This multi-agency group 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 invasive *Spartina* species (*Spartina anglica*, *S. densiflora*, and *S. patens*) by 2018 along the coasts of BC, Washington, Oregon and California.

In 2010, the *Spartina* program expended \$218,642 in direct and in-kind costs. Program components included monitoring, removal, coordination, and outreach which were guided by science and evaluation. The monitoring program included mapping approximately 100km in the Fraser Delta and approximately 90km of shoreline on the East Coast of Vancouver Island, near Baynes Sound and the Gulf Islands. The inventory revealed that the abundance and density of *Spartina anglica* in Boundary Bay and Roberts Bank increased dramatically from 2007 to 2010.

Overall, there was an increase of 107% more *Spartina anglica* plants detected in 2010 than in 2009. Removal efforts in 2010 used manual hand digging, mechanical excavating, and covering techniques. In 2010, British Columbia removed approximately 10% (0.2 Acres) of an estimated 2.0 Acres of non-native *Spartina*. Based on available resources and location of existing infestations, the primary focus is the removal of *S. anglica* and *S. densiflora*. Approximately 0.2 acres of 0.3 acres (66%) of *S. anglica* were removed, and all known *S. densiflora* plants were removed (over 50 plants along 22 km of coastline) until at the end of the monitoring year we found a new 1.0 acre infestation. Approximately 0.7 Acres of *S. patens* remained untreated at the end of 2010. Despite the relatively small acreage of *Spartina* present in BC, if left unchecked this infestation could grow rapidly into thousands of acres increasing the costs of eradication.

This years outreach component focused on recruiting volunteers and increasing awareness of the impacts of *Spartina*. This was achieved through articles submitted to web, tours, and print media sources. The BCSWG uses sound science and evaluation to improve the effectiveness of the eradication program by implementing changes as new methods are learned.

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 been discovered in BC: *S. densiflora* (Vancouver Island) and *S. patens* (Burrard Inlet). These species tend to impact shorelines that are rockier and will establish on the high tide mark.

The impacts of *Spartina* species include: conversion of mudflats to monoculture stands, loss of habitat to waterbirds and fish, accretion of sediments, and modification of drainage patterns. Introduced on the Pacific Coast, *Spartina* over the years has spread northward from Washington. Intertidal areas in Washington dominated by *Spartina* have exhibited large declines in the abundance of shorebirds and waterfowl. Significant financial resources have been required to control *Spartina* in Washington State costing upwards of one million dollars per year. Even with this effort, *Spartina* continues to be a problem infesting many acres of shoreline habitat in Washington State. As with most invasive species, controlling the spread at the early stages of species expansion is the most cost-effective approach. Therefore, it is critical to ensure *Spartina* is eradicated in BC. Otherwise, the loss of intertidal habitats 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 both the Puget Sound Partnership and the Washington State Department of Agriculture which are two U.S. agencies that are involved in *Spartina* eradication in Washington State. All agencies involved bring valuable expertise to the group. The focus of this group is to employ early detection, rapid response methods to eradicate *Spartina*. Currently, there are mapping and removal efforts taking place around the Fraser Delta, Bayne Sound (Vancouver Island), and the Gulf Islands. However, more work is needed to monitor other parts of the BC Coastline.

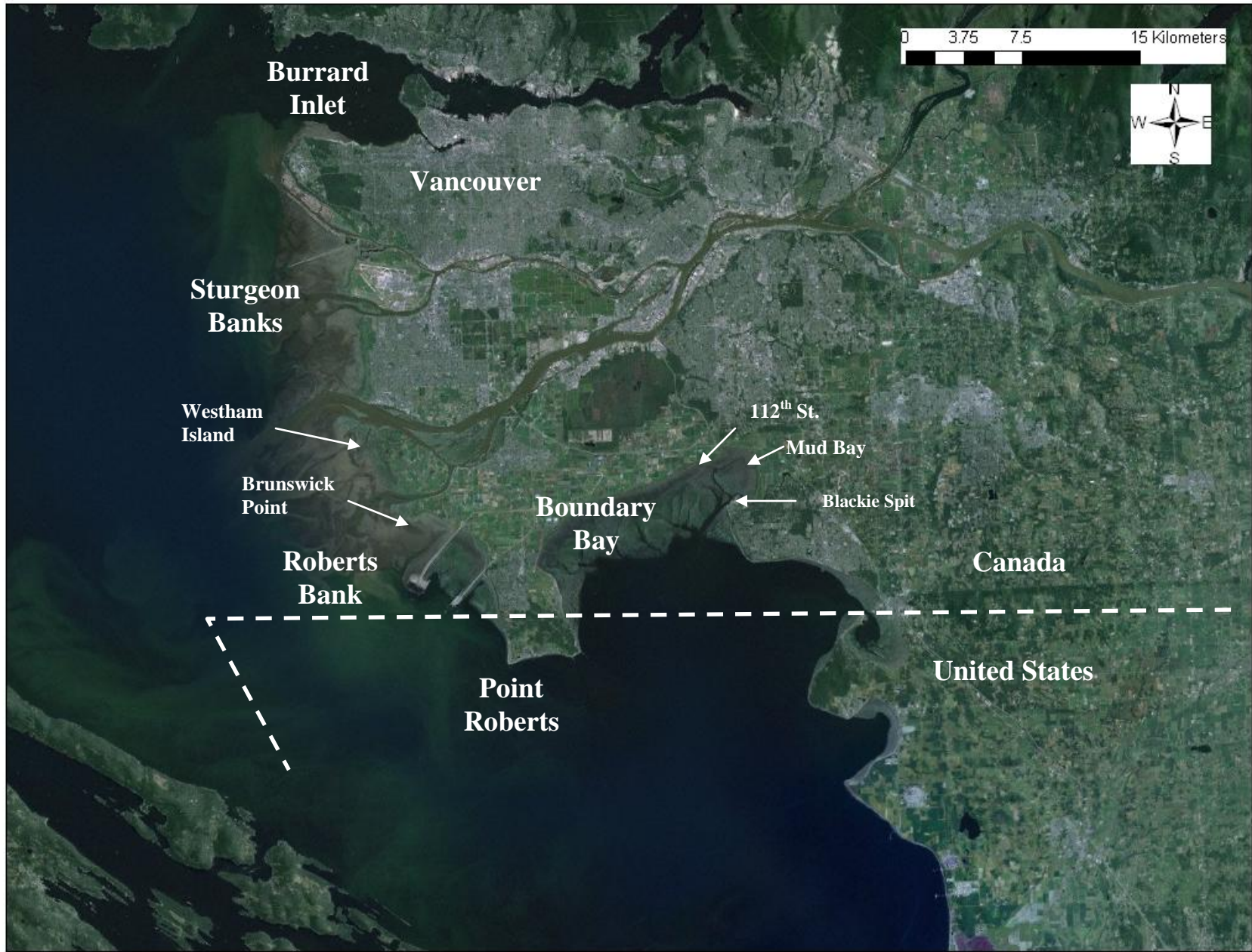


Figure 1. Areas in the Fraser River Delta

Fraser Delta Program - Detection

South Fraser

In 2010, it took approximately 60 days to monitor about 100km of shoreline in the Fraser Delta. Mapping efforts continued to follow the same methods from 2008/09. The manual method of walking the intertidal habitat with hand held Global Positioning System (GPS) units (Garmin Etrex, Garmin GPSmap76S, Garmin GPSmap60Cx, Garmin 12XL, Garmin Dakota20, Marine Navigator Map 76) were 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. This was extremely valuable when it came to the removals because it reduced searching time and led to effective removals by volunteers.

As seen in Figure 2 the area searched this year was expanded from previous years covering shores and mudflats from the US/ Canada Boarder at Peace Arch Park,



Figure 2. Extent of area searched for *S. anglica* - 2010

continuous to the northern edge of Sturgeon Bank, covering Mud Bay, Boundary Bay and all of Roberts Bank rounding Brunswick Point to include the south west shore of Westham Island. The mudflats and near by shores of Port Moody were also surveyed during the kayak pilot program. It is recommended that the west intertidal area of Westham Island be thoroughly surveyed in 2011 because of its close proximity to the infestation at Brunswick Point.

Spartina anglica was found growing in all intertidal zones and a variety of substrates ranging from fine silt/mud, sand to cobble. It is growing in brackish water at Brunswick Point. *S. anglica* was found as seedlings, as isolated clones and integrated with other marsh vegetation.

Figure 3 shows the cumulative mapping results for *S. anglica* in the Fraser Delta area in 2010.

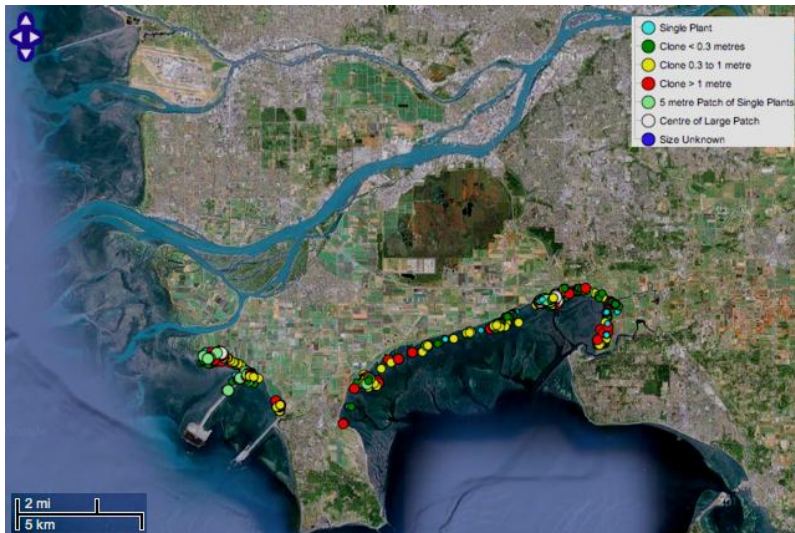


Figure 3. *Spartina anglica* Distribution in the Fraser Delta Area - 2010

Overall, there was an increase of 107% more *Spartina anglica* plants detected in 2010 than in 2009 (not counting the 98 small and large patch categories). In 2010 additional mapping effort occurred which may have contributed to a higher detection of *Spartina*. This increase is characterized by 194% more single plants (seedlings), 141% more clones in the <0.3m size group, 103% more clones in the 0.3m – 1.0m size group, and 23% more clones in the >1.0m size group. The 5m diameter patches of smaller plants increased to 166% of 2008 levels and starting this year, 20 patches of mixed size plants much larger than 5m diameter we mapped. (Table 1, Figure 4)

Size	2005	2006	2007	2008	2009	2010
Single plants	167	107	41	56	67	197
Clone < 0.3m	329	229	111	110	221	532
Clone 0.3m-1.0m	204	210	108	60	234	475
Clone > 1.0m	90	42	33	61	149	184
Patch 5m dia.	0	97	49	47	12	78
Large Patch >5m	0	0	0	0	0	20
Total	790	685	342	334	683	1486

Table 1. *Spartina anglica* Size Classes Mapped from 2005-2010 in Boundary Bay and Roberts Bank.

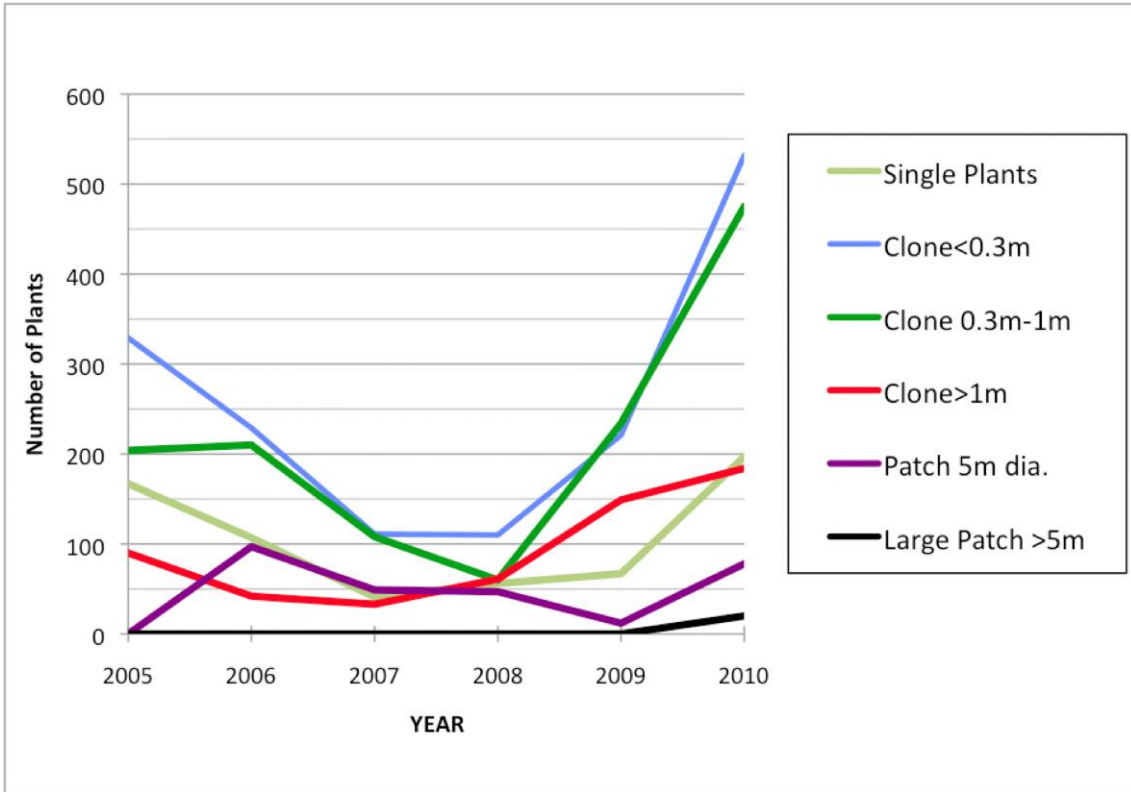


Figure 4. *Spartina anglica* Size Classes Mapped from 2005-2010

The following three focus areas of greatest concern were selected for analysis:
 (See Figure 1 for their locations)

- Brunswick Point,
- 112th Street and
- Mud Bay.

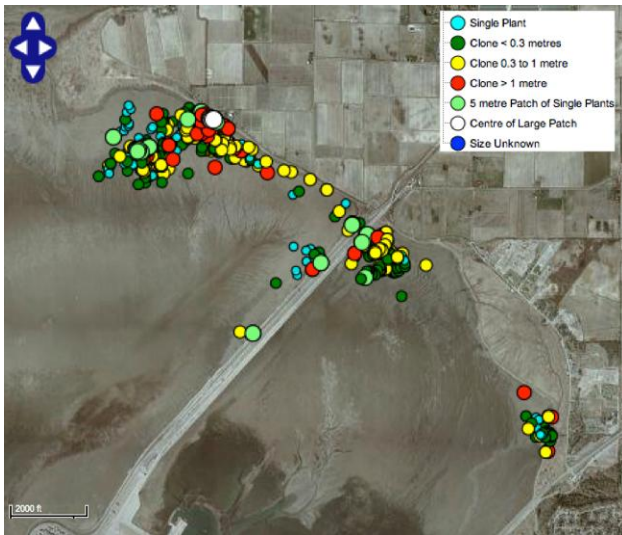


Figure 5. Distribution of *S. anglica* at Brunswick Point – 2010

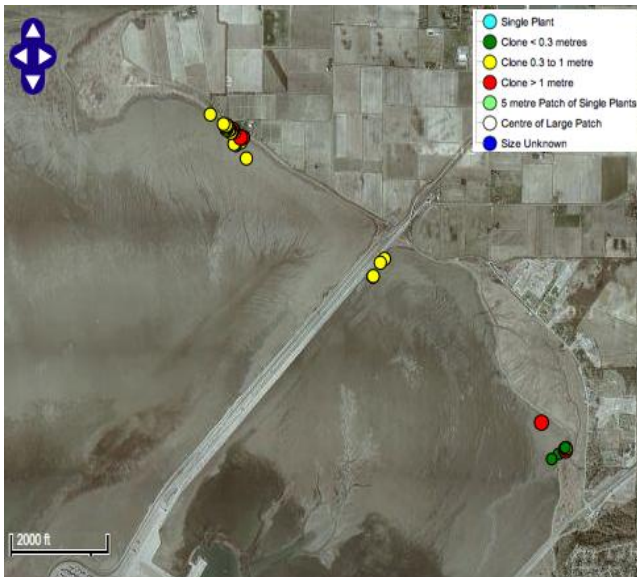


Figure 6. Distribution of *S. anglica* at Brunswick Point - 2007

Brunswick Point:

This area has great ecological value to avian and fish species and is also a significant source of biofilm that shorebirds utilize as a valuable food source. The *S. anglica* infestation in this area has spread considerably over the past several years. A large infestation of all clone sizes was found on the mudflats close to Brunswick Point and many 1+m clones were present in the intertidal marsh zone between the point and Delta Port Causeway. The rapid expansion may be attributed to the limited amount of resources to control this infestation in 2007 to 2009. Considerable removal effort was made in this area in 2010 using hand tools for small plants on the mud flats and the Linkbelt Amphibious Excavator on the marsh zone to halt the *S. anglica* expansion (discussed later in this report).



Figure 7. Distribution of *S. anglica* at 112th Street – 2010



Figure 8. Distribution of *S. anglica* at 112th Street – 2007

112th Street:

This area is the largest and densest infestation in Boundary Bay. Despite removal efforts in 2007, 2008 and 2009 there is still a large infestation in this area. The majority of points in the 2010 data are clones in the <0.3m and 0.3-1.0m ranges. The drastic increase may be due to not enough resources for removal, difficulty in detection due to *Spartina* being mixed in with other vegetation, and some plants and/or rhizomes were not removed in previous years. This emphasizes the need for field training on identification and proper removal of the plants, including underground rhizomes. It appears that from 2007-2010 the infestation has spread eastward.

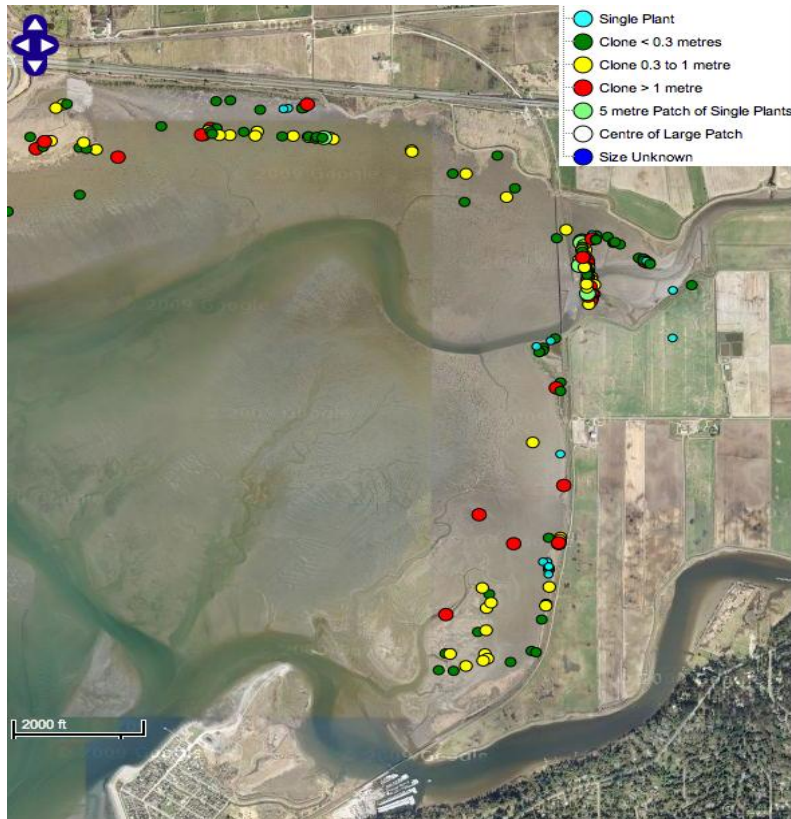


Figure 9. Distribution of *S. anglica* at Mud Bay – 2010*

***Three clones >1m near the train trestle (2007) were not mapped in 2010 but are still present at that location.**

Mud Bay:

This area is of concern because it is at the mouths of the Serpentine and Nicomekl Rivers with outflows that could spread the seeds to new locations. The infestation in this area was spreading both east and west from 2007 to 2008 and in 2010 the mapping shows continued expansion west, east and south in spite of hand and machine removals efforts.

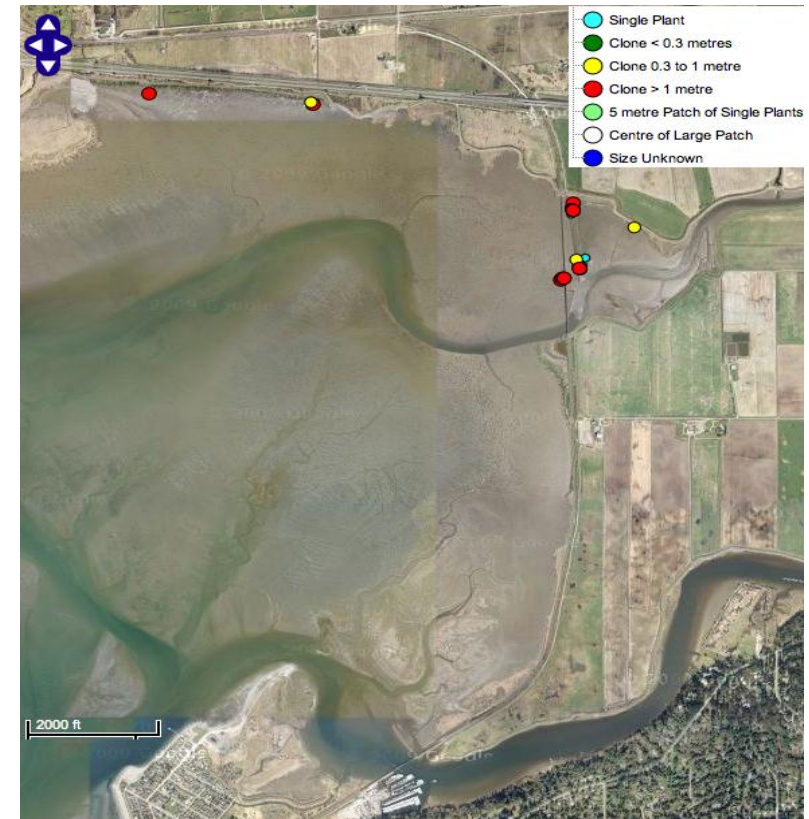


Figure 10. Distribution of *S. anglica* at Mud Bay – 2007

Kayak Monitoring Pilot

This year the BCSWG undertook a pilot kayak monitoring program modeled on the methods employed by People for Puget Sound (PFPS) to locate and map *Spartina sp.* An experienced sea kayak guide was contracted to learn the PFPS methods and then train other volunteer kayakers to monitor shorelines in the Fraser Delta. Volunteer kayakers attended one of two training sessions that were conducted in Boundary Bay October 23rd, and November 14, 2010. Volunteers received formal training from the project coordinator that included information about *Spartina anglica* and other *Spartina* species, proper survey and identification techniques, and kayak safety guidelines.

Figure 11 shows the 35km of shoreline that was surveyed in the four surveys conducted September- December 2010 after the initial training/learning period. *S. anglica* was the only species searched for and was not detected on the west shores of Richmond or on Port Moody mud flats. Surveys were conducted with a daylight tidal window of + 8 to a + 12 tide to ensure surveyors could paddle near enough to vegetation for visual confirmation, yet so water levels did not submerge and hide the *Spartina* vegetation.

Outreach activities for the kayak program included presentations at Capilano University, Craigslist ads, a Facebook group (currently with 38 members, with over 60% of whom are either working sea kayak guides, or owner operators of Sea Kayaking Outfitters/and or Guiding Companies).



Figure 11. Kayak Monitoring Track, West Richmond & Port Moody, BC - 2010

Fraser Delta Program - Removals

Manual Removals

Using an early detection and rapid response approach, a total of 1640 sites were removed by hand in the Fraser Delta. The high priority areas (112th Street, Mud Bay, and Brunswick Point) determined in 2008 remained the same target locations for 2010 eradication efforts. Consistent with the previous methods of this program, participants dug up individual plants and smaller clones using long and short-handled garden shovels into large garbage bags. At 112th Street and Brunswick Point two small all-terrain vehicles gathered up the bags filled by participants and transported them to the dyke or to a near by disposal bin stationed for the removal work. In other areas the bags were manually dragged to the dyke using inexpensive molded snow sleds (a new technique for 2010). The 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 chance of bags ripping. At the end of each hand removal day filled bags were moved from the dike by pickup truck to the disposal bins stationed at 112th St. and Brunswick Point. In August, after the removal season, the one bin was taken to Metro Vancouver's Incineration Facility and one bin was taken to the Metro Vancouver landfill.

An alternate technique of transporting bags of *Spartina* from the mud flat to the shore was also explored. The bags were tied closed and anchored on the mudflat with a cargo net overnight, to be picked up later on a rising tide with a ridged haul inflatable boat. Unfortunately a boat was not available for the pick up trial but anchoring the filled bags with a cargo net through a few tide cycles with windy conditions was successful. There may be an opportunity to complete the boat pickup trial in 2011.

Some of this years program funding was allocated to hiring a four person crew to conduct further removals and mapping. This crew focused on hand removals, seed head clipping, additional mapping, and a stem plot survey.

No actions were taken with the *S. patens* infestation in the Burrard Inlet. It is recommended that seed head clipping should be conducted at this site until a long term solution is determined.

Mechanical Removals

Concord Excavating and Contracting Ltd. was hired to conduct mechanical removals of *S. anglica* at Brunswick Point and 112th Street. Approvals were granted by Fraser River Estuary Management Program, Corporation of Delta, Canadian Wildlife Service, Tsawwassen First Nations, and the Ministry of Environment. A 2010 Linkbelt amphibious excavator with 0.6 PSI of ground pressure was used to remove and bury clones (>0.3m) in 123 locations (GPS recorded) on the intertidal marsh areas of 112th St. and Brunswick Point.

Based on an estimate of 4 clones of varying size buried per recorded location an estimated 490

clones were buried. These removals took 32 hours of machine time. The excavator dug holes and buried these clones with a minimum cap of 2m of substrate. The total cost for these removals including mobilization was \$20,000.



Figure 12. Linkbelt Excavator Removing *S. anglica* at Brunswick Point, BC - 2010.

A burial site study conducted in 2007 examined 66 burial sites. It was found that all sites were free from *Spartina* and in some areas, native plants had already begun to repopulate the site. These results suggest that *Spartina* plants were not able to grow to the surface after being buried 2m deep. These results were expected because of the burial depth; however no studies or data had previously proven the effectiveness of burial techniques. Over all the burial site study supports the use of an excavator as a control technique. Monitoring of the 2010 burial sites is being considered for 2011.

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, Pacific Coast Collaborative Agreement* and actions under B.C.'s *Oceans and Coastal Strategy*. The *BC Spartina Response Plan* (Dresen et al, 2009) indicated that mechanical control efforts to date 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, but herbicide application is not currently permitted in estuarine environments in B.C. 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 cause less compaction and disturbance by reducing the number of people and equipment entering the estuarine environment and would be more cost effective. The following principles are guiding the investigations of the working group:

- Utilize the most effective products possessing the least impacts to non-target species;
- Target application methods to minimize amount of product required for control of *Spartina*;
- Practice ongoing improvement of methods and timing to maximize application efficacy;
- Ensure consistent treatments to achieve optimal results, and;
- Maintain public education and awareness about invasive species and associated risks.

The working group is assessing the options and risks and continues to practice due diligence as it determines the viability of herbicides as a control option for *Spartina* in BC. If support is received from partners to proceed with integrating herbicide as a control for *Spartina*, the working group will work with federal and provincial agencies to ensure all applications and procedures are in accordance with regulations and guidelines.

Vancouver Island Program

In 2005, on Vancouver Island, *Spartina patens* was confirmed in the Comox estuary (has been present for several decades), and *Spartina densiflora* was detected in and around Baynes Sound. Despite much of the shoreline of Vancouver Island and the Gulf Islands being at risk for invasion, most of the region has yet to be surveyed for the presence of *Spartina*. In 2008, the Coastal Invasive Plant Committee (CIPC) developed an Island *Spartina* Working Group to develop a *Spartina* monitoring and management program on Vancouver Island and the Gulf Islands. Their goal is to have a group that can focus specifically on *Spartina* to coordinate inventory/management, and report back to the CIPC and the BCSWG regarding progress.

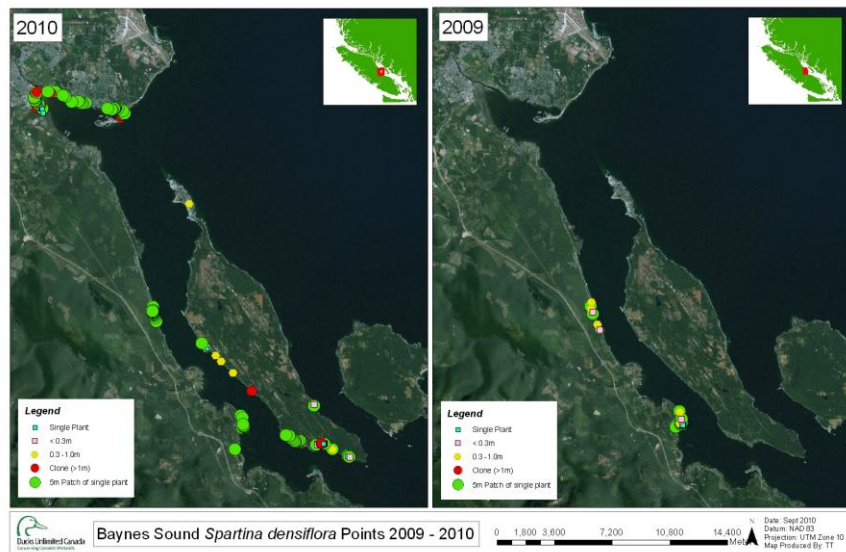


Figure 13 – 2008 *Spartina densiflora* Distribution in Baynes Sound

In 2010 mapping efforts on Vancouver Island were focused around Baynes Sound and Main Island and Prevost Island in the Gulf Island archipelago. In total ~90km of shoreline was surveyed using both land and boat monitoring techniques. The Washington State Department of Agriculture came up for two days to provide expertise and training for boat monitoring practices. A large infestation of ~1acre of *S. densiflora* was discovered on Denman Is. (Figure 13.). The full perimeter of Denman Island was not mapped (see Figure 15) in 2010. Another large infestation was discovered in Deep Bay was not mapped due to lack of resources. It is recommended that Deep Bay, the rest of Denman Island, and the Tofino mud flats be mapped in the 2011 program. No *Spartina sp.* was found on Main Is. or Prevost Is. The mapping followed the same protocol as the established Fraser Program when field staff went on shore to investigate suspected plants seen from the boat running near shore.

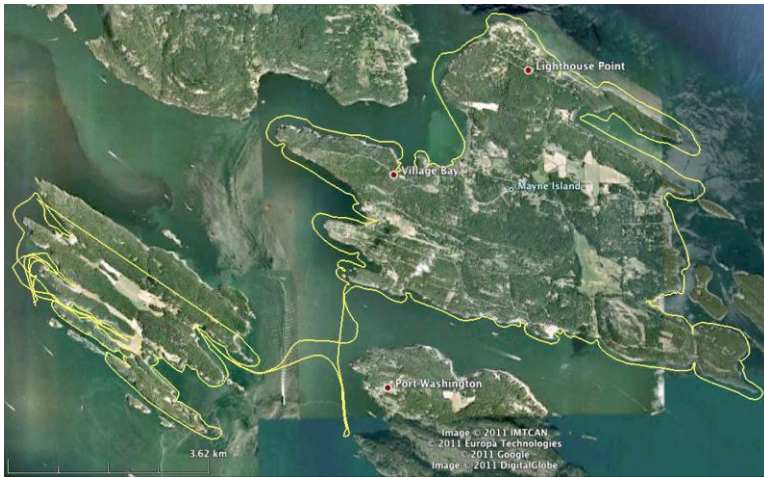


Figure 14. Southern Gulf Islands Spartina Survey Track, Oct. 20, 2010

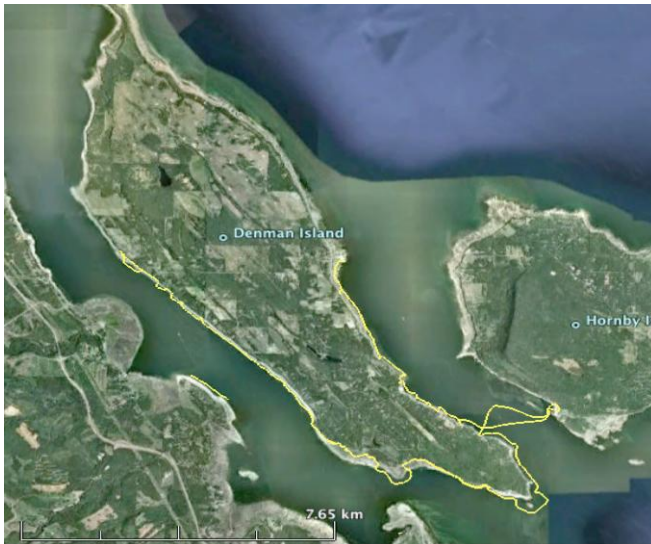


Figure 15. Northern Gulf Islands Spartina Survey Track, Oct. 21, 2010

The boat monitoring method demonstrated by WSDA staff worked well for detecting *S. densiflora* at suitably high tides permitting close approach of a small power boat. Surveyors are often put a shore in one location and picked up in another down the beach so they can accurately locate the clones and patches using hand held GPS. This method requires a boat crew minimum of 3 (one to stay with boat if it can not be beached) or 2 for safety if the boat is smaller and can be beached.

Data Management

In 2010, data on the type of *Spartina* recorded (species and size class) and the extent of the area searched were collected using the same methods as prior years. The species and size class data were entered in two databases: the Community Mapping Network (CMN) Invasive Species Atlas and the BC Invasive Alien Plant Program (IAPP). The contribution to the IAPP provides data on a provincial basis, while the CMN data is used to target areas for planning control and monitoring. Data can be viewed at www.spartina.ca on an interactive web map with interactive tabular views of the accumulated data – permitting advanced queries and filtering of *Spartina sp.* data, 2004 to 2010. Data from all field workers for the Fraser Delta Program were collected and compiled by CMN to post to www.spartian.ca and then combined into one ESRI shape file for DUC GIS staff for any additional analysis. Vancouver Is. Program data first came to DUC before posting to www.spartina.ca

A new version of the CMN web mapping application will be announced in early 2011 where the map extents and scope of relevant information (e.g. shore zone classification for BC/Washington State, *Spartina sp.* mapping in Washington State) have been expanded. This will give a Pacific Coast context to the growing *Spartina sp.* infestation and facilitate international cooperation for detection and control.

Outreach

Website

- Community Mapping Network is used to display spatial data on the web including the information on the distribution of *Spartina*. (www.spartina.ca)
- Spartina-ca List Serve set up by BCSWG to communicate & coordinate with identified volunteers and partner organizations in BC. spartina-ca@vancouvercommunity.net
- Friends of Semiahmoo Bay Society –volunteer call out, information & partner links (<http://www.birdsonthebay.ca/>)

Print Media

- *Spartina* Invasion in BC - Wingspan (Winter/Spring2010)
- Coastal Invasive Plant Council –produced a brochure which includes *Spartina*
- Greater Vancouver Invasive Plant Council - produced aquatic invasive plant brochure

Tours

- *Spartina* Presentation to Friends of Semiahmoo Bay Shorekeepers
- Vancouver Island *Spartina* identification training work shop in Comox

Finances

The Port Metro Vancouver provided a grant for \$25,000 for the 2010 program. The funding covered the hard costs of the excavators and other supplies required for manual removals. The Ministry of Environment provided \$50,000 of funding to be used in 2010. This funding was allocated to cover the costs of developing an herbicide pilot program, manual removals, and coordination. In addition to external funding, members of the BCSWG contributed time and resources to the project. These in-kind and direct contributions were essential to the success of the project this year. Through the BC Conservation Foundation, the Government of Canada provided \$4,900 towards a work crew in 2010.

The total cost of the *Spartina* program in 2010 was \$218,642. The expenses included \$92,396 in direct costs and \$126,246 in in-kind donations from members of the BCSWG. A total of 20 agencies contributed financial resources (direct or in-kind) to the project (Table 2). The breakdown of each program component (Inventory, Removals, Coordination, Outreach, and Science/Evaluation) can be found in Figure 16.

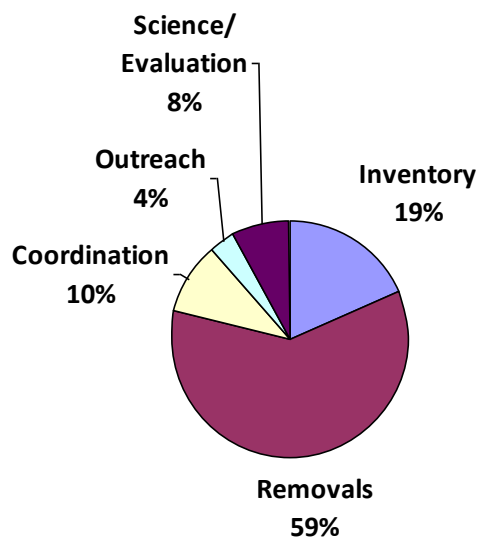


Figure 16 - Percent of Total Expenses for Each *Spartina* Eradication Program Component for 2010

Table 2. BC Spartina Eradication Program Expenditures 2010*

Agency	Program Components					Summary		
	Inventory	Removals	Coordination	Outreach	Science/ Evaluation	Direct Costs	In-Kind	Total Contribution
BC Ministry of Environment		\$ 38,000	\$ 3,800		\$ 10,800	\$ 50,000	\$ 2,600	\$ 52,600
BC Ministry of Agriculture & Lands	\$ 1,200	\$ 800	\$ 2,400	\$ 600	\$ 2,000		\$ 7,000	\$ 7,000
City of Surrey - SHaRP Program	\$ 1,200	\$ 4,000		\$ 600			\$ 5,800	\$ 5,800
City of Surrey - SNAP Program		\$ 6,000					\$ 6,000	\$ 6,000
Coastal Invasive Plant Council	\$ 2,400		\$ 1,600	\$ 1,000		\$ 200	\$ 4,800	\$ 5,000
Community Mapping Network	\$ 4,900		\$ 2,000	\$ 1,200		\$ 2,500	\$ 5,600	\$ 8,100
Corporation of Delta	\$ 6,162	\$ 14,880	\$ 2,000			\$ 1,846	\$ 21,196	\$ 23,042
Ducks Unlimited Canada	\$ 400	\$ 3,800	\$ 3,400	\$ 1,800	\$ 4,000	\$ 5,000	\$ 8,400	\$ 13,400
Environment Canada- Canadian Wildlife Service	\$ 1,200	\$ 3,200	\$ 1,200				\$ 5,600	\$ 5,600
Friends of Semiahmoo Bay Society	\$ 3,000	\$ 3,500	\$ 1,000	\$ 650		\$ 750	\$ 7,400	\$ 8,150
Government of Canada - Summer Jobs Program		\$ 4,900				\$ 4,900		\$ 4,900
Greater Vancouver Invasive Plant Council	\$ 9,600	\$ 28,400	\$ 2,400			\$ -	\$ 40,400	\$ 40,400
Metro Vancouver		\$ 3,300	\$ 400			\$ 1,000	\$ 2,700	\$ 3,700
Parks Canada	\$ 2,000					\$ 1,200	\$ 800	\$ 2,000
Vancouver Island Land Management Program	\$ 3,200						\$ 3,200	\$ 3,200
Port Metro Vancouver	\$ 4,000	\$ 20,400	\$ 1,000			\$ 25,000	\$ 400	\$ 25,400
Vancouver Island University	\$ 1,200		\$ 200	\$ 800			\$ 2,200	\$ 2,200
GL Wiliams & Associates				\$ 800			\$ 800	\$ 800
People for Puget Sound			\$ 400	\$ 400			\$ 800	\$ 800
DFO Fisheries & Oceans			\$ 550				\$ 550	\$ 550
Total Expenses	\$ 40,462	\$ 131,180	\$ 22,350	\$ 7,850	\$ 16,800	\$ 92,396	\$ 126,246	\$ 218,642

* All amounts are based on \$400/day/person

Cross Border Partnerships

West Coast Governors Agreement on Ocean Health was signed in February 2010 by Premier Gordon Campbell under the Pacific Coastal Collaborative. The document explicitly makes a commitment to eradicate *Spartina* on the West Coast by 2018. In 2010 the work plan was also finalised and is available at http://westcoastoceans.gov/Docs/Spartina_Final_Work_Plan.pdf. Our US partners have been pursuing a number of funding sources to implement the plan to supplement some baseline funds that are available. The signature of BC onto the work plan gives the Ministry of Environment (MOE) the task to support *Spartina* eradication efforts. MOE was involved in providing some funds out of the former Oceans and Marine Fisheries Branch towards *Spartina* eradication. Staff from the MOE Aquatic Conservation Science Section and BC Parks also participated in exploring the herbicide permitting process and developed communications with relevant agencies.

As mentioned previously, the Washington State Department of Agriculture was a key partner in the boat monitoring tour in the Gulf Islands and Denman Island. The objective of the tour was to increase the extent of shoreline in B.C. being monitored for *Spartina* and to train partner agencies in Canada the methodology of detecting *Spartina* through the boat monitoring. This method of detection has proven to be an effective way to access many of B.C.'s remote and unpopulated coastlines. This collaborative effort has led to the discovery of the largest *S. densiflora* infestation known in BC.

Concluding Remarks

The success of the 2010 *Spartina* Project could not have been completed without the commitment of the organizations of the BCSWG or the financial contribution from the Port Metro Vancouver and the Ministry of Environment. The total cost of the *Spartina* program in 2010 was \$218,642. The expenses included \$92,396 in direct costs and \$126,246 in in-kind donations from members of the BCSWG.

In 2010, British Columbia removed 10% (0.2 Acres) of an estimated 2.0 acres of non-native *Spartina*. Based on available resources and location of existing infestations, the primary focus is the removal of *S. anglica* and *S. densiflora*. Approximately 0.2 acres of 0.3 acres (66%) of *S. anglica* were removed, and all known *S. densiflora* plants were removed (over 50 plants along 22 km of coastline) until the end of the monitoring year we found a new 1.0 acre infestation. Approximately 0.7 acres of *S. patens* remained untreated at the end of 2010.

This year ~100km of coastline was monitored in the Fraser Delta. There was a dramatic 107% increase in *S. anglica* plants detected in the Fraser Delta from 2009 -2010. The spatial data for 112th, Mud Bay, and Brunswick Point areas show that from 2007-2010 the infestation had notably expanded its reach and density. Due to the rapid expansion of the infestation at Brunswick Point and 112th, it is recommended that the majority of removal efforts are focused on this area. It is important that a seed head clipping regime be started at the Burrard Inlet *S. patens* infestation to prevent the spread of seeds until a more permanent solution can be implemented.

The Vancouver Island Program monitored ~90km of shoreline in Main and Prevost Islands and in the Baynes Sound area. An infestation of *S. densiflora* ~1 acre was detected on Denman Island with another large infestation in Deep Bay that has yet to be mapped. Removals were conducted from Union Bay to Ships Point. It is recommended that Deep Bay, the rest of Denman Island, and the Tofino mud flats be mapped in the 2011 program.

It is recommended that the BCSWG continue to develop and implement evaluation practices for boat monitoring, covering techniques, mechanical removals, and herbicide application. This will allow the eradication program to change as new methods are learned and as new challenges arise. The newly created BC Responses plan will also help to guide the direction of BC's eradication program.

The cross-border partnerships that have been developed over the years have proved to be an extremely valuable asset to the BCSWG. Through joint ventures such as the drift card study we are now able to target our mapping approach to focus on areas with high risk of infestation. Continued collaborative work will facilitate information sharing and will improve and expand control techniques associated with *Spartina* in both BC and Washington.