Vancouver Island *Spartina* Eradication Program
2012 Progress Report

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Introduction

The following report provides a summary of the *Spartina* Inventory completed for Vancouver and select Gulf Islands during 2012. The Coastal Invasive Plant Committee (CIPC) and the Vancouver Island Land Conservation Management Program (VILCMP) continues to work toward the eradication of non-native, invasive *Spartina* species from British Columbia's coast. This work was conducted on behalf of the British Columbia *Spartina* Working Group (BCSWG), a multi-agency group which recognizes the potential impacts of *Spartina* on local shorelines and wildlife habitat and supports the Pacific Coast Collaborative goal of eradication of all non-native invasive *Spartina* species (*Spartina anglica*, *Spartina alterniflora, Spartina densiflora* and *Spartina patens*) by 2018 along the coasts of BC, Washington, Oregon and California.

The purpose of the *Spartina* Inventory was to provide accurate and quality information with regards to the presence, distribution and treatment methods for invasive *Spartina* Species on Vancouver Island and surrounding islands. Information collected during the surveys may assist with the implementation of future invasive plant management strategies within Vancouver Island and region.

History

Spartina, commonly known as cordgrass, belongs to the Poaceae (grass) family, and is a perennial bunchgrass. Two species of *Spartina* have been found on Vancouver Island to date: *S. densiflora* (dense flowered cordgrass) and *S. patens* (salt meadow cordgrass). Another *Spartina* species, *S. angelica* has been found along the Fraser River Delta on BC's mainland. A fourth *Spartina* species: *S. alterniflora* has not been detected along BC's coast but has been found in nearby Washington State and we are on the lookout for it here.

Both *Spartina patens* and *Spartina densiflora* were confirmed on Vancouver Island in 2005, though *S. patens* was detected in 1974/75 in Comox. The VICLMP as well as the Vancouver Island Conservation Corps summer crew, has contributed to the *Spartina* Eradication Response Plan for Vancouver Island since 2007. At that time the Baynes Sound coastline was GPS surveyed and mapped for both *S. densiflora* and *S. patens*. Additionally, *S. densiflora* plants were removed from the initial infestation areas: Ship's Point and Fanny Bay. Further GPS mapping and removal work was completed in 2008 by the Vancouver Island Conservation Corps summer crew. In 2009, 2010

and 2011 GPS mapping and ongoing removals were completed by VICLMP field staff. In 2010 mapping efforts on Vancouver Island were focused around Baynes Sound, Main Island and Prevost Island in the Gulf Island archipelago, using both land and boat surveying techniques. Despite these ongoing removals completed over the past 6 years, *S. densiflora* has continued to proliferate throughout Baynes Sound. *S. patens* remains primarily contained in the Courtenay Estuary, with isolated patches found on Sandy Island and Union Bay.

The 2012 field work expanded to include surveys of key estuaries throughout Vancouver Island, and this was the first year that detailed field surveys by foot covered the entire coast from Deep Bay to Courtenay; as well as select areas of coastline from Courtenay to Campbell River and on Denman and Sandy Islands. Over 125 km of shoreline was surveyed by foot. In conjunction with surveys, crews manually removed *S. densiflora* clones and seed clipped inflorescence of larger patches.

Potential Impacts and Threats

Spartina has the ability to outcompete native estuarine and foreshore plant species in crucial intertidal habitats. It spreads rapidly through both seed propagation and rhizome growth, potentially inundating tidal mudflats and shorelines. As seeds germinate and new areas are quickly colonized, monoculture stands form with the ability to outcompete native vegetation. The results are changes in shoreline sedimentation and natural drainage patterns, altering tidal mudflats into salt meadow habitat, devastating fish, shellfish, crab, waterfowl and many other species dependant on foreshore ecosystems. *Spartina* is capable of restricting river mouth water flow, 'choking out' entire estuaries, increasing flood risk of an area and altering navigational routes by increasing elevation.

Introduced to British Columbia, *Spartina* species have spread northward from Washington State where intertidal areas infested with *Spartina* have shown large declines in the abundance of shorebirds and waterfowl. Significant financial resources have been required to control *Spartina* in the states of Washington, Oregon and California; costing millions of dollars each year. Even with these efforts, *Spartina* continues to be a problem infesting many acres of shoreline habitat in Washington State. As with most invasive species, prevention and 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, resource industries and the economy and it will require considerably greater resources to control in the future.

S. densiflora, and S. patens both threaten critical estuarine and coastal wetland habitat on Vancouver Island; a region which holds half of the province's eight most important estuaries. Although estuaries and coastal wetlands make up less than 3% of British Columbia's coastline, they provide habitat to 80% of coastal fish and wildlife species. Beyond their remarkable habitat values, estuaries have the ability to sequester carbon up to ninety times quicker than the uptake rate of an equal area of forest, reduce the effects of storm surges, detoxify waste, and mitigate floodwater. Despite their importance, over 40% of estuaries throughout BC are threatened by development, modification, and pollution. Around 60% of the estuarine habitat along the Strait of Georgia has already been lost.

Baynes Sound, where the majority of *S. densiflora* and *S. patens* have been identified, is recognized worldwide as critical migratory bird habitat. Additionally the estuary is ranked as Class 1 estuary, of which there are only 8 in this class, in British Columbia.

Characteristics

The general characteristics of two *Spartina* species are shown in Table 1 below.

Table 1.

	S. densiflora		***S. patens***
Leaves	Green/grayish, rolled inwards when fresh, 4-8 mm wide and up to 43cm long	Leaves	Green/yellowish, rolled inwards when fresh, 1-4mm wide and up to 50cm long
Stems	Erect, up to 1.5m in height	Stems	Rarely erect, up to 1.2m in height
Seedheads	2–13 spikes, 60^0 from central axis, flowers April to Oct	Seedheads	Up to 30 spikes, droopy, reddish, flowers late summer
Growth Pattern	Dense tufts/clones	Growth Pattern	Dense mats/carpets
Habitat	Cobble beaches to salt	Habitat	High marsh zone

	marshes. Low tide mark to High tide mark.		
Seeds	July through October	Seeds	Late summer to early fall
Located	Deep Bay to Royston, Sandy Island and Denman Island	Located	Comox bay; Goose Spit to Union Bay and Sandy Island
Photos		Photos	
			
			

Methodology

Field work was conducted by crew members: Steven Godfrey (VILCMP), Alison Millham (CIPC), Mike Reid (CIPC), Jennifer Manuel (CIPC) and Clayton Billett (TNT) in July and between Sept and Nov 2012. The shoreline between Deep Bay and Campbell River, Denman and Sandy Islands were surveyed by foot. Select estuaries were surveyed by foot and by boat including: Cowichan, Chemainus, Nanaimo, Englishman, Little Qualicum, Fanny Bay, Coal Creek, Salmon River, Cluxewe, Marble River, and Quatse estuaries.

The methods used to complete surveys were those developed by both Forest, Lands and Natural Resource Operation's Invasive Alien Plant Program (IAPP) as well as the BC *Spartina* Mapping Protocol for the Community Mapping Network (CMN). IAPP forms were used to collect Site and Invasive Plant information required for operational level surveys, using Reference Guide IV (Appendix B). Completed forms identified the Invasive Plant species, location, area, jurisdiction, distribution, density and treatment methods. UTM coordinates were collected using a handheld GPS unit Garmin 62s or Garmin 60Csx, within 10m accuracy. The *Spartina* Mapping Protocol (Appendix A) integrates with the Community Mapping Network (CMN), where historical data of *Spartina* work in BC has been compiled and is displayed in an interactive map format. The IAPP database houses invasive plant data for all of BC and contains a multitude of plant species.

All sites have been entered into the IAPP database and will soon be entered into the CMN database. IAPP database, at this time, does not have the Department of Fisheries and Oceans (DFO) as an option for jurisdiction and as this field must be selected to complete an entry; Regional District was used instead with a comment regarding actual jurisdiction. A request has been put in to FLNRO to add DFO as a jurisdiction. The IAPP database uses the convention that plants found within 100m of each other are mapped as a single site and infestations larger than 0.2 hectares are mapped as polygons. While the CMN maps each plant and infestations up to $5m^2$. Therefore final maps for each program visually display the same information differently with IAPP having a tendency to show more area infested, with fewer sites and for CMN to show less area infested, with more sites. For the purposes of this report, sites from CMN were used to display the sites.

Foreshore areas were surveyed on foot and accessed from public roads and allowances. Creek outflows and industrial operations required crews to backtrack and find alternative access points.

Spartina presence was recorded and then the plant was either removed, seed head clipped or in several instances left untreated. Plant material and seed heads were removed and placed in heavy duty garbage bags and later taken to the Comox Valley Waste Management Center. In some cases where there was no nearby road access to the area and there was more material than the crew could carry, seedheads were first clipped, placed in bags, and carried out to prevent dispersal, with remaining plant material being placed well above high tide. Care was taken to place this plant material well above high tide where there was no chance that the plant could establish itself. Working with the ebb and flow of tides was essential to be able to access and have complete coverage of the foreshore as *S. densiflora* was found from the low tide mark right up to the high tide mark.

Results

For the purposes of this report, data analysis was done by using generated extracts from the IAPP database. Maps in this report, however, show sites using the naming convention used with CMN database.

Vancouver Island Estuary Surveys

Table 1. Summary of 2012 *Spartina* Estuary Surveys

Estuary	Survey Method	Date of Survey (2012)	*Spartina* found?	Notes:
Cowichan	Canoe	Jul. 26	No	None
Chemainus	On foot	Aug. 16	No	None
Nanaimo	On foot	Jul. 14&Oct 10	No	None
Englishman	On foot	Jul. 10	No	None
Little Qualicum	Canoe & on foot	Jul. 10	No	None
Fanny Bay	On foot	Jun. 13	Yes-Removed	Not found here in 2011
Coal Creek	On foot	Jun. 13	Yes-Removed	Inc. presence from 2011
Salmon River	Canoe & On foot	Jun. 11	No	East side not surveyed
Cluxewe	Power Boat & On foot	Aug. 30	No	None
Marble River	Power Boat	Aug. 31	No	Nice estuary!
Quatse	On foot	Aug. 31	No	None

Map 1. Cowichan River Estuary

Survey Method: Canoe/ Binoculars (Route shown in green), *Spartina* found: No

Map 2.Chemainus Estuary

Survey Method: Foot w/ 45X Scope (route shown in blue), *Spartina* found: No

Map 3. Nanaimo River Estuary

Survey Method: On foot w/ 45X Scope (foot route in blue, boat route in green), *Spartina* found: No

Map 4. Englishman River Estuary

Survey Method: On foot w/ 45X Scope (route show in blue), *Spartina* found: No

Map 5. Little Qualicum River Estuary

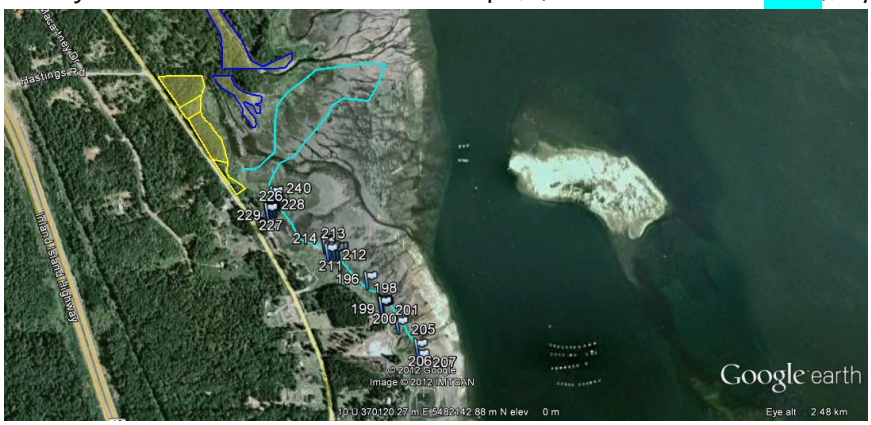
Survey Method: Canoe (Route shown in green), *Spartina* found: No

Map 6. Fanny Bay Conservation Area

Survey Method: On foot w/ 45X Scope (Route shown in blue), *Spartina* found: Yes - REMOVED

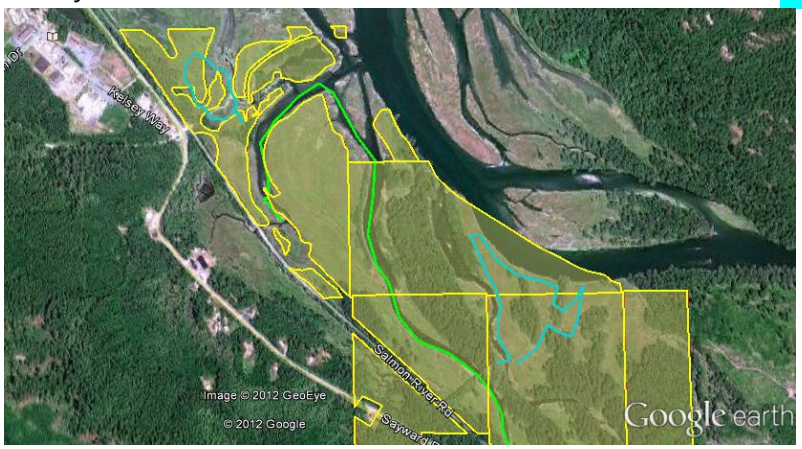
Map 7. Coal Creek Conservation Area

Survey Method: On foot w/ 45X Scope, (Route shown in blue), *Spartina* found: Yes - REMOVED



Map 8. Salmon River Estuary:

Survey Method: Canoe & on foot with binoculars(on foot blue, canoe green), *Spartina* found: No



Map 9. Cluxewe WMA

Survey Method: Canoe & on foot with binoculars(on foot-blue, canoe-green), *Spartina* found: No

Map 10. Marble River Estuary

Method of Survey: Powerboat w/ binoculars (Route shown in green), *Spartina* found: No

Map 11. Quatse River Estuary

Survey Method: On foot w/ 45X Scope (route show in blue), *Spartina* found: No

Baynes Sound Inventory

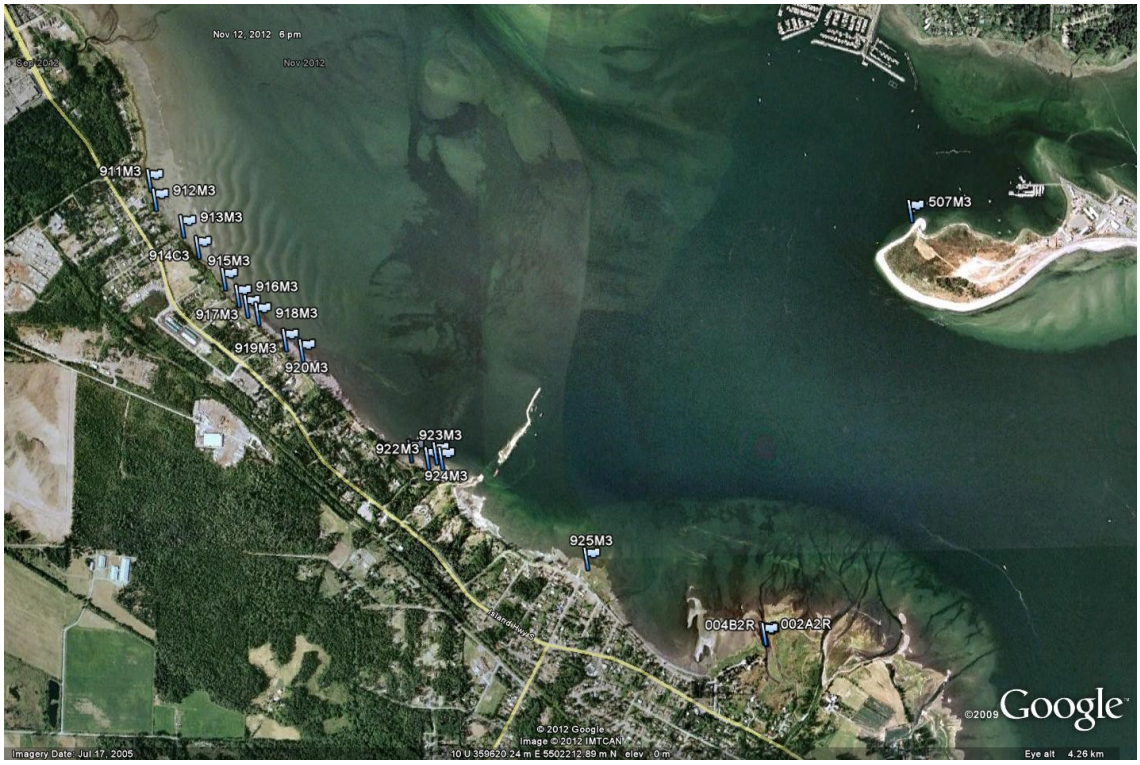
The Baynes Sound foreshore area was initially surveyed for the presence of *Spartina* species during several days in July. These surveys found and manually removed *S. densiflora* close to Coal Creek Conservation area, Fanny Bay conservation area and the Deep Bay Spit. Then beginning in September, the entire coastline from Deep Bay Spit to Comox, Sandy Island and portions of Denman Island were surveyed again with intensive foot based method. The later surveys removed or clipped the seeds from *S. densiflora* plants.

Spartina Patens

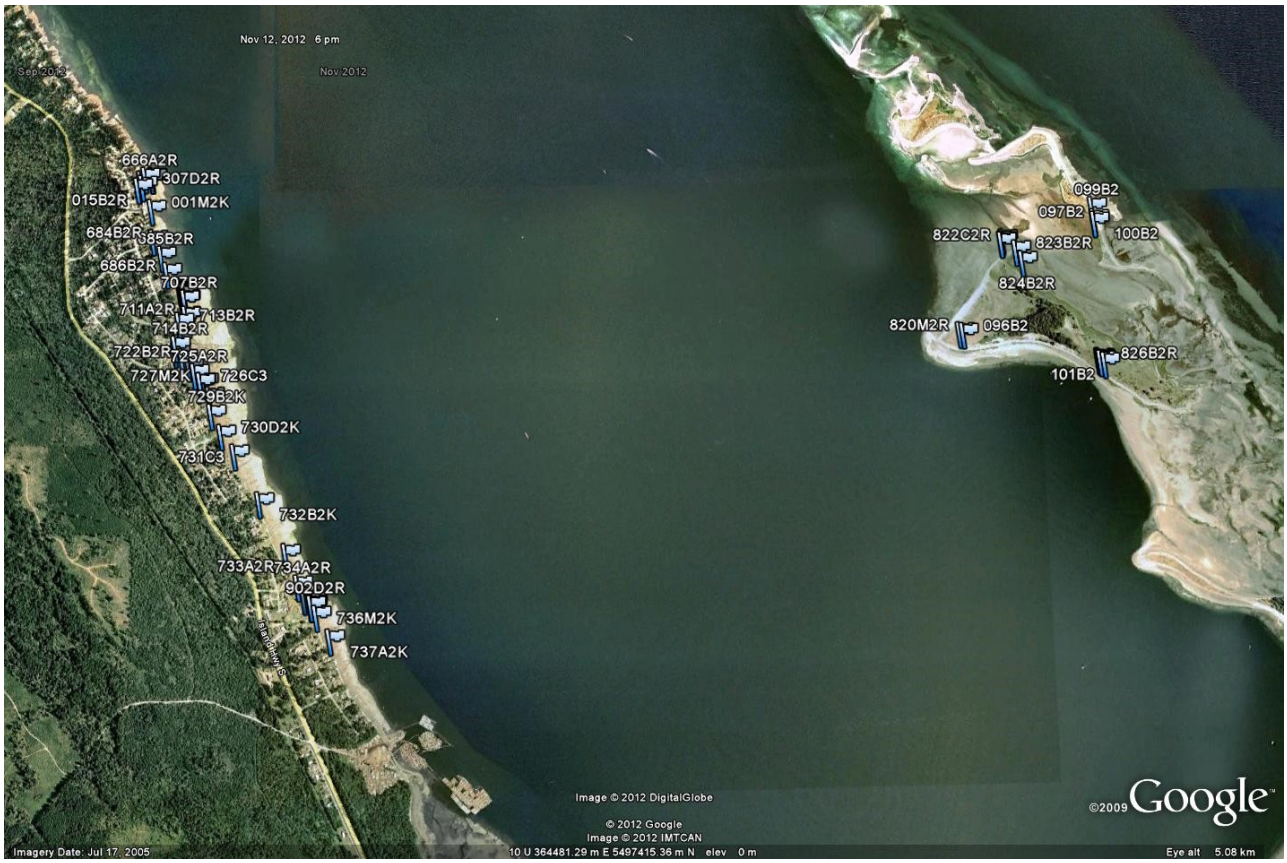
S. patens was found predominantly along Comox Bay from Goose Spit to Royston, and in limited distribution from Royston to Union Bay and on Sandy Island. These waypoints are shown on Maps 12, 13 and 14 with the CMN naming convention. Two sites were located on the east side of the Sandy Island (SiteID 290535 & 283600), these sites together comprise 6m^2 of area. Sites from Union Bay to Royston (SiteID 290489 & 290492), these sites comprise 22m^2 area. From SiteID 290341, *S. patens* increases gradually increases in distribution and density north to Comox Bay.

Map 12. Comox Estuary with *S. patens* waypoints

Map 13. Courtenay to Royston & Goose Spit with *S. patens* waypoints (except 004b2r &002a2r which are the northernmost points of *S. densiflora*)



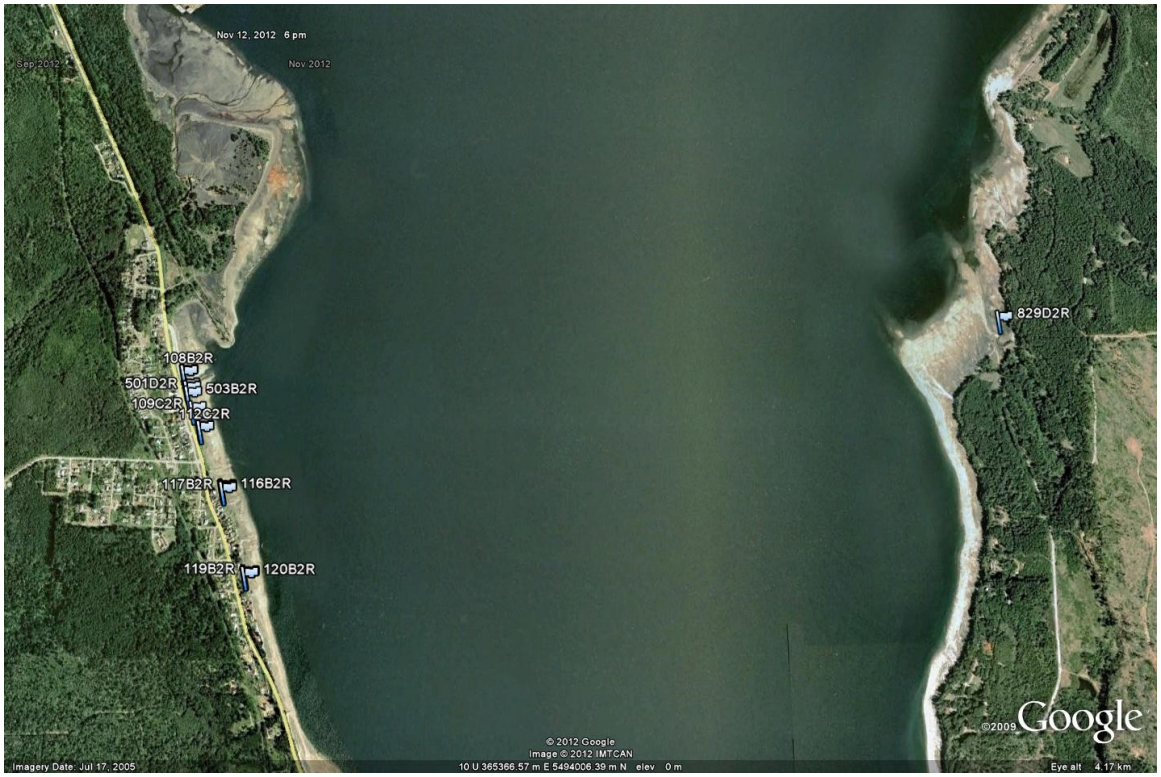
Map 14. Royston to Union Bay and Sandy Island with both *S. patens* and *S. densiflora* points



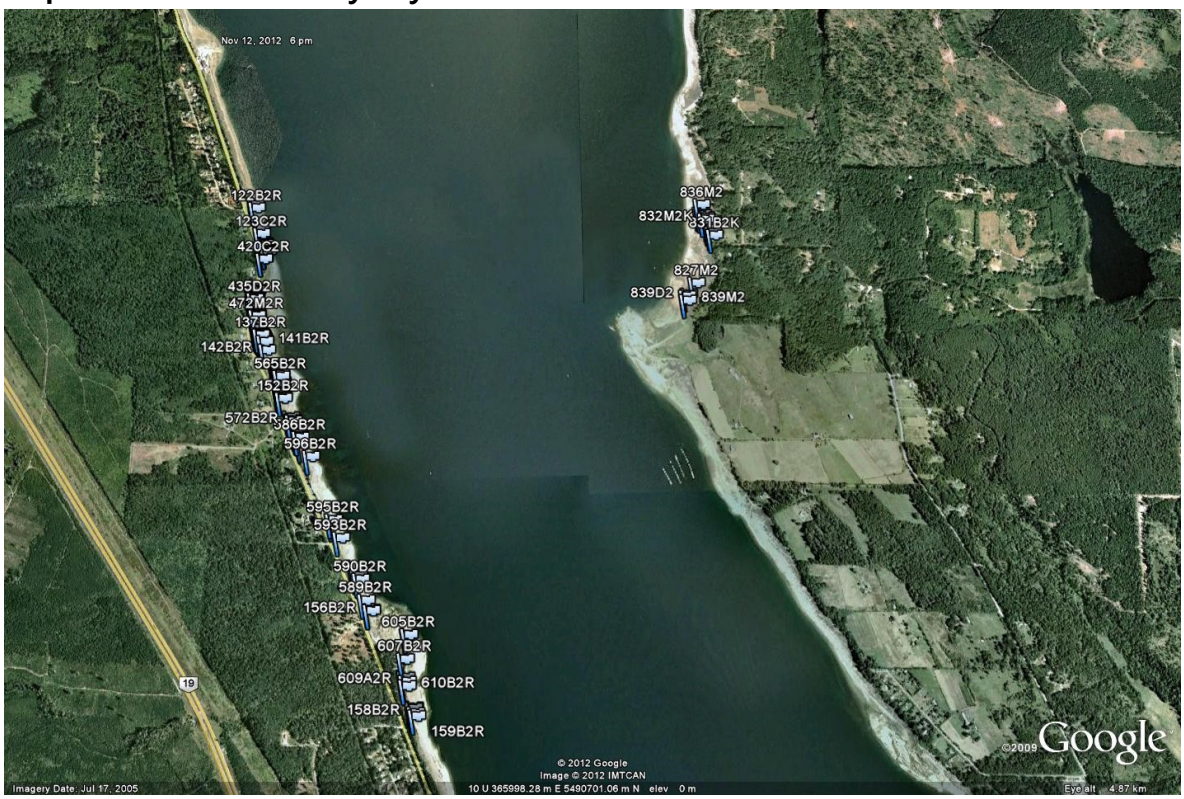
Spartina densiflora

S. densiflora was found from Royston south to Deep Bay and on the shores of Sandy and Denman islands. Sandy Island had 5 *S. densiflora* sites mapped in IAPP, see Map 14. Of those sites, 4 sites were mechanically treated comprising of 257m^2 with the plants dug out and 1 site had the seed heads clipped 17m^2 as the plants were already under a foot of water with the tide coming in. In terms of eradication efforts for S. densiflora there remain large patches of left untreated on Denman Island, due to lack of time in the season. All sites found on Vancouver and Sandy Islands were treated with manual removal or by seed head cutting. Specific treatment methods used for each site is described in IAPP, and on the CMN a waypoint ending in "k" indicates the site was seed clipped or an "r" indicates that the site was removed.

Map 15. Union Bay and west side of Denman Island with *S. densiflora* points

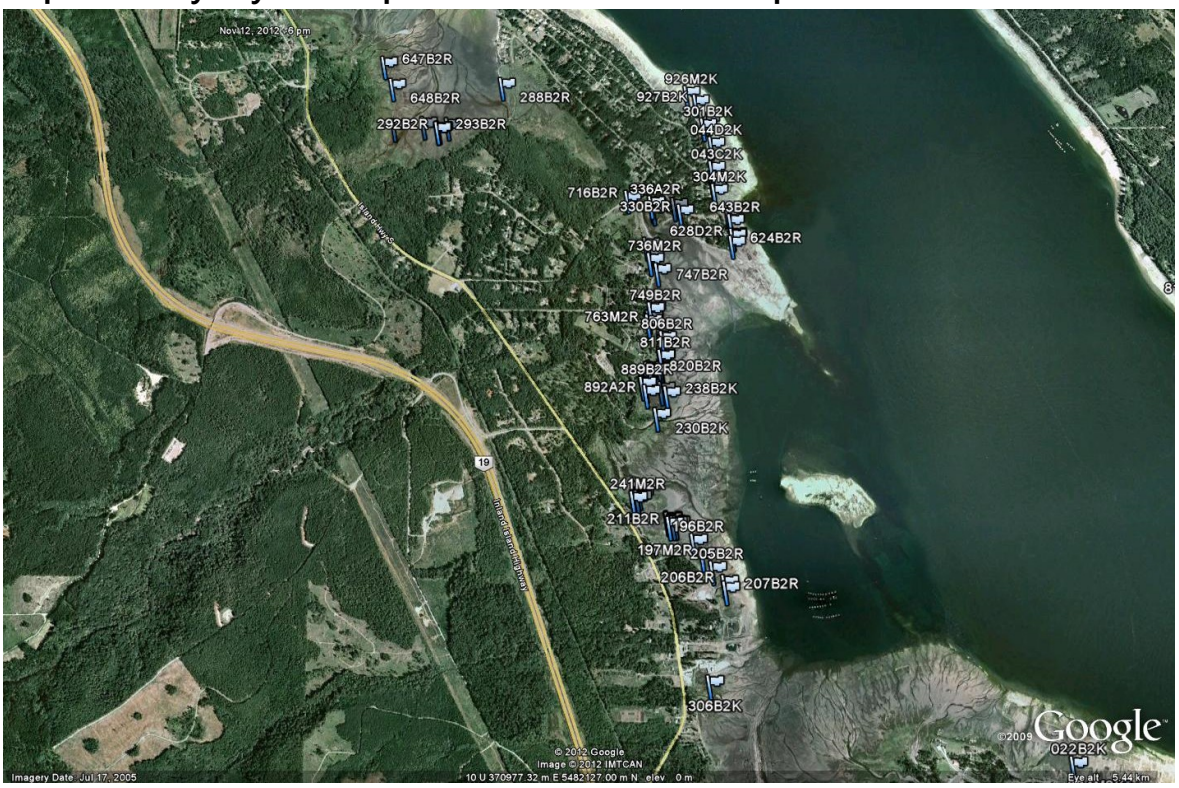


Map 16. North of Buckley Bay and the west side of Denman Island with *S. densiflora*

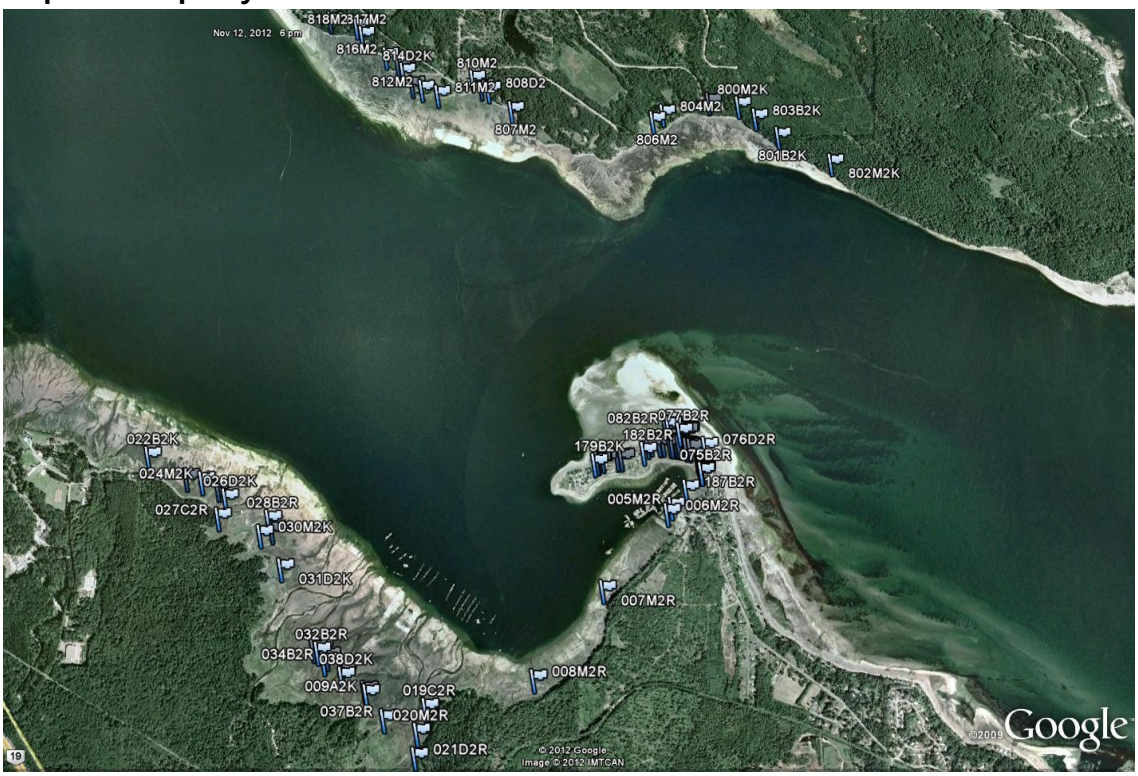


Map 17. Buckley Bay Ferry Terminal and Tsable River outflow with *S. densiflora*

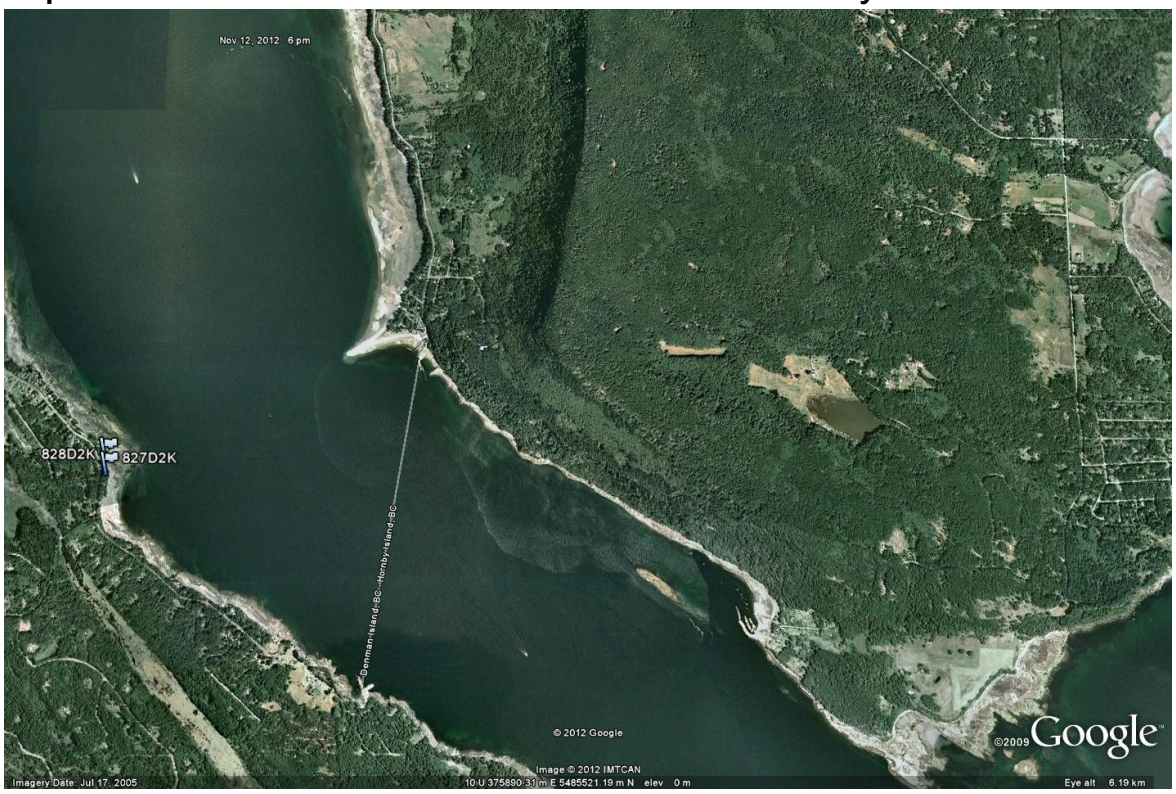
Map 18. Fanny Bay and Ships Point with *S. densiflora* points



Map 19. Deep Bay and Southern coast of Denman Island with *S. densiflora* sites



Map 20. East side of Denman Island and west side of Hornby Island sites



Denman Island was the last area to be surveyed, and a number of large sites were mapped. See Map 15 through to Map 20. Sites were predominantly located on the west side of the island with only two sites located on the east side. Two sites (290511 & 290593) with 6m^2 were completely removed. Another 8 sites (290513, 290508, 290505, 290506, 290504, 290597, 290594, 290596) with 2949m^2 were seed clipped and 11 sites (290527, 290525, 290524, 290523, 290521, 290520, 290518, 290516, 290515, 290514, 290598) left 1.0470 hectares untreated due to lack of time in the season to complete treatments and a complete inventory. *S. densiflora* was found along the foreshore area adjacent to Boyle Point Provincial Park. Fillongley Provincial Park was also surveyed with no *Spartina* found.

Vancouver Island had 33 sites in IAPP comprising of 2.9639 hectares with the seed heads removed (see Table 2) and recorded in IAPP as mowed. Another 70 sites (See Table 3) with 0.6832 hectares was dug out and taken to landfill.

Table 2. IAPP Sites which had inflorescence removed.

290302	290306	290325	290614	290374	290486	290490
290301	290307	290324	290381	290375	290497	290491
290300	290308	290326	290373	290376	290496	290493
290303	290309	290327	290377	290458	290484	
290305	242102	290328	290378	290726	290489	

Table 3. IAPP Sites which were manually removed.

290706	290714	290701	290715	290287	290290	290612
290705	290713	290700	290629	290286	290304	290625
290717	290702	290695	290630	283527	290299	290623
290712	290704	290698	290631	290282	290310	290624
290719	290707	290699	290627	283528	290311	290379
290720	290708	290696	290628	290296	290357	290380
290721	290709	290693	290587	290295	290617	290372
290722	290711	290632	290585	290294	290618	290494
290716	290710	290633	290280	290293	290619	290495
290703	290718	290694	290288	290292	290620	290485
290487						

From all of the treatments conducted in 2012 for Vancouver Island and nearby areas, there was 1070kg of plant material removed an taken to the Comox Valley Waste Management Center. Another approximately 300kg of plant material was removed and placed above high tide. Where soils were disturbed, crews collected native seeds from nearby native species including *Plantago maritime, Triglochin maritimum and Grindelia integrifolia* and spread onto the disturbed site. After finding large areas with *S. densiflora* present, it became apparent that there would not be enough time left in the season to manually remove each and every clone, the field crew began to clip the seed heads from flowering plants in October, see Figure 2. 190kg of seeds were taken to landfill and an estimated 120kg of seed was placed above high tide and buried in a forest.

Figure 2. Large patch of *S. densiflora*, with inflorescence in the process of being clipped.

The summer to fall season of 2012 was unusually warm and sunny; this may have been a factor for the late flower production that was noticed in *S. densiflora*, with flowers developing in mid-November. The field crew began cutting the inflorescence from larger patches in early October, then re-checking in November, to find that many of the cut clones had sent up new flowers with immature seeds. Anecdotal observations noted that concentrations of *S. densiflora* was often found at the outflow of creeks and rivers.

The clonal growth pattern of *S. densiflora* appeared to be enhanced with layering. It was noticed by crew members that where rocks pinned down one or more lateral tillers, these re-rooted to create larger diameter clones.

Samples of *S. densiflora* were taken and put into 1 gal pots by crew member, Alison Millham for observation. Four samples were taken of small <30cm diameter clones and four samples were taken of 30cm diameter clones with inflorescence removed, all from Ships Point in Fanny Bay. The smaller clones had developed seed heads by mid-November while the larger clones had turned a pale yellow color. Continued observations may lead to important growth patterns. By cutting the inflorescence and lateral tillers, *S. densiflora* may be sufficiently weakened so that when dug up, the remaining plant material could be safely disposed of on land above high tide.

Contact was made with an oyster lease operator, Macs Oysters. Management came out with field staff to look first hand at *S. densiflora* plants located close to the company's packing plant.

Management indicated that they would be willing to help with future eradication efforts, by lending equipment or time to help with removals and identification.

Inflorescence were counted on Oct 15, 2012. Twenty random inflorescence samples were selected. The average of the 20 inflorescence had 152 seeds per inflorescence. This is only an estimation as seeds on mature inflorescence had begun to drop. Other research (Kittleson Pamela Thesis) has shown an average of 1977± 80 viable seeds are produced per plant (0.25 to 0.5 square meters). With the removal of inflorescence from at total of 6832m^2 area on Vancouver and nearby Islands – that would amount to approximately 27million seeds removed and prevented from spreading.

Field crews 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. As *S. densiflora* grows taller that the other marine grasses, it is not expected that other shorebirds would have the ability to reach the seeds. Additionally it was observed that influence of tides was a vector of spread, as pools of *S. densiflora* seeds were seen deposited after high tide, see Figure 3. The field crew gathered and removed what they could from these fallen seeds.

Figure 3. *S. densiflora* seeds washed up by tides, adjacent to a large patch.

Shade trial for *S. patens*

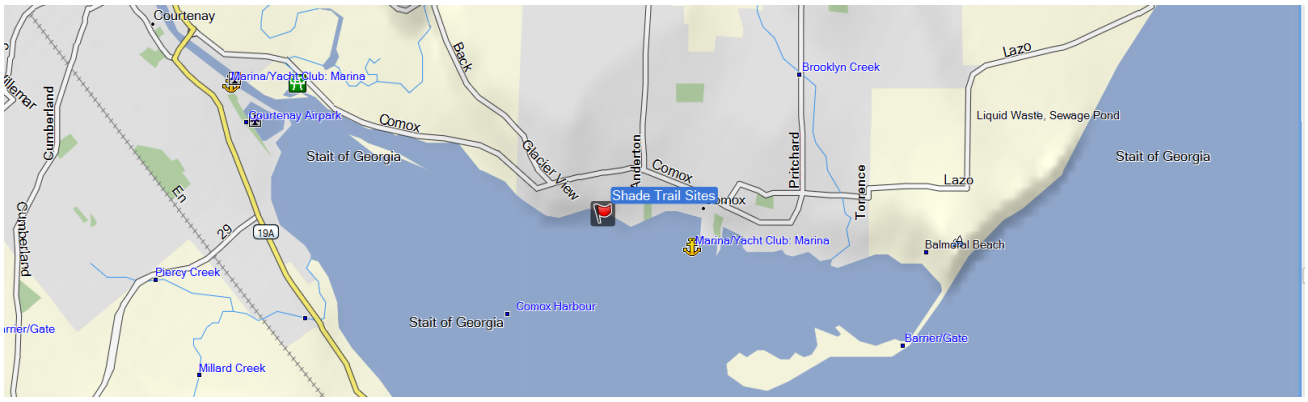
A shade trial for research purposes was installed along the Comox foreshore on Nov 16, 2012. The shade trial is intended to cover the invasive cordgrass for 2 years and prevent it from photosynthesising and therefore be deleterious. This type of shade trial has been used successfully in Oregon State and another site was set up this year in Burrard Inlet by the Fraser Delta working group.

Sixteen *S. patens* sites were evaluated for suitability for a shade trial, with characteristics of size, location, proximity to native vegetation and low action beachfront taken into consideration. A site from Comox foreshore (Figure4) was selected 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 Nilex's "Woven 2002". Nilex Woven Geotextiles are woven from durable, high-modulus polypropylene yarns into competent, robust, dimensionally stable geotextiles which are water permeable. Rebar was installed into the beach for photo monitoring. Nearby patches of *S. patens* will serve as a control site.

This site will be monitored regularly for two years, at which time the sites will be revegetated if needed. If the trials prove to be successful, this method of eradication may be applied to larger areas.

Figure 4. Shade Trials for *S. patens* on Comox foreshore

Map 21. Location of *S. patens* shade trial site (UTM: 10 U 360020 5504034)



Conclusions

With the intensive foot based surveys, complimented by boat surveys; a thorough inventory of Baynes Sound was conducted and the data gathered shows that there is still a moderate amount of removal work to complete, with some gaps in the inventory. As only a portion of Denman Island was surveyed and Hornby Island has not been surveyed, it is recommended that these Island receive a complete foot based inventory; additionally Texada and Lasqueti Islands could also benefit from surveys. These inventories will serve to guide comprehensive management practices and to plan for treatment methods.

In terms of eradication efforts for *S. densiflora* there remain large patches left untreated on Denman Island, due to lack of time in the season to complete treatments. All sites found on Vancouver and Sandy Islands were treated with manual removal or by seed head cutting, with the treatment type indicated by the last letter of the CMN waypoint. A waypoint ending in "K" indicates that the site was seed clipped and a site ending in a "R" indicated that the site was removed, where no letter indicates that no treatment occurred. Priority for treatment should first go those sites on the shores of Sandy Island Provincial Park, Boyle Point Provincial Park, Coal Creek and Fanny Bay Conservation areas with known sites. The second priority is to treat all *S. densiflora*, with a minimum of inflorescence clipping. Continued collaboration with the Denman Island Conservancy to map and control the large patches of *S. densiflora* are achievable. The third priority is to manually remove all *S. densiflora* and to monitor known sites. Large patches of *S. densiflora* will require considerable effort to remove and could involve combining a number of techniques including: use of an excavator, include volunteer stewardship groups, like the Comox Valley Conservation Center, and interested local residents.

Eradication efforts for *S. patens* would benefit from a more detailed survey along the Comox Bay to have a clearer picture of how to implement control measures. The first priority is to monitor the Shade Trial sites for *S. patens*. The second priority is to begin limited manual removals, focusing on the outlier infestations. Sandy Island should have the two *S. patens* sites (SiteID 290535 & 283600) targeted for manual removal with hand tools as they are still small and adjacent to Sandy Island Provincial Park. SiteID 290489, 290492, 290341 are recommended for manual removal, this would create a southern containment line at Hilton Rd in Royston. The third priority is to explore other options for removing the large volume and area for eradication goals to be met.

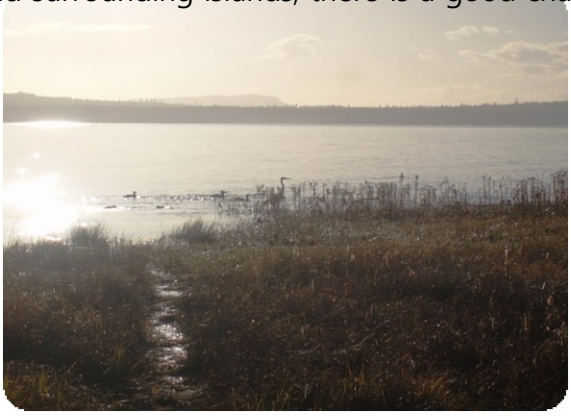
Restoration of areas which undergo mechanical digging treatments should be also include a re-vegetation plan. Native seeds from nearby native species including *Plantago maritime, Triglochin maritimum and Grindelia integrifolia* may be collected at the time of treatment and spread to disturbed foreshore areas. Native vegetation may also be established by harvesting small plugs in areas where native species are abundant and planting them on disturbed areas. At the very least soil disturbances should be lightly tamped down and covered with nearby tidal debris to keep sites from being re-invaded by *Spartina* species or other aquatic invasive vegetation.

It is recommended that in subsequent years, inventory and removal work start in early summer and end by October, when the seeds begin to drop. Continued dialogue with oyster lease operators may lead to future collaborative efforts, as potential shoreline impacts could be felt by this industry. Increased contact via presentations, press release or notices for local residents may lead to more support and understanding of the *Spartina* Program. More resources to hand out to interested local residents, businesses and stewardship groups would be beneficial, whether it is the *Spartina* Key chain (Appendix C) or a small brochure, specific to *S. patens* and *S. densiflora* , with relevant information on it.

Implementation of a boot wash and brush station for Field Technicians as they move between sites would prevent any unintentional spread of seeds which can get caught in the folds of clothes or in treads of boots.

Some difficulties and limitations should be considered when completing future surveys and removals, including public access to foreshore areas is often limited due to the private residences and roads so routes must be planned accordingly. Additionally some creek outflows and foreshore industries were impassable so routes around these need to be adjusted. Having access to a boat is necessary for remote islands and islets.

With continued collaborative efforts towards inventory and removal of *S. densiflora* and *S. patens* from Vancouver Island and surrounding islands, there is a good chance that these species will eventually be eradicated.



Appendix A

Spartina Mapping - Saving & Naming Waypoints

1) Hold the GPS antenna/receiver above your head while standing still to get the best satellite reception.

2) Save a waypoint using averaging (30 to 60 counts/seconds) to improve position accuracy

3) Rename each waypoint as follows: A waypoint will have 5 digits

- **first 3** digits are determined by the GPS (range 001 to 999). The GPS will not let you save two waypoints with the same name.

- 4th digit = the size class of the plant

- 5th digit = the species of *Spartina*

Size Class Codes:

S = seedling or single plant	
A = small "clone" or plant cluster less than 0.3m diameter	
B = clone0.3m to 1.0m diameter 	
C = clonelarger than 1.0m diameter	

D = cluster of seedlings in an area approx. 5m in diameter	
M = center of a large area (>5m) with too many *Spartina* clones or plants to map individually. Indicate the extent of the area with more "M" points or the track technique on the perimeter. Include a text note with the data to describing what you did.	

***Spartina* Codes:**

1 =*Spartina anglica* **2 =** *Spartina densiflora*

3 =*Spartina patens* **4 =***Spartina alterniflora*

Examples of renamed waypoints:
067B1 = a *S. anglica* clone, diameter 0.3m to 1.0m
003Z1 = stopped searching for *S. anglica* here
798S2 = seedling of *S. densiflora*

The Excel template file for submitting your GPS data can be found at http://*Spartina*.ca. The site includes other aids for identifying *Spartina* sp.

Mapping Removed Plants:
R = seedling or clone removed by hand
Y =*Spartina* burial site (excavator buries clones under 2m of sediment.
X= extent of larger area of plant removal. (same directions as "M" points)

Searching:

Z = extent of your search area - start & end points along a shore or the corners of the area of mud flat searched - even if *Spartina* was not found.

It is very important to know where volunteers have search and not found *Spartina* sp. You can also use the track technique when searching. Include a short text note with your data to help us interpret your search waypoints.

Recording GPS Tracks:
You can save a "track" in you GPS of the outer perimeter of the area you have searched and submit it with a text file explaining what you did. This "track" technique can be used in place of a series of points captured to define an area as in the "M", "X", "Z" codes. Using the “track” technique reduces the data entering time by avoiding point averaging but requires that you keep moving. If you stop moving during a track you may gather too many points in one location. Some GPS receivers support setting the track recording based on distance moved. This is a good technique that allows you to stop walking for short periods without collecting extra track points. If you use the distance moved option, set to a value of 10m, which will give the best results without collecting extraneous points.

APPENDIX B

IAPP Reference Guide, Part one, Module 1.5 can be found at:

http://www.for.gov.bc.ca/hra/Publications/invasive_plants/IAPP_Reference_Guide/Module%201.5.pdf

APPENDIX C

Spartina ID cards/keychain can be found at:

http://cmnbc.ca/files/atlas_files/2009Spartina%20ID%20Cards.pdf