

Restoration of Coastal Sand Ecosystems on the Coast of British Columbia

Symposium Proceedings

Victoria, February 27, 2018

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Cover illustrations

From left to right: photo of excavator removing *Ammophila* spp at Wickaninnish Beach, British Columbia, by Ross Vennesland (Parks Canada); photo of Pink Sand-verbena (*Abronia umbellata*) flower on the West Coast Trail at Clo-oose Bay, British Columbia, by Ross Vennesland (Parks Canada); and photo of Scotch Broom (*Cytisus scoparius*) infestation on Savary Island, British Columbia, by Claudia Schaefer.

Contents

Symposium Participants

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Symposium Agenda

Coastal Sand Ecosystems (CSE) of British Columbia
Hosted by Parks Canada
2018 Symposium AGENDA
Tuesday, February 27, 2018 - 9:00am to 4:30pm
Horticultural Centre of the Pacific - 505 Quayle Rd. Victoria, BC

9:00 am	Doors open
9:30-9:45 am	*Welcome* – Ross Vennesland (Parks Canada) and Seliliye (Belinda Claxton) of Tsawout First Nation
9:45-10:00 am	*Overview of Status Report on CSE (2011)* – Nick Page (Raincoast Applied Ecology)
10:00-10:30 am	*Back from the Brink: Restoring the Endangered Pink Sand-verbena to Pacific Rim* – Ross Vennesland (Parks Canada)
10:30-11:00 am	*Dynamic Dunes - 10 years of CSE Restoration and Recovery of Associated Species at Risk at Pacific Rim National Park Reserve* - Mike Collyer (Parks Canada)
11:00-11:15 am	**Break**
11:15-11:45 am	*CSE overview of Cordova Shore, James Island and Sidney Island* – Nick Page (Raincoast Applied Ecology)
11:45-12:15 am	*Ecosystems on the Edge - Restoring CSE on Sidney Island* - Pippi Lawn, Gulf Islands National Park (Parks Canada)
12:15-1:15 pm	**Lunch**
1:15-2:00 pm	*Highlighting the cultural and ecological values of the Island View Beach Area* - Belinda Claxton SELILIYE (Tsawout First Nation)
2:00-2:30 pm	*Island View Beach Management Plan overview and update* – Todd Golumbia (Capital Regional District)
2:30-2:45 pm	**Break**
2:45-3:15 pm	*Rathtrevor Beach Provincial Park sea wall removal and CSE restoration project* - Erica McClaren (BC Parks)
3:15-3:50 pm	*CSE restoration at Metro Vancouver Regional Parks* – Tamsin Baker (South Coast Conservation Program) on behalf of Metro Vancouver *CSE Stewardship on the South Coast, with focus on Savary Island* – Tamsin Baker (South Coast Conservation Program)
3:50-4:30 pm	Next Steps discussion: Topics to include: • Framework for information sharing on CSEs • Ensuring long-term sustainability of CSE project results • Funding sources for CSE restoration • Coordination of educational messaging

Introduction

On February 27, 2018, the Parks Canada Agency hosted a one-day symposium in Victoria, British Columbia (BC), bringing together numerous organizations that have been managing and restoring Coastal Sand Ecosystems (CSEs) along the British Columbia coast. This coast-wide meeting of CSE recovery and restoration practitioners was long overdue, with the last gathering having occurred in 2013 (a meeting of the currently inactive CSE Recovery Team).

The focus of the 2018 symposium was to share success stories and lessons learned and facilitate greater communication between organizations and practitioners. The symposium began with a welcome from Ross Vennesland of the Parks Canada Agency, followed by a traditional First Nations welcome by Seliliye (Belinda Claxton) of the Tsawout First Nation (upon whose traditional territory the venue was located).

Overview of Coastal Sand Ecosystems on the Coast of BC

Nick Page of Raincoast Applied Ecology opened the presentations with an introductory overview of CSEs in British Columbia. Nick initially became involved in studying CSEs through his Master of Science degree and subsequent interest in Sand-verbena Moth (*Copablepharon fuscum*), the first federally listed moth species at risk in Canada. With the growing number of CSE species at risk being listed (e.g., several plants were also listed at that time, such as Pink Sand-verbena, *Abronia umbellata*), the Parks Canada Agency and the Province of BC subsequently initiated a CSE Recovery Team. Along with several others, Nick co-authored an ecosystem-level Status Report for CSEs that was funded by the Parks Canada Agency (Page et al. 2011; circulated to participants before the symposium).

Nick's presentation discussed the distinctiveness and distribution of CSEs, and the dynamic physical and ecological processes that shape them. Human-related threats were discussed as well. By changing the movement of sand, humans change these ecosystems' unique processes and accelerate the process of colonization by other vegetation (that threatens sand adapted species). Introduced grasses (such as *Ammophila* spp) have been used in Canada and the US to stabilize moving sand and these invasive species have become widespread. Human development can also affect sources of sand. For example, some CSE areas were created by sand from feeder bluffs and development on these bluffs can impact sand movement. Another similar issue impacting sand movement is the armouring of sandy shorelines to reduce erosion (that occurs naturally in CSEs). The effects of stabilized sand or blocked sand sources not only affects the affected area, but adjacent areas of CSE as well.

Discussion:

- There was a question regarding searocket as an introduced species. Both species (American Searocket *Cakile edentula* and European Searocket *Cakile maritima*) have been introduced, with the American searocket having been introduced earlier in the past century. The European species arrived more recently.

Restoring the Endangered Pink Sand-verbena to Pacific Rim National Park Reserve

Ross Vennesland of the Parks Canada Agency gave a presentation on efforts over more than a decade to recover the federally endangered Pink Sand-verbena in Pacific Rim National Park Reserve. Co-authors included Mike Collyer and Danielle Bellefleur of the Parks Canada Agency

and Matt Fairbarns of Aruncus Consulting. Ross also acknowledged the many other people that have assisted over the years to make this long running project a success, including Louise Blight of Procellaria Consulting, Sibylla Helms and Conan Webb of the Parks Canada Agency, Rob Hagel of the Canadian Forest Service, as well as several local First Nations (Ditidaht, Tla-o-quiaht and Huu-ay-aht) and many technicians and volunteers.

An overview of Pink Sand-verbena was presented, including the different threats facing the species, including demographic collapse from small population size, beach logs (which occur at unnatural concentrations due to decades of logging), invasive species and human disturbance. Before industrial logging, beach logs would typically have had root balls and would not have moved (rolled) like logging debris does today. The motion of the logs can destroy plants growing on the beach. There are also significantly more logs than would occur naturally, and these numerous logs can cover habitat and make it completely unavailable to CSE plants. Another threat is direct human disturbance, such as trampling by feet or by machines. CSEs can tolerate some human disturbance, but not too much. A unique human disturbance threat for this area was the discovery of unexploded military ordnances, which closed some locations to restoration efforts for several years as the material was investigated and removed. This work also caused additional habitat disturbance (e.g., from vehicles used to scan the sand dunes).

Historical Pink Sand-verbena occurrence data showed that the species was only ever known from three locations on the coast of BC (Flores Island, Pachena Bay and Cheewaht at Clo-oose Bay). New surveys were done along the coast to search for plants at known locations and to determine if other locations were as yet undiscovered. The plant was not observed at Flores Island or Pachena Bay and surveys did not record any new populations. This left just a single remaining population at Clo-oose Bay, where plants were most recently observed in 2001 and 2002. These results brought concern that the species was on the verge of extirpation, or already extirpated, from Canada.

The Recovery Strategy recommends that three viable populations be restored or established. An experimental approach to recover the species was undertaken using seeds taken from plants at Clo-oose Bay (thanks in large part to resident Jim Hamilton who originally found the plants there after a nearly 50 year absence). Seeds and seedlings were grown in a greenhouse (first at the Canadian Forestry Service in Victoria and later in Ucluelet), and have been added to four sites that were determined to be suitable for translocation: Clo-oose Bay, Keeha Beach, Wickaninnish Beach and Schooner Cove.

The presentation reviewed the results of population restoration efforts, which have been largely, but not entirely, successful. Tremendous success has been achieved at Wickaninnish Beach and Schooner Cove (with hundreds of natural plants germinating each year). But success has been more limited at Clo-oose Bay and Keeha (where only a limited number of natural plants continue to germinate each year). Experiments were also undertaken to determine if fertilizer would aid in seedling growth and how planting location (e.g., beach versus dune habitats) affected growth rates and seed production. Growth was typically strongest closer to the beach, with fertilizer having a mixed effect – aiding growth most in dune habitats away from the beach (likely because nutrients from the ocean naturally fertilize plants close to the beach but diminish inland). Direct restoration efforts have been discontinued at Keeha Beach, but will continue at Clo-oose Bay, Wickaninnish Beach and Schooner Cove, with most effort in the coming years at Clo-oose Bay to improve success at this key location (where the plants were last seen naturally without human intervention). Overall, the success of the translocations has been demonstrated by the continuous production of natural plants at all restoration sites.

Looking to the future:

- Continue analysis and publish results.
- Create a report for the SARA registry to update the Recovery Strategy.
- A multi-species recovery plan for Pacific Rim with 5-year implementation plan will be coming out soon including actions for CSE and Pink Sand-verbena.
- Undertake additional translocations, habitat restoration (including beach log removal) and continue monitoring.

Discussion:

- Where did the mystery plant come from at Clo-oose Bay? It was likely in the seed bank. Also, the seeds do float so perhaps it came from Oregon or Washington State.
- How was the seed germination rate increased? Originally, Matt Fairbarns got lucky with very few seeds germinating out of hundreds of seeds, but once a plant germinates, they produce lots of seeds. Techniques like de-husking achenes, cold stratification of seeds and fertilizer in root trainers also helped with germination rates through time.
- Achieved about 80-90% germination from seeds. Conducted trials using several different treatments (UV light, heat mats, fertilizer, depth of planting, gemination media, mass tray and single cell horticulture block trays) and it was found that shallow (2mm) planting in single cell horticulture block trays in a sand perlite media was best overall (with better initial germination rates on heat mats but with the tendency to have lower survival - mostly due to not turning the mats off or transplanting soon enough). In all of the efforts, the seed was removed from the achene and the only trick there was to avoid nicking the seed – and that was learned to be done effectively.
- It was suggested that a more passive approach could be to create lots of seed in the nursery and inundate areas (as seeds can persist over time). Mike Collyer has tried this approach with variable results. Early work at Clo-oose used some seed planting trials and had poor response. Creating a seed bank could be possible with benefits not seen for several years. Scattering seed should be effective with the new plants likely to generate many more seeds because the plants have more room to grow than in a tiny greenhouse. However, it might be less expensive/seed to grow fewer plants in the greenhouse and scatter fewer seeds each year than could be produced by a crop of out planted plants.
- For the issue of beach logs that act like rolling pins, could allowing beach fires work as management? The issue of beach logs is still being discussed and the project tried to avoid areas with lots of logs. Allowing the public to help with management through beach fires could be problematic as to avoid encouraging fires on a large scale. Another option is to have crews buck up the logs and burn them.
- More data is needed regarding the amount of beach logs and their impact. There is some indication that there are less logs now due to less logging. Hakai Institute had an article regarding the impact of beach logs that is worth reviewing.

Dynamic Dunes - 10 years of Coastal Sand Ecosystem Restoration and Recovery of Associated Species at Risk at Pacific Rim National Park Reserve

Mike Collyer of the Parks Canada Agency presented on the details of the sand dune restoration work at Pacific Rim National Park Reserve that has been on-going for over 10 years.

In the CSE status report, Page et al (2011) identified 11 CSE sites within Pacific Rim National Park Reserve (PRNPR) and noted that the park "protects the largest concentration of sand beaches and dunes on Vancouver Island". This restoration work has focused at the Clo-oose Bay (Cheewaht), Keeha, Wickaninnish and Schooner Cove sites.

Several SARA listed (or soon to be listed) species call these sites home, including: Pink Sand-verbena (PSV) (which Ross has discussed; contributing to its recovery was one of the primary drivers for this restoration project), Edward's Beach Moth (*Anarta edwardsii*) (with the only known occurrence in the park being an individual collected by Nick Page in 2001), Sand-verbena Moth (SVM) (summer student Dave Lawless photographed the only known occurrence in the park in 2011) and Silky Beach Pea (*Lathyrus littoralis*). There are also many other species of conservation concern.

In Pacific Rim, the main threat to CSEs are invasive beach grasses (*Ammophila arenaria* and *A. breviligulata*). These grasses disrupt sand transport, which is needed to maintain the environment that the rare CSE species require.

Folks at the park and one crusader in particular (the late Barry Campbell) recognized that the invasion of *Ammophila* spp was a serious problem and were trying to tackle the issue as early as the late 1990s.

In 2008/09, additional federal funding was secured to: 1) undertake habitat restoration at three sites – Wickaninnish, the mouth of Sandhill Creek (Combers), and Cheewaht; 2) establish PSV at three sites (Wickaninnish, Keeha and Cheewaht) and further develop the PSV propagation and translocation program; 3&4) Engage First Nations partners and the public and park visitors in participatory learning experiences and outreach; 5) monitor and further understand geomorphological processes (sand transport and topography) in partnership with Ian Walker's group at UVic (see the poster for their results); and 6) monitor response in vegetation and ecological communities to restoration efforts.

The project encountered several challenges and developments that modified the objectives, including: the detection of SVM in 2011 (that added the need for moth monitoring/inventory activities), the discovery of unexploded ordnance at the Wickaninnish site in 2012 (that temporarily halted restoration work at both Wickaninnish and Combers sites), and changes in staffing and budget allocations from the 2012 federal budget that resulted in a shift of restoration and recovery efforts for PSV from Clo-oose Bay and Keeha to the Schooner Cove dunes. Subsequently in 2013, there was an excellent PSV response at the new Schooner site and Schooner was thus swapped for Keeha as one of the three primary targeted PSV translocation sites. In 2016, after detecting a decline in Silky Beach Pea at the Schooner site and the concurrent development of its recovery strategy, Silky Beach Pea augmentation was added as one of the project objectives.

The restoration techniques used for invasive grass removal have primarily included hand removal (digging, pulling and cutting) and machinery removal. Early mechanical work was done using a backhoe with a root rake to try to shake the sand out of the grass and roots to make it easier to burn or otherwise dispose of. Pretty quickly the back hoe was traded for tracked excavators which are much better at getting around in the sandy environment and by the end of the work the best operators had mostly abandoned the root rake. Later in the work, there was less separating and more 'deep burial' using a horizon flipping technique where sand and grass roots were excavated to 1.5 m in depth, piled, and then cleaner sand was excavated and piled separately. The "dirty" (grassy) pile was then buried beneath the clean sand. This has turned out to be the most cost efficient method.

The project has used a large volunteering and visitor engagement program involving 1000s of volunteer hours annually. Volunteer events, school groups and individuals have all contributed to the project. Manual removal of grass by hand was particularly important when working around rare plants and other features that we did not want to impact. There was also small trials of burring, weed whacking, and light limitation. The light limitation worked and was conducted by a UVic Restoration of Natural Systems student. This involved covering the grass or hand removal areas with tarps and cardboard. This was labour intensive, although it seemed to be effective.

At the Wickaninnish site, Page et al (2011) found that the extent of sparsely-vegetated dunes declined from 16.5 ha in 1930 to 9.2 ha in 2007 (56% decline). Heathfield and Walker also measured changes to open sand in the Wickaninnish dune system between 1973 and 2007, using air photos, and found a 28% loss of open sand. In the Wickaninnish to Combers zone, 26.5 ha of CSE habitat was dominated by *Ammophila* spp. By 2011, 2.51 ha had been treated/restored. Invasive grass control continues in "restored" areas, using both park staff and volunteers, to keep the invasive grass from returning. Ian Walker's group found that the restoration work increased sand transport dynamics and, at least along one section of the Wickaninnish site, the dune is being seen to expand into the forest.

The effects of invasive grass on both habitat and infrastructure at Combers/Sandhill Creek (where the area dominated by the invasive grasses has been rapidly expanding) were discussed. Efforts to reverse these effects by digging trenches through the expanding "spit" or foredune separating the river from the beach in an attempt to wash out the tip of the "spit" were not successful.

At the Clo-oose/Cheewaht site, a comparison of airphotos from 1930 and 2007 showed how the small dune had been cut off from the beach by forest that grew up along the foredune. There were no invasives at Clo-oose/Cheewaht, but it is believed that a higher than natural density of drift logs (associated with forestry operations over the last century) were washed into the backshore and caused accretion of sand. This provided new sites for vegetation colonization, leading to an accelerated succession of the foredune to forest. Additionally, while still on the beach these logs are one of the threats identified for survival of a PSV population both by occupying habitat and by their destructive action when moved by winter storms. As discussed by Ross, the efforts to establish PSV both on the beach and in the dune (while it was cut off from the beach) had only limited success.

At Clo-oose/Cheewaht between 2010 and 2015, and working with the Ditidaht First Nation, the following occurred: trees were felled, a BCFSC chainsaw operator's course for DFN and Park personnel was put on, downed vegetation was bucked and removed, and, finally in November of 2015, an excavator was flown in to remove stumps, roots and soil. This returned most of the foredune to an unvegetated mineral soil (sand) state. The 2016 planting of Pink Sand-verbena in the newly restored area has shown the best results at the site to date and two Silky Beach Pea plants were also found at the site (this species had not previously been known at this location and may have arose from seeds long buried by the tree island). Maintenance by periodic removal of new drift logs deposited in front of, and on, the restored foredune will be required on an ongoing basis.

The presentation ended with brief discussions of work at Keeha and Schooner, the Pink Sand-verbena propagation work, moth surveys, the establishment of critical habitat in the park for the Sand-verbena Moth and other CSE related aspects of the park's new SARA multi-species action plan. The current status of the recovery work was summarized: 29% of CSE habitat dominated by invasive grass has been treated; dynamic sand transport regimes have been re-established at

the Wickaninnish, Schooner and Clo-oose/Cheewaht sites; and in addition to the PSV results Ross covered, the response in terms of increased area occupied by Pink Sand-verbena, Silky Beach Pea and Yellow Sand-verbena was presented.

Coastal Sand Ecosystem Overview of Cordova-Sidney Landscape

Nick Page of Raincoast Applied Ecology presented on the CSE of the Cordova Shore, James Island and Sidney Island location on the southeastern part of Vancouver Island. The presentation covered the geological, ecological and cultural landscape, the vegetation and resources. The botany of the CSE of this area includes plants well adapted to the environment, including Black Knotweed (*Polygonum paronychia*), Yellow Sand-verbena (*Abronia latifolia*), Contorted-pod Evening-primrose (*Camissonia contorta*), Silver Burweed (*Ambrosia chamissonis*) and Silky Beach Pea. Invasive Scotch Broom is certainly a threat with some areas dominated by 'old growth' broom. However, it is likely that many of the native species persist in the seed bank of the sand. Yellow Sand-verbena (YSV) can create many seeds which are adapted to blow across sand and persist in the seed bank for decades. There are also adapted moths, such as the federally endangered Edward's Beach Moth (*Anarta edwardsii*) which is the most dominant moth on James Island. However, its host plant is unknown. This lack of knowledge makes recovery planning challenging. Fallow deer eat black knotweed and sometimes it is necessary to add an enclosure to protect the plant. The endangered Contorted-pod Evening-primrose is thriving in some places, such as Sidney Spit and is dominant on James Island.

Discussion:

- What factors determine which plants are growing where? A normal CSE will have beach grass (*Leymus mollis ssp. mollis*) and Beach Pea (*Lathryrus japonicus*), but then it depends on a variety of factors: on stochastic variation, transit, on the other colonized plants, and type of zonation, topographic, soil.
- With Large-headed Sedge (*Carex macrocephala*), sometimes it looks like nothing else grows with it – is it something to do with chemistry? Likely due to resource partitioning. Once it gets established it outcompetes the other CSE plants.

Restoration of Coastal Sand Ecosystems on Sidney Island in Gulf Islands National Park Reserve

Pippi Lawn of Parks Canada Agency presented on two years of work to restore CSE on Sidney Island located in the Gulf Islands National Park Reserve. The restoration work was undertaken to improve habitat for six species at risk that occur at the site, including the endangered Contorted-pod Evening-primrose. The Contorted-pod Evening-primrose population was heading towards extirpation due to encroachment from invasive species such as Scotch broom and European beach grass. Other species at risk include the Edward's Beach Moth, Common Nighthawk (*Chordeiles minor*), Silky Beach Pea, American Glehnia (*Glehnia littoralis* ssp. *Leiocarpa*) and Yellow Sand-verbena.

The species at risk depend on open sand spaces amongst scattered, low-profile vegetation. Large thickets of Scotch broom and invasive European beach grass were reducing open spaces and stopping sand movement. As a consequence, the species at risk were being limited to a narrow band just above the high tide mark and there was concern that a storm could wipe them out. In addition, the area is popular with people and trampling was a threat. The project

removed all the Scotch broom from the site, cleared European beach grass from priority areas and installed closure fencing and signage to better protect the area.

Invasive plants were removed manually and then burned. Hand saws and brush cutters were needed to remove the mature Scotch broom. Re-sprouting was minimal and there was very little germination of broom from the seed bank, unlike in other, non-CSE areas. The invasive beach grasses have underground rhizomes that re-sprout and must be re-treated regularly. The first pass of invasive grass removal is time-consuming, but repeated treatments are easier. Volunteers were recruited to help treat the European beach grass. Once removed, the grasses were piled on pallets to dry out and then burned. During the work, it was found that the Contorted-pod Evening-primrose germinated at the site in November.

To assist in the recovery of the Contorted-pod Evening-primrose, in partnership with the species at risk rare plant nursery at Fort Rodd Hill National Historic Site, additional seeds were sowed at the site. As a result of project activities, the population size of the Contorted-pod Evening-primrose at the site was increased by 950% relative to previous years, with over 30,000 new plants added to the population. The project has also resulted in an increase in the number of Silky Beach Pea shoots at the site following restoration. To aid with monitoring, innovative Unmanned Aerial Vehicle technology was used to conduct detailed, three-dimensional, topographical surveys, in partnership with Mike Collyer of Parks Canada Agency. In regards to managing visitors who might find the newly open area appealing, signage and fencing were installed. New website information was developed, and new interpretive signage will be installed soon.

Discussion:

- Question regarding the driftwood percentages and its impact on wildlife habitat. There could be more studies done on this. One student (Rebecca Tranmer) found that Nighthawks use CSE areas that contain small woody debris, possibly as it can provide some camouflage.

Highlighting the Cultural and Ecological Values of the Island View Beach Area

Seliliye (Belinda Claxton) of the Tsawout First Nation presented on the cultural and ecological values of TIXEN, also known as the Island View Beach Area, located on southeast Vancouver Island. The Tsawout First Nation population was initially 7000 people, but now numbers 1000, which has greatly affected her people. She shared her extensive background and that she has expertise in nature walks, medicinal walks and knowledge of their language. Through her family and others such as Nancy Turner, Nick Page and Kate Shapiro, she has learnt about the unique CSE found in the area. She shared with the audience some traditional and family stories of the area (such as the giant people and crabs that lived on James Island), and about how the area has changed over time. She and her family may not have known initially about the CSE and its uniqueness, but always were respectful in traditional ways and learned of some traditional uses, such as using reef nets made of cedar, stinging nettle and dune grass that could be naturally recycled once used. She stressed that teaching the traditional ways, including the use of native plants, is important to the community and our children. She encouraged more respect of the land and the planting of native plants such as those with berries and wild crabapples.

She brought copies of a photobook *TIXEN: A Special Place* published by the Tsawout First Nation that gives an overview of the cultural values of the species and ecosystems of TIXEN (the Tsawout name for the CSE habitats in their territory).

Discussion:

- How can/should non-natives share traditional First Nation knowledge and stories? Belinda's opinion is that anyone should feel free to share the stories otherwise they will be lost. But to be sure to be properly familiar with the traditional uses of various native plants.

Island View Beach Management Plan

Todd Golumbia, Environmental Conservation Specialist of the Capital Regional District (CRD), gave an overview and update on the Island View Beach Management Plan within the context of Coastal Sand Ecosystem (CSE) restoration issues. His presentation discussed the many complexities and considerations when looking to restore an area. To give some context about the plan, he gave an overview about the park whose public use has been increasing. Although the natural areas have been extensively modified over the years due to past agricultural practices, shoreline modifications and wetland drainage, the park has some good remnant natural areas with CSE.

The basis for updating the management plan in 2011 was, in part, to incorporate eco-cultural restoration concepts developed as part of the larger Cordova Shore (TIXEN) plan. This approach was somewhat ahead of its time. The park management planning process was discontinued due to public pressure. The process was rebooted in 2015, but due to a lack of clarity around park objectives, values and habitat conditions a common understanding was elusive and differing ideas about what the priorities were led to a lack of trust.

In order to move forward and to build a higher level of trust, CRD relied on third party experts to provide data on species at risk, ecological mapping and critical habitat. The information presented was held to a high level of scrutiny and, this factual information was intended to better inform the discussion. For example, the park is home to several species at risk. The BC Conservation Data Centre was asked to provide all occurrence data for the area and Environment Canada was asked to provide all the critical habitat designations and mapping data. These data were used by CRD to create a SAR factsheet and further details on critical habitat and jurisdiction to provide clarity. One challenge in providing clarity was that each of the recovery strategies for the listed species (Contorted-pod Evening-primrose, Edward's Beach Moth and Sand-verbena Moth) was inconsistent with respect to descriptive wording and mapping approaches to define Critical Habitat. It is important to reduce confusion for stakeholders by using consistent and accurate data. All reference data used was available publicly through the responsible agencies data servers. However, this alone does not lead to consensus.

In spring of 2017, another revision of the management plan was created to reflect a gradient of natural habitat values in the north and recreational values in the south. Like any compromise, not all were happy, but it was seen as an improvement. Restoration planning was initiated in preparation for management plan approval. The CRD is now in discussions with the Tsawout regarding park management and collaboration across the larger landscape (Cordova Shore or TIXEN).

There are many lessons to be learned. When you lose trust, it is difficult to win it back. To develop trust, achieve a common understanding in the beginning, identify values and common interests and have agreement to use clear information and information sources to deal with the challenges of fact versus fiction. Create a common understanding that balances between values and science. Listen first and leave no one behind.

Discussion:

- Did people purposefully misunderstand the information presented? No that was not the case.
- To dispel misinformation, the CRD went down to the beach and set up an info table to engage park users in person. At first many expressed anger due to the information they had heard. However, once they had a calm and informed discussion about their values and the landscape, people generally calmed down and became supportive.
- What about entitled people that are only interested in their individual use of the park? Communication is best. We don't need more info/data, we all need to express ourselves better. Everyone has a right to express themselves. It is important to move forward, not back.
- Stakeholders wanted more information about natural values, to better understand and make informed decisions. Provide opportunities for learning and understanding, keeping in mind how different demographic groups or age groups offer and receive information.
- Many residents feel a sense of ownership and stewardship towards the park. All opinions are valid, they need to be communicated effectively.

Rathtrevor Beach Provincial Park Sea Wall Removal and Coastal Sand Ecosystem Restoration Project

Erica McClaren of BC Parks presented on a recent project to remove a 650 m long seawall constructed in 1971 at Rathtrevor Beach Provincial Park located in Parksville on Vancouver Island. When this seawall was first built, it did not take long for erosion and beach loss to occur. The aesthetics of the wall were also not appealing. The planning process to remove the wall began in 2013. Modeling showed that the area was highly sensitive to shoreline erosion. Options were brought forth with one to remove the seawall and let natural processes occur. The other option of seawall removal included its removal followed by the addition of materials that mimic what the shoreline was like historically. This second option was chosen.

This green-shores approach involved bringing logs back by attaching woody debris via rock ballasts. In the planning process, there was consideration taken that this was an archeological site. One new site was found near the seawall and during the restoration process there was an archeologist and First Nation representative on site to observe. Maps were created to show the original extent of the CSE location. Many areas have been disturbed and have potential for restoration. There was a significant community outreach and a consultation component before the work was undertaken. Little feedback resulted from the consultation process and no public concerns were raised.

Work began with salvaging the native plants (with consideration for their deep tap roots). They were stored in parking lots in boxes and the work was done in the fall. Seeds were also collected from Silver Burweed plants. It took two days to break up the wall. New beach material was brought in to bring back the historical grade of the beach and care was taken to match the sizes/composition of the existing sediment. Considerations for forage fish habitat were also taken. Logs with root wads were hard to source. Two logs were placed on the front, with one behind and then wired with rock anchors. The salvaged plants were then planted and there was adhoc seeding of the Silver Burweed seeds – half in the fall and half in the spring to test the efficacy of each timing window. Some beach access management occurred with the placement of split-rail fencing and access signs. Monitoring is occurring with some regrowth already happening. This restoration project is relatively new and the restoration efforts have just begun. There is lots of potential for future work.

Discussion:

- Where did you get the materials? And will you have to undertake maintenance of the work done? Materials were found locally in Nanoose. Additional maintenance may have to occur but it is hoped that the sand bar off Rathtrevor Park will bring sand in. It is hard to know if the original sand source still exists. Time will tell.
- What was the historical amount of logs? It is unknown. Information from Cape Scott and Vargas Island both show the issues of having not enough and too many logs. It is simply hard to know the balance.
- How did grasses transplant? So far they are doing well and hopefully will fill in.
- The added sediment is also doing well. During the project a storm came in and did a natural adjustment. The sediment seemed to do well this winter too.
- Project video done by BC Parks can be found here: http://www.env.gov.bc.ca/bcparks/explore/parkpgs/rathtrevor/
- Next steps will be to diversify the ecological community and to do more research regarding what was there previously.
- Question regarding the seawall project public consultation. There was no open house, but discussions were had and letters circulated to neighbours who were supportive. Once the work was done, some didn't even realize the seawall was removed. It did impact some orchids that the community value, but the plants came back.

Coastal Sand Ecosystem Restoration at Metro Vancouver Regional Parks

Tamsin Baker of the South Coast Conservation Program (SCCP) gave a brief summary on the CSE restoration activities occurring at Iona Beach and Boundary Bay Regional Parks on behalf of Robyn Worcester, Natural Resource Management Specialist for Metro Vancouver Parks. Iona Beach Regional Park is one of only two areas of CSE left in the Fraser Lowlands and has three red-listed ecological communities. A significant threat has been the spread of Scotch Broom. Broom removal using volunteers was not achieving the desired results, so Metro Vancouver implemented an accelerated Scotch Broom removal project to reduce the seed bed and implement restoration and monitoring. The work began in 2012/13 with two different kinds of treatments. One was only broom removal and the other was the removal of the topsoil and levelling of the subsoil. Planting of native CSE plants (such as dune grass plugs) occurred and long-term vegetation monitoring plots were established. Work has continued in additional areas of the park from 2015 to 2017, with the help of many volunteers doing the native plantings and removing re-growing Scotch Broom and Himalayan Blackberry. For sites where topsoil was not removed, these sites have been re-treated. Most recently an area of grass lawn along the new boardwalk was restored back to CSE habitat. Evidence of *Bruchidius villosus* (Seed Weevils) and *Aceria genistae* (Nalepa) (Gall mites) have been seen. Since 2012, over 9 hectares of invasive species have been removed. One interpretive sign was also installed. Into the future, volunteer maintenance will continue, as well as the possible use of contractors in higher regrowth locations.

In Boundary Bay Regional Park, the Boundary Bay Park Association (BBPA) started a stewardship program in 2017 focusing on invasive plant removal. They succeeded in removing all the known large Scotch Broom plants from the park and then focused on Himalayan Blackberry. During their annual EcoBlitz event, BBPA volunteers planted 550 dune grass (*Leymus mollis*) plugs and pots to restore the CSE vegetation near the beach. The planting restored a corridor of beach along a trail from the foreshore into the park. The area restored

had been impacted from recreational activities, storm damage and off leash dogs. Logs were moved to protect the plants and to encourage park users to stay on the trail. BBPA staff and volunteers will maintain and monitor the site for years to come.

Discussion:

- Question about google groups type format or similar to facilitate ongoing networking in CSE. This question was referred to the discussion at the end of this symposium.

Coastal Sand Ecosystem Stewardship on the South Coast

Tamsin Baker of the South Coast Conservation Program (SCCP) gave an overview on the stewardship activities undertaken on various South Coast CSE locations (Savary Island, Thormanby Island, Iona Beach and Boundary Bay) since 2012. To engage landowners, community members and land managers about CSE, a variety of stewardship activities occurred including creating displays, a CSE brochure (PDF at www.sccp.ca), community events and educational signage in various locations. There was also rope fencing placed to reduce trampling at Buccaneer Bay on Thormanby Island. Removal of invasives such as Scotch Broom occurred manually on Savary Island and Thormanby Island, with the help of the community. Broom removal on Savary will continue until March 2019. Most CSE areas on the South Coast are already protected, but a large 350 acre parcel with critical habitat for Contorted-pod Evening-primrose in the middle of Savary Island (known as DL 1375) is currently being purchased by the Savary Island Land Trust and The Nature Trust of BC through a public acquisition campaign.

A summary was also provided regarding the recently developed *Monitoring Protocol for Plant Species at Risk in Coastal Sand Ecosystems* by biologist Phil Henderson to monitor the Contorted-pod Evening-primrose populations on Savary Island using a citizen science-based approach. The protocol was tested in the spring of 2017 and the adjusted survey technique will again be used in May of 2018. A total of 779 plants were counted in the Meadows location of Savary, compared to 190 in the same area in 2004.

Discussion:

- What would be good types of weatherproof material for signage (e.g. how would we do our signs different now that we have seen what happens to them)? Best to ask your local sign printer. Best to pay extra for the better coating to stop UV damage.
- At Iona Beach, the broom came back. Why was it coming back there versus other sites where it was controlled better? Perhaps because of the large seed bank in the soil and the nearby broom plants still producing seeds that could blow into the restored area.
- Noted on Savary Island that it was very moss covered where the Contorted-pod Evening-primrose was. It might require some further site modification to help the plant along on other parts of the site.
- New funding announcement from Environment and Climate Change Canada (ECCC) on engaging youth with nature that could be investigated.

Discussion of Next Steps

Ross Vennesland of the Parks Canada Agency ended the symposium by leading a discussion on next steps for CSE recovery on the coast of BC.

Discussion:

- Increase the sharing of information and create a community of practice on-line with the ability to share documents.
- Using Google Groups and SharePoint was discussed. One issue is that Provincial staff are limited in what sharing platforms they can access.
    - **ACTION:** Ross Vennesland will investigate a format to create a community of practice on-line presence.
- There should be a broad CSE meeting every five years with regular meetings/webinars in the interim. Although a yearly in-person meeting would also have some value.
    - **ACTION:** To explore the possibility of an annual meeting: Pippi Lawn, Kym Welstead and Tamsin Baker to discuss.

- Consider going back to the Recovery Team format with a rotating chair.
- For funding, Kate Shapiro reminded the group that ECCC's Habitat Stewardship Program (HSP) and Aboriginal Fund for Species at Risk (AFSAR) funding are options.
- There may also be some new federal funding for connecting kids with nature.
- Other funding could come from local foundations, but depends on nature of the work.
- There is a need for funds to cover on-going work. It is important to maintain the gains achieved in the areas where restoration work has already occurred.
- Consider creating more partnerships to use each other's resources – such as volunteer lists from other groups. Better coordinate volunteer events to give volunteers a diversity of experiences.
- One challenge for getting added capacity is that some CSE areas are fairly remote – such as getting folks out to visit the west coast sites. Look into 'voluntourism' opportunities.
- Species at Risk Action Plans do not necessarily bring funding with them – there needs to be more of priority on this, for new funding to be created. Parks Canada is currently funding its internal multi-species Site-based Action Plans through a multi-year, multi-million dollar national effort.
- Be sure to include an indigenous and cultural aspect to the restoration work.
- Help from post-secondary field schools is an option. However, this can be expensive and there has been a shift towards schools wanting the activities to be closely tied to the curriculum with clear learning outcomes for the students.
    - The project must be 'sold' to post-secondary institutions. Can communicate research gaps to them for possible student projects. Have some interesting projects for students to do, but the projects should ideally be part of a larger research initiative.
    - Parks Canada provides good environmental student support through providing training and equipment.
- There needs to be some coordination on the educational messaging of CSE to raise awareness on stewardship. Make important connections and be consistent in wording.
- Share ways to make more permanent signs. The SCCP has examples of carefully worded CSE-related signs (www.sccp.ca).
- Look to invasive species educational campaigns for examples of larger-scale coordinated messaging.
- Have public events in accessible areas to engage and educate the community. Do educational walks showing the restoration projects.
- Create a CSE 'bucket list' brochure with a map showing all the CSE locations that can be visited to encourage education and stewardship.

Appendix:

Presentations, Posters & Abstracts

Overview of Coastal Sand Ecosystems in BC

1. What are Coastal Sand Ecosystems?

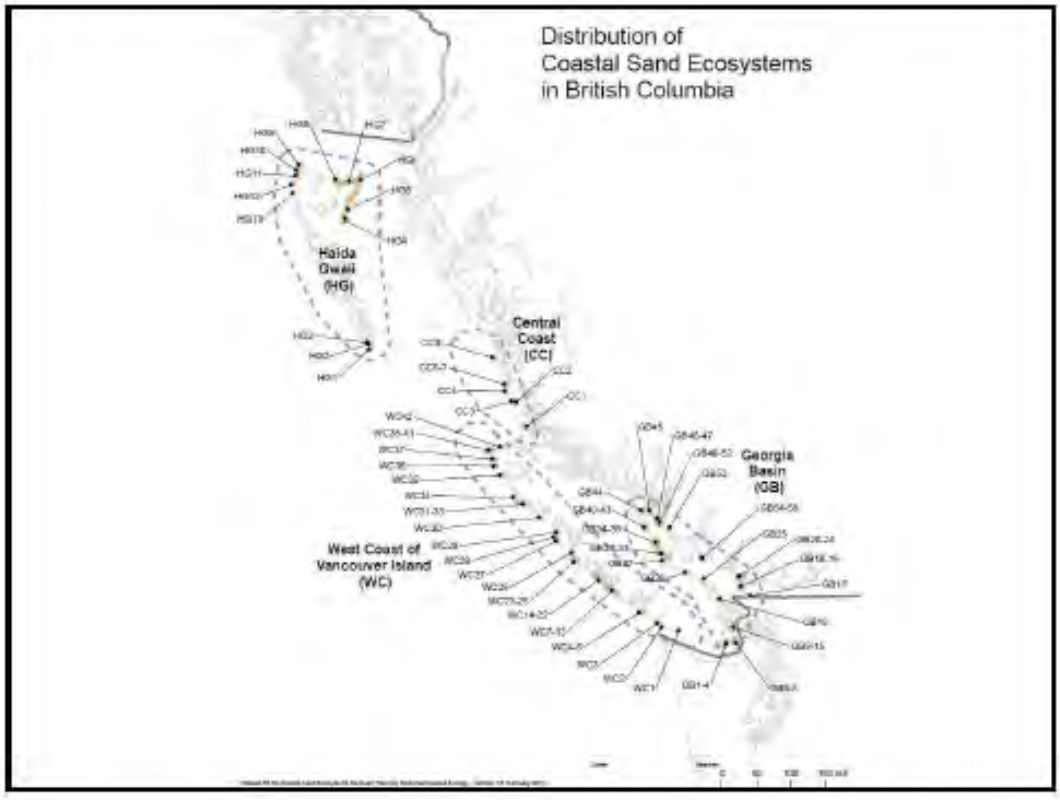
1. Coastal sand ecosystems encompass the terrestrial portion of beaches, spits, and dunes in which sand is the dominant substrate.
2. They contain sparsely-vegetated and herbaceous ecological communities, as well as associated forest, wetland, and bluff communities.
3. They are regionally rare, often isolated, and support species at risk.
4. They are structured by marine-related disturbance processes (e.g., sand movement, tides, storm surges, ocean spray), local climate, soil development, and vegetation succession.

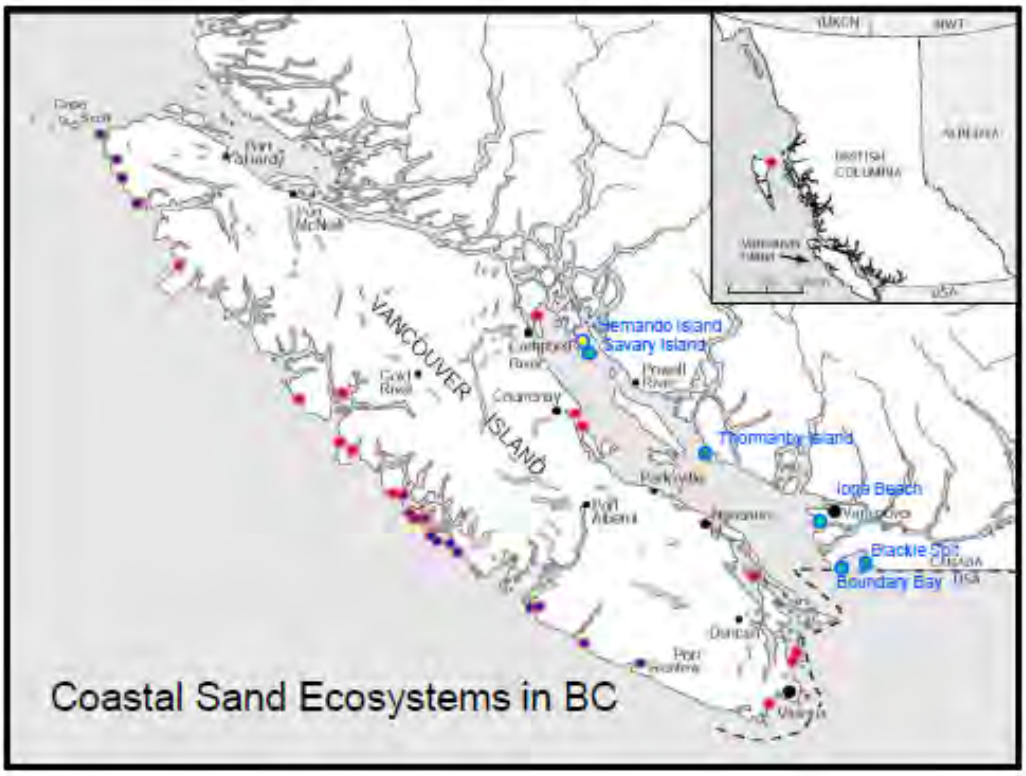

Representative CSE
- Marine – terrestrial interface
- Zonal communities
- Spatially distinct (islands)
- Sparsely-vegetated / herbaceous

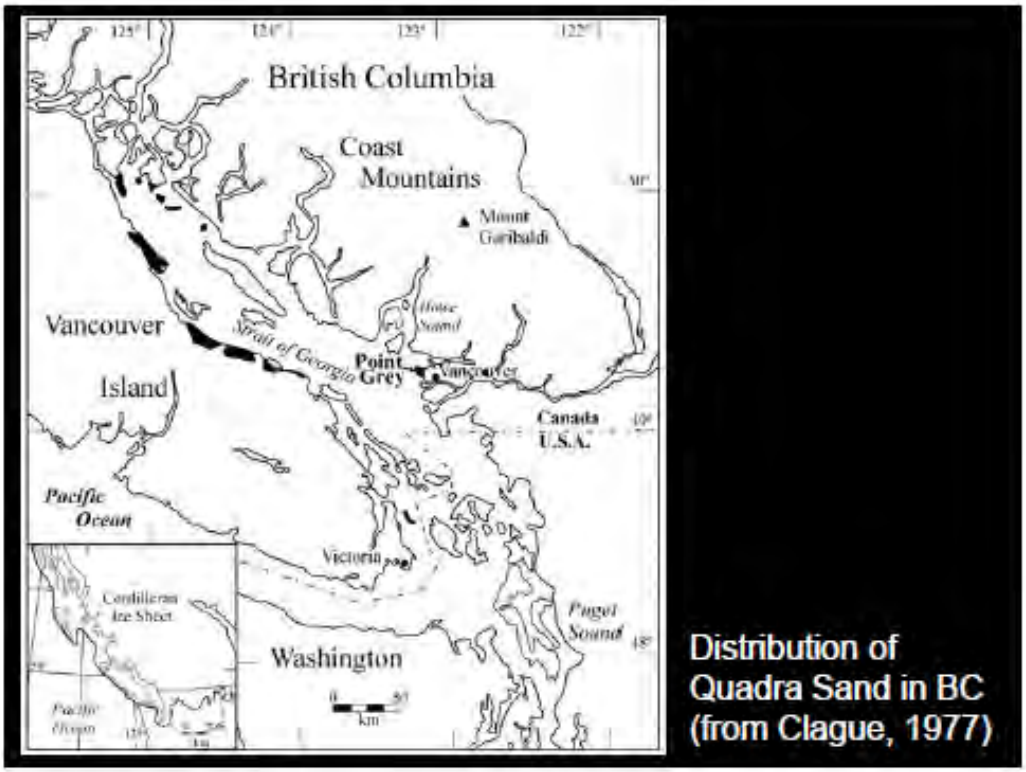

Open sand with sparse vegetation perennial vegetation

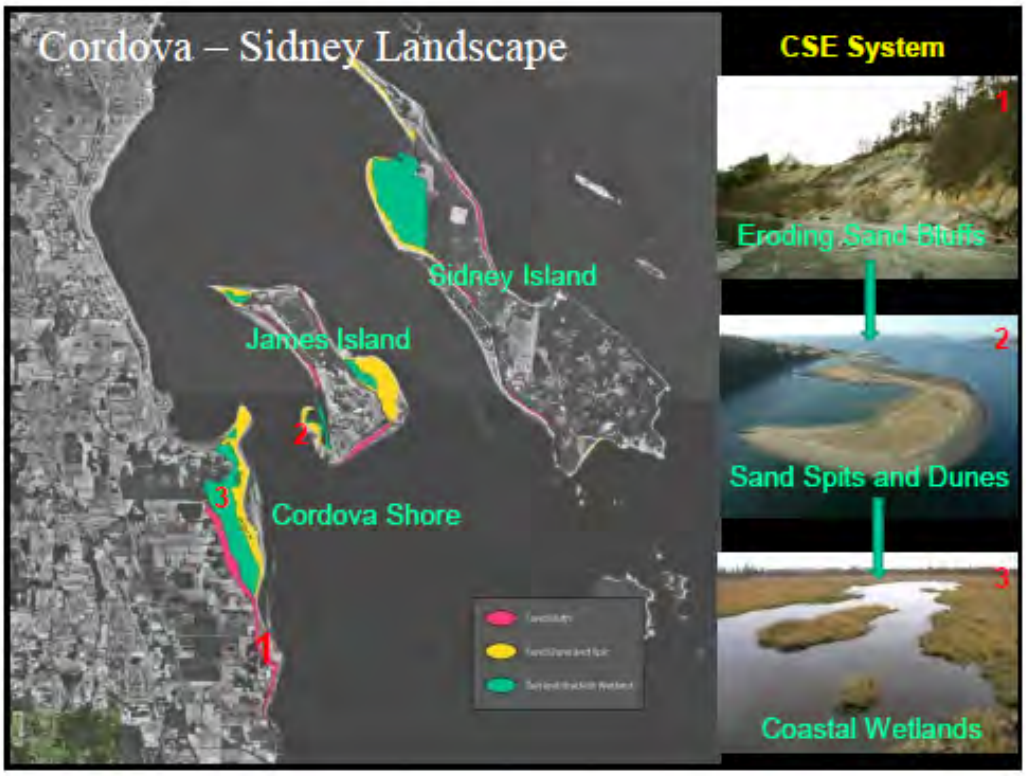
2. Distribution of CSEs

- Coastal sand ecosystems occur in four areas of BC:
  - (1) Georgia Basin (east coast of Vancouver island and the Fraser River delta);
  - (2) west coast of Vancouver Island;
  - (3) central coast; and
  - (4) Haida Gwaii
- Using an area-based assessment method, the area of occupancy for all (125) sites in BC is 2548 ha. This includes 60 sites in the Georgia Basin totaling 490 ha (19%), 43 sites on the west coast of Vancouver island totaling 245 ha (10%), eight sites on the central coast totaling 24 ha (1%), and 13 sites on Haida Gwaii totaling 1789 ha (70%).




YUKON
NWT
ALBERTA
BRITISH COLUMBIA
USA
VANCOUVER ISLAND
Hernando Island
Savary Island
Courtenay
Powell River
Thormanby Island
Parksville
Port Alberni
Iona Beach
Blackie Spit
Boundary Bay
Duncan
Victoria
Coastal Sand Ecosystems in BC


British Columbia
Coast Mountains
Mount Garibaldi
Vancouver Island
Strait of Georgia
Point Grey
Canada
U.S.A.
Pacific Ocean
Victoria
Cordilleran Ice Sheet
Washington
Puget Sound
km
Distribution of Quadra Sand in BC (from Clague, 1977)


Cordova – Sidney Landscape
Sidney Island
James Island
Cordova Shore
1
2
3
CSE System
1
Eroding Sand Bluffs
2
Sand Spits and Dunes
3
Coastal Wetlands


Vaucroft Beach
Buccaneer Bay Provincial Park
Gill Beach (Buccaneer Bay)
Thormanby Island

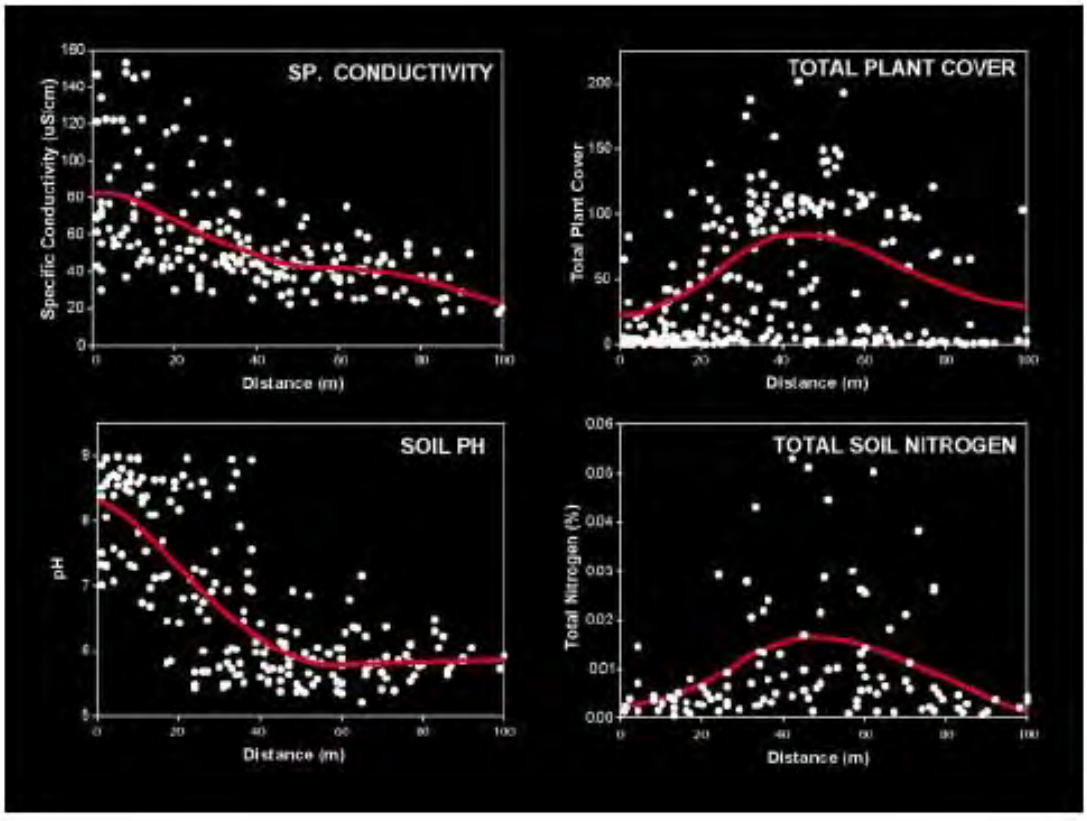
2. Physical and ecological processes

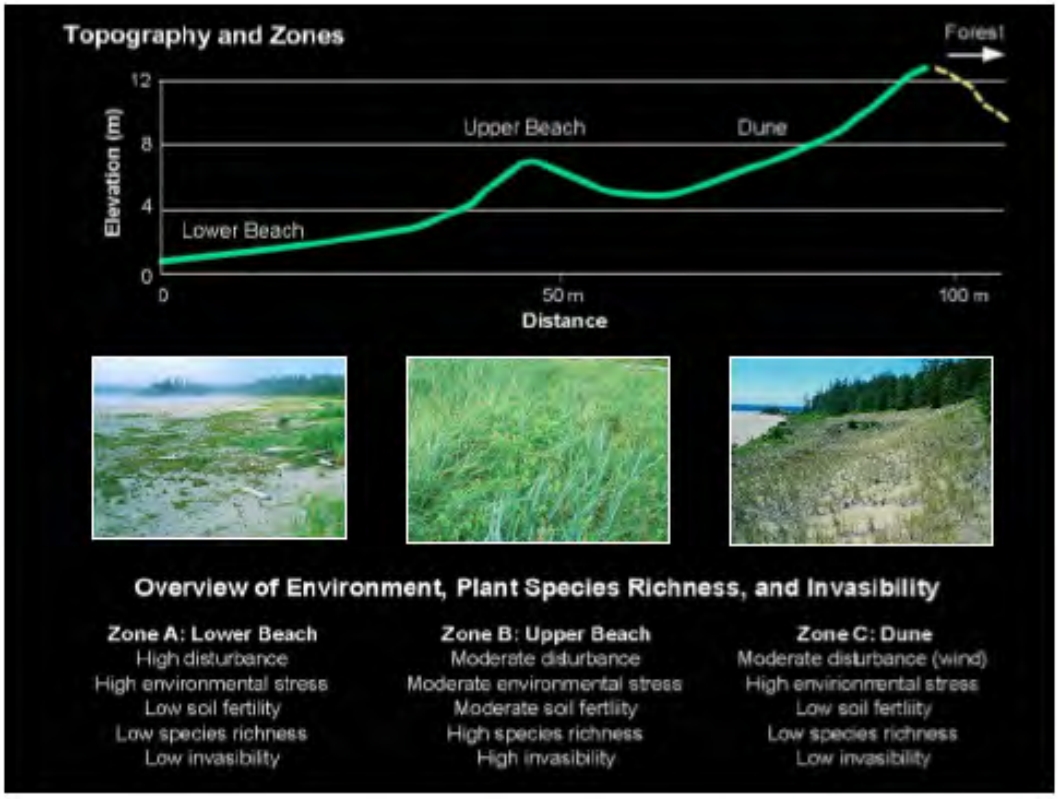
- Dynamic ecosystems that are sustained by frequent disturbance.
- Inhospitable physical environments for plants and an animals: dry, nutrient poor soils, frequently disturbed by sand movement, marine influence (water movement; salt spray).
- Often sparsely-vegetated because of competition for limited resources (water and nutrients).
- Zonal or banded patterns set by shoreline processes.
- Successionally complex: mix of ecosystems from very young to hundreds of years old.


Stressful physical environments

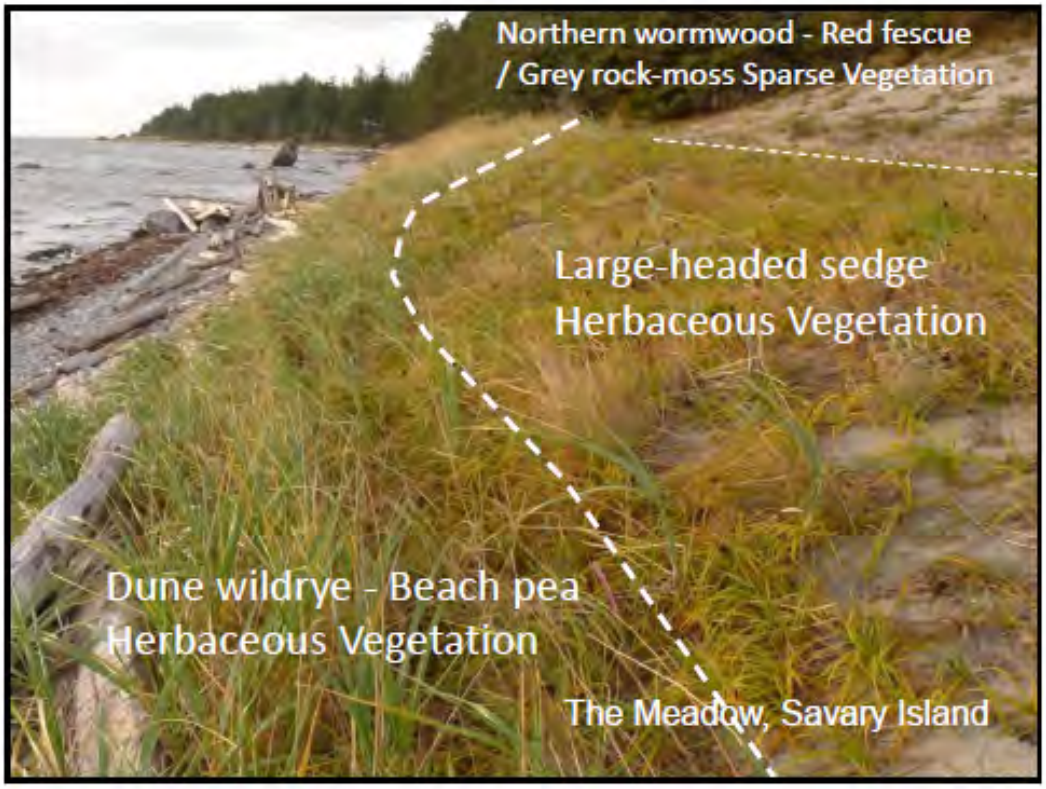

Local sediment transport (burial)

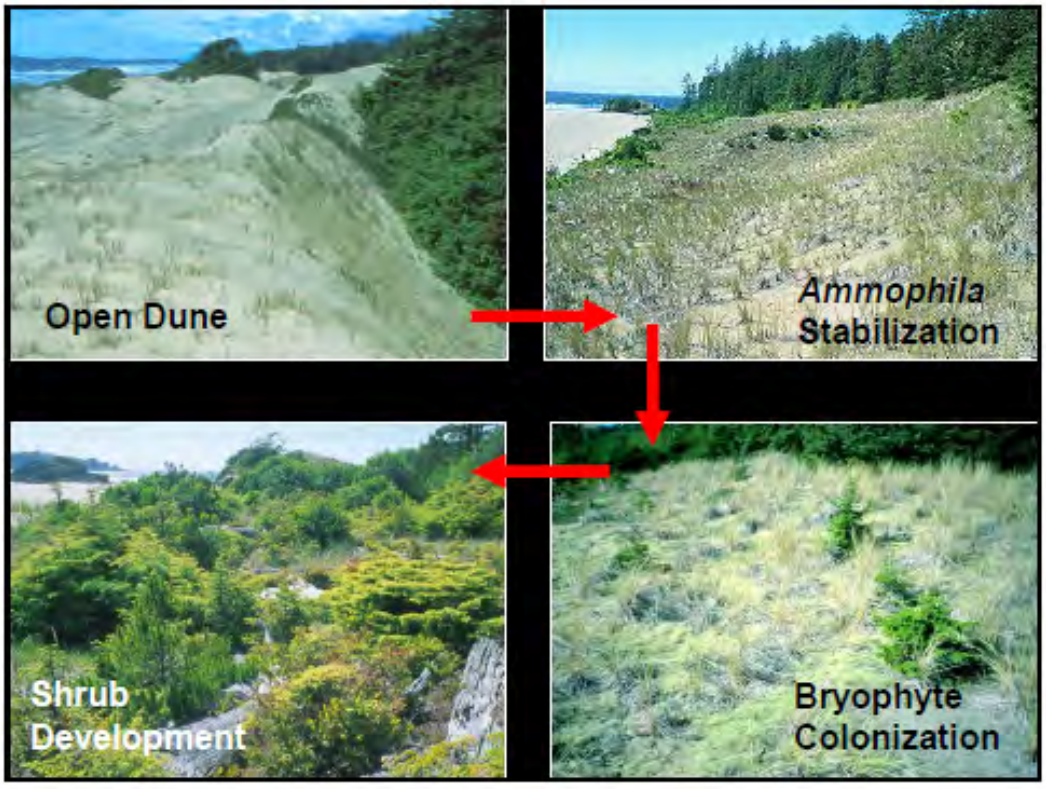

Episodic disturbance (tsunami scar?)
Keeha Bay, Bamfield, BC


SP. CONDUCTIVITY
Specific Conductivity (uSicm)
Distance (m)
TOTAL PLANT COVER
Total Plant Cover
Distance (m)
SOIL PH
pH
Distance (m)
TOTAL SOIL NITROGEN
Total Nitrogen (%)
Distance (m)


Topography and Zones
Forest
12
8
4
0
Elevation (m)
Upper Beach
Dune
Lower Beach
0
50 m
100 m
Distance
Overview of Environment, Plant Species Richness, and Invasibility
Zone A: Lower Beach
High disturbance
High environmental stress
Low soil fertility
Low species richness
Low invasibility
Zone B: Upper Beach
Moderate disturbance
Moderate environmental stress
Moderate soil fertility
High species richness
High invasibility
Zone C: Dune
Moderate disturbance (wind)
High environmental stress
Low soil fertility
Low species richness
Low invasibility


Zonal Plant Community Development
Vargas Island, BC


Northern wormwood - Red fescue
/ Grey rock-moss Sparse Vegetation
Large-headed sedge
Herbaceous Vegetation
Dune wildrye - Beach pea
Herbaceous Vegetation
The Meadow, Savary Island

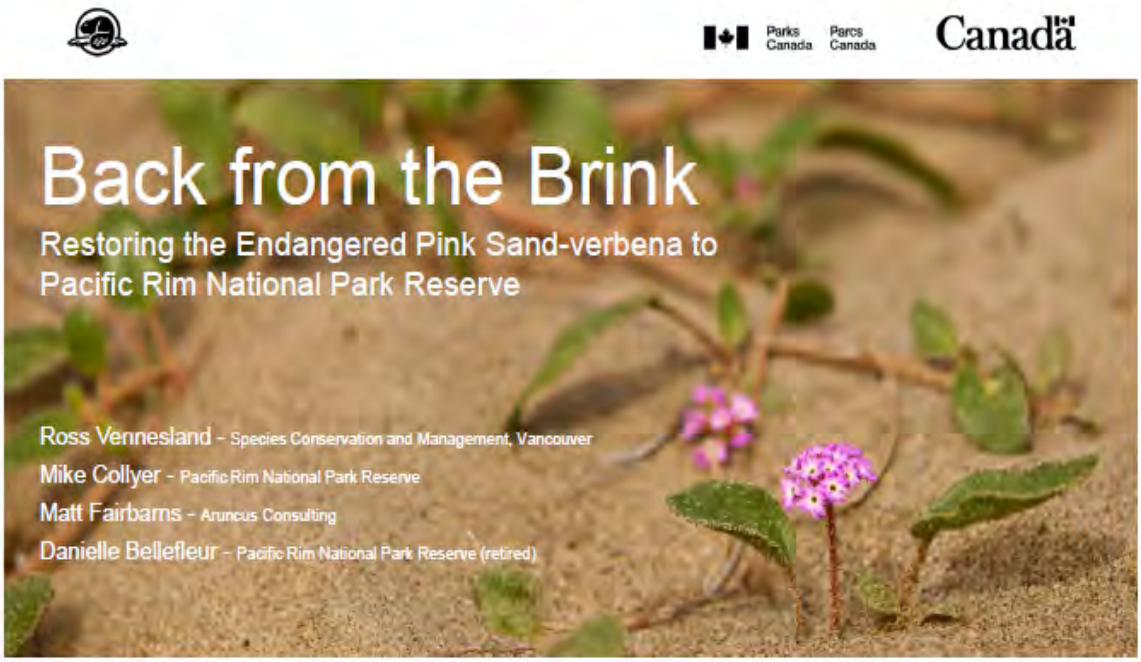

Open Dune
Ammophila
Stabilization
Shrub
Development
Bryophyte
Colonization

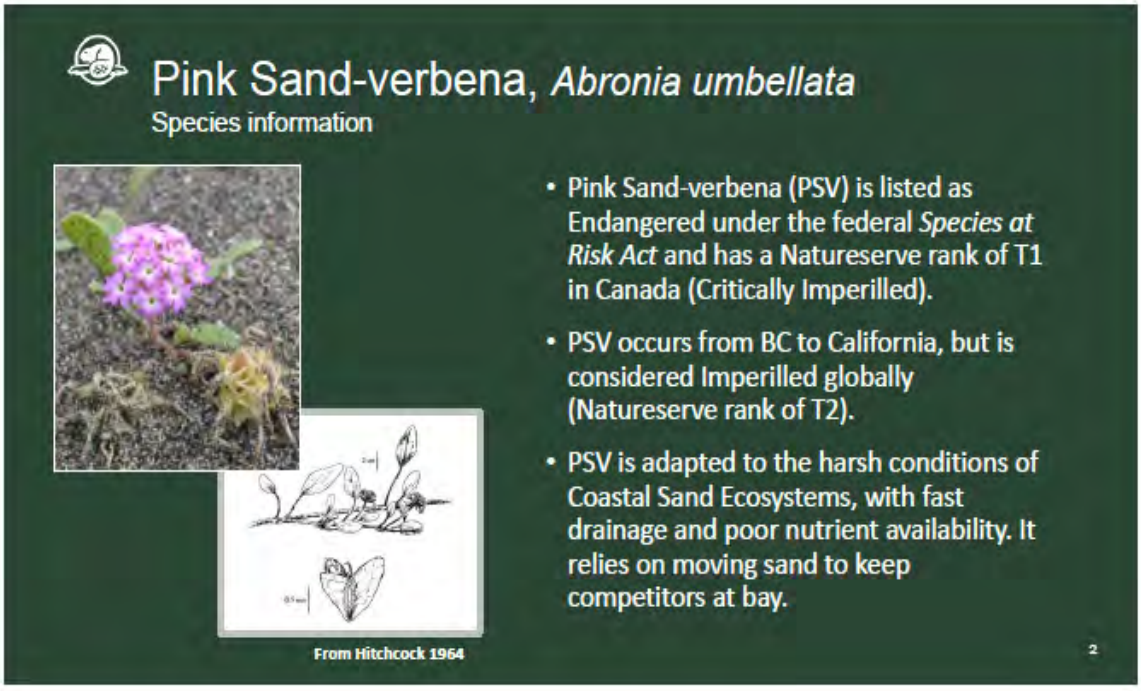

Dune succession
Cow Bay, Flores Island


Pairing of Sand Source Areas (feeder bluffs)
with Depositional Site (spits)
Example of Cape Lazo Bluffs and Goose Spit at Comox

Shoreline armouring can disrupt sand supply

Back from the Brink: Restoring the Endangered Pink Sand-verbena to Pacific Rim National Park Reserve





Pink Sand-verbena, *Abronia umbellata*

Species information

Primary threats and limiting factors affecting PSV and its habitat include:

- Demographic collapse
- Beach logs (logging debris)
- Invasive species
- Human disturbance

3

Pink Sand-verbena in Canada

Historical locations

- PSV is known from 3 historical locations in Canada:
  - Flores Island near Ahousaht (1915)
  - Pachena Bay (1927)
  - Clo-oose Bay (1941)
- Clo-oose Bay population re-appeared in 2000 (2 plants) and 2001 (3 plants) after an apparent 59 year absence.
- A perilous existence with high risk of demographic collapse.

4

Pink Sand-verbena in Canada

Range-wide surveys and recovery planning

- Surveys were conducted annually from 2006 to 2010 to look for any additional PSV populations and to assess potential sites for restoration of the species.
- No additional populations were discovered.
- 76 potential translocation locations were identified and habitat was rated based on the presence of 1) fine sand, 2) strandline ecology, 3) invasive species, and 4) human disturbance.
- Recovery strategy (2007) recommends that 3 viable populations be established, including Clo-oose Bay, using a local seed source.

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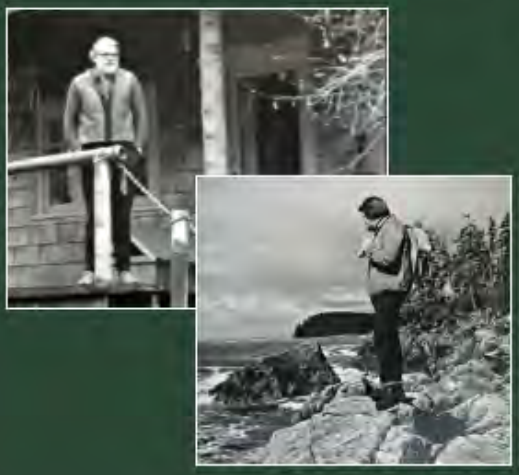
Pink Sand-verbena in Canada

Clo-oose Bay and Jim Hamilton



- Cloose Bay is a wild and remote location on the West Coast Trail, home of PSV, a mostly abandoned community and lots of human and botanical intrigue. There was a First Nation village (Clo-oose) and a European village (Cheewaht).
- Jim Hamilton (1931 to 2017) was the last long term resident of the village of Cheewaht. He worked on the telegraph line (first installed in 1890) to aid in rescuing shipwreck survivors.

6

Pink Sand-verbena in Canada

Clo-oose Bay and Jim Hamilton

- Jim spent many years looking for PSV after last seeing it in the 1940s when he was a young boy.
- His discovery of the return of PSV in 2000 was central to the success of this project due to the seed that he and George Douglas collected that provided a local seed source.
- He was an inspiration to everyone at Parks Canada.

7

Pink Sand-verbena in Canada

Project rationale

- The project was first initiated in 2006 to collect and propagate seeds collected in 2000-2001 at Clo-oose Bay (led by Matt Fairbarns).
- Although this species has always been rare in Canada, the restoration project was seen as an experiment to attempt enhancement of a peripheral population to mitigate risk of demographic collapse.
- When species decline, many persist on the periphery not the core, giving added value to the persistence of peripheral populations and especially for globally rare species.

8

Pink Sand-verbena

Propagation

- Clo-oose Bay seeds were obtained from George Douglas (n=14) and Jim Hamilton (n=500). Propagation began in 2006.
- Only one of the Douglas seeds germinated (the rest were attacked by a fungus).
- Most of the Hamilton seeds were not viable. Like the Douglas seeds, only one of the 500 seeds from Hamilton germinated.
- These two plants form the basis of the entire PSV propagation program. It is not clear if they are from one or two individuals.
- Thousands of seedlings have since been produced, through de-husking and cold stratification of seed.

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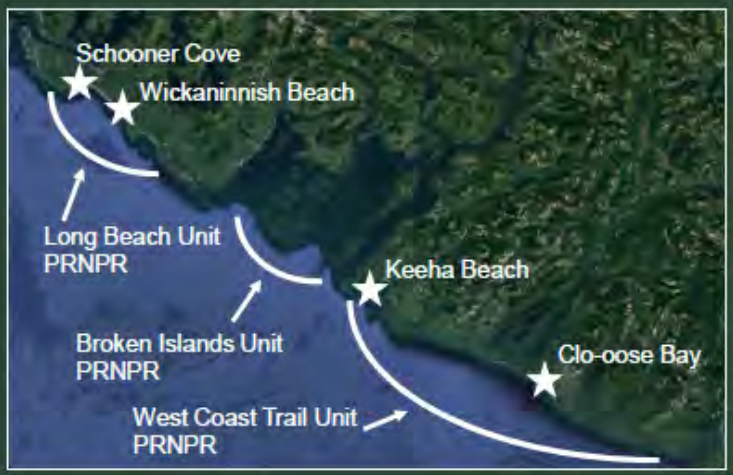
Pink Sand-verbena in Canada

Translocation locations



Translocations have occurred at 4 of 17 sites rated as high or medium suitability, all in Pacific Rim National Park Reserve (PRNPR):

- Clo-oose Bay (2008-2010, 2015-2017)
- Keeha Beach (2010-2011)
- Wickaninnish Beach (2010, 2011, 2014)
- Schooner Cove (2012-2015)

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Clo-oose Bay translocation results

Initial work – 2008 to 2010

- Initial outplanting occurred from 2008 until 2010.
- Investigations included:
  - Seeds vs seedlings (only 1of 740 seeds germinated)
  - Fertilized vs unfertilized plants (F<0.01; P>0.5)
  - Beach habitat vs dune habitat (Shoot length: T=2.5, P=0.04; Fruits: T=1.6, P=0.1)
  - Dune habitat appeared to be lacking in nutrients compared to the beach habitat
- Challenges faced included beach logs, herbivory (mammals and gastropods), winter storms.
- Plants grew well on beach, but with no habitat open to the sea above the storm line, efforts were moved to other sites until restoration could occur.

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Wickaninnish translocation results

Planting locations and plant dispersal in 2016

12

Schooner translocation results

Planting locations and plant dispersal in 2017

13

Overall translocation results

All sites pooled by year

The success of the program is demonstrated by the continuing stable production of natural plants as the number of translocated plants has declined from 2015 to 2017.

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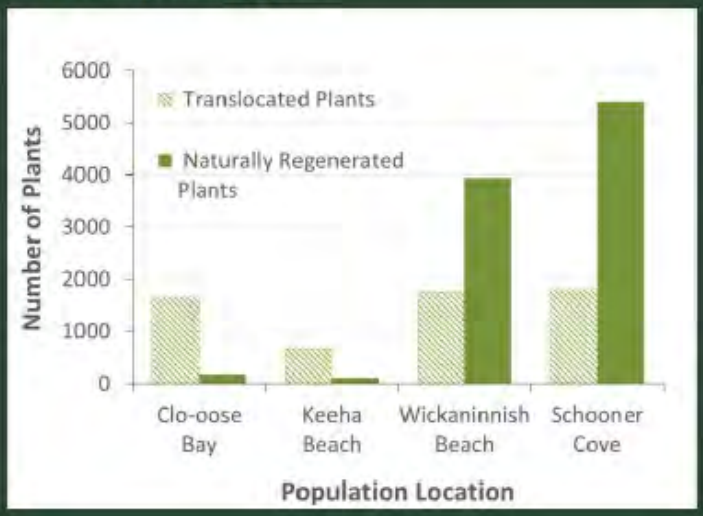
Overall translocation results

All sites pooled by year



Success limited at Clo-oose and Keeha, but substantial at Wickaninnish and Schooner (natural regeneration 2-3 x translocated plants). Recent habitat restoration efforts at Clo-oose will improve success there in future years.

15

Clo-oose Bay habitat restoration

Supplementary work 2010 to 2016

- Sometime after the 1930s, forest species colonized the foredune and by the 1970s completely cut off the dune from its oceanic influence. A natural but problematic situation for rare species.
- Between 2010 and 2015 the forest was removed. As part of this work an excavator was flown into Cheewaht to return the foredune to a un-vegetated sand substrate.
- Significant new planting is now underway on the upper beach at the dune entrance above the winter storm line.

16

Mesosite and fertilizer effects

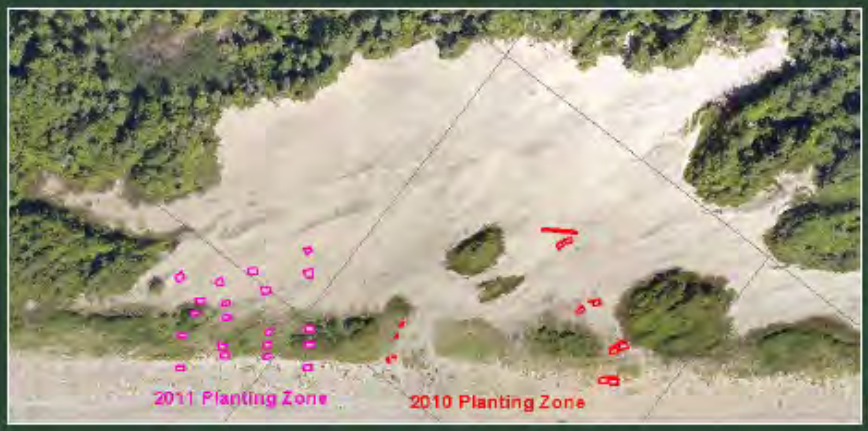
Testing effects of dune morphology and fertilization

- First tested at Clo-oose, but beach logs prevented a good layout. Nevertheless, the beach appeared better habitat than the dune at Clo-oose (nutrient load?).
- Beachgrass removal allowed for proper block layout at Wickanninish 2010-2011.
- Dune morphology investigated with several blocks and 2 treatments looked at the effect of fertilizer.
- About 80 plants per block (e.g., foredune, dune crest, backdune, dune swale) with half low fertilizer and half high fertilizer.

17

Mesosite and fertilizer effects

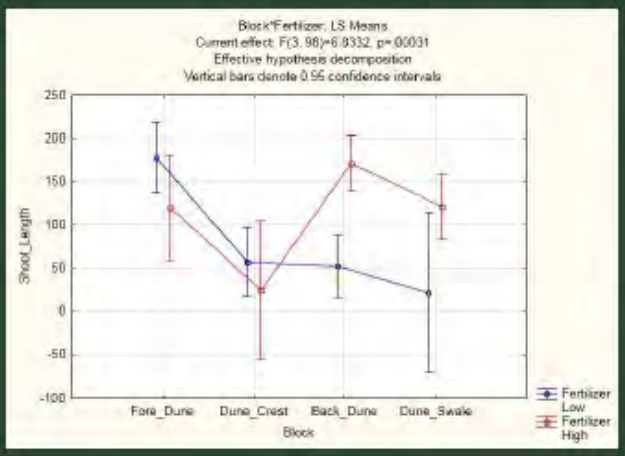
Testing effects of dune morphology and fertilization



18

Mesosite and fertilizer effects

Testing effects of dune morphology and fertilization



- Significant block x fertilizer interaction in 2011, so block and fertilizer analyzed separately:
  - Block - F=5.4; P=0.002
  - Fertilizer F=7.4; P=0.007
- Fertilizer had a significant effect only away from oceanic influence.
- Dune morphology (aka mesosite) had a significant effect only when fertilizer was not enhanced.

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Collaboration & Outreach

Many partners and collaborators since 2006

- Extensive support from First Nations:
  - Huu-ay-aht, Ditidaht, Tla-o-quiaht and Ucluelet nations have supported work on their lands and provided crucial assistance in the field
- Academic partners:
  - UVIC (Ian Walker)
  - Queens U (Chris Eckert, Karen Samis)
- Outreach and education:
  - Interpretive programs
  - Brochures, web site, media

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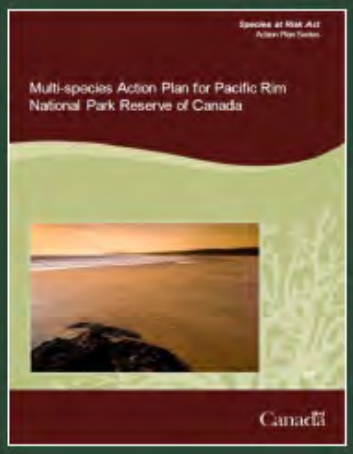
Next Steps



- Analysis and publication of results
- 5 Year Implementation Report soon to be posted on Species at Risk Public Registry
- Continued implementation of Site Based Action Plan posted in 2017
  - Population Viability Analysis
  - Additional translocations as feasible/necessary
  - Maintain dune habitat by removing European dune grass, tree islands, and beach logs from dunes. All previously treated dune habitat is maintained annually.
  - Key sites are surveyed annually and outlying areas are surveyed biannually to assess if a stable or increasing population is present at Clo-oose Bay (Cheewhat) and one or more additional sites.

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Dynamic Dunes - 10 years of Coastal Sand Ecosystem Restoration and Recovery of Associated Species at Risk at Pacific Rim National Park Reserve

SARA species of PRNPR CSE

Pink Sand-verbena (SARA Endangered)
Sand-verbena Moth (SARA Endangered)
Edward's Beach Moth (SARA Endangered)
Silky Beach Pea (SARA Threatened, pending)

Many other species of conservation concern including:

- Yellow Sand-verbena (host plant for Sand-verbena Moth),
- American glehnia, (G5T5, S3, Blue);
- Beach morning glory *(Convolvulus soldanella* syn. *Calystegia soldanella,* G5, S3, Blue);
- Large-headed sedge *(Carex macrocephala,* G5, S3S4, Yellow);
- Dune bluegrass *(Poa macrantha,* G5, S3S4, Yellow);
- Black knotweed *(Polygonum paronychia,* G5, S3, Blue);
- Dune tansy *(Tanacetum bipinnatum* ssp. *Huronense,* G5T4T5, S3S4, Yellow);
- California wax-myrtle *(Myrica californica,* a disjunct population from main population centre in Oregon and California, G5, S3, Blue).


Pink Sand-verbena


Silky Beach Pea


Edwards' Beach Moth


Yellow Sand-verbena


Sand-verbena Moth

Threats to CSE in PRNPR

Invasive Beach Grasses:

- *Ammophila arenaria* (European beachgrass / marram grass). Native to Europe and North Africa.
- *Ammophila breviligulata,* (American beachgrass) Native to the North American Atlantic coast and Great Lakes

High Drift Log Density

- Occupies habitat, acts as a destructive agent during winter storms, disrupts sand transport and provides sites for vegetation colonization


A. arenaria


A. arenaria on foredune


A. breviligulata


Drift Logs covering Pink Sand-verbena Critical Habitat at Cheewaht Beach

Early Restoration Work

Folks at the Park and one crusader in particular (the late Barry Campbell) recognized that the invasion of *ammophila* was a serious problem and were trying to tackle the issue as early as the late 1990s.

Back dune grass patch before and after removal by hand

First attempt to dig trenches through Combers "spit"

Restoration Project goals (2009)

1) Habitat restoration at three sites (Wickaninnish, Cheewaht, Combers)
2) Establish PSV at three sites (Wickaninnish, Cheewaht, Keeha)
3) Engage First Nations partners
4) Engage the Canadian public and park visitors in participatory learning experiences and outreach

Monitor and further understanding of :

5) Geomorphological processes (sand transport and topography)
6) Vegetation and ecological communities

6

Challenges & Changes

The project encountered several challenges & new developments that modified the objectives and scope including:

2011:
- Sand-verbena Moth Observation

2012:
- Unexploded explosive ordinance found in Wickaninnish Dunes
- Personnel & resource challenges
- Added restoration and PSV translocation at Schooner
- Simplified vegetation monitoring
- Partnership with HFN to remove invasive grass and translocate PSV on TSL at Keeha

2013:
- Stopped PSV augmentation at Keeha after seeing great response at Schooner

2014 & 2016:
- Intensive moth surveys

2016:
- Silky Beach Pea Augmentation

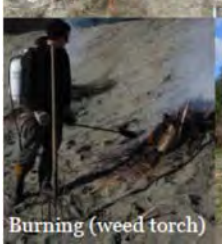
Restoration Techniques


Horizon flipping


Light limitation


Volunteers & manual removal


Weed whacker


Burning (weed torch)


More volunteers!

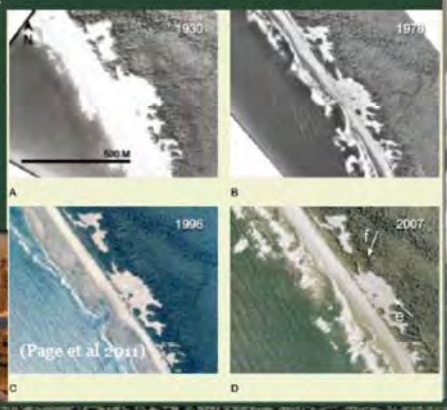

Grass disposal


Grass separation with root rake

Wickaninnish

Habitat Loss & Conditions Pre-restoration:

- Extent of sparsely-vegetated dunes declined from 16.5 ha in 1930 to 9.2 ha in 2007 (56% decline) (Page et al 2011)
- 28% decline in open sand surface between 1973 and 2007
- In the Wickaninnish to Combers zone 26.5 ha of CSE habitat was dominated by *Ammophila spp.*

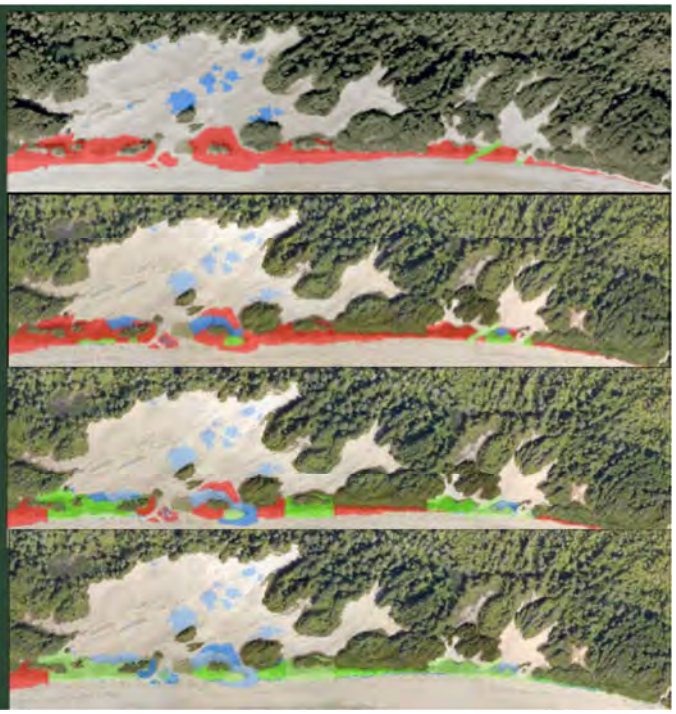


Wickaninnish

Restoration Progress:

- 2008 0.44 ha treated
- 2009 0.85 ha treated
- 2010 1.78 ha treated
- 2011 2.51 ha treated

Invasive grass control continues with both staff and volunteers in the "restored" areas to keep the invasives from re-establishing



Wickaninnish Geomorphic Response

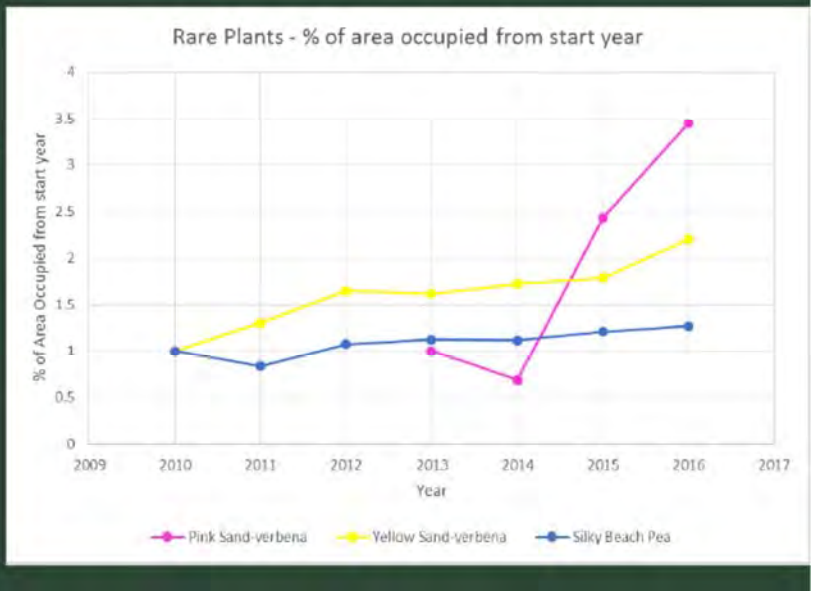
Ian Walker's group found that the restoration work increased sand transport (see the poster for details) and at least along one section of the Wickaninnish site we have seen the dune expand into the forest.

Wickaninnish Ecological Response

Area occupied by rare plants has increased.

YSV occupies 220% of it's 2010 extent
SBP occupies 125% of it's 2010 extent
PSV occupies 350% of it's 2013 extent

Notes:
1. Habitat restoration work conducted between 2009 and 2011
2. PSV plantings in 2010, 2011 and 2014.



Combers / Sandhill Creek

Habitat and infrastructure losses:

- area dominated by *Ammophila* expanded from 0.88 ha in 1969 to 5.69 ha in 2005
- Loss of parking and day use area

Trenches were dug through the spit in an attempt to allow winter storms and diverted stream flow to wash out the tip of the expanding "spit" but these efforts were not successful and restoration of the site was abandoned for the time being

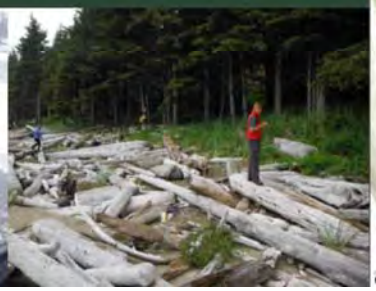
Cheewaht Pre-Restoration

No invasive grasses but, high density of drift logs associated with industrial logging disrupted sand transport, provided new sites for vegetation colonization and led to accelerated succession of fore and back dune zones

Forested foredune restoration zone was entirely CSE in 1930s

Drift logs and high energy narrow beach also made for an ephemeral habitat for PSV.

Efforts to establish PSV on the beach and in the dune prior to restoration were not highly successful



Cheewaht Restoration

Between 2010 and 2015, working with the Ditidaht FN we: felled the trees in conjunction with a BCFSC chainsaw operator's course for DFN and Park personnel; bucked and removed downed vegetation and finally in November of 2015 flew in an excavator to remove stumps, roots and soil returning most of the foredune to an un-vegetated mineral soil (sand) state.

2015 – buried drift log

2015 – excavator flown in

2013 – falling & chainsaw course

2014 – bucking, brushing & log disposal

2015 – before stump & soil removal

2015 – stump & soil removal

2013 – start of falling

2013 – end of falling

2015 – after log and soil removal

2016 – new drift log deposition

Cheewaht Results

2016 planting of PSV in the newly restored area has shown the best results at the site to date

Two Silky Beach Pea plants found in restored area (not previously known at Cheewaht)

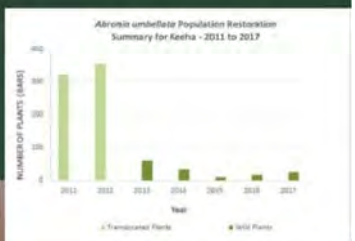
Ongoing efforts to keep the area free of new drift logs will be required

DFN crew worked to remove newly deposited drift logs in 2016

PSV planting areas 2016 after drift log removal

Keeha Summary

2011: PSV planting on eastern portion of the beach (on park lands)
2012: Planting of PSV in pocket dune on Huu-ay-aht Treaty Lands, zero wild PSV occur from 2011 planting
2013: Invasives removal and PSV monitoring with community members and staff with CTV interview.
2013-2017: PSV monitoring indicates relatively poor results




2012 - HFN assists with habitat restoration

2013 – CTV interview with HFN partners

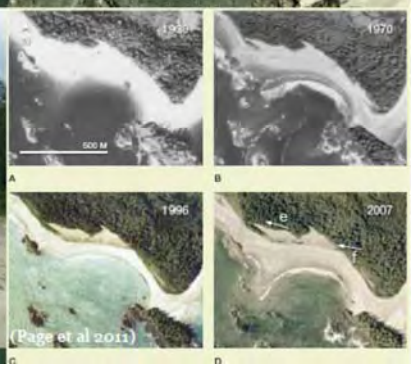

2014 - HFN assists PSV monitoring

Schooner

Habitat Loss & Conditions Pre-restoration:

- Native sparsely-vegetated communities declined from 4.4 ha to 1.0 ha (23% of historic extent) since 1930 (Page et al 2011)
- 28% decline in open sand surface between 1973 and 2007
- 1.9 ha of CSE habitat was dominated by *Ammophila spp.*
- Much of foredune succeeded to forest
- Decline in Silky Beach Pea between 2003 and 2016 detected.

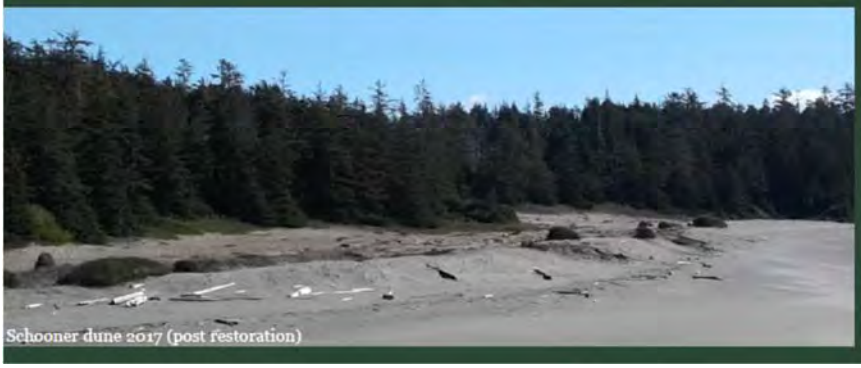

Schooner dune prior to restoration (Beaugrand, 2008)



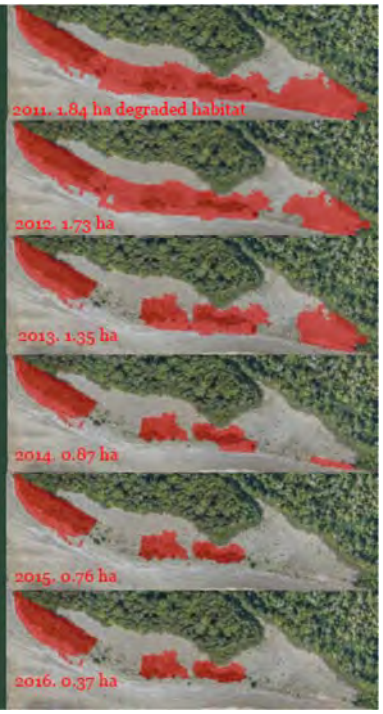
Schooner

Restoration Progress:

By 2017 1.46 ha of dune habitat that was dominated by *Ammophila spp.* have been restored. An additional 0.373 ha of forest vegetation was also removed from the foredune zone which restored exposure of another 0.97 ha of backdune to more "natural" aeolian processes.



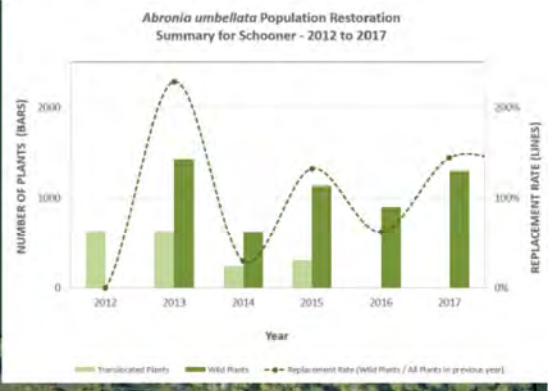
Schooner dune 2017 (post restoration)



Schooner

Pink Sand-verbena & Silk Beach Pea Recovery:

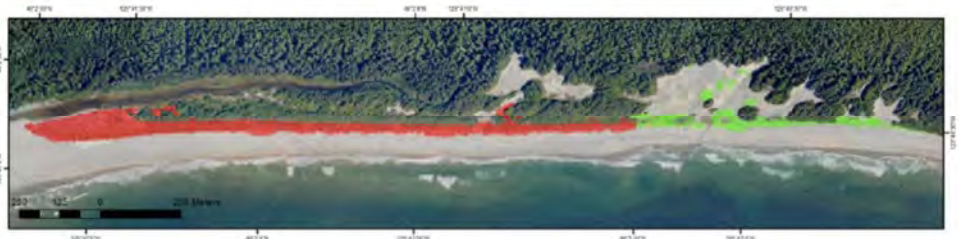
- Best Pink Sand-verbena recovery site.
- Detection of a decline in Silky Beach Pea at the site was a contributing factor for additional restoration in 2016-17 including removal of foredune forest. By fall 2017 53 new SBP were found within areas that were forested until restored in March 2017. Similarly, PSV established immediately in much of this newly restored area.



Status 2017

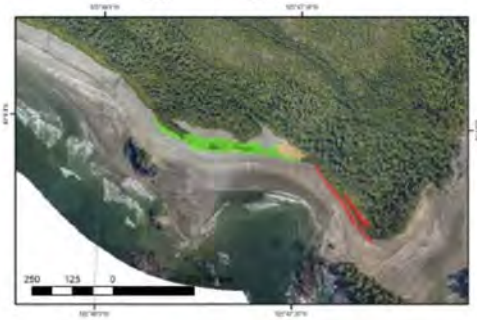
As of March 2017:

29% of the invasive grass removed and dynamic sand transport regimes restored to the two main dune complexes of the Park.



Status of Invasive Beach Grass as of Mar. 2017

- invasive beach grass as of Mar 2017
- new growth as of Mar 2017
- regrowth as of Mar 2017
- removed as of Mar 2017



Status (as of Mar 2017)	Area (m2)
Invasive beach grass as of Mar 2017	84770
New growth as of Mar 2017	15
Regrowth as of Mar 2017	3696
Removed as of Mar 2017	35372
Total Mapped extent as of Mar 2017:	123852
% removed as of Mar 2017	29%

Pink Sand-verbena

Propagation

5890 PSV grown and planted out. All from seed stock collected at Clo-oose Bay in 2000 and 2001. Originally propagated by Fairbarns & McCoy amongst others at the Pacific Forestry Centre. Starting in 2011 the Park built operated a greenhouse.

Best general methods :

- Removal of seed from achene (cuticle clipper works well)
- Cold stratification for 2 weeks (Kaye, 1999)
- Very shallow planting in small horti block (germination trays) in 3:1 sand-perlite mix
- Transplant to root trainers in 6:2:1:1 peat-sand-vermiculite-perlite mix with slow release fertilizer, micronutrients and lime
- Hardening regime prior to planting

Trials with various other methods (sowing in single trays , transplanting to larger pots etc.) and with use of heat mats, UV lights and additional fertilizer during germination (see following slide) were explored

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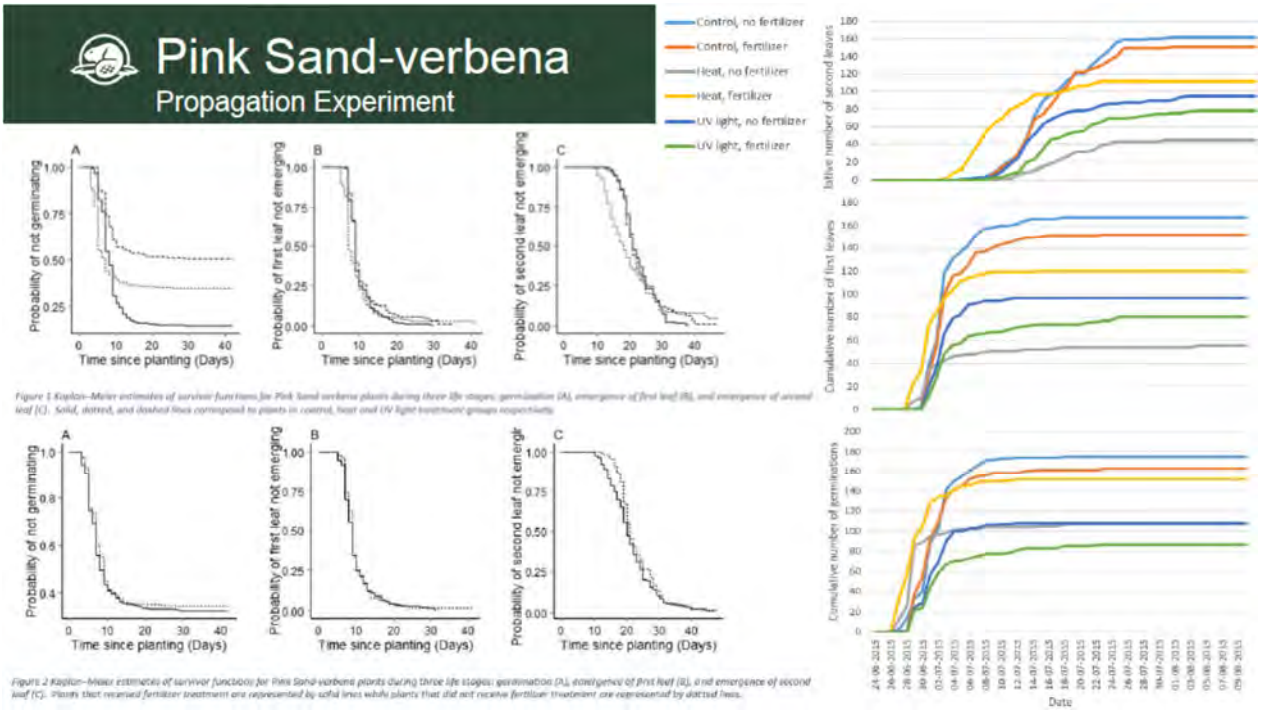
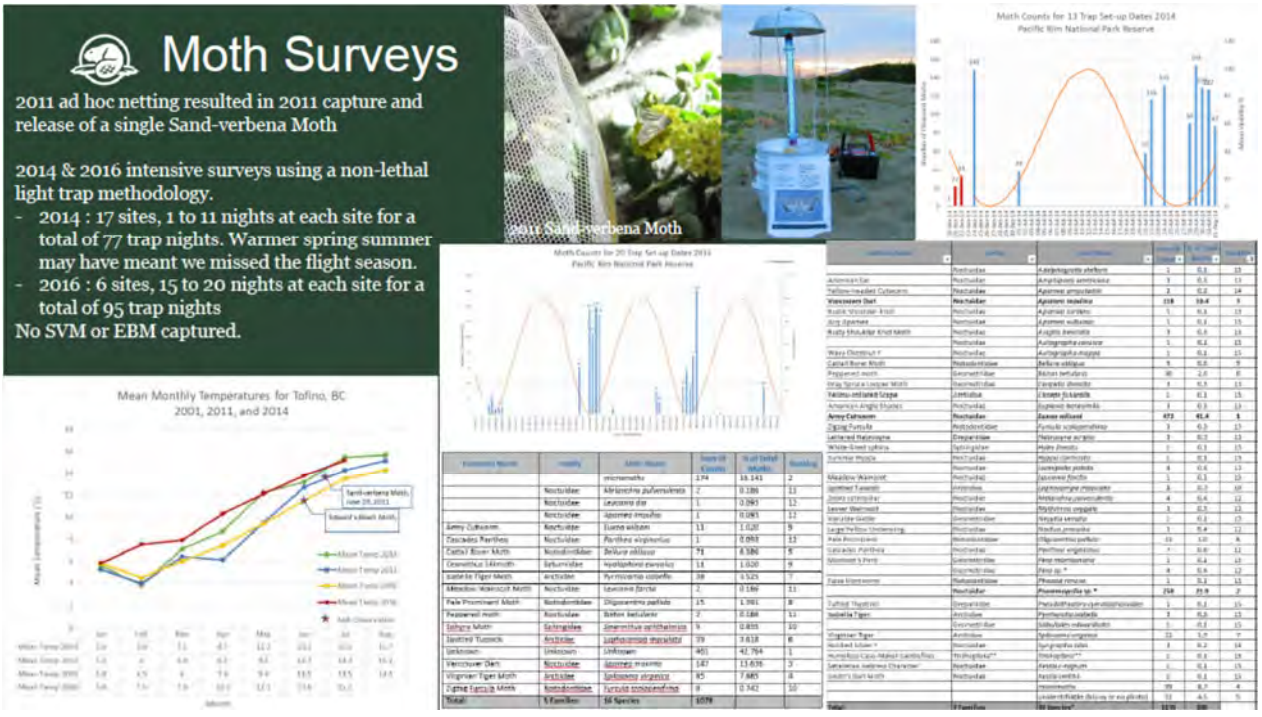
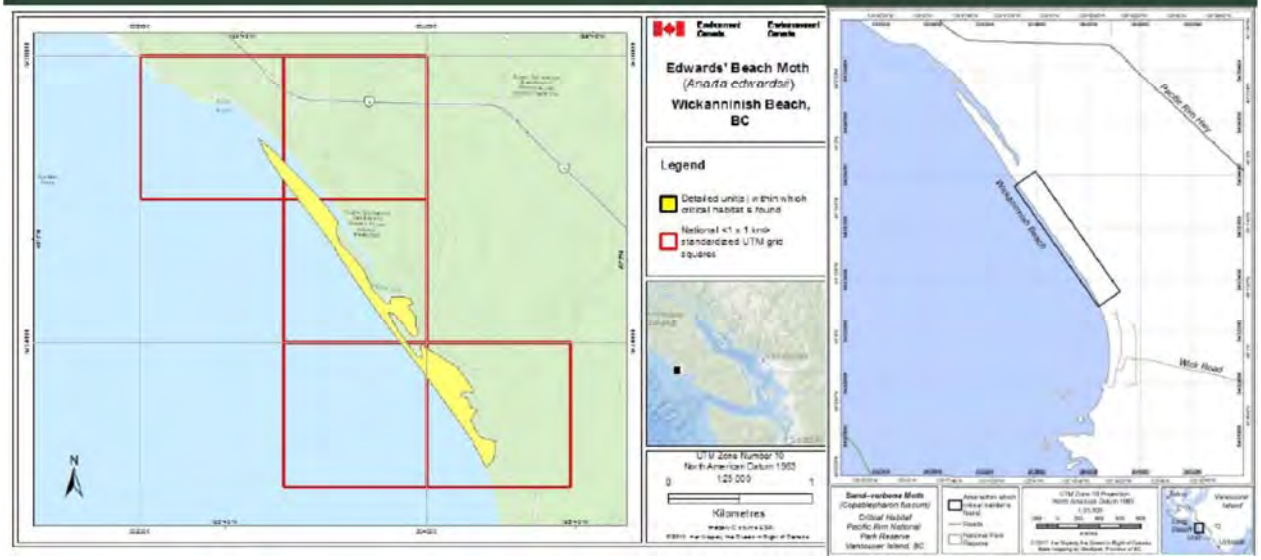


Figure 1 Kaplan–Meier estimates of survivor functions for Pink Sand-verbena plants during three life stages: germination (A), emergence of first leaf (B), and emergence of second leaf (C). Solid, dotted, and dashed lines correspond to plants in control, heat and UV light treatment groups respectively.

Figure 2 Kaplan–Meier estimates of survivor functions for Pink Sand-verbena plants during three life stages: germination (A), emergence of first leaf (B), and emergence of second leaf (C). Plants that received fertilizer treatment are represented by solid lines while plants that did not receive fertilizer treatment are represented by dotted lines.



Moth New Critical Habitat Established



Next Steps & Questions

Maintenance of Restored Sites at PRNPR
- manual removal
- continued engagement of visitors, students and others through our volunteer program

Continued Monitoring at all sites

26

References

Heathfield, D. (2009). *Drift log debris, foredune morphodynamics, and stabilization: Wickaninnish Bay, British Columbia*. Unpublished directed study. University of Victoria, Victoria, British Columbia, Canada.

James N. McNair, Anusha Sunkara and Daniel Frobish (2012). How to analyse seed germination data using statistical time-to-event analysis: non-parametric and semi-parametric methods. Seed Science Research, 22, pp 77-95 doi:10.1017/S0960258511000547

Kaye, T.N. 1999. Propagation of Endangered Species: Variable Germination of Pink Sand-verbena from Pacific Coast Beaches. Combined Proceedings International Plant Propagations' Society. v48.1999. pg 617-621.

Page, N., P. Lilley, I.J. Walker and R.G. Vennesland. 2011. Status report on coastal sand ecosystems in British Columbia. Report prepared for the Coastal Sand Ecosystems Recovery Team. vii + 83 pp.

Therneau T (2015). A Package for Survival Analysis in S. version 2.38, http://CRAN.R-project.org/package=survival.

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Geomorphology Publications & References

The project supported and benefited from studies of the geomorphology of the Park's dune systems which resulted in the following publications and reports:

Beaugrand HER. 2010. Beach–dune Morphodynamics and Climate Variability Impacts on Wickaninnish Beach, Pacific Rim National Park Reserve, British Columbia, Canada. Unpublished MSc Thesis, University of Victoria, Canada.

Darke IB, Eamer JBR., Beaugrand HER, Walker IJ. 2013. Monitoring considerations for a dynamic dune restoration project: Pacific Rim National Park Reserve, British Columbia, Canada. Earth Surface Processes and Landforms. DOI: 10.1002/esp.3380

Eamer JBR, Walker IJ. 2010. Quantifying sand storage capacity of large woody debris on beaches using LIDAR. Geomorphology 118: 33–47.

Eamer, J.B.R., Walker, I.J., 2013. Quantifying spatial and temporal trends in beach-dune volumetric changes using spatial statistics. Geomorphology 191, 94–108.

Eamer JBR, Darke IB, Walker IJ. 2013. Geomorphic and sediment volume responses of a coastal dune complex following invasive vegetation removal

Heathfield DK, Walker IJ. 2011. Analysis of coastal dune dynamics, shoreline position, and large woody debris at Wickaninnish Bay, Pacific Rim National Park, British Columbia. Canadian Journal of Earth Sciences 48: 1185–1198.

Heathfield DK, Walker IJ, Atkinson DE. 2012. Erosive water level regime and climatic variability forcing of beach–dune systems on southwestern Vancouver Island, British Columbia, Canada. Earth Surface Processes and Landforms. DOI: 10.1002/esp.3350

Walker IJ, Beaugrand HER. 2008. Coastal Geoindicators Monitoring-Protocol for Climate Change & Coastal Erosion in Canada's Pacific Coastal National Parks. Unpublished report submitted to Pacific Rim National Park Reserve. Pacific Rim National Park Reserve: Ucluelet, BC; 39 pp.

Walker IJ, Eamer JBR, Darke IB. 2013. Assessing significant geomorphic changes and effectiveness of dynamic restoration in a coastal dune ecosystem. Geomorphology 199: 192–204

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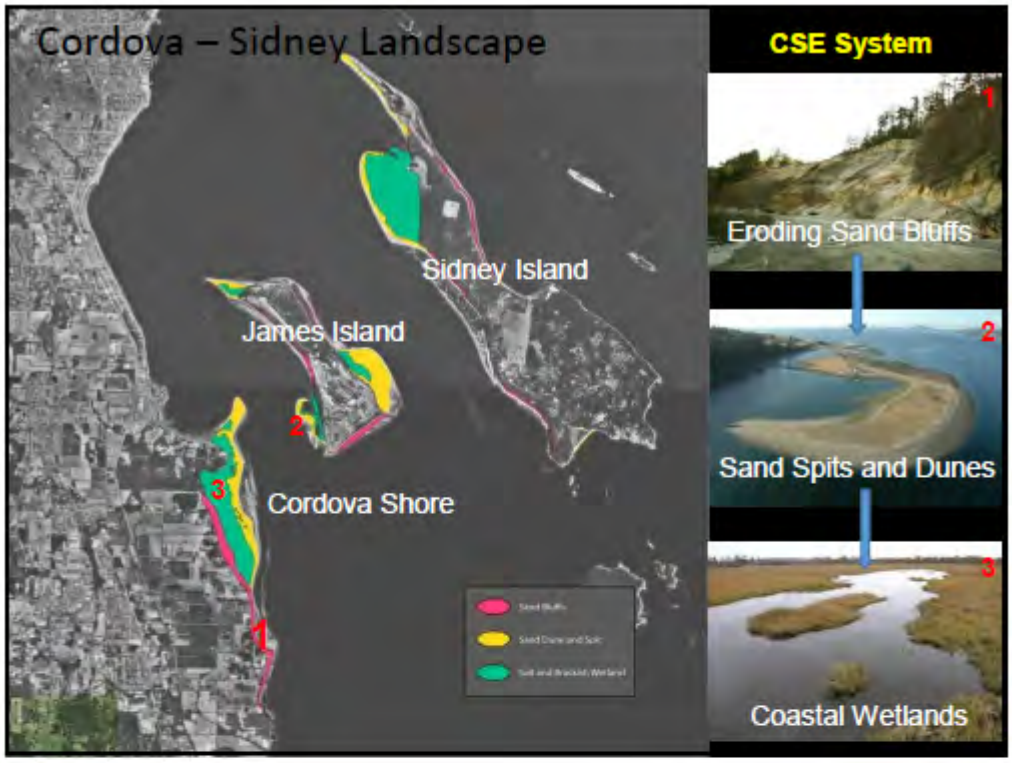
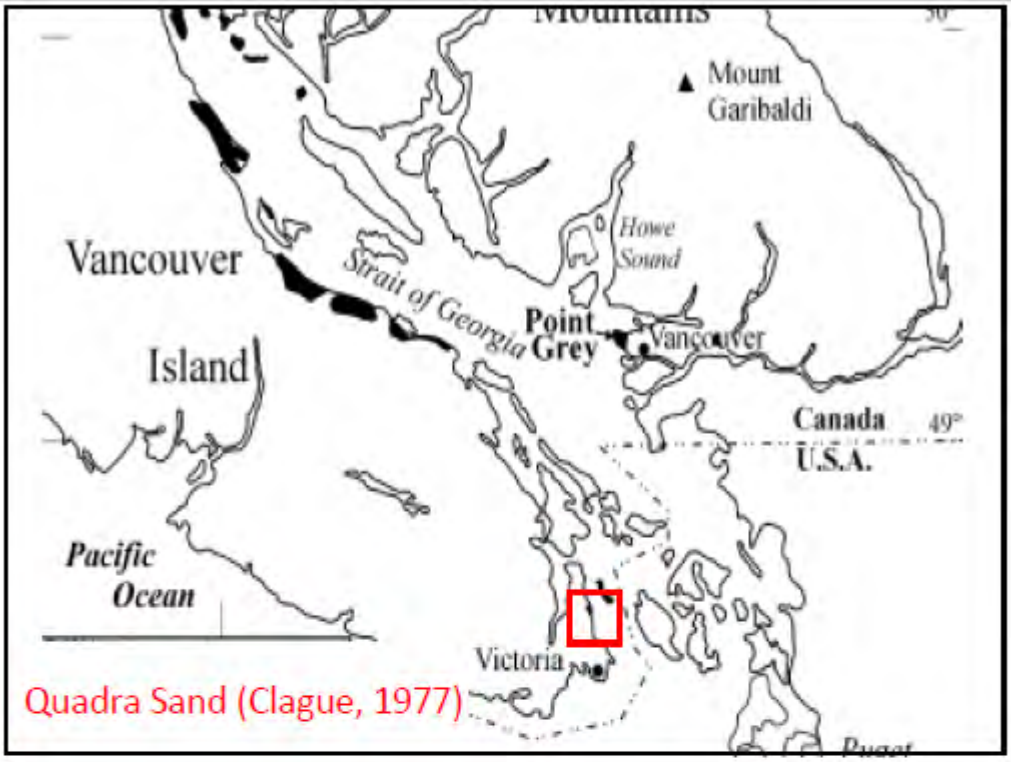
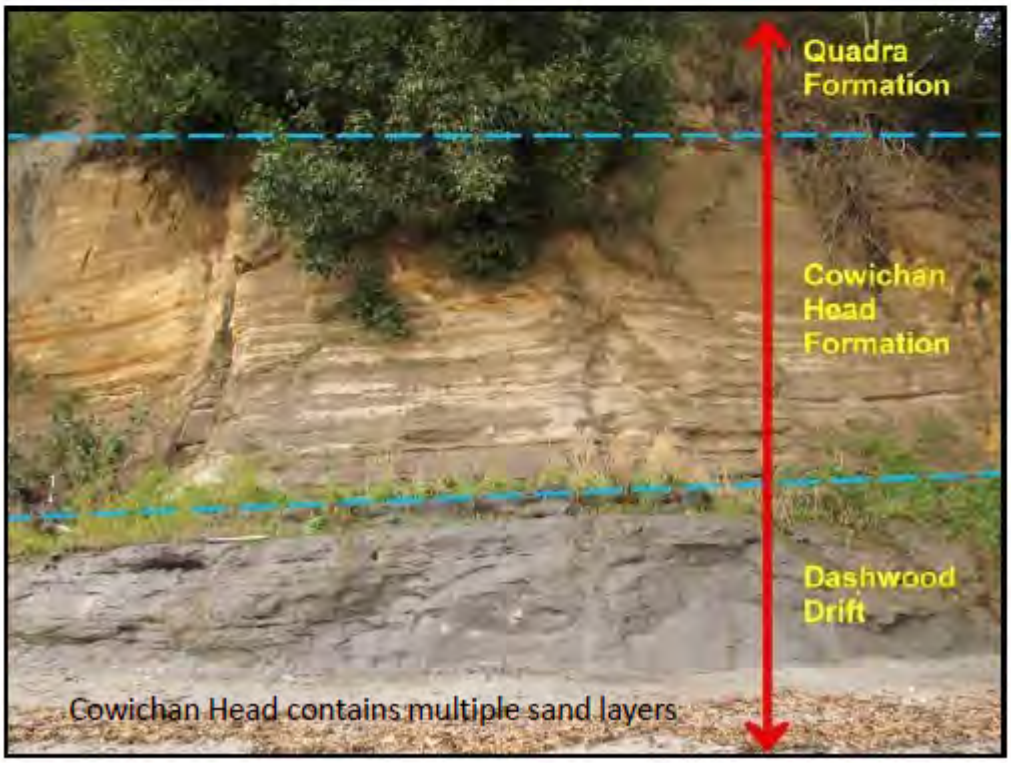
Plants of the Cordova-Sidney Landscape


Cordova – Sidney Landscape
Sidney Island
James Island
2
3
Cordova Shore
1
CSE System
1
Eroding Sand Bluffs
2
Sand Spits and Dunes
3
Coastal Wetlands


Sand Supply:
feeder bluffs provide sand to coastal sand ecosystems
South Bluff, James Island


Mount
Garibaldi
Howe
Sound
Vancouver
Strait of Georgia
Point
Grey
Vancouver
Island
Canada
49°
U.S.A.
Pacific
Ocean
Victoria
Quadra Sand (Clague, 1977)


Quadra
Formation
Cowichan
Head
Formation
Dashwood
Drift
Cowichan Head contains multiple sand layers


Cowichan Head Bluffs
Ecosystems of Cordova Shore
N
N


Village (North) Spit on James Island


Powder Jetty Salt Marsh on James Island


Powder Jetty Salt Marsh, James Island

Plants and Plant Communities

- Adapted to inhospitable physical environment: dry, nutrient poor, frequently disturbed, marine influence.
- Often sparsely-vegetated because of competition for limited resources.
- Zonal or banded patterns set by shoreline.
- Concentration of species at risk: species that are provincially or federally rare.

Sea-rocket (Cakile) Sparse Vegetation


Red Fescue Herbaceous Vegetation

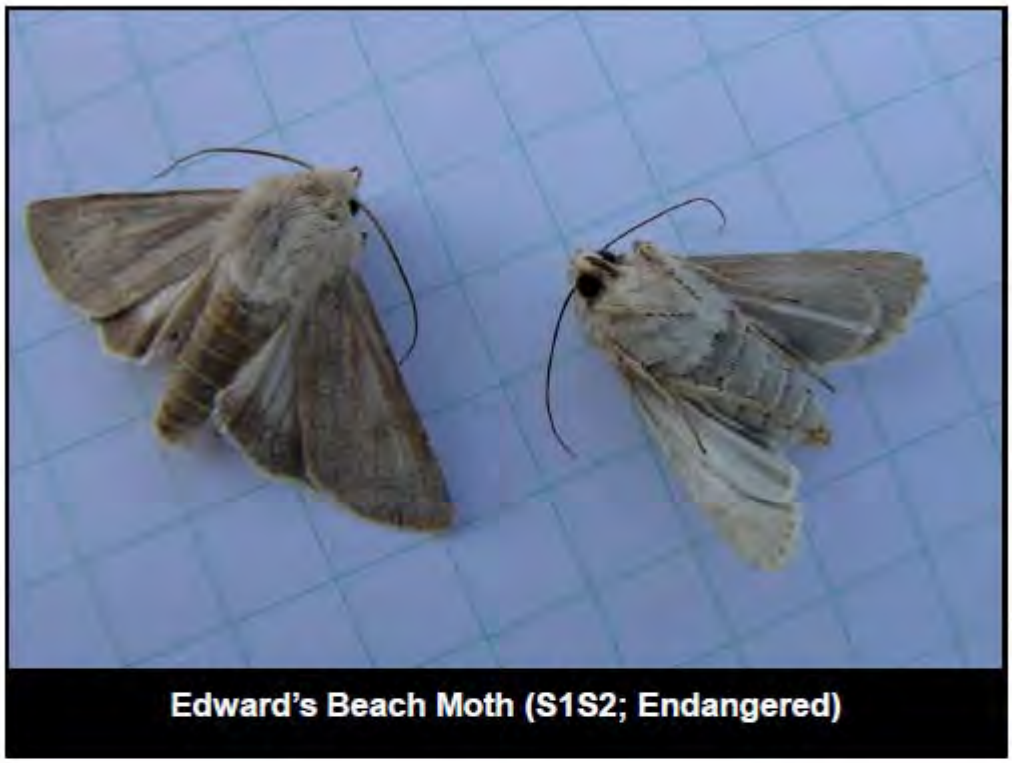

Large-headed Sedge Herbaceous Vegetation


Black knotweed / Racomitrium Stable Dunes


Scotch Broom Shrubland


Yellow Sand-verbena


Sand-verbena Moth (S1; Endangered)



Edward's Beach Moth (S1S2; Endangered)


Silky beach pea


American glehnia


Silvery burweed


Silvery burweed


Black knotweed


Barestem desert-parsely &
Leymus x vancouverensis


Contorted-pod Evening-primrose

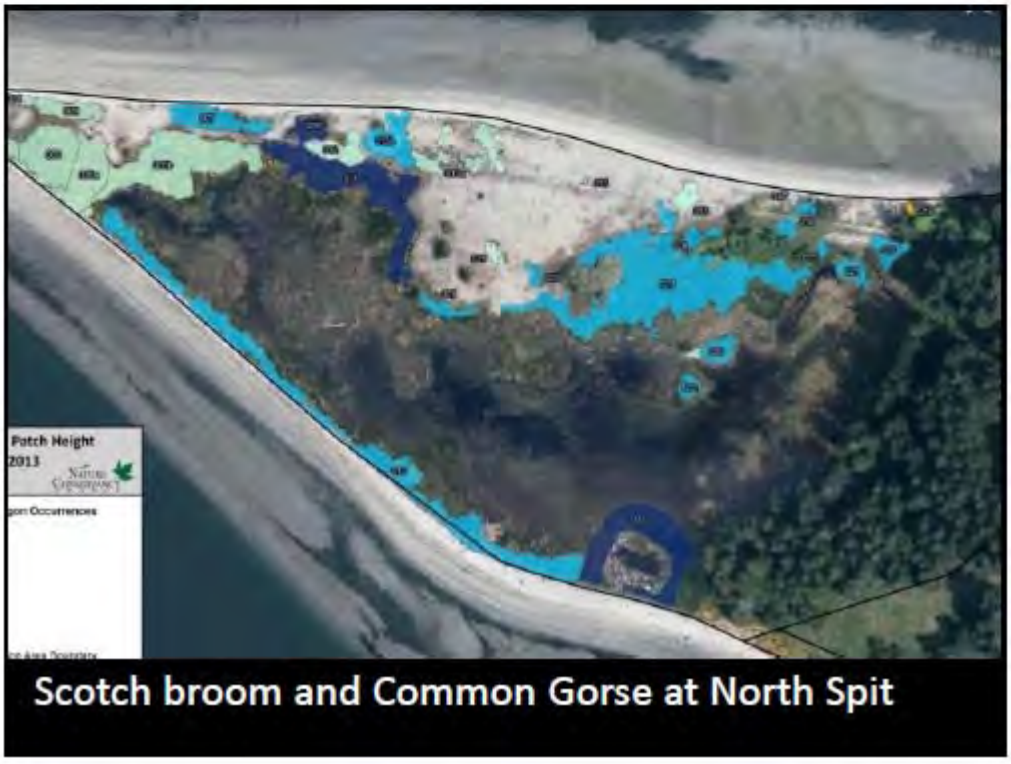

Contorted-pod Evening-primrose


Contorted-pod Evening-primrose


Fleshy jaumea


Stabilization is a natural part of succession

Scotch broom and Common Gorse

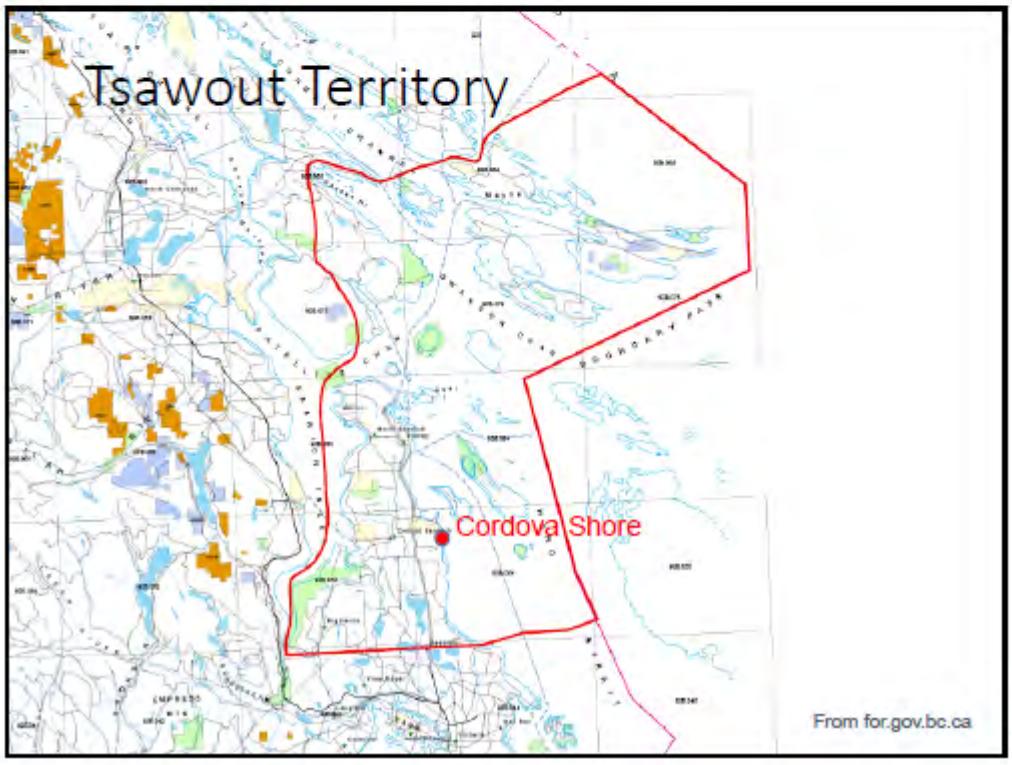


Scotch broom and Common Gorse at North Spit


European beachgrass


Beach logs


Home of the Tsawout First Nation


Tsawout Territory
Cordova Shore
From for.gov.bc.ca

Resources

- Status Report on Coastal Sand Ecosystems in British Columbia (2011).
- Cordova Shore Conservation Strategy (2012).
- Nature Conservancy of Canada (volunteer for a James Island work party).

Questions?

nick@raincoastappliedecology.ca

Ecosystems on the Edge: Project Restoring Coastal Sand Ecosystems on Sidney Island

Threats to Coastal Sand Ecosystem

- Encroachment and stabilization
- Loss of sand movement and bare sand

Why?

- Invasive plants
  - Scotch broom
  - Invasive grass, esp. European beach grass
- Bryophyte and lichen 'crust'
- Woody debris

- Trampling and other disturbance by visitors and dogs
- Deer browsing
- Sea level rise/ climate change

3

Key Project Activities

- Manual removal of target invasive species from tip of Sidney Spit
- Augment species at risk populations
- Install fencing and signage
- Engage with volunteers and partners
  - Expand volunteer program – Foster volunteer engagement and stewardship opportunities
  - Strengthen partnerships - Share and collaborate in regional approach to CSE restoration

4

Protecting Species at Risk From Unintended Outcomes Throughout Project

- Applied Open Standards for Practice of Conservation and Results Chains to test assumptions
- Minimized risks through identifying appropriate mitigations within EIA process and applying them throughout project
- Use staged approach and combined continuous monitoring with adaptive management
- Signs/fencing to address easier access to sensitive habitat once shrub barrier was removed

5

Invasive Plant Removals

Scotch broom

- All mature Scotch broom now removed!
- Hand saws and brush saw
- ~3000 m^3 treated
- Biomass burned
- Minimal resprouting

6

Invasive Plant Removals

European beach grass

- ~500 m^3 treated (approx. 65% of area)
- Regular repeated treatments needed as it resprouts from rhizomes
- Focus of volunteer program

7

Volunteer Program

- Volunteers: community groups, clubs, universities, schools, individuals
  - E.g. UBC and UVic Parks Canada Clubs, Greater Victoria Green Team, UVic Field School, Shawnigan School, Glenlyon School, Parkland Secondary, Camosun and UVic classes, Volunteer Victoria, Fort Rodd Hill volunteer list, Canadian Society of Evolution and Ecology, Outdoors Club
- 14 organizations, 254 individuals and 33 events have contributed **1561 volunteer hours** to the project over the past year

8

Volunteer Program

9

Augmentation of SAR Populations

- Partnership with Species at Risk Nursery at Fort Rodd Hill
- Augment populations of rare plants by sowing additional, nursery-grown seed onto prepared habitat
- Scalp ground prior to sowing

10

Augmentation of SAR Populations

- Augmentations to date: endangered Contorted-pod Evening-primrose and red-listed American Glehnia and Yellow Sand-verbena
- Some rare plant seed provided by Tsawout First Nation – from TIXEN






11

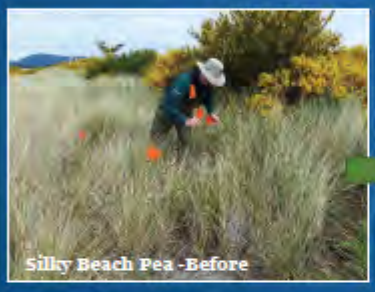
Incredible Response of Contorted-Pod Evening-Primrose

- Project activities (habitat improvement and augmentation) resulted in 950% increase in annual population counts this year relative to previous years
- Over 30,000 new plants!

12

Monitoring – Vegetation, Species at Risk

- Vegetation monitoring
  - Decrease in cover of invasive shrubs/trees from 59% to <1%
- Species at Risk monitoring
  - Expansion of yellow-sand verbena
  - Population increases for contorted-pod evening-primrose and silky beach pea
  - Stable counts for nesting pairs of common nighthawk



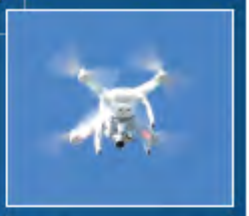
13

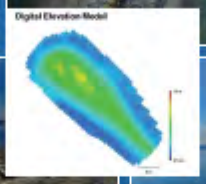
Monitoring – Vegetation, Species at Risk

14

Monitoring – UAV surveys

- UAV survey, photogrammetry and topography mapping
- Collaboration with Mike Collyer at Pacific Rim NPR
- 'Before' imagery captured in January last year
- 'After' imagery to be captured next month





Monitoring – UAV surveys

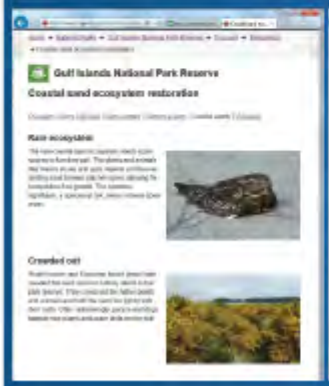
Closure Signage and Fencing

- Closure signage and post-and-rope fencing installed around perimeter of restoration site

17

New GINPR CSE Web Pages

http://www.pc.gc.ca/en/pn-np/bc/gulf/decouvrir-discover/natcul6/sablescotiers-coastalsands



18

Interpretive Signage

- Interpretive signage developed

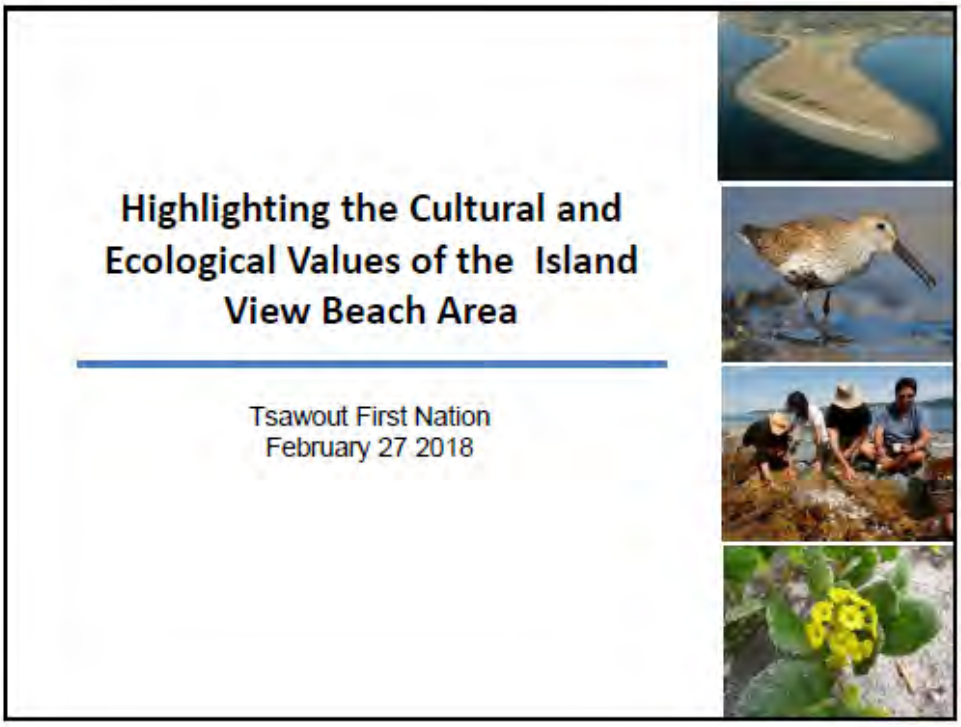
19

Acknowledgements

- Volunteers!, Nathan Cardinal (GINPR), Conan Webb (GINPR), Ian Cruickshank (GINPR), Morgan Davies (GINPR), Ben Tooby (GINPR), Athena George (GINPR), Nicole Paleczny (GINPR), Kelly Forbes (GINPR), Stephanie Woods (GINPR), Jay Zakaluzny (GINPR), Mike Collyer (Pacific Rim National Park Reserve), Nathan Fisk (Species at Risk Nursery at Fort Rodd Hill), Tsawout First Nation, Todd Golumbia (CRD), Jocelyn Wood (NCC), Rebecca Tranmer (SFU)

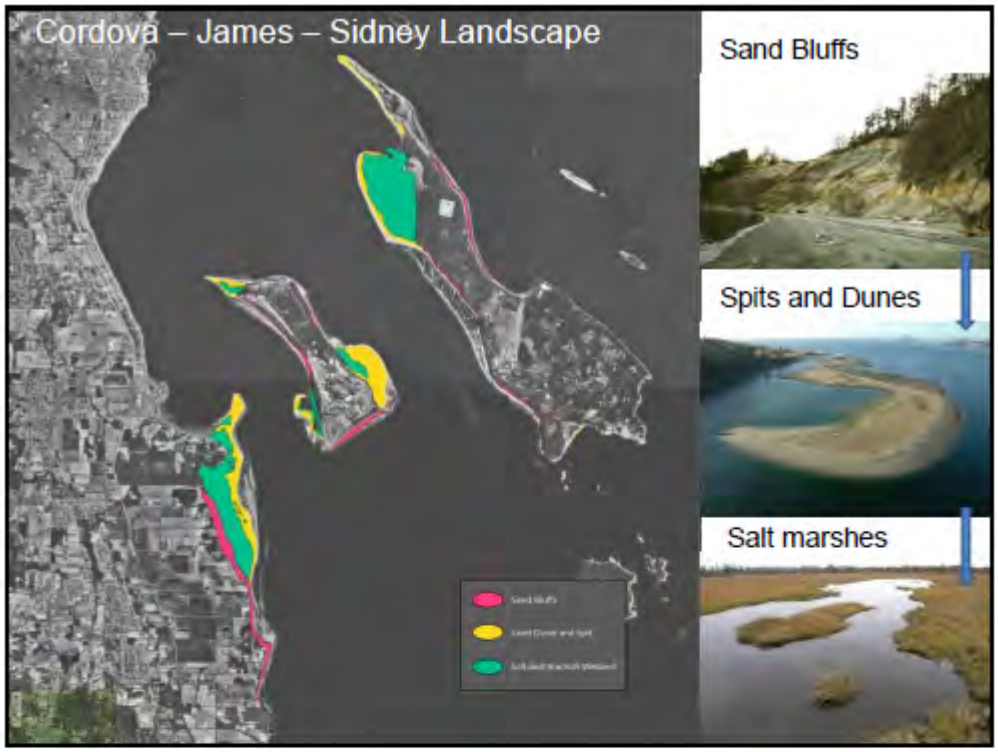
20

Highlighting the Cultural and Ecological Values of the Island View Beach Area



Unique cultural and ecological landscape

- Nick Page talked about the unique geological and ecological patterns that create our landscape in coastal BC: bluffs, spits, and wetlands
- TIXEN has supported us and other Saanich (W̱SÁNEĆ) people for time immemorial.
- We have a high concentration of species that we have worked hard to protect with Environment Canada funding which includes plants, insects, birds and fish.


Cordova – James – Sidney Landscape
Sand Bluffs
Spits and Dunes
Salt marshes


Pears Island
Coal Island
Sidney Island
James Island
D'Arcy Island
Sidney Channel Important Bird Area

Cultural Values and Traditional Resources

TIXEN – this special place has been used for pit cooks, clam digging, hunting, fishing and plant harvesting for generations. We have old pit cook sites and a burial site there to prove it. The sites are full with stories, legends and meaning for our Tsawout people.

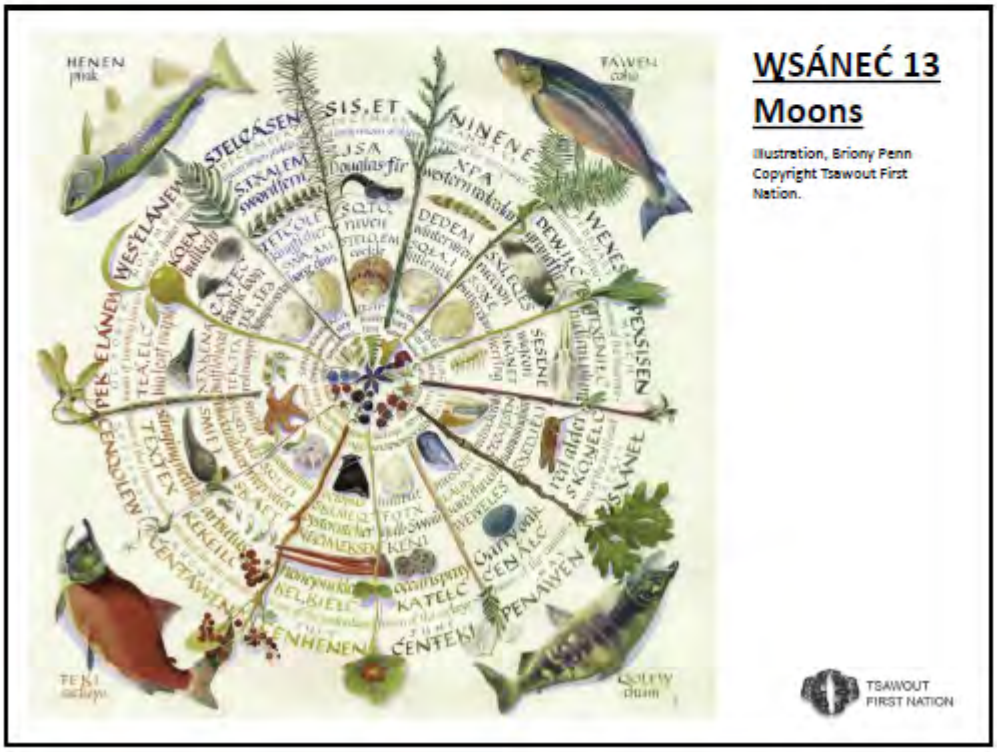
The fish, clams, crabs, urchin, remain an essential part of our diet. We also hold many educational pit cooking sessions and interpretative walks with our own people, the local schools and universities.

We harvest plants for medicinal purposes (Indian Consumption plant, yarrow, carrot, beach pea), and technologies (baskets, twine for nets, etc). In the winter season, we hunt ducks and other birds for food and ceremonial purposes for longhouse gatherings.


Teaching school children about traditional marine foods


Barestem desert-parsley
Nookta rose
Yarrow
Chcolate lily

Medicinal plants are harvested from beach and dune areas



WSÁNEĆ 13 Moons

Illustration, Briony Penn
Copyright Tsawout First Nation.

TSAWOUT FIRST NATION

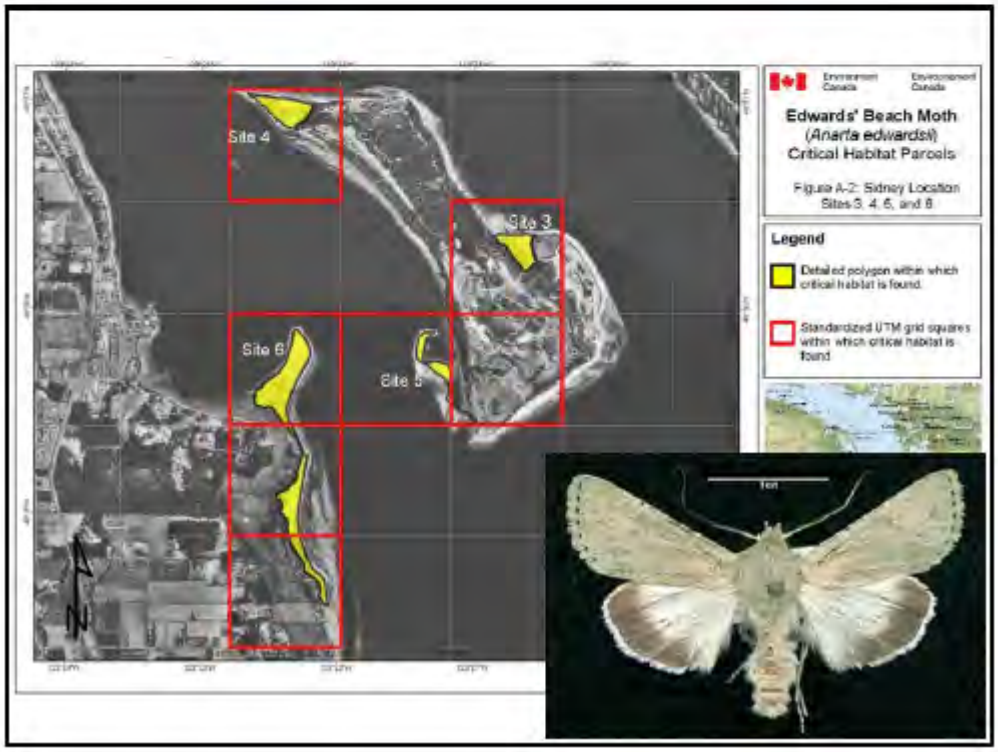
Species at Risk

Species at risk are of concern because of rarity, restricted range, and/or population decline.

Eight SARA listed species occur on or near the East Saanich IR#2:

1. Contorted-pod evening-primrose (Endangered)
2. Howell's triteleia (Endangered)
3. Sand-verbena Moth (Endangered)
4. Edward's Beach Moth (Endangered)
5. Silky beach pea (Threatened)
6. Common nighthawk (Threatened)
7. Great Blue Heron, *fannini ssp.* (Special Concern)
8. Western Branded Skipper, *oregonia ssp.* (Endangered)


Sand-verbena Moth
Bounding Rectangle Within Which Critical Habitat for Sand-verbena Moth Occurs
Within the Bounding Rectangle, Critical Habitat is Composed of:


Site 4
Site 3
Site 6
Site 5
Edwards' Beach Moth
(Anarta edwardsii)
Critical Habitat Parcels
Figure A-2: Sidney Location
Sites 3, 4, 5, and 6
Legend
Detailed polygon within which critical habitat is found.
Standardized UTM grid squares within which critical habitat is found

Key Points

We have worked hard to protect TIXEN. Recreational use must be balanced with protection of important ecological and cultural values.

This includes: fencing off protected areas, restoring sand dunes (removing invasive species), protecting intertidal zones, and wetlands, monitoring and limiting off leash dogs, commercial dog walkers and banning of 4 x 4's, educating the public and signage, meetings with neighbours.

Protection of cultural sites cannot be considered secondary to recreation use; Tsawout's inherent right to traditional resources is protected by law. We are now working with CRD Island View Beach Park and the District of Central Saanich to ensure that this place is protected.

Island View Beach Regional Park: Seeking Successful Restoration Outcomes in a Complex Landscape

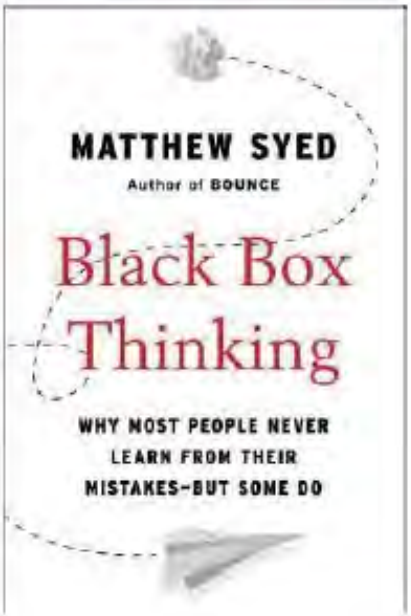
Lessons from the Beach

Island View Beach Regional Park

Seeking Successful Restoration Outcomes In A Complex Landscape.

Todd Golumbia
Environmental Conservation Specialist
Capital Region Parks
February 28, 2018

Lessons from the Beach



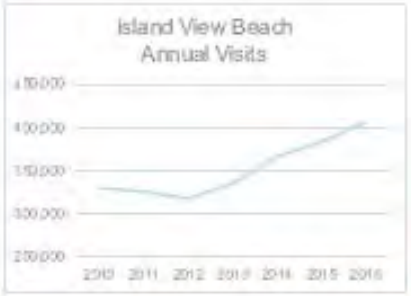
OVERVIEW

- Island View Beach
- Management Planning
- Species at Risk
- Critical Habitat
- Experts in a post truth world.

Lessons from the Beach

CONTEXT

- Remnant Coastal Ecosystems
- Human-dominated Landscape



Lessons from the Beach

Lessons from the Beach

Making a difference...together

Winter, 1990

Fall, 2017

Lessons from the Beach

Making a difference...together

ECOSYSTEMS

Lessons from the Beach

THE PROCESS

- 1989
- 2010
- 2011
- 2013
- 2015
- 2017…

Lessons from the Beach

FACT OR FICTION

- Sensitive
- Rare
- Endangered
- At Risk
- Critical

- Species
- Habitats
- Ecosystems

Lessons from the Beach

NatureServe Canada

eBird

British Columbia Coastal Waterbird Survey

BIRD STUDIES CANADA
ÉTUDES D'OISEAUX CANADA

COSEWIC
Committee on the Status of Endangered Wildlife in Canada

TRUST THE EXPERTS

- Who are the Experts?
- We are not the experts
- You are not the experts
- They are not the experts
- Who are the experts?

Lessons from the Beach

Recovery Strategy for the Sand-verbena Moth

Photo: Nick Page

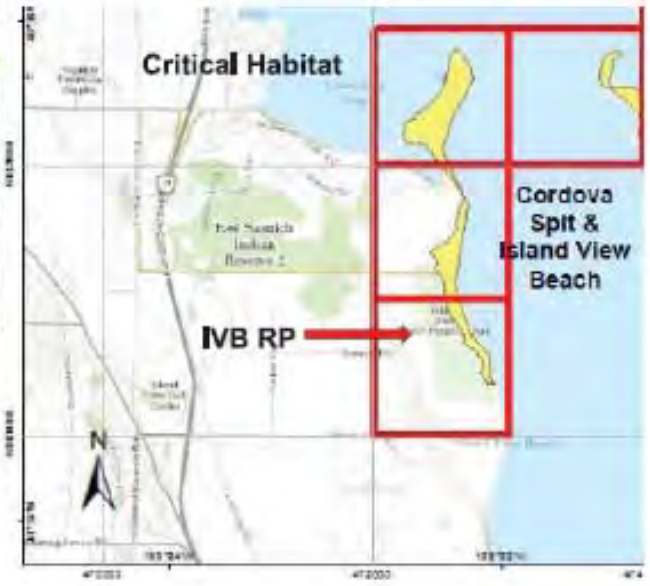
Recovery Strategy for the CPEP (Contorted-Pod Evening-Primrose)

Photo: Matt Fairbarns

"Tell us what's **in the park**"

Recovery Strategy for the Edward's Beach Moth

Photo: Nicole Kroeker



Lessons from the Beach

THE ELEPHANT IN THE ROOM

- Berm, Ditch, Drain
- Medium Tide 2.4 m (blue)
- King Tide 3.4 m (green)

Lessons from the Beach

Lessons from the Beach

THE PLAN

- Development Concept reflects opposing gradients
- Compromise between use and protection
- Present vs. Future

Lessons from the Beach

RESTORATION

Lessons from the Beach

Lessons from the Beach

- **Trust ME** I'm an Expert – Who's Expert are you?
- Just the **Facts** – or the Alternative Facts

Lessons from the Beach

- **Ecosystems are dynamic**
- Paucity of technical information vs. paucity of **common understanding**
- **Don't leave anyone behind**

Coastal Sand Ecosystem Restoration of Metro Vancouver Parks

Prepared by: Robyn Worcester, RPBio
Natural Resource Management Specialist – West Area, Metro Vancouver Regional Park

Regional Parks System....

Iona Beach Regional Park – Broom removal area

Iona Beach CSE Workplan….

- Accelerate scotch broom removal at Iona Beach Regional Park
- "Reduce" Scotch broom seed bed
- Implement ecosystem restoration program
- Monitor for evidence of re-invasion and recovery of desired ecosystem


2013
2012-13 Broom Removal Area

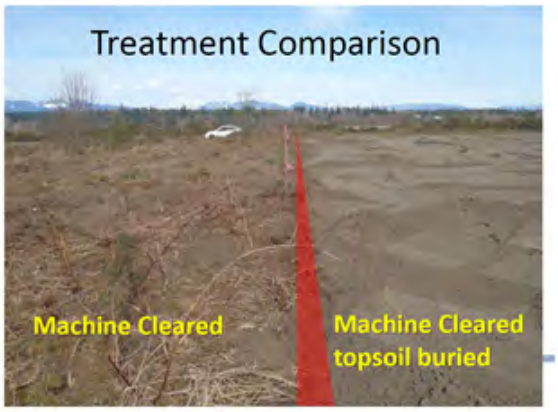
Treatments….


Legend
Hand Removal
Machine removal
Topsoil removal

Broom Removal…

Removal of “top soil”


"Levelling subsoil"


Treatment Comparison
Machine Cleared
Machine Cleared
topsoil buried

Progress … September 14, 2014

March 2013

September 2014

Iona Beach Regional Park – Broom removal area

Work from 2015-2017

- By machine: 23,880 m^2 invasives area cleared
- 1600 volunteers removed regrowing scotch broom and Himalayan blackberry seedlings by hand
- More than 5000 volunteer hours contributed
- At least 25 tonnes of green waste removed from maintenance work alone

Iona Beach Regional Park – Broom removal area

Outcomes achieved since 2012

- More than 9ha of invasives removed
- 12 long-term monitoring plots established
- More than 5000 dune grass plugs planted
- 1000's of volunteers and volunteer hours contributed to site maintenance
- One interpretive sign installed
- Lots of use observed by ground-nesting bird species and other wildlife

Iona Beach Regional Park – Coastal Sand Restoration

New site reclaimed

- 828 native plants planted
- 82 volunteers helped with 434 hours
- In the worst October weather you can imagine!

Boundary Bay Regional Park – Coastal Sand Restoration

Before

After

New site reclaimed

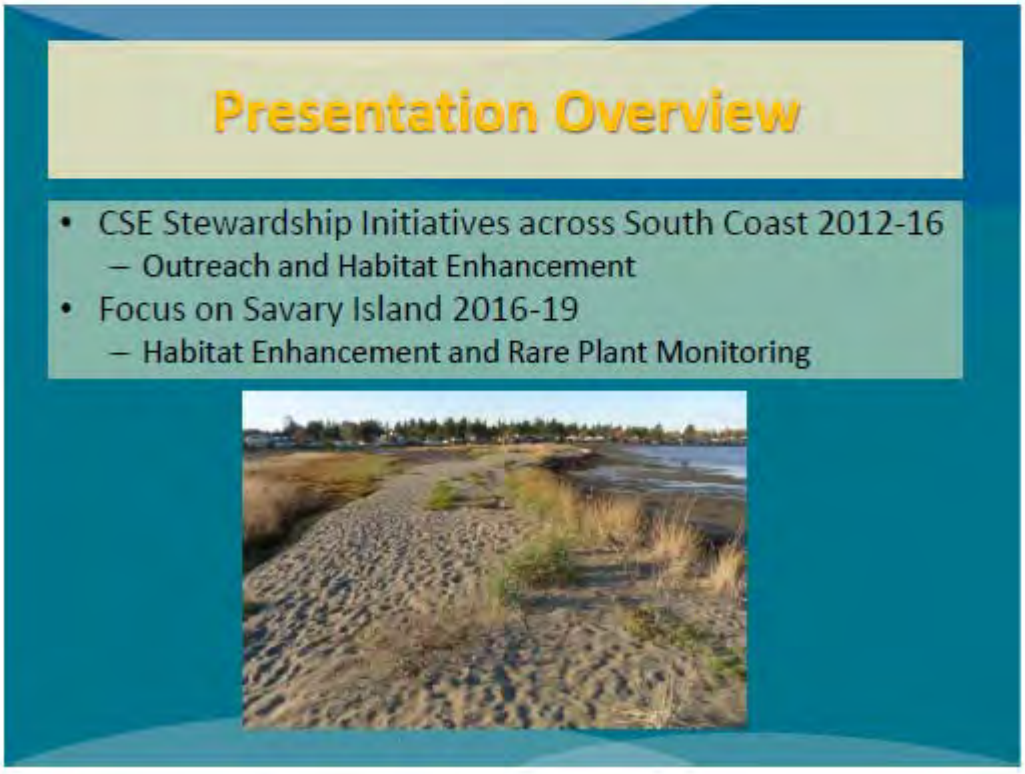
- 550 native plants planted
- 17 volunteers helped with 51 hours

Next steps

Move volunteer maintenance of restoration areas:

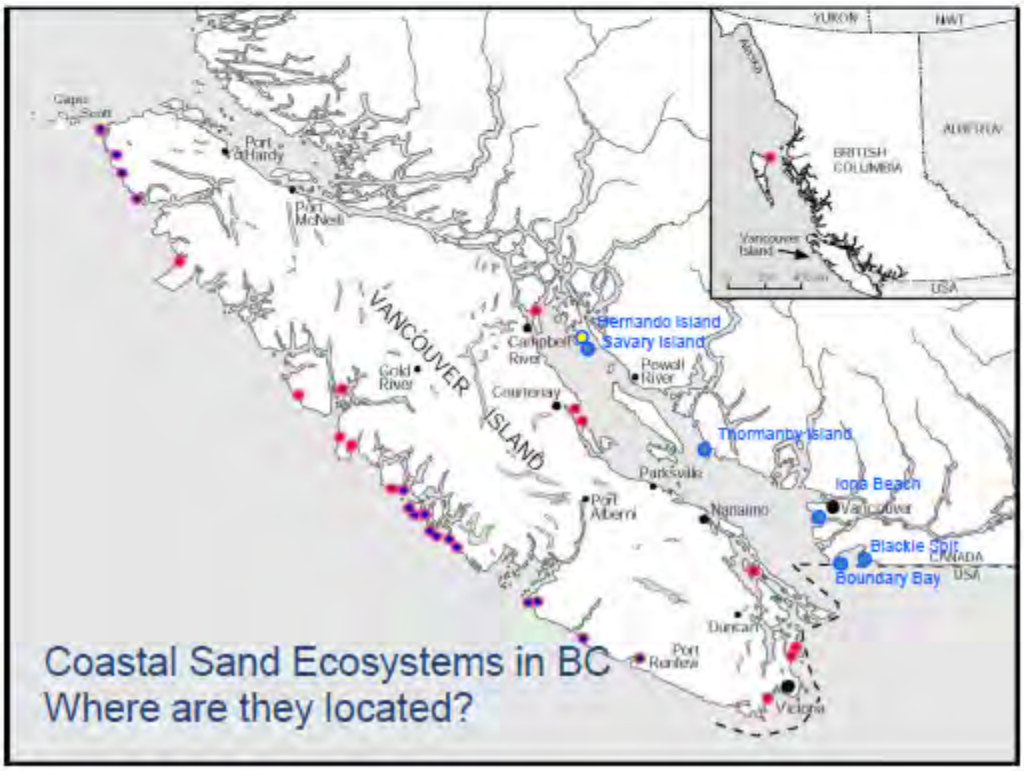
- Over 400 UBC Community Based Education students are scheduled for broom pulls in spring 2018
- Possible use of contractor maintenance in higher-regrowth areas

Coastal Sand Ecosystem South Coast Stewardship Summary



SCCP's CSE Stewardship Program

- Initiated by the Province in 2012 following Status Report
  - Inventory plus Stewardship
- Additional three years of funding from Environment and Climate Change Canada (Habitat Stewardship Program) for stewardship



Savary Island

Coastal Sand Ecosystems – Education

To engage landowners, community members and land managers to learn about CSE and being good stewards

- **Pull-up displays**
- **Brochure**
- **Events**
- **Signage**

Brochure:
PDF at sccp.ca

Events to Engage Residents:
Coastal Sand Summer Celebration 2013-2015 at Buccaneer Bay Provincial Park on Thormanby Island


Walk and Talks with biologist Phil Henderson on Savary Island at various neighbourhoods
SAVARY ISLAND
LAND TRUST SOCIETY


Nature Beach Nature Walks in Delta
Beach Grove and Boundary Bay Village

Coastal Sand Ecosystems – Signage

Beach Grove signs – 3 signs put up on posts
Similar signage at Buccaneer Bay Provincial Park

Savary Island signage post – 3 posts were put up

Interpretive Signage

Boundary Bay Village interpretive signage – 2 posts

Savary Island interpretive signage – 2 locations – Indian Point and Meadows Beach

Similar signage at Iona Beach

Coastal Sand Ecosystems – Human Impact Mitigation

- Rope fencing at Buccaneer Bay Provincial Park
- Management guidelines document for Vaucroft (North Thormanby)

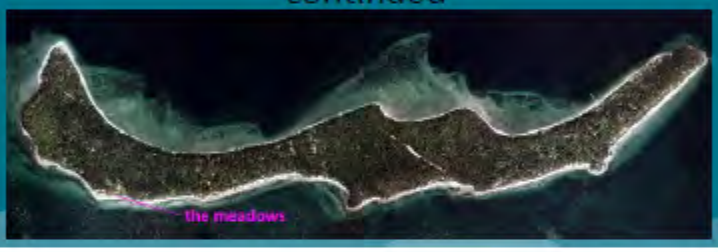
Coastal Sand Ecosystems – Habitat Improvement

- Control of invasive species
- Focus on Scotch Broom (but also English Ivy)


Savary Island –
Indian Point
Coastal Sand Ecosystem Restoration of Indian Point
Scotch Broom Removal 2014
Before
After


Savary Island –
Meadows Beach
Scotch Broom Removal
2015
Before
During
After

Savary Island 2016 – Meadows Beach Scotch Broom removal continued



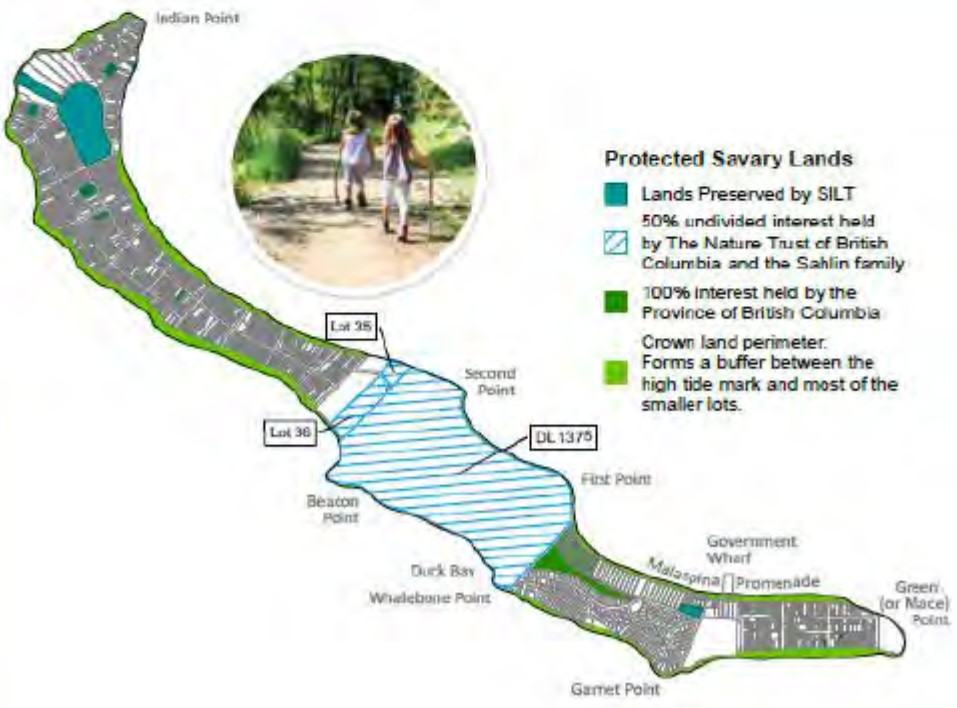
City of Delta removed invasives in Boundary Bay


Beach Grove Restoration 2012 – Before removal of English Ivy


AFTER!

Coastal Sand Ecosystems – Land Protection – NEW! Help Save the Heart of Savary Island

- **Deal reached to purchase 350 acres (DL 1375)**
- **Contorted-pod evening-primrose critical habitat**
- **Includes forest with old growth**
- **Donate via Nature Trust of BC**
- **Over $2 million raised towards $4 million goal**



Coastal Sand Ecosystems – Monitoring of Contorted-pod Evening-primrose

- **Developed in 2016 for Savary Island**
- **To determine survival and productivity of plants in existing populations**
- **Show and record changes in habitat**
- **Has detailed instructions, including equipment list and data sheets for the field**

Monitoring Protocol for
Plant Species at Risk in
Coastal Sand Ecosystems

Illustrated survey protocol for monitoring
the Contorted-pod Evening-primrose *Camissonia contorta*
population at The Meadows, Savary Island, British Columbia

April 2016

Developed for
Thetis Baker
South Coast Conservation Program

Developed by
Phil Henderson
Shire Environmental Consulting

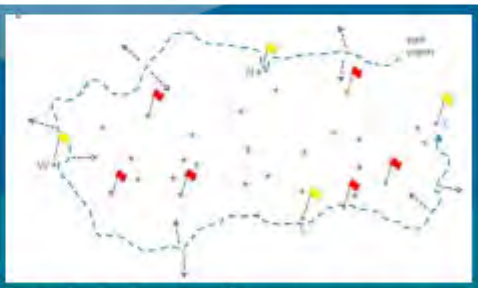
Canada

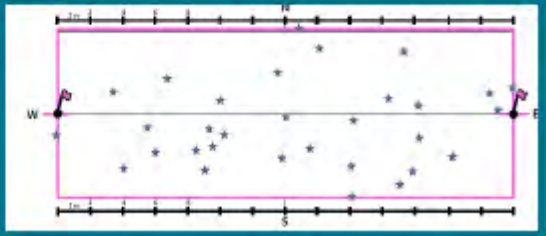
Coastal Sand Ecosystems – Monitoring of Contorted-pod Evening-primrose

- A method of censusing the population (counting all individuals) was chosen over sampling
- Method chosen to fit skills and resources of those who will be most likely to do the monitoring – Citizen Science approach

Coastal Sand Ecosystems – Monitoring of Contorted-pod Evening-primrose

- Establish the extent of the population and define the edge using flags, and find the N, E, S and W boundaries
- Mark survey area and walk the site counting plants in each quadrant





Coastal Sand Ecosystems –
Monitoring of Contorted-pod Evening-primrose
Year 1 of Testing in May 2017
Results

- 779 plants were recorded over .20 ha
- Last survey in 2004 counted 190 plants over .28 ha

Coastal Sand Ecosystems –
Monitoring of Contorted-pod Evening-primrose
Year 1 of Testing in May 2017
Other notes

- 4 surveyors was ideal number
- Time of year and day important, as is training to identify plants
- New plants detected to the west

- High concentration along path suggests disturbance helps with dispersal
- Little to no Scotch broom in main plot
- To be continued in May 2018


Thank you to our supporters!
SAVARY ISLAND LAND TRUST SOCIETY
BRITISH COLUMBIA
metro vancouver
Ce projet a été réalisé avec l'appui financier de :
This project was undertaken with the financial support of:
Environnement et Changement climatique Canada
Environment and Climate Change Canada


South Coast Conservation Program
Contact info:
Tamsin Baker
tamsin@sccp.ca
www.sccp.ca
604 202 2381

Poster: Rare Plants and their Threats within Coastal Sand Ecosystems: Flores Island, Vargas, and Cape Scott Provincial Parks

Working Collaboratively to Assess Rare Plants and their Threats within Coastal Sand Ecosystems: Gibson Marine (Flores Island), Vargas, and Cape Scott Provincial Parks

Erica L. McClaren, Conservation Specialist, BC Parks & Marta T. Donovan, Botanist, BC Conservation Data Centre

Beach morning glory *Calystegia soldanella* at Cape Scott

Project Objectives:

1) To revisit occurrences of rare plants recorded by the BC Conservation Data Centre to more accurately map their locations and to assess their conservation status;
2) To gain a better overall inventory of other plants associated with these coastal sand ecosystems;
3) To assess threats to coastal sand ecosystems from invasive plants, human recreation and other potential climate change-related factors.

Figure 1. Plant survey locations in 2014 & 2015.

Methods:

Between June 4 and 5, 2014 we conducted plant surveys at Whitesand Cove, Gibson Marine Provincial Park and on two beaches (Dick and Jane's, Hopkin's) within Vargas Island Provincial Park, BC. In 2015, we conducted plant surveys between June 15 and 17 at Nels Bight, Guise Bay and Experiment Bight beaches within Cape Scott Provincial Park, BC (see Figure 1).

Table 1. Rare plants observed during coastal sand ecosystem surveys.

Species	BC Status	Location (s)
Yellow sand-verbena, *Abronia latifolia*	Red	Guise Bay, Gibson Marine
Beach morning glory, *Calystegia soldanella*	Red	Guise Bay, Gibson Marine
American glehnia, *Glehnia littoralis ssp. leiocarpa*	Red	Guise Bay, Nells Bight, Gibson Marine, Vargas Island
Black knotweed, *Polygonum paronychia*	Blue	Gibson Marine
California gale, *Myrica californica*	Blue	Vargas Island

We observed three provincially red-listed species within Cape Scott Provincial Park. At Gibson Marine Provincial Park we recorded three provincially red-listed species and one provincially blue-listed species. Vargas Island Provincial Park contained two provincially blue-listed species (see Table 1). All of these rare plant records were previously known by the BC Conservation Data Centre but we collected more accurate data on locations, population size & extent, plant associations, and threats. Silky beach pea (*Lathyrus littoralis*) had previously been reported from Cape Scott and Vargas Island Provincial Parks, but these very small populations were likely transient and were not detected during our surveys.

Yellow sand-verbena *Abronia latifolia* at Cape Scott

Threats:

Overall, the greatest imminent threat to the integrity of these coastal sand ecosystems was from invasive species, such as European beachgrass which can stabilize sand movement and modify habitat conditions so that invasion by other invasive species is facilitated (see Table 2).

European beachgrass (*Ammophila arenaria*) at Vargas Island.

Table 2. Associated invasive plants detected during surveys.

Species	Location(s)
European beachgrass, *Ammophila arenaria*	Gibson Marine, Vargas Island
Velvet-grass, *Holcus lanatus*	Cape Scott, Vargas Island
European searocket, *Cakile maritima*	Cape Scott, Gibson Marine, Vargas Island
American searocket, *Cakile edentula*	Cape Scott, Gibson Marine, Vargas Island
Hairy cat's ear, *Hypochoeris radicata*	Cape Scott, Gibson Marine, Vargas Island

Off-road vehicle threats to coastal sand ecosystems

Intensive off-road vehicle recreation can crush vegetation near the surface, disrupt hydrological processes and act as a vector for invasive species. Threats from climate change are likely but their magnitude is uncertain at this time.

American glehnia *Glehnia littoralis ssp. leiocarpa*

Cape Scott Provincial Park – Thanks to Jessie Moore and Kathryn Ryan-Wilson, BC Parks

Black knotweed *Polygonum paronychia*

Abstract: Assessing Significant Geomorphic Changes and Effectiveness of Dynamic Restoration in a Coastal Dune Ecosystem

Ian J. Walker*, Jordan B.R. Eamer, Ian B. Darke

Coastal Erosion and Dune Dynamics (CEDD) Lab, Dept. of Geography, University of Victoria, Victoria, British Columbia, Canada

* Corresponding author. E-mail address: ijwalker@uvic.ca (I.J. Walker).

Received 6 August 2012; Received in revised form 19 March 2013; Accepted 4 April 2013; Available online 29 April 2013

ABSTRACT: A shift from restoring coastal dunes as stabilized landscapes toward more morphodynamic ecosystems is underway. This paper uses results from a recent case study where invasive vegetation was removed from a coastal dune complex in western Canada as a first step in a dynamic ecosystem restoration project. Spatial statistical methods, used in the natural sciences to quantify patterns of significant spatial–temporal changes, are reviewed and the local Moran's Ii spatial autocorrelation statistic is explored for detecting and assessing significant changes. Cluster maps of positive (depositional) and negative (erosional) changes were used to derive statistically significant volumetric changes within discrete geomorphic units (beach, foredune, transgressive dune) over one year following vegetation removal. All units experienced net increases in sediment budgets compared to a pre-restoration surface. The beach experienced the highest episodic erosion and volumetric change and greatest net annual sediment budget. Compared to the beach, the annual sediment budget of the foredune was 19% whereas the transgressive dune was 33%. The foredune recovered rapidly to initial erosion during restoration and subsequent natural events with consistently positive sediment volumes and attained a form similar to that pre-restoration. Aeolian deflation and sand bypassing through the foredune was greatest in the two months following vegetation removal and peak accretion in the transgressive dune resulted from depositional lobes extending from the foredune, smaller dunes migrating within the complex, and growth of a precipitation ridge along the eastern margin. Several methodological and logistical considerations for detecting significant change in dynamic dune landscapes are discussed including sampling strategy design, data normalization and control measures, and incorporating uncertainty and inherent spatial relations within acquired datasets to ensure accuracy and comparability of results. Generally underutilized in coastal geomorphology, spatial autocorrelation methods (e.g., localMoran's Ii) are recommended over spatially uniform threshold approaches for the ability to detect local change processes and explore hypotheses on spatial–temporal dynamics. Finally, several key geomorphic indicators, that are believed to aid in re-establishing ecological conditions and processes that favor more resilient and natural dune ecosystems, are identified for assessing the effectiveness of dynamic restoration projects including: increased aeolian activity, enlarged active sand surface area, positive sediment budgets, increased dune morphodynamics, improved geomorphic diversity, and enhanced geomorphic resilience. Although limited in temporal scope, the case study results show that the initial phase of the restoration treatment was effective in enhancing all indicators except for increasing sand surface area. Given decadal scale observations of climatic changes and longer-term eco-geomorphic trajectory toward stabilization in the region, however, it is unlikely that the geomorphic effectiveness of this restoration effort will continue without continued frequent treatment interventions.

Abstract: Beach–Dune Sediment Budgets and Dune Morphodynamics Following Coastal Dune Restoration, Wickaninnish Dunes, Canada

Ian B. Darke,[1*] Ian J. Walker[1] and Patrick A. Hesp[2]

[1] Coastal Erosion and Dune Dynamics (CEDD) Laboratory, Department of Geography, University of Victoria, Victoria, British Columbia, Canada

[2] Beach and Dune Systems (BeaDS) Laboratory, School of the Environment, Flinders University, Adelaide, South Australia

*Correspondence to: Ian B. Darke, Coastal Erosion and Dune Dynamics (CEDD) Laboratory, Department of Geography, University of Victoria, Victoria, British Columbia, Canada. E-mail: idarke@trentu.ca

Received 10 October 2014; Revised 10 January 2016; Accepted 20 January 2016

ABSTRACT: The results from three years of surveying and monitoring a dynamic foredune and dunefield restoration effort on Vancouver Island, Canada is presented. Complete removal of foredune vegetation occurred in three phases spaced a year apart in an effort to control invasive Ammophila spp. The collection of airborne LiDAR, orthophotographs, and bi-monthly topographic surveys provided a means to quantify and examine sediment budgets and geomorphic responses. Three survey swaths, corresponding with each phase of vegetation removal, were established to provide detailed topographic coverage over the impacted beach, foredune, and dunefield landscape units. The swath corresponding with the first phase of removal recorded a positive sediment budget of 1·3m3m_2 after three years. A control swath, with data collected for a year prior and two years following removal, exhibited a distinct pulse of sediment delivery into the dunefield unit with a maximum gain of 0·03m3m_2 pre-removal compared to 0·11m3m_2 post-removal. Vegetation analysis zones, associated with each of the three swaths, demonstrate a range of vegetation responses due to variation in the vegetation removal and subsequent re-invasion or removal methods employed. The first site to be cleared of vegetation, received ongoing invasive re-growth control, and three years following removal vegetation cover dropped from 57% in 2009 to 13% in 2012 (_44%). An adjacent site was cleared of vegetation two years later (only one year of recovery) but experienced rapid Ammophila re-invasion and percent cover changed from 61% in 2009 to 26% in 2012 (_35%). The data presented provides insights for improving the application of sediment budget monitoring in dynamic restorations and discusses the potential for detailed spatial–temporal survey data to improve our understanding of meso-scale landscape morphodynamics following foredune disturbance. Overall, the vegetation removal treatments reduced the extent of invasive grass and increased dunefield mobility and dynamic activity.

Abstract: Monitoring Considerations for a Dynamic Dune Restoration Project: Pacific Rim National Park Reserve, British Columbia, Canada

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ABSTRACT: Historically, management of coastal dune systems has often involved artificial stabilization of active sand surfaces in order for coastal areas to be more easily controlled and modified for human benefit. In North America, the introduction of invasive grasses, namely European and American beach (marram) grasses (Ammophila spp.) has been one of the most successful strategies used for stabilizing active coastal dune sands. Recent research has demonstrated, however, that stabilization of coastal dunes often leads to reduced landform complexity and resilience, as well as declines in species diversity. More 'dynamic' restoration efforts have emerged over the past 20 years that encourage dune mobility and aeolian activity in order to provide a more resilient biogeomorphic system. In North America, there is generally little research relating restoration methods and outcomes to geomorphic responses despite the fundamental importance of sedimentary processes and dune morphodynamics in broader ecosystem function. This paper aims to better situate dynamic dune restoration within current geomorphic understanding. A brief review of key terms and concepts used in the emerging field of dynamic dune restoration is provided and expanded upon with respect to geomorphologic considerations. A case study of a recent dynamic restoration effort in Pacific Rim National Park Reserve, British Columbia, Canada is provide to demonstrate how these concepts are applied. Introduction of European marram at this site, coupled with a warming climate and increased precipitation in recent decades at this site, is thought to be associated with a rapid decline in aeolian activity, system stabilization and accelerated ecological succession. Preliminary results on the response of the dune system to mechanical removal of Ammophila are presented to provide the foundation for a research framework to guide the broader restoration project. Recommendations for improving treatment methodologies and monitoring protocols are provided to aid future restoration projects of this nature.