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Increasing our Awareness of Krummholz Forest

A PEI Forested Landscape Priority Place Project

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Environment and Climate Change Canada
Environnement et Changement climatique Canada

Prince Edward Island CANADA

Canada

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KRUMMHOLZ IN CONTEXT

The Krummholz zone, or “crooked wood” zone, is typically a subalpine phenomena. (Rankin, 2014) Found all over the globe with particularly well-studied sites located in the Northeastern states (NYNHP, 2022), exposed peaks in the Rocky Mountains (UA, 2007), the Carpathian mountains (Perzanowski, 2022) ,the famous “Tuckamore” of Newfoundland (Alden, 2013) and Labrador (Daley, 2009), and mountains in tropical regions (Devilliers, 1996). The commonalities between these distant and disparate habitats are their shared growing conditions rather than the species composition. These sites are all very exposed with generally low-nutrient substrates, harsh winter conditions and consistently high year-round winds. (Rankin, 2014)

These are the forces that cause the natural pruning which result in gnarled and bent krummholz specimens. According to Dan Sperduto of the US Forest Service, they grow, “where a tree’s resource gains exceed its losses by the thinnest of margins necessary to sustain survival”(Rankin, 2014). During the relatively calmer summer season, specimens push for all the growth they can muster. In some years they can only grow by the millimetre while better years by centimetres. Once the harsh winter winds and ice arrive, these young growing shoots are desiccated and die back resulting in very slow yearly growth rates as well as gnarled and witchy-looking tree forms due to apical bud death. In sites of highest winds, these tree can take on a low carpeting form following the average median direction of the most consistent winds.

Krummholz, a word of German origins, is perhaps best used as an action rather than a distinct habitat. Each of these previously mentioned regions are home to very different species of trees, animals and other flora. In the White Mountain region, red spruce (P*icea rubra*) is an uncommon krummholzing species clinging to exposed ledges and hillsides. (NYNHP, 2022) Whereas the dominant species of the Carpathian krummholz consist of mountain pine (P*inus mugo),* dwarf juniper (*Juniperus communis nana*) as well as green alders (*Alnus viridis*). (Perzanowski, 2022)

Our Island krummholz regions are more often dominated by white spruce (*Picea glauce)* with black spruce (*Picea mariana)*, balsam fir (*Abies balsamea)* and eastern larch (*Larix laricina)* present on sites with more access to water.

KRUMMHOLZ IN CONTEXT

As distinct as these areas can be, there are a number of common adaptations among krummholz-capable species across the globe. Trees found krummholzing are predominantly coniferous. Many typical coniferous adaptations developed over 300 million years ago when the global climate was distinctly hotter and dryer. Coniferous plants evolved a series of morphological adaptations geared towards water conservation; from small needle-shaped leaves limiting transpiration to resinous coatings that resist drying winds. Their reproductive habits also take advantage of high winds to transport pollen as well as their mildly-winged seeds. (Powell, 2009)

Another wide-ranging family of plants have developed similar adaptations under completely different climatic conditions, the heath family (*Ericacaea*). Evidence to date suggests that this family adapted to growing in recently glaciated areas. (Larsen, 1982) Places with poor, thin and acidic soils, exposed growing conditions, poor drainage and colder climates. The majority of these conditions and many members of this family can be found in both coastal and subalpine krummholz across the globe. This family generally develops shallow-spreading root systems with a number of mycorrhizal associations ensuring their survival in the thinnest of soils. (Sellmer, 2013) This family often has sclerophyllous leaves, which roughly translates to “hard leaves”. These leaves limits the loss of water through transpiration which results in slower growth rates, longer lifespans, and increased protection against drought. Sclerophyllous leaves often persist year-round, extending the growing season as well. (Larsen, 1982) Although these varied adaptations arose in reaction to harsh post-glacial winters, they can work equally well in both alpine and coastal settings.

The are also a number of adaptable groups of shrubs which are commonly found in krummholzing regions such as the junipers, alders and members of *Myricacaea*. Both alders and members of the *Myricacaea* are able to fix nitrogen from the atmosphere into absorbable ionic forms in the soil through a symbiotic relationships with bacteria. This is a handy adaptation for growing in areas with poor soils.

Krummholzing areas are wild habitats at the mercy of the elements and often found on dynamic terrains. Avalanches, seasonal weathering, and coastal erosion, among other natural forces, combine to create extremely harsh growing conditions with precarious stability and vast seasonal shifts. Plants that. can germinate and survive these locales are some of the hardiest specimens around with a bevy of adaptions for drought, wind-resistance, and various strategies for coping with thin and/or poor soils.

Common Juniper (*Juniperus communis*)

ISLAND KRUMMHOLZ


East Point Krummholz

Island krummholz share many similarities with alpine krummholz and are home to species from many of the previously mentioned families. Our coastal flora do not share all the difficulties that alpine growers must endure. For one, higher elevation sites tend to have lower average temperatures year-round, creating growing conditions akin to the sub-arctic. Alpine sites also have the benefit/threat of mountain fogs which can supply much needed moisture to the plants and animals but can also bring acid rains. (That being said, our coastal habitats present some unique challenges and conditions not faced by higher elevation tree lines.

On Prince Edward Island, our north-facing shores as well as parts of our eastern and western coasts are subject to consistently strong winds which gain power as they blow southward through the Gulf of St. Lawrence. This is due to the relatively low surface friction across ocean compared to land. This climatic process bombards our northern coasts with strong winds throughout the year; it also creates the strong wave action eroding our sandbar Island. The strong winds and waves carry salt crystals off the sea blasting any and all vegetation along the coast. These crystals act has a constant “sandpaper” abrading tender shoots of new growth and damaging emerging buds. Combined with the desiccating power of ocean winds and generally poor coastal soils, these areas are extremely hard places to grow.

Our predominantly sandstone geology creates vastly different growing conditions compared to the talus slopes of alpine settings. Ranging from sand to clay, our coastal krummholz sites have highly varied soil compositions which affect nutrient availability and water-holding capacity.

Krummholz trees located in dune systems grow in almost pure sand. While sand typically has a high rate of drainage, topographical variations (ex: dune slacks) created by wind events, such as blow-outs, can bring the dune surface much closer to the water table resulting in water-saturated sands. These areas are important habitats for a variety of heath plants (particularly cranberries), orchids and mosses. These areas provide large amounts of food for local wildlife and pollinators.

Clifftop krummholz often grow in clay-based soils over solid sandstone resulting in poor drainage. The thickness of the soil on these sites affects the floral species found. Thinner soil sites tend to be dominated by three-toothed cinquefoil, cranberries, and crowberries while thicker soil sites develop -

- a greater resemblance to a bog habitat with species such as bog laurel, pitcher plants, sundews, and cloudberry.

Low plains soils tend to be a mixture of clay and silt providing much more water retention for local flora regardless of strength of prevailing winds, reducing the severity of krummholz growth patterns. Many of our low plain shores are located along our calmer southern coast which showcase the weakest krummholz effect.

Soil composition along our shores is integral in dictating the species composition as well as the limits and severity of the krummholz effect. For example, the North Cape study site showcases a wider variety of coniferous and shrub species experiencing krummholz shaping with taller specimen heights nearer to the shore despite consistently high winds. The Clearspring study site has thinner soils with lower species diversity and a lower density of krummholzing spruce along the clifftop.

Like many of PEI's natural habitats, our coastal krummholz zones have a long history of degradation. Our northern shores were likely once a relatively unbroken line of krummholzing shrubs and conifer trees slowing erosion and providing a buffer to inland habitats against coastal winds. Over the last 300 years, European settlers cleared land for agricultural production right to the edges of cliffs and into the backs of dunes; this can be clearly seen in the historic aerial photos from the 1930's of all three of the Parks Canada study sites. These photos show farm fields throughout the National Park abutting large dunes with winds spreading sand across the agricultural areas. (Sobey, 2003) Other locations like the Clearspring and Cow River sites show ample krummholz regeneration from past farming as well as coniferous krummholz spread into any and all un-mowed fields along the coast. Still other areas, such as the coastline between Malpeque and New London bays are still farmed or have been developed into waterfront properties. This coastline generally passes the wind strength threshold for the krummholz effect to occur, however consistent human intervention prevents this. Areas along this coast which have been left wild show typical krummholzing patterns of growth.

Carpeting Conifers

ISLAND KRUMMHOLZ

Our coastal krummholz zones are also important shelter for a number of species, especially birds. Our Island krummholz areas can be especially crucial in providing food and respite to a number of migrating species. For example, the East Point study site hosts a number of uncommon avian species during the off-season. Coast sites are also used by a whole other subsection of species lacking in alpine sites: marine flora and fauna. The interplay of nutrients flowing between terrestrial and marine habitats and the resulting species richness and cascading trophic interactions are poorly understood. For example, nitrogen fixed along krummholzing shorelines by native shrubs and epiphytic lichens may enter the marine environment through submarine groundwater discharge. (Beusen, 2013) This gradual delivery of nutrients may create more productive and stable coastal zones resulting in better habitat for marine life, including shore birds, seaweeds and shellfish. Long-term studies by more knowledgeable researchers would be needed to begin to understand these processes locally.

There is also the soil-stabilizing power of established coastal krummholz which help to anchor cliffs and dune systems, slowing the average rate of erosion as well as reducing the number of large-scale erosional events which can occur during storm surges. Similarly to buffer zones along riparian zones, functional coastal krummholz can prevent agricultural run-off from infiltrating our estuaries and coastal near-shores. Large one-off erosional events as well as increased annual erosional averages couples with agricultural run-off can transport large quantities of nitrogen into our marine waters. This can affect the health our shellfish industry not to mention our coastal habitats. Interestingly, a report from 2012 highlighted the previously mentioned Malpeque to New London Bay coastlines as having the highest average erosion rates, an area also distinctly lacking coastal buffers of krummholz. (Webster, 2012)

Island krummholz are an important ecological legacy crucially securing the boundaries of our province, producing ample food for local wildlife, sheltering migrating birds, providing refuge for rare species of native flora as well as protecting our inland forests, fields, estuary and riparian zones from winds, salt-spray, and flooding. Although krummholzing coastlines are often inhospitable environments for hiking and gnarled enough looking to spoil a cottager's view-scape, these diverse, dynamic, and resilient eco-systems have been under-valued for too long.

Hog Island Krummholz

WINDY WOODS


North Cape Krummholz

The greatest force affecting krummholz development on Prince Edward Island are our coastal winds, particularly those coming from the north which can pick up speeds over the Gulf of St. Lawrence. Our exposed northern shores have the highest consistent year-round winds will continue act against the growth of coastal conifers slowing their growth, changing their growth form, and creating a host of other challenges.

Wind acts as a desiccating agent on plant life, sucking high quantities of moisture from unhardened growing tips and to a lesser extent hardened-off buds and leaves. Combined with small particulates such as sand and salt, this creates a highly abrasive desiccating force which can cause die-back in new growth, inhibit branch development on the windward side, or even cause apical bud death which causes the plant to grow horizontally rather than vertically.

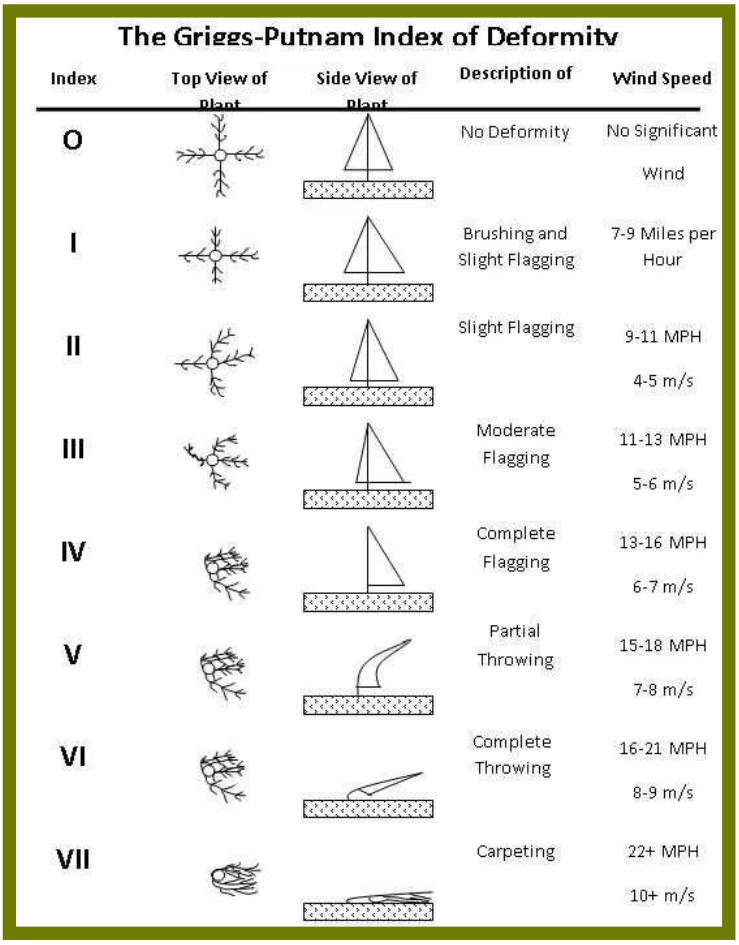

Cliffside Desiccation

Global research into the effect of wind on trees and forests shows that the most crucial element correlating to the greatest effect on plant growth is the mean annual wind speed rather than the maximum potential speed on any particular site. Consistently high winds maintain the harsh conditions across seasons which result in the krummholz effect. Areas with occasionally strong winds or that are prone to large wind events tend to have singular destructive disturbances which blow-over or break existing growth rather than slowly and consistently erode its growing capacity. (Hewson, 1979)

Shorelines with large stretches of open water as well as exposed mountainsides enable consistently strong winds to blow year-round resulting in the desiccation and abrasion needed for krummholz shaping.

WINDY WOODS

A study published in 1979 by E.W. Hewson et al, developed a visually cued system for estimating the mean annual wind speed which looks at the deformation of typical conifer trees growth patterns. This has been dubbed, "the Griggs-Putnam Index of Deformity", which correlated seven stages of tree shape to various subsets of mean annual wind speeds. (Hewson, 1979) This method is still used globally in early assessments for wind farm sites. (Anjum, 2014)



According to this index, the photo of the tree to the lower right, which is located at Campbell's Cove Campground, shows moderate to complete flagging, index three or four. You can see the limited branch growth on the windward side which places the mean annual wind speed at approximately 6 meters per second, alternately 11.7 knots or 21 km/h.

The Griggs-Putnam Index has proven very useful during the course of this study as the frequency of site visits did not allow for enough wind speed data to create accurate averages. Some sites such as East Point and North Cape have lots of available wind data as the former is an official weather station and the latter is the home to a wind farm. Mean annual wind speed was estimated using the index for each of the thirteen study sites.


The Krummholz Effect

Deciduous trees can also establish in the krummholz zone however they are always less common than their coniferous counterparts. Deciduous trees tend to lack many of the water-saving adaptations evolved by the conifers which limits their success. That being said, multiple deciduous species of trees were found during site visits including white birch, pin cherry, grey birch, red maple, mountain ashes, and aspens. These specimens were more commonly found in the most sheltered portions of the krummholz zone although those growing in more exposed locations generally showed very different reactions to the consistently strong winds.

WINDY WOODS

By their very definition, deciduous trees shed their leaves over the winter months reducing the strength of wind-loading compared to coniferous species. The deciduous strategy relies on larger but shorter-lived leaves which are too fragile to maintain during the winter months. Shedding leaves prior to the winter reduces the damage done seasonally as compared to conifer species. The desiccating winds have greater effects over the summer months, limiting water availability to each individual tree. This causes slower and thinner apical growth with is more vulnerable to die-back during late summer droughts and winter winds.


Deciduous Die-back

The photo from Cameron Island to the right shows ample leaf development lower in the canopy where there is some shelter from the coastal winds. The apical growth in the top-most exposed one to three feet of the canopy has died-back resulting in a lower canopy height in the forests most exposed to winds along the coast.

There a number of deciduous shrubs such as bayberry, winterberry holly, alders, roses, and serviceberries which often grow in the krummholz zone showcasing many of the same patterns of growth as deciduous trees with ample dead twigs on the extremities of the plants.


Clearspring Sloping Krummholz Forest

The mean annual wind speed greatly influences the level of krummholzing seen on each site with greater consistent speeds causing increasingly horizontal growth forms. This results in an inclining canopy angle growing in height with distance from the shore, slowing coastal winds as they move inland. This angled and dense krummholz zone becomes a substantial wind buffer to habitats on the leeward side. This is exemplified in the Southern Hog Island forest, which has substantially tall and healthy deciduous tree species growing such as northern red oak and white ash in close proximity to the shore. This un-ploughed coastal forest shows the potential for both shoreline and inland restoration that functional krummholz can provide.

ESTABLISHING KRUMMHOLZ

Coastal krummholz zones are harsh sites that can be difficult to survive even for established specimens. Shore plants must endure intense winds and salt spray as well as difficult growing mediums, including thick sand deposits with high drainage to thin clay soils with poor aeration.


Young White Spruce

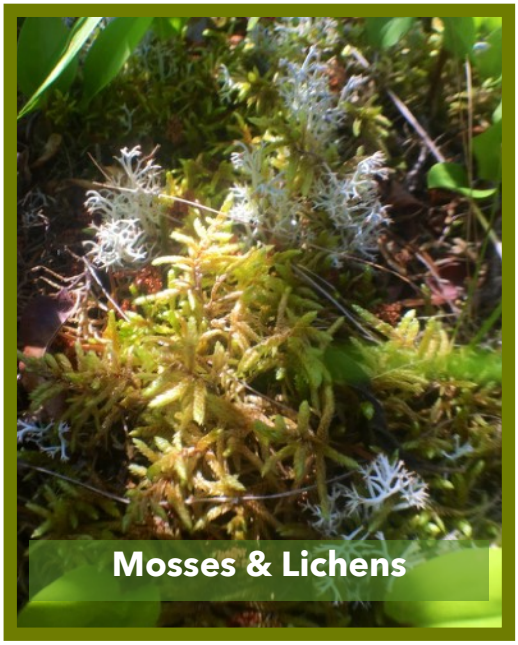
Germinating and surviving the seedling stage under these conditions is a true herculean effort. Evidence from site visits suggests a succession of events and species are needed to create the micro-conditions required for the beginnings of a coastal krummholz. (Powell, 2009)

In areas of moderate to high-mean annual wind speeds, the exact species involved in this successional process vary primarily based on the coast type and soil properties. White spruce (*Picea glauca*) is the most common krummholz zone tree species across the Province, growing in 11 out of 13 sites.

Cliffs tend to have soils with more drainage issues allowing the establishment of eastern larch, balsam fir and black spruce. Dryer sites, particularly dune systems tend to be a mixture of white spruce at dryer elevations and black spruce in the wetter swales and dune slacks.

At the scale of a seed, things change. Even small obstructions, whether natural debris like logs, minute changes in topography, or human-made junk can drastically change the growing conditions in a very small area. At a micro-scale, these obstructions change the flow of wind which can reduce desiccation, encourage wind-blown seeds to gather, as well as concentrate rainwater run-off all onto the same small spot. (Melanson, 2007) Most young spruce were found growing in small divets, against logs, and amongst wildflowers, which all adjusted micro-conditions improving growing conditions.

Mosses and lichens are crucial in these processes too. Acting as a moist shag-carpet, mosses provide an excellent substrate to catch seeds, shelter them from wind, and provide the ambient moisture needed for germination. A relatively recent study have indicated that mosses in the Boreal forest make associations with nitrogen-fixing cyanobacteria, key in maintaining productivity in these eco-systems. (Kobylinski, 2015) Whether these processes are taking place along our coasts and krummholzing habitats would require further research.


Mosses & Lichens

Lichens provide services as well. Dune systems like the Basin Head study site are blanketed in a variety of lichens, primarily from the *Cladoniaceae* family. These include a variety reindeer lichens as well as fishnet and British soldier lichens. The reindeer lichens on several sites can be particularly prolific, comprising over 50% of the ground cover. These lightly coloured species have a high albedo, reducing sun and heat to the sands beneath. Many of these species of lichens fill a role much like that of decomposing forest logs. They act as sponges which soak up rainfall to ration for dryer times. A number of lichens, such as the lungwort family (*Lobariaceae*) as well as species from the *Bryoria* genus, can also form associations with nitrogen-fixing cyanobacteria. (Cameron, 2006) These species fix a variety of key chemical elements from the surrounding air which can be transferred to the soils below by heavy rains. They can also aid in regulating ambient atmospheric moisture levels which in turn can moderate temperatures in under the forest canopy. (Adams, 2009)

Although poorly studied and easily missed, mosses and lichens may be integral components in the natural succession and continued health of our coastal forests. In the thickest copses of krummholz with wild tangles of horizontal branches, thick and low to the ground, there is little light for larger vascular plants. Branches and trunks in these areas are often peppered with lichens including species from the *Usnea*, *Bryoria, Ramalina* and *Hypogymnia* genera. The heavily shaded forest floor below is always home to moss species of the *Polytrichum* and *Dicranum* genera, often mixed with typic boreal species such as *Pleurozium shreberi* and *Hylocomium splendens*. (Pope, 2016)

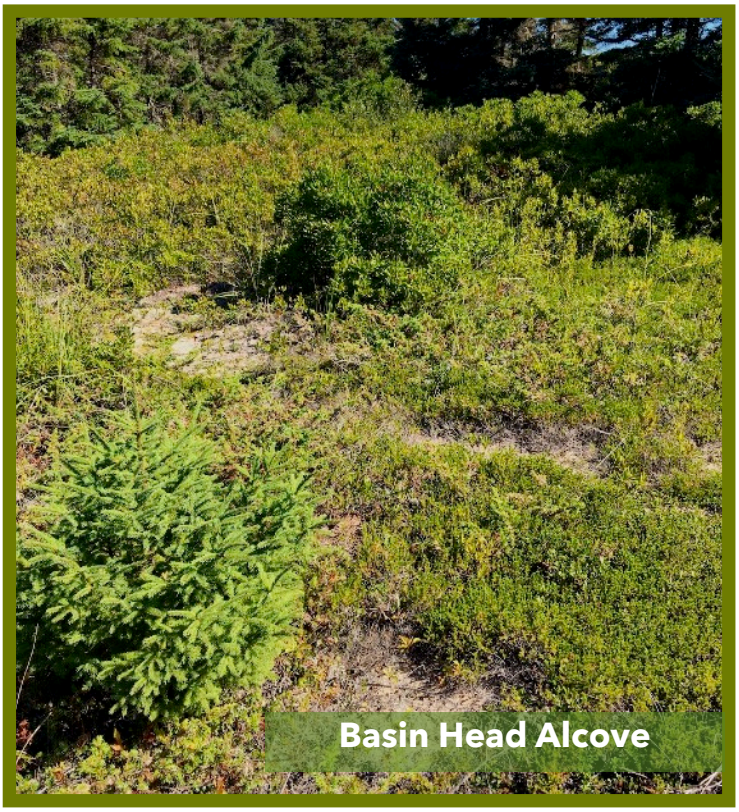

Reindeer Lichens

ESTABLISHING KRUMMHOLZ


Stanhope Krummholz

The early phases of krummholz development are a game of numbers and luck. Presuming there are ample seed sources, a large number of conifer seeds will reach the ground. Most will land in impossible places for propagation. Whether on bare earth away from moist mosses or lichens, perched and desiccating on the side of a cliff, falling into the salty sea, or drifting onwards across the dry dunes. Those that land in an optimal positions with enough shelter and moisture to sprout will still have an uphill battle to survive. (Melanson, 2007)

The coastal shrubbery and wildflowers which often establish before the spruce or fir, can be both a help or a hindrance. As previously mentioned, these low-growing species can change the dynamics of wind, heat and moisture at small scales which can make all the difference to young seedlings. There were areas found so thick with bayberry and wild rose that they seemed to be inhibiting the germination and growth of krummholzing tree species. This oppressive cover of shrubbery is temporary. It is only a matter of time until an extreme wind event or a poor growing year which will prune or kill areas of shrubbery increasing light levels reaching seeds and young plants. The dead standing woody shrubs continue to provide shelter against the winds for developing tree specimens.


Basin Head Alcove

Once conifers establish on site, they begin to alter the growing conditions more and more. Often areas of developing krummholz grow in star-like patterns with lines of spruce extending towards shore with small sheltered alcoves of shrubbery between these jutting arms. This is most likely due to the shelter provided by each growing conifer. As one gains a foothold, the leeward side of that specimen becomes a well protected site to grow which encourages other conifers to establish behind the initial colonizer. This cascading process creates these starfish like arms extending away from the forest edge.

THREATS TO ISLAND KRUMMHOLZ

Campbell's Cove Campground

Due to the very forces that shape them, krummholz grow in extremely difficult conditions. Constantly blasted by winds and salt sprays, often growing in shifting sands or on eroding coastal cliffs, they truly live life on the edge. Young and establishing specimens are even more vulnerable, living year to year hoping to gain more than is loss in the desiccating winds. Despite these issues, most of the study sites show an ample mix of conifer ages among the krummholzing trees. Many of the study sites also had many dead standing specimens of small diameters, demonstrating the game of numbers played during krummholz development. In areas of shelter, such as between the clumps more mature conifers, a huge number of seeds collect in the eddies caused by the slowing winds. Many will never germinate, drying out or being gobbled up by wildlife. Others will grow a little, only to be desiccated and killed while young. For every established tree bending with the wind, it is hard to imagine how many seeds and saplings from the same generation came and went.

Old Field Forest

The limiting factors for these processes seem to be a combination of available seed sources, soil health and most importantly, human intervention. Farming is responsible for the greatest loss of Krummholz across the Province. Much of the North Shore was under agricultural production until post-1950, including the National Park. (Sobey, 2004) These previously farmed sites had the least healthy krummholz and lowest diversities. The Clearspring study site was recently farmed up until a cliffside road. The clifftop beyond the old road had more species and was most likely the seed source for many of the species found throughout the site. Nowadays, these areas are kept open to maintain oceanfront view-scapes. Many mowed areas along these coasts are blanketed in clipped spruce, if the mowing stopped, the krummholz would return.

CLASSIFYING COASTLINES

North Enmore Low Plain Shore with Shore Berm

Although PEI has a uniform geology compared to the other maritime provinces. We lack any substantial areas of igneous or metamorphic rock, save for the famous Iron Rock of the Hog Island study site. Underneath the soils of much of the Province lay thick beds of permian-era sandstone, a fast eroding sedimentary rock, which over time breaks down into sand-sized grains. Although relatively uniform, there are relatively small discrepancies between various Island coasts with some eroding faster compared to others. This interaction, between coastal geology and marine forces, is responsible for the creation of our bays and headlands, salt marshes and estuaries, as well as our dune systems. (Nimbus, 2001)

Our iron-oxidizing soils were deposited on Prince Edward Island during the late stages of the last ice age, roughly 12,000-8,000 years ago. As glaciers melt they have a variety of processes for depositing till. When dropped quickly from a frozen state, the till remains a jumble of sizes and materials. When released in meltwaters cascading from the glacier, these glacial fluvial deposits will be sorted and dumped in groupings of similarly-sized grains of rocks. Given a consistent speed of flow, moving water will drop heavier material first and lighter materials as the speed of flow decreases. This natural sorting mechanism is responsible for the regional characteristics of our soils. (Nimbus, 2001) These variations in our soils composition greatly affect which species of flora will establish on each coastal site. Sites like the North Enmore and North Cape study sites, with clay-based soils lean towards water-tolerant plants like black spruce, eastern larch and many members of the heath family. Sandy sites will often form dunes depending on their location along our coastal littoral cells. On these dry and sandy sites white spruce will often dominate krummholz with shrubs such as wild rose, bayberry and chokecherry.

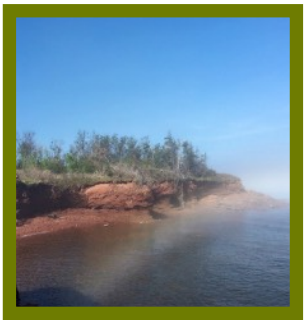
The results of this interplay between geology and soil composition can be sorted into a relatively small number of categories. A relevant report (Davies, 2011) was published by Coldwater Consulting Ltd called, “Geomorphic Shoreline Classification of Prince Edward Island”. The consultants categorized the Island’s coasts based on geological composition and formation.

CLASSIFYING COASTLINES

For the purposes of this study, the classification system was simplified. The nearshore classification was not considered as it was beyond our capabilities to examine sufficiently. The *foreshore* and *backshore types* were used, although the *wetland type* was excluded. The study (Davies 2011) was also examining estuary systems. Throughout this study the *backshore type* is referred to as the *coastal type*. These changes were made to further tailor categories for contrasting native flora and fauna across the different coastal types and relevant habitats.

Nearshore Type (3)	Foreshore Type (3)	Backshore Type (5)	Backshore Height (m)
Rocky	Rocky	Cliff	This is a numeric field containing the elevation of the backshore above mean sea level.
Sandy	Sandy	Bluff	
Marsh	Marsh	Low Plain	
		Dune	
		Wetland	

Based on these categories, our shores can be broken down into four *coast types*.



- **CLIFFS:**
  A largely vertical sandstone shoreline which generally has a rocky backshore, often a wave-cut platform. They are created by erosional processes caused by marine winds and waves interacting with geological composition.

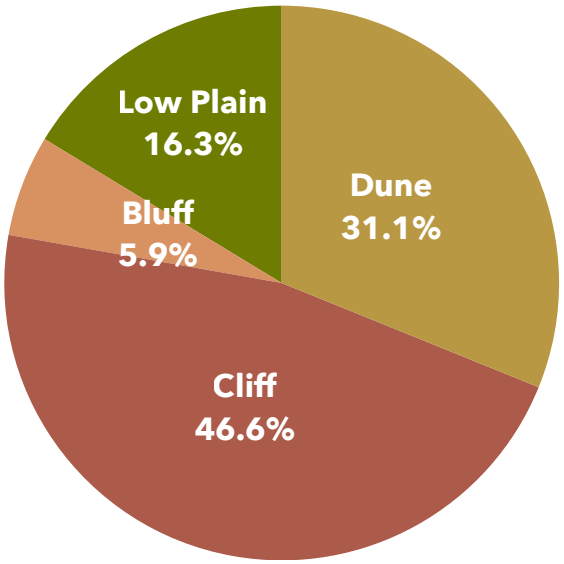
- **DUNE SYSTEMS:**
  A coastline created through marine deposition of sand-sized grains of eroded sandstone. Can range from small sandy berms to large dune systems depending on the rate of accumulation.

- **LOW PLAINS:**
  Located primarily along our southern shores and the inland edges of our estuaries. Another coastline built through marine deposition, this type of shore tends to be in areas of weaker year-round winds.

- **BLUFFS:**
  Often made of unconsolidated geological materials, from sands to pebbles to cobblestones. These relatively vertical structures of loose material tend to slump towards the coast creating an angled slope with debris littering the backshore of the beach.

CLASSIFYING COASTLINES

ISLAND-WIDE SHORELINE TYPE BREAKDOWN



Using data from the previously mentioned study (Davies 2011), but excluding estuarine shorelines (which are typically located more inland with shelter from coastal winds) the graph to the left shows a percentage and Island-wide breakdown of occurrence for each coastal type.

Cliffs and Dunes are by far the most common types of coasts, particularly along the north shore in areas with the strongest mean annual wind speeds. These provincial proportions affected our choices of adequate krummholz sites, with a greater number of cliff and dune sites studied compared to the other types

The table below show the coastal classification of all 13 studies sites across the province. The *coastal, foreshore, and backshore types* were determined qualitatively, applying the previously mentioned categories during site visits. The *growing substrate* classifications come from Provincial soil data and were confirmed during site visits. (Unknown Author, 2017)

2021-22 KRUMMHOLZ STUDY SITES COASTAL CLASSIFCATION

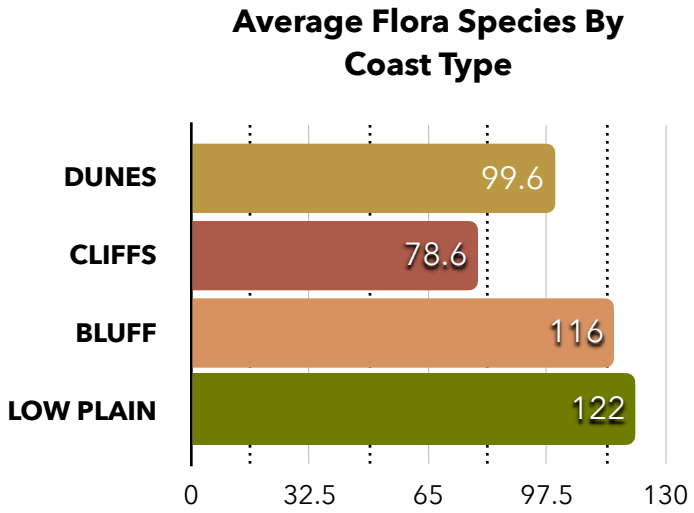
COASTAL TYPE	#			
DUNES SITES	**5**	**FORESHORE**	**BACKSHORE**	**GROWING SUBSTRATE**
Long Pond		Sandy	Sandy	Sandy
Stanhope		Sandy	Sandy	Sandy-Sandy Loam
Stanhope Cove		Sandy	Sandy	Sandy-Sandy Loam
Basin Head		Sandy	Sandy	Sandy
Hog Island		Sandy	Sandy	Sandy
CLIFF SITES	**5**			
East Point		Rocky	Rocky	Fine Sandy Loam
Clearspring		Rocky	Rocky	Fine Sandy Loam
Cameron Island		Rock/Sand	Rock/Sand	Loam
North Cape		Rocky	Rocky	Peat Bog
Belmont		Rocky	Rocky	Sandy Loam
BLUFF SITES	**2**			
Cow River		Sandy	Sand/Unconsolidated	Variable
Campbell's Cove		Sandy	Sand/Unconsolidated	Loamy Sand
LOW PLAIN SITES	**1**			
North Enmore		Sand/Silt	Clay/Saltmarsh	Fine Sandy Loam
TOTAL SITES:	**13**			

CLASSIFYING COASTLINES

Field Work Basin Head Secondary Dunes

These classifications are relatively simple to gauge, making them valuable when assessing coastlines for restoration work. Although no two sites are the same, sites of each coastal type tend to have similar arrays of native species as well as habitat types present depending on the growing substrate. With a few easy observational diagnoses, native species selection for site restoration will be more efficient.

By categorizing coastlines, we are also able to compare and contrast various types of sites to glean wider trends and informative deductions about our coastal habitats. For instance, this chart shows the average species richness, or species count, for each coastal type. At this point, the compiled and contrasted data has been more useful in seeing the gaps in our research. For example, while this graph shows that low plain types of coast have the highest species richness on average, there was actually only one site classified as a low plain compared to five each for dune and cliff sites, skewing results. Dunes are another interesting category in which sites of high recreational use and/or a recent history of farming had species richness rates well below average while the back dune systems of the Basin Head and Hog Island study sites were incredibly diverse. Cliff sites often have the least amount of protection against the coastal winds which is most likely the reason for their lower average rates of species richness.



This comparative analysis would benefit from more sites, particularly low plain and bluff sites. It would also be informative to compare sites throughout the rest of the maritimes where krummholz can be found.

COASTAL HABITATS

Cow River Waterway and Krummholz

The previously mentioned coastal type categories are a good starting point for assessments geared towards restoration work but there is more nuance to these coastal ecosystems. During the field work, patterns of flora communities, soil differences, and growing conditions became apparent. Each site can be seen as a shore type made up of a mosaic of habitat types. By categorizing these habitats found at each study site, more specific species lists could be collected detailing which species thrive in which habitats. Dune systems illustrate an excellent example of this nuance. Although typically dry due to the sandy substrate, coastal winds shape dune systems into peaks and troughs, often called dune slacks or swales. These low elevation hallows between larger dunes can become saturated by their proximity to the water table, creating an area perfect for water-loving species such as sphagnum mosses, rare orchids, as well as various members of the heath family. (Cox, 2003)

For the purposes of this study, each sites was assessed to record each habitat type found, which were then mapped out. Plant surveys were broken into each habitat type, creating a targeted list of species that could be used in restoration work on similar coasts with similar habitats. This strategy of data collection also allows for more analysis contrasting flora species found across sites, coastal types and habitats. By creating nuanced data sets of species information, we can also look for patterns of species richness across similar habitats. For this study *Flora* includes traditional plants as well as lichens, fungi and seaweeds.

For example, the average species diversity of the backshore habitat in bluff coastal types is more than double of any other. Slumping bluff sites all showed evidence of gradual soil creep down the slope, often carrying large sods already populated with species from the top of the bluff. Some of these sods are able to take root when they reach the backshore, which not only adds to our species richness count but also add organic matter and more fertile soils to the near-bluff backshore.

COASTAL HABITATS: FORESHORE

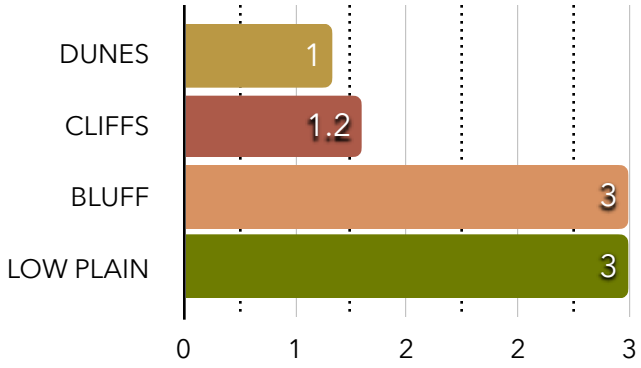
A Coastal Wrack

FORESHORE

Ranging from near-shore into the mid-wrack zone. This area is almost impossible for most vascular plants to survive in, with the exception of eel grass (Zostera marina).

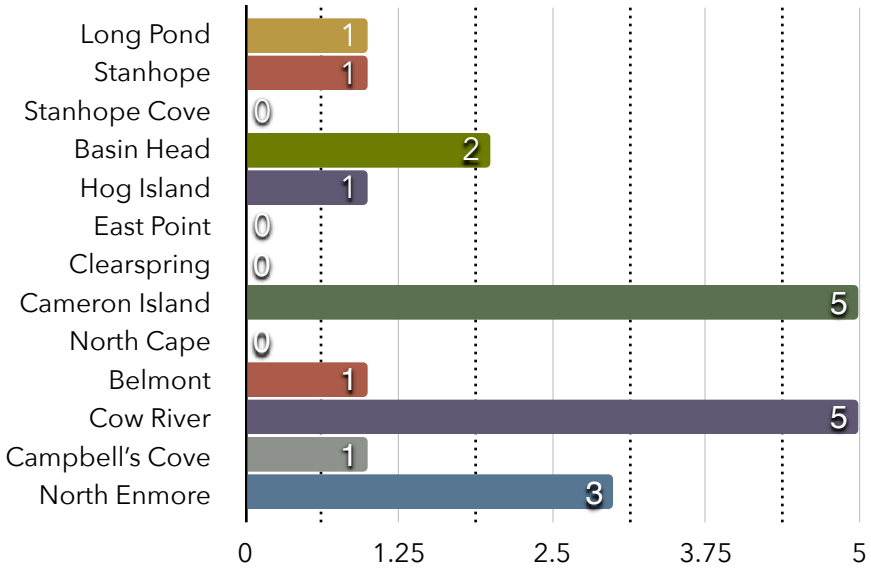
Completely under the influence of the tides, this habitat is fully inundated twice a day. Species found in this habitat are greatly influenced by wave action combined with the geological substrate, typically sand, cobblestone or sandstone. These characteristics created various micro-habitats such as tidal pools and sandbars. This is where an array of seaweeds and marine creatures can be found including wracks and kelps as well a variety of mollusks, crustaceans, and starfish

Average Foreshore Flora Species By Coast Type



Frozen Crab

Foreshore Flora Species By Study Site



COASTAL HABITATS: BACKSHORE

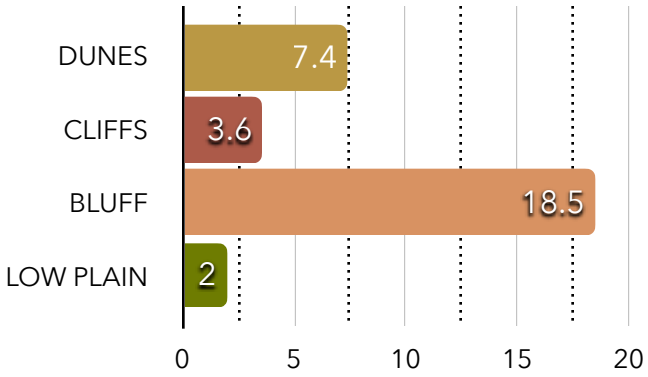

Sea Milkwort (*Glaux maritima*)

BACKSHORE

Typically ranging from the mid-wrack zone to further inland, this study defined the back-shore as the mid-wrack zone to the high tide limit.

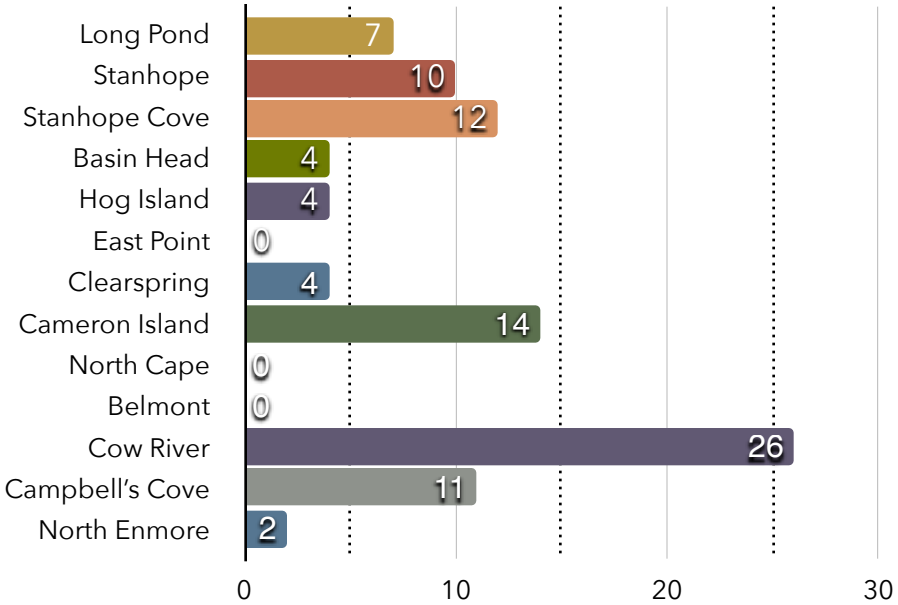
Although affected by many of the same forces as the fore-shore, this habitat has enough escape from the saline swash of the sea that many species are adapted to grow here. Common flora species found include sea rocket, a number of oraches, sand spurreys, and sea milkwort. These species all have a variety of adaptation for dealing with salt as well as unique reproductive strategies for coping with our malleable shorelines.

Average Backshore Flora Species By Coast Type




Stanhope Backshore

Backshore Flora Species By Study Site



COASTAL HABITATS: PRIMARY DUNES

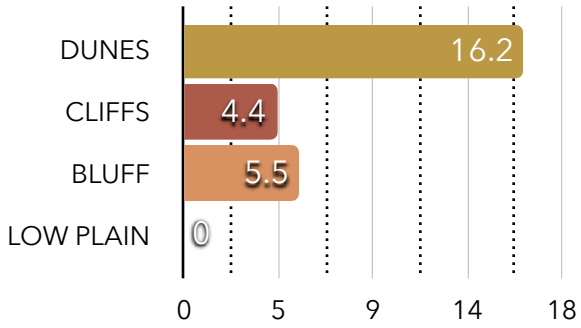

Hog Island Primary Dune

PRIMARY DUNES

A depositional and ever-changing habitat with a sandy substrate, heavily exposed to coastal winds and waves.

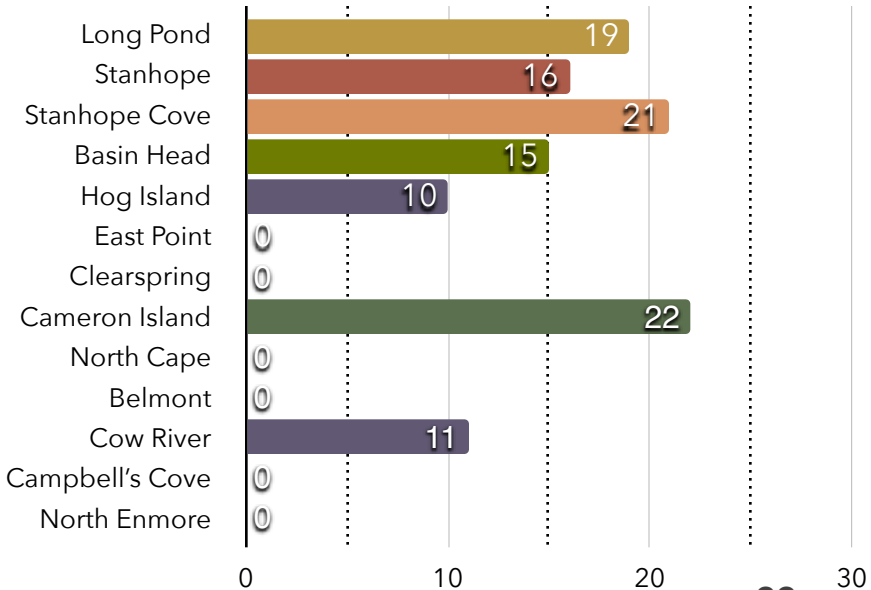
Anchored by a vast network of marram grass rhizomes, seaside dunes are at the mercy of seasonal deposition and destruction allowing only adaptable and pioneering species to grow. Seaside goldenrod, yarrow, beach-pea, and the non-native beach wormwood are common dune colonizers, often found growing along the ridge of the dune. A difficult environment for seeds to germinate, many species use rhizomes as part of their reproductive strategy including starry false Solomon's seal and seabeach-sandwort.

Average P. Dune Flora Species By Coast Type




Marram Grass
(*Ammophila breviligulata*)

Primary Dune Flora Species by Study Site



COASTAL HABITATS: SECONDARY DUNES

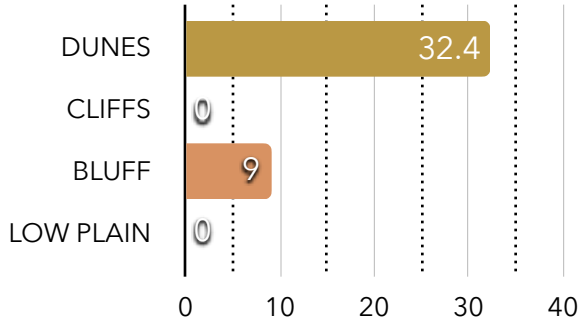
Hog Island Secondary Dunes

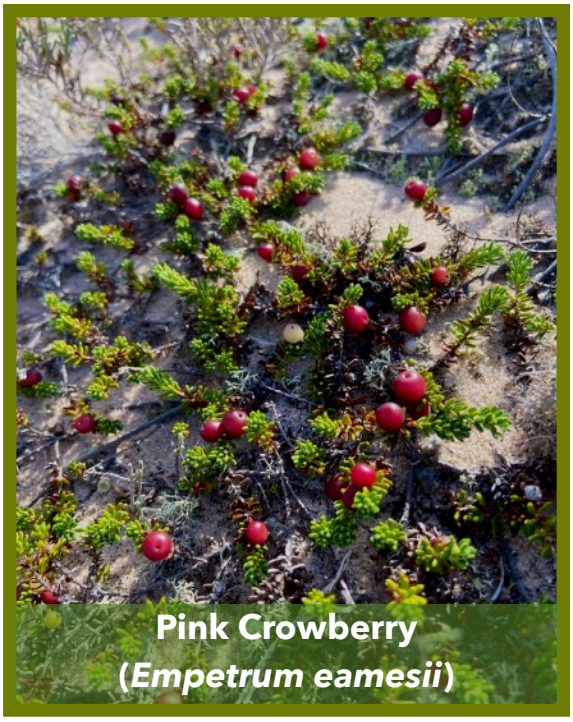
SECONDARY DUNES

A sandy habitat sheltered by the primary dune which can form vast heath-like areas.

Protected be the seaside primary dunes, these back dunes are under less pressure from coastal winds and salt spray. Because of this, they tend to be blanketed in a variety of vegetation, commonly crowberries, hudsonia, reindeer lichens, and a variety of berry producing plants. The abundant ground cover improves growing conditions allowing for the establishment of pockets of conifers, most commonly white spruce or black spruce depending on the elevation at which they grow, which dictates their access to water.

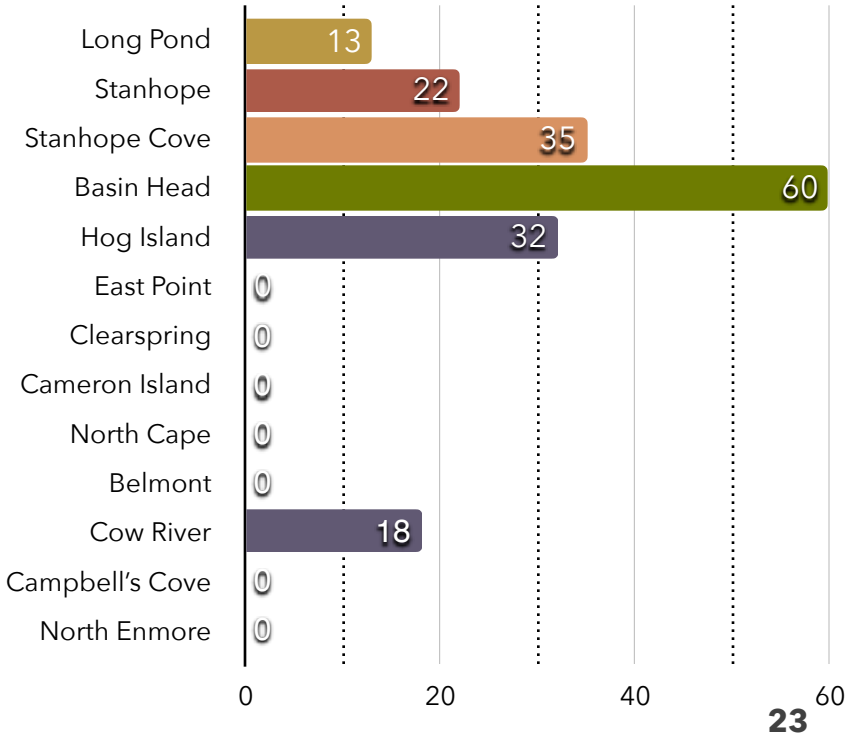
Average S. Dune Flora Species By Coast Type





Pink Crowberry (*Empetrum eamesii*)

Backdune Flora Species by Study Site



COASTAL HABITATS: CLIFF-FACE


Cow River Cliff-face

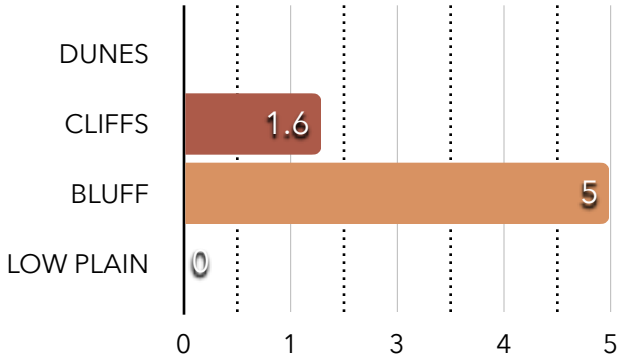
CLIFF-FACE

A largely vertical structure, either slumping or straight, bordering the shore and defined by geological composition and erosional forces.

Sheer rock faces such as those found at North Cape and East Point do not provide many good sites for plant life. While slumping unconsolidated bluffs have better sites for flora to temporarily establish. Slumping sites actually send down sods of clifftop specimens through erosional processes.

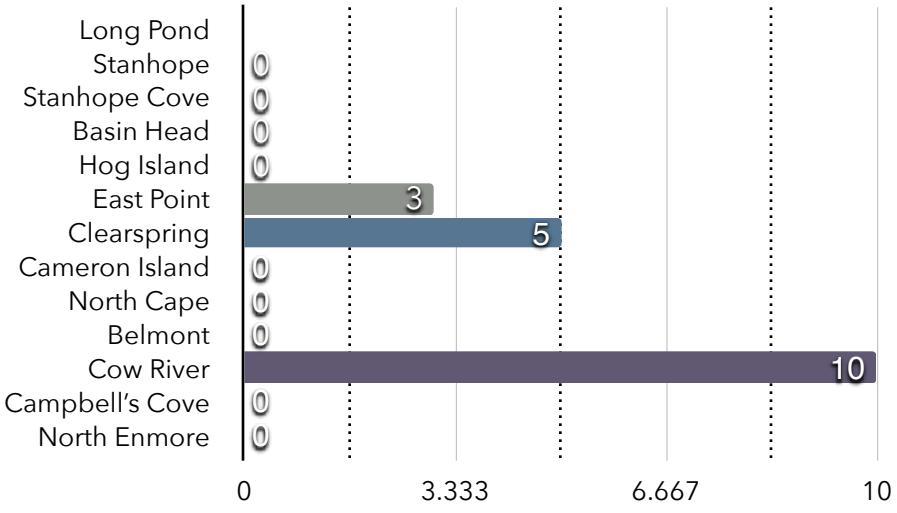
Although this is a precarious place to grow, some species have made it their specialty including plants like yarrow, seaside plantain, and our native sandspurreys.

Average Cliff-face Flora Species By Coast Type




Seaside Plantain
(*Plantago maritima*)

Cliff-face Flora Species by Study Site



COASTAL HABITATS: CLIFFTOP

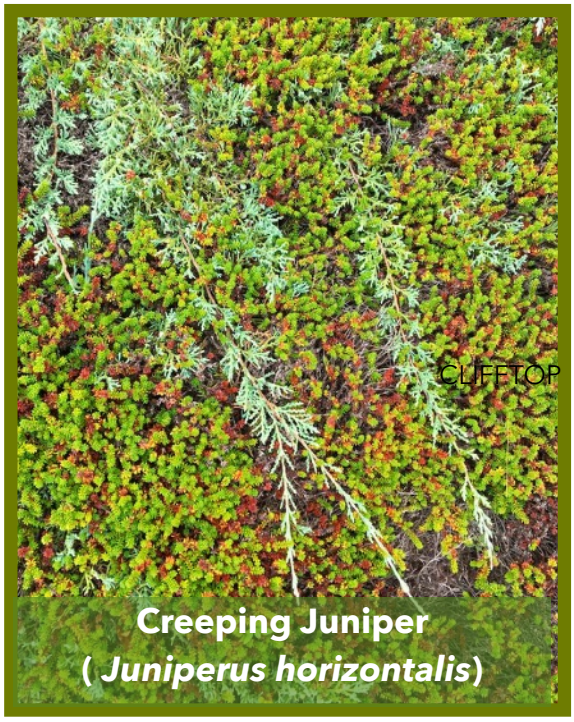

Clearspring Clifftop

CLIFFTOP

The top of a vertical face generally running perpendicular to the shore influenced heavily by erosion and winds.

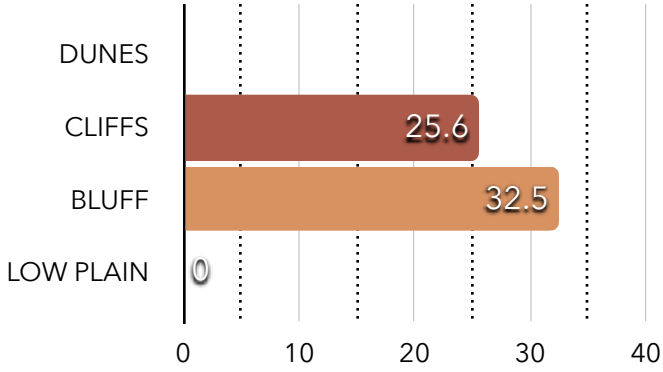
This habitat often has carpeting conifers including study sites like East Point, North Cape and Clearspring. With little protection from winds, the flora found growing in this habitat are strongly influenced by soil type and its qualities for moisture retention.

This harsh habitat is home to a number of low-growing plants including three-toothed cinquefoil, cranberries, creeping juniper, and crowberries.

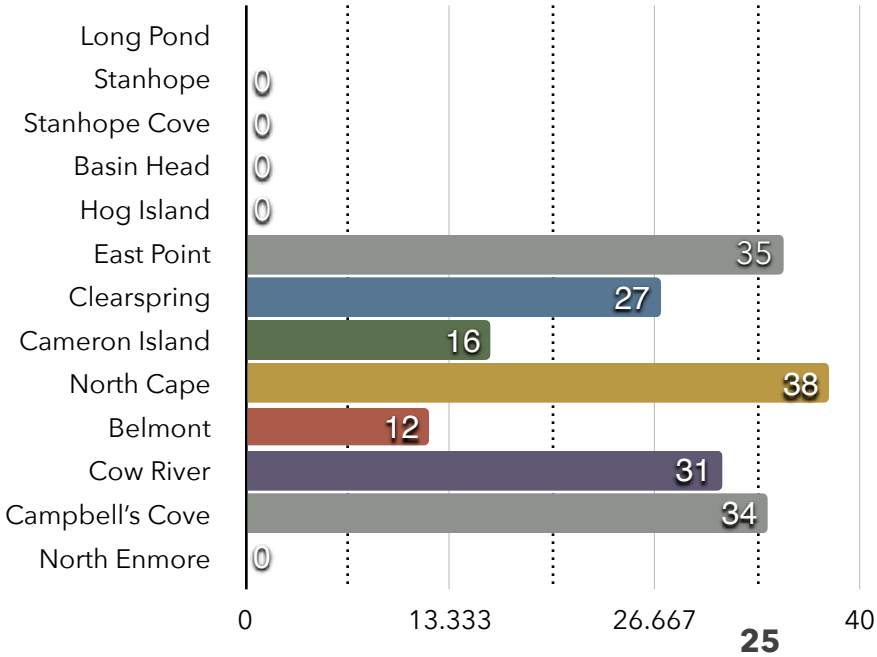


Creeping Juniper
(*Juniperus horizontalis*)

Average Clifftop Flora Species by Coast Type



Clifftop Flora Species by Study Site



COASTAL HABITATS: SHORE BERM

North Enmore Shore Berm

SHORE BERM

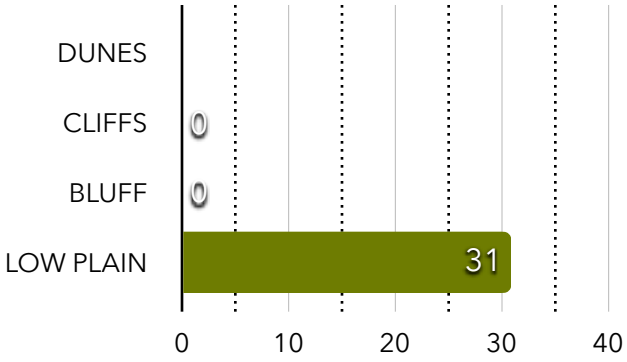
A low shoreline generally bordering the high-tide line, often associated with soils that have higher clay contents.

Found primarily along the south shores, these habitats are generally along low plain shores and are often adjacent to salt marshes. The gentler tides and estuarine setting create highly productive shorelines.

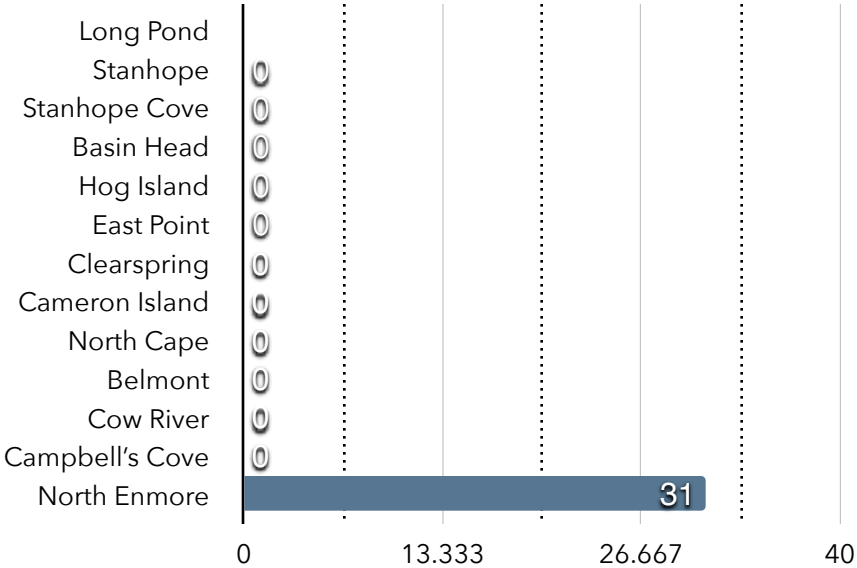
These salty and generally narrow habitats are host to a variety of halophyte species such as rough cocklebur, eel grass, common ragweed, and the rare Canada germander.

Rough Cocklebur
(Xanthium strumarium)

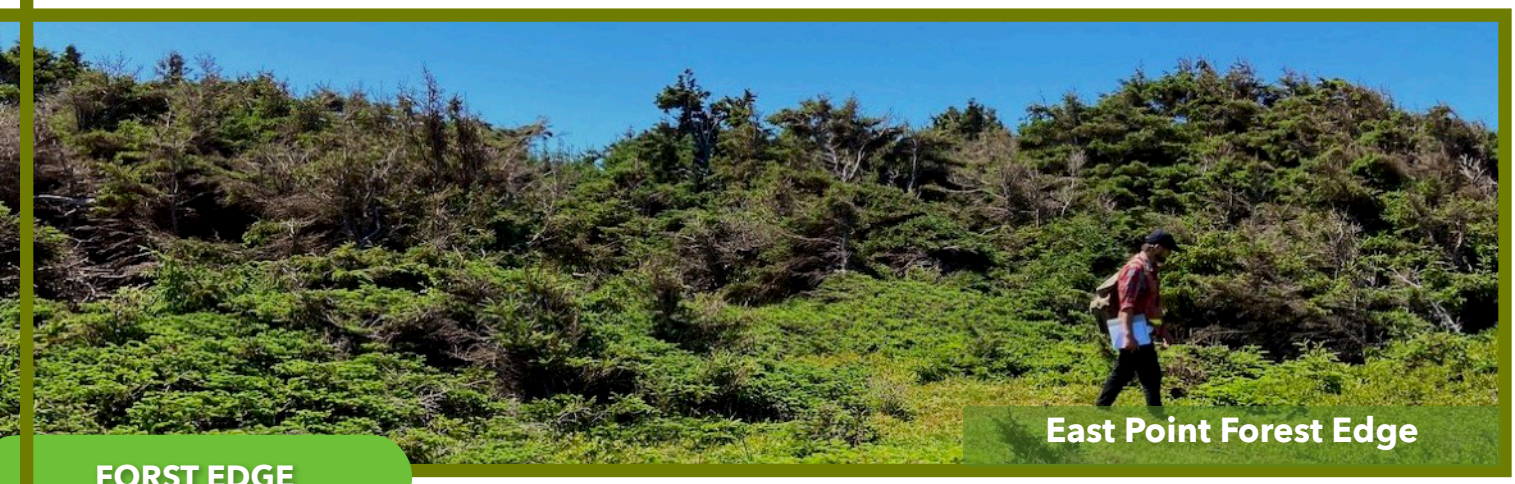
Average Shore Berm Flora Species by Coast Type



Shore Berm Flora Species by Study Site



COASTAL HABITATS: FOREST EDGE



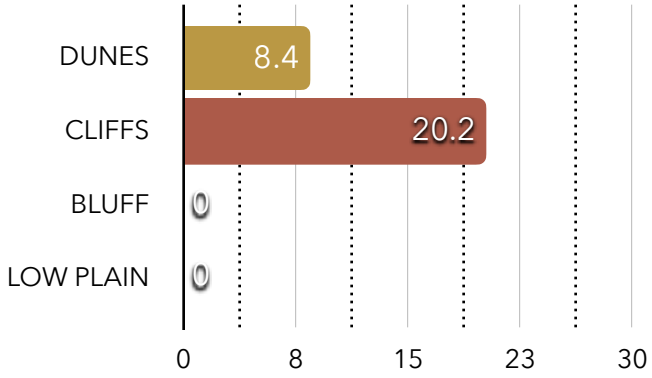
East Point Forest Edge

FORST EDGE

The least easily defined habitat more akin to a transitionary zone, often exposed to strong winds.

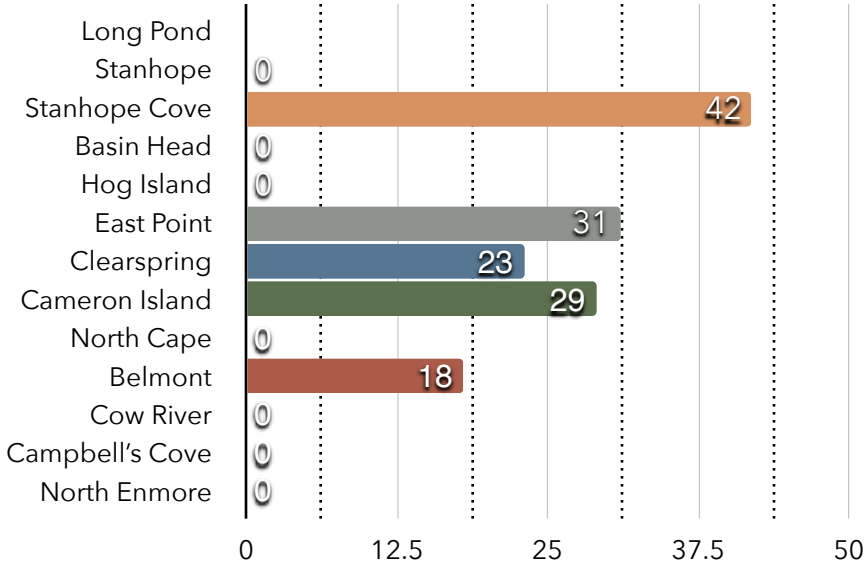
This habitat often blends from forest to shore, displaying clearly ascending trees heights which correlate to the mean annual wind speeds. Generally found on cliff sites where the strongest winds produce a more pronounced krummholz effect. These habitats are generally home to the thickest stands of low-growing krummholz, a place where you can only crawl due to the thickets of horizontally branching bows.

Forest Edge Flora Species By Coast Type

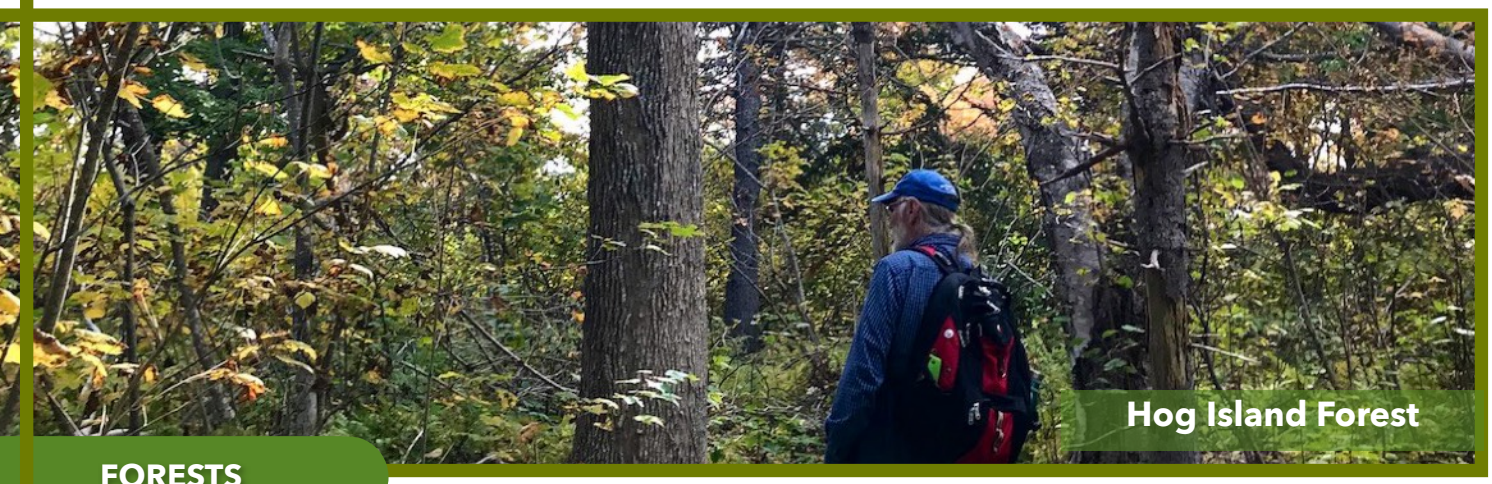


Severe Krummholz Effect

Forest Edge Flora Species by Study Site



COASTAL HABITATS: FORESTS

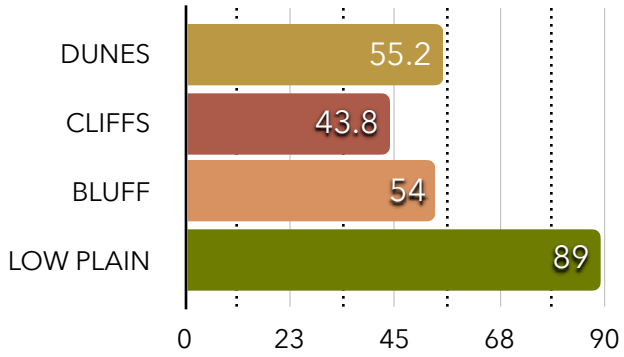

Hog Island Forest

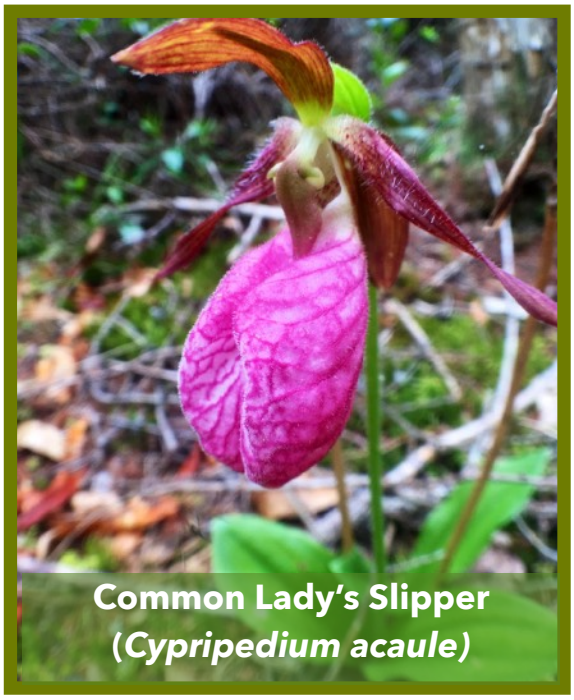
FORESTS

Dunes and krummholzing forest edges often shelter this habitat from the full force of the coastal winds.

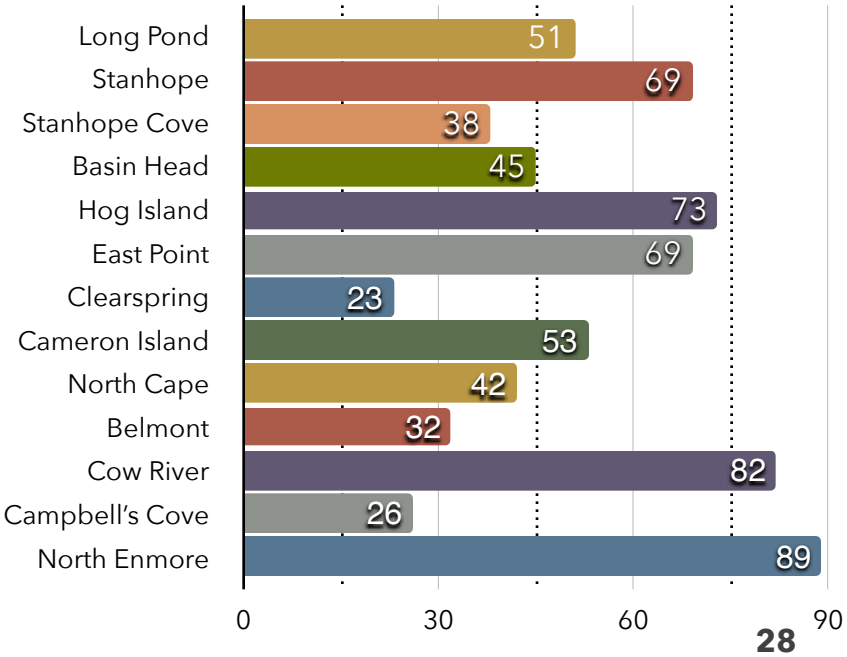
Island Forests have amazing potential and the forest on Hog Island truly showcases what can grow so close to the coast. Many of our coastal forests are in poor health, often due to past agricultural practices. With proper coastal protections in the form of healthy krummholz, our coastal forests can grow more than white spruce trees including native species such as red oak, white ash and sugar maple as well as variety of wildflowers and ferns.

Forest Flora Species by Coastal Type




Common Lady's Slipper (*Cypripedium acaule*)

Forest Flora Species by Study Site



COASTAL HABITATS: SWALES

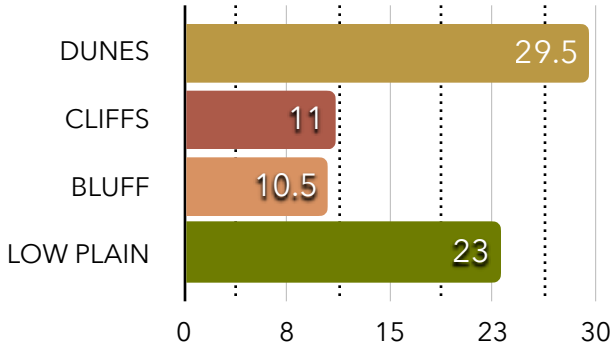
Basin Head Inter-dune Slack

SWALES

A freshwater-dominated wetland generally found where topographical elevation and the water-table meet.

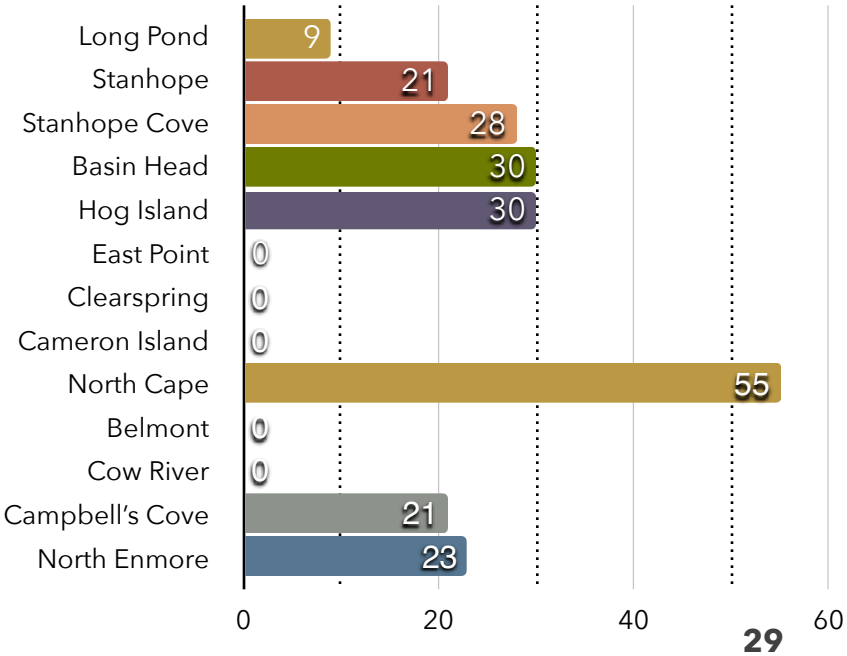
This habitat heading is a bit of a catch-all and in future studies could be separated into more distinct categories of wetlands. Typically these areas are defined by poor drainage and an excess of water allowing for a completely different host of species to grow. These habitats can vary from perched bogs at the North Cape site to inter-dune slacks at the Basin Head site. Species found in these habitats often include sphagnum mosses, orchids, as well as our native carnivorous pitcher plants and sundews.

Swale Flora Species By Coast Type



Round-leaf Sundew (*Drosera rotundifolia*)

Swale Flora Species by Study Site



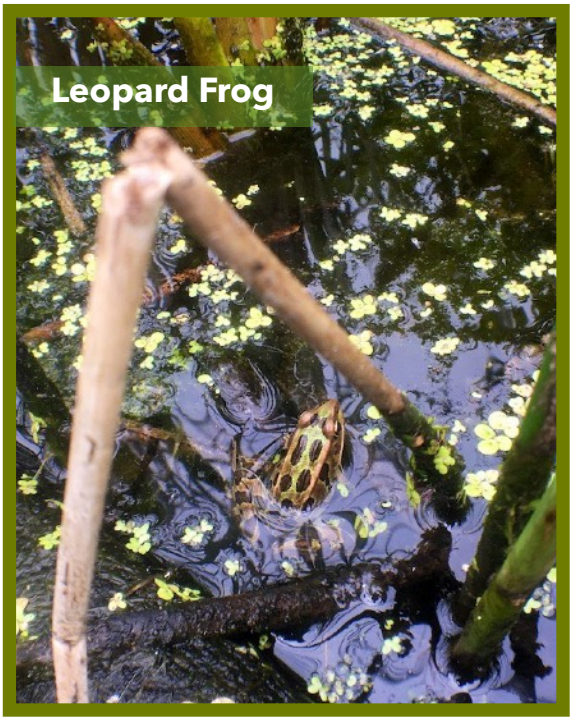
COASTAL HABITATS: WATERWAYS


Cow River Waterway

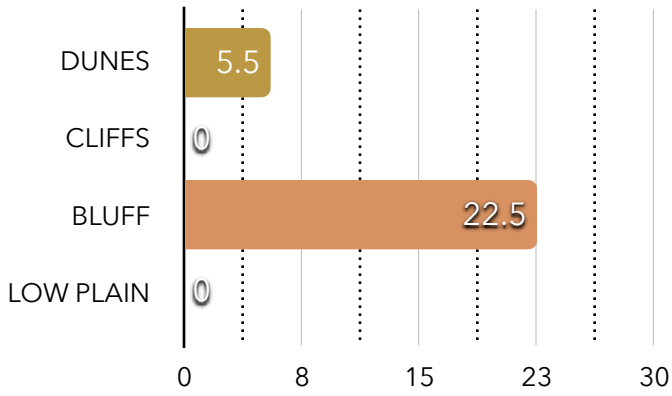
WATERWAYS

Another freshwater habitat defined by running water where a stream or river meets the sea.

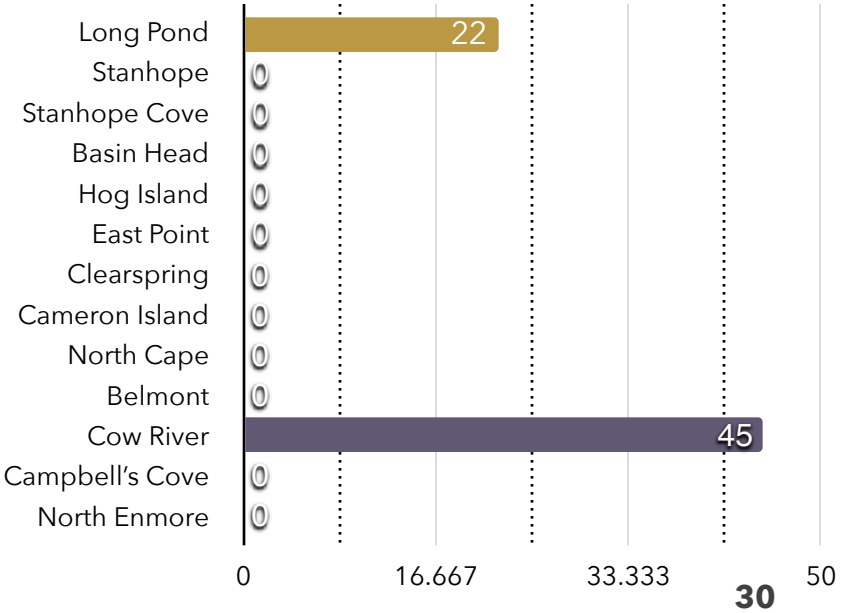
Like other riparian zones, these habitats can be home to a unique grouping of plant species depending on the substrate of the river. The Long Pond study site has a waterway running through sand which lacks the sheer number of species compared to the Cow River site in which the diverse flora grows in a silty/sandy substrate. Waterways also affect the diversity of fauna, attracting a number of aquatic and semi-aquatic species such as beavers, various amphibians among many more.


Leopard Frog

Waterway Flora Species by Coast Type



Waterway Flora Species by Study Site



COASTAL HABITATS: SALT MARSHES

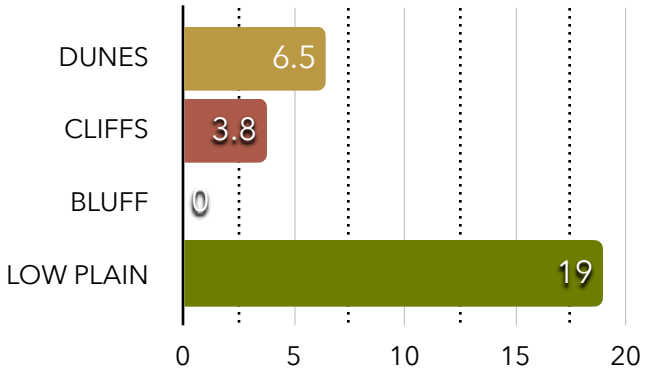
Cameron Island Saltmarsh

SALT MARSHES

A saltwater-dominated coastal wetland comprised of salt-tolerant flora such as the spartina grasses.

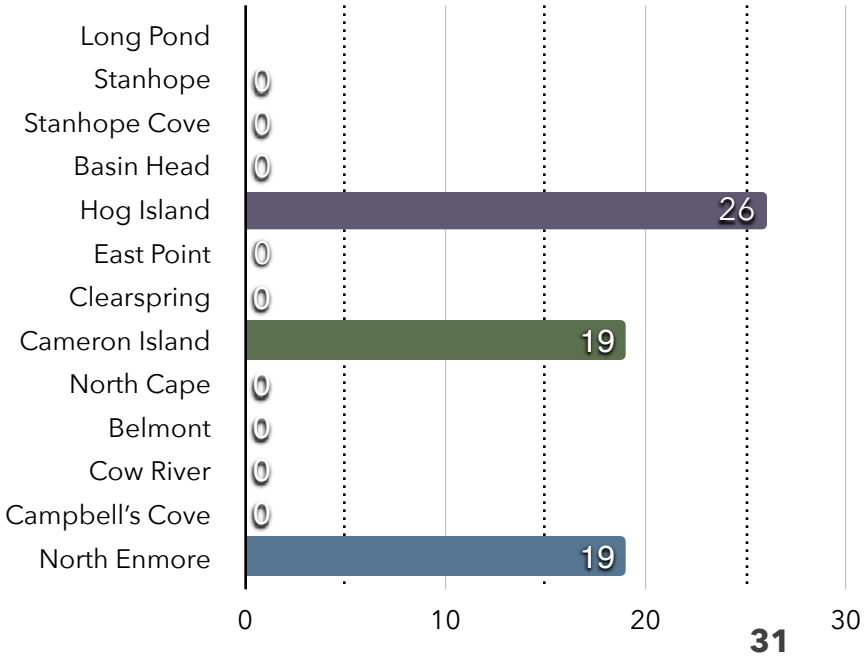
Most often associated with coasts of low plains, these productive habitats are wholly unique and heavily influenced by the intrusions of salt waters daily. These habitats are depositional and occur in areas of slower moving waters and most often lower average wind speeds. A number of unique halophytes such as Canada germander, sea lavender, and sea glasswort can be found on these salty flats.

Salt Marsh Flora Species Average By Coast Type



North Enmore Saltmarsh

Saltmarsh Flora Species by Study Site



COASTAL HABITATS:: DISTURBED AREAS

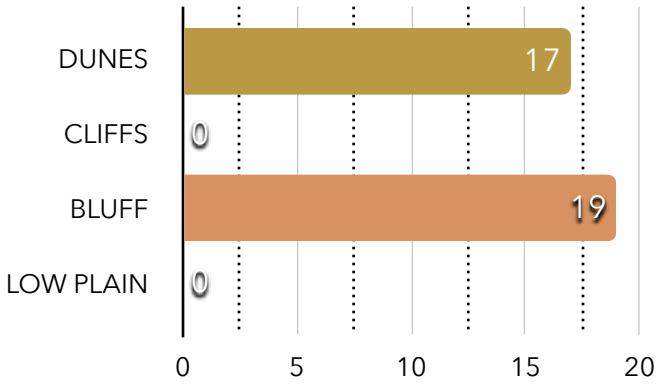
Mowed Campground

DISTURBED AREAS

Any area which has seen recent or consistent disturbance of vegetation or soil such as parking areas, campgrounds, and mowed shorefront..

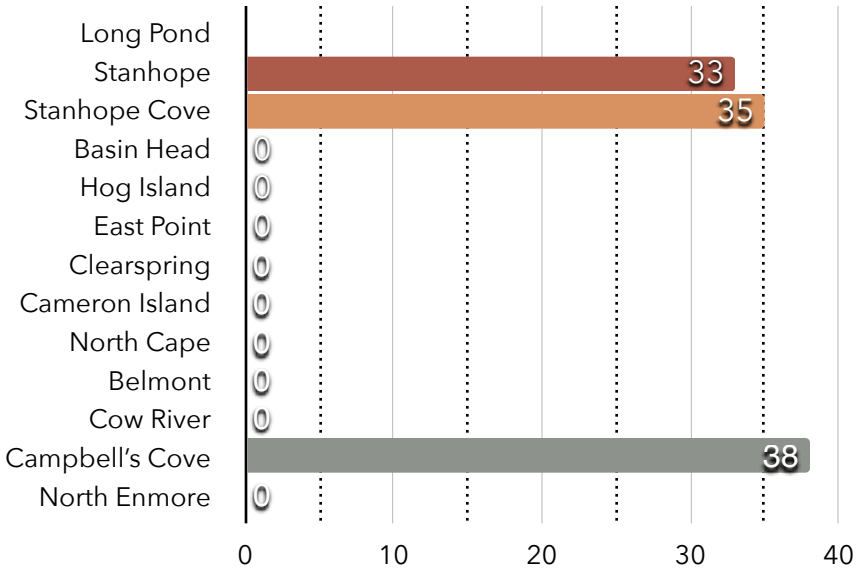
Island coastal properties with recent human intervention are common across the province. These sites often have compacted soils that differ in composition from the rest of the area. There can also be more litter, increased infrastructure and often lots of traffic. These areas can still be home to a diversity of different plants although they tend to be non-native species, often considered weeds.

Disturbed Area Flora Species By Shore



Roadway through Krummholz

Disturbed Areas Flora Species by Study Site



COASTAL FLORA

Tuberous Grass Pink (*Calopogon tuberosus*)

As previously discussed, our Island coasts can be categorized into several types based on their coastal orientation, location, and geology. These attributes, combined with topographical variance and land-use history create a mosaic of coastal habitats including krummholzing groves of trees. These habitats are distinct yet connected, supplying seed, pollen, fruit, nesting sites, and more to variety of creature which do not adhere to these artificial boundaries. Swale conditions bleed into nearby secondary dunes which provide ample berries for those that prefer to nest in more sheltered forests.

A primarily goal for this krummholz study was to catalogue the amazing array of flora living in our coastal habitats. For the purposes of this study, *Flora* includes fungi, lichens and seaweeds as well as traditional plants. *Flora* effectively refers to anything living that isn't an animal. This created a simpler dataset for both collection and analysis. It should also be acknowledged the limitations placed on data collection by observer bias. The majority of the botanical field work was done by one researcher who has more experience in forest ecosystems. This presented a steep learning curve with identifying many of the coastal plants living in these habitats. With that in mind, botanical field work was conducted frequently and throughout the season to provide ample time for on-site identification. Each site was visited three to four times between May 2021 and Dec 2021. Visits to each site were approximately 4-6 hours in duration with over 2,500 botanical photos taken in total. The Belmont Provincial Park study site is the exception to this schedule, which, lacking krummholz develop, was visited less to make time for more relevant sites. In August 2021, the research team was accompanied by James Churchill from the Atlantic Canada Conservation Data Centre to examine lichens on the Basin Head, East Point, and North Enmore study sites. This was a very illuminating experience and a valuable collaboration in terms of training and improved data collection.

COASTAL FLORA

It is safe to assume that there are a good number of flora species that have been missed during botanical surveys, especially amongst the mosses and lichens.

This also includes species from a number of genera in which keying out the exact species is very technical or extremely seasonal. These genera include the asters, oraches, goldenrods, grasses, rushes, sedges, and cottongrasses, among others. Seaweeds are also an under-represented category of flora due to lack of expertise and difficult access to some beaches.

Wooly Hudsonia
(Hudsonia tomentosa)

According to a Publication by Environment Canada: (Henderson, 2009)

- Misidentification rates in large-plot multi-species surveys are 5% to 10% for botanists with 10 to 30 years experience in the regional flora.
- Overlooking rates in large-plot multi-species surveys are >10% for botanists with experience in the regional flora, and no time-limit restrictions.
- Overlooking and misidentification rates are greater for graminoids and bryophytes (difficult to identify), while trees and shrubs (largest plants) are the least frequently overlooked or misidentified.

Botanical Field Work

COASTAL FLORA

Canada Sandspurrey (*Spergula canadensis*)

Coastal plants have had to evolve a number of innovative adaptations to cope with the environmental stresses of living so close to the ocean. Salt from our marine environments is transported inland by wind and waves, permeating backshore sands, intruding through salt marsh estuaries, and abrading trees growing along coastal cliffs. Any plant growing in these kinds of habitats much have adequate defences or capacities for defending against and processing excess salts.

Not only can salt damage plants through external mechanisms but it can also penetrate growing substrates absorbing and binding with water in the soil. Sandy soils tend to have less salt holding capacity than soils with more clay. Soil salts can have a series of drought-like effects on plants, from preventing their roots from actually absorbing water to pulling water out of the roots through a disruption of the process of osmosis. It can even compromise the absorption of essential nutrients such as calcium, magnesium and potassium. As mentioned previously, there are a number of shore plants which form strong mycorrhizal association to secure water as well as essential nutrients. There is also the potential role of mosses and lichens in sequestering nitrogen, improving water availability and providing a number of essential elements. (Cox, 2003)

Desiccated Juniper

Airborne salts can act as an abrasive medium literally pelting plants with rough fast-moving projectiles. Many shorelines plants have tough leaves and stems which regulate water loss. Whether in the form of needles as which many coniferous shore trees or through sclerophylly, improved lignification of components of the leaves' cell walls, seen in many heath plants. (Read, 2003) Other woody plants have adapted a more subtle stratagems like the pliable wood of willows. Recent studies on trembling aspen suggest that their unique leaf petiole geometry, which causes their trembling, actually aids in reducing water loss in dry environments by reducing ambient temperatures and improving light penetration. (Kim, 2019) Many beach plants have adapted some version of these kinds of adaptations such as the thickened leaf cuticle of sea rockets and many oraches to the needle-like leaves of the sandspurreys and the exotic common saltwort. (Cox, 2003)


Cranberries and Crowberries

Plant reproduction also faces a number of challenges along coastlines. Some previously mentioned, such as the desiccating power of wind on germinating seeds and young saplings. Other issues come from coastal processes of deposition and erosion. Dune systems, particularly the backshore and primary dune habitats, experience strong seasonal meteorological changes as well as endure storm surges, blow-outs, and other powerful weather events. These can reclaim chunks of dune back to the ocean or dump large amounts of sand on top of existing vegetation. These processes happen both gradually and suddenly along our coastlines. (Short, 2012) Many species use a rhizome-based strategy, allowing them to spread underground regardless of the new sands loaded onto the surface such as the important dune plant, marram grass. (Cox, 2003) The dioecious creeping juniper primarily reproduces vegetatively with roots growing from layered carpeting branches extending across clifftops. (Gucker, 2006) Other coastal growing plants use similar above-ground strategies such as silverweed and wild strawberry.

Others adapted their seed dispersal mechanisms. Sea rocket produce a raceme of buoyant fruits which can survive at sea, drifting down shore to find a better beach elsewhere. This is just half of the story. Seeds growing towards the top of the plant break off and release with more ease sending them blowing across the sands or out to sea. The seeds near the base of the plant stay attached longer increasing their chance of being buried in situ. Half of their offspring are pioneers taking their chances on the ocean currents while the other half try to continue growing in proven situations. (Cox, 2003) There are also a number of coastal plants with other types of dual strategies. Rough cocklebur seed dispersal obviously relies on furry mammals to snag the hooked projections on its bur. However, these burs are also incredibly buoyant which allows for a secondary strategy of marine migration. (Cox, 2003) Most of the coastal sites studied had a high number of berry producing plants from raspberries to various heath plants as well as crowberries, roses, bayberries, huckleberries, and many more. These plants both rely on and provide for local wildlife living along the coast as well as species on the move like migrating birds or mammals using coastal corridors to pass between habitats.

One unique set of convergent adaptations evolved by two separate genera of native plants, is carnivory. Our native round-leaf sundew and northern pitcher plant were found in coastal wetlands including the clifftop bogs of North Cape and the dune slacks of basin head. Both of these species have distinct carnivorous adaptations to assist in essential nutrient acquisition which is useful when growing in poor soils with low available nutrients.

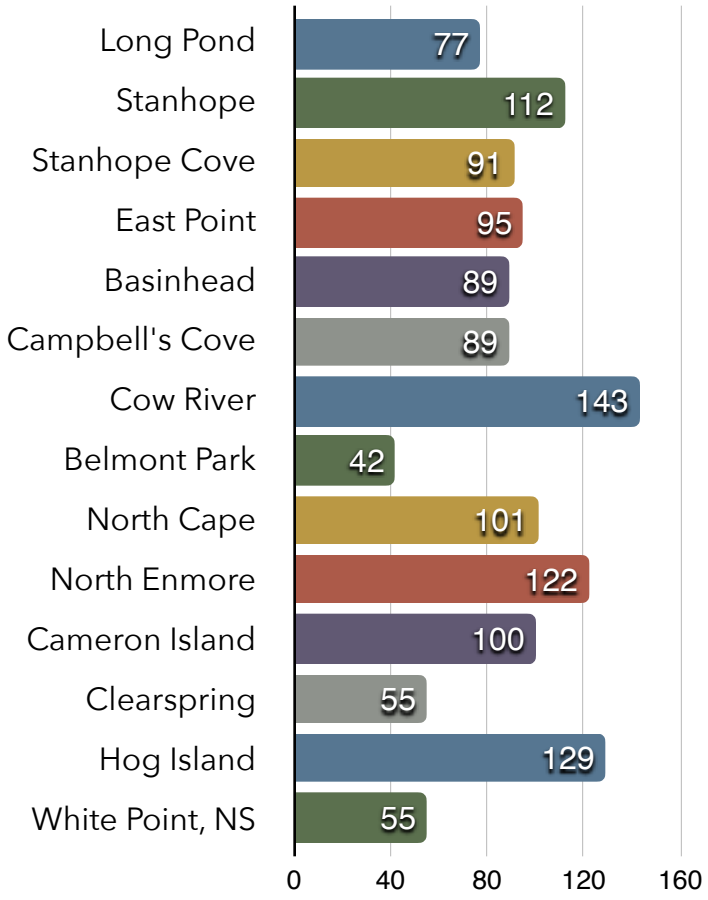
COASTAL FLORA

The graph to the right shows the total number of flora species found at each study site. This also include a site in Northeastern Cape Breton, Nova Scotia, called White Point, which was explored for two hours during a researcher's summer vacation in August 2021.

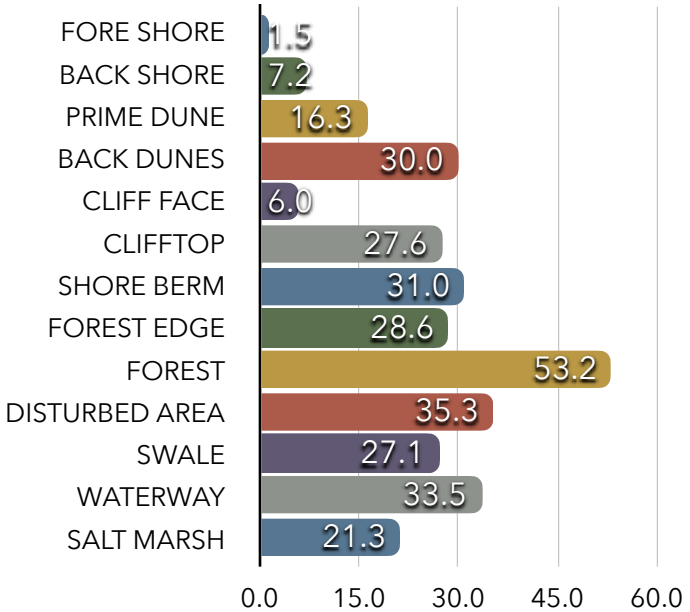
The average flora species count, across all Island sites, is 95.8. Based on the previously mentioned publication, it is wise to assume field surveys had a combined overlooking and misidentification rate of 20-25%. (Henderson, 2009) This number is most likely higher due to the fact that this study included lichens, fungi, and sea weeds in its flora counts.

The Belmont Park site has the lowest species count as it was visited the least and has a history of heavy human intervention. Cow River had a number of habitats present including a very productive waterway. Hog Island's forest was the source for a large proportion of the species found.

Total Flora Species By Site



Average Flora Species for All Study Sites By Habitat



The graph to the left shows the individual average flora species count for each type of habitat found during field work. These averaged were derived by combining species counts across each site by habitat type and then dividing by the number of each individual habitat occurrence.

Forest habitats were represented across every site and were generally the most biodiverse habitats, although this is also the habitat type in which researchers have the most identification experience. Disturbed areas had a high average species count but this was because of a much higher proportion of non-native species including many common weeds as well as a variety of common non-native landscaping plants.

COASTAL FLORA


Sphagnum Moss

Flora survey lists for each site were broken down into multiple botanical categories to allow for better analysis. *Flora* was separated into six broad categories with 16 subcategories:

- **Woody Plants:** including trees, shrubs, heath plants and berries (*the Rubus and Ribes genera).*
- **Wildflowers:** including shade-tolerant, sun-loving, coastal, and water-tolerant.
- **Ferns and Friends:** including ferns, clubmosses, and horsetails.
- **Non-Vascular:** including mosses and liverworts.
- **Fungi and Lichen:** including fungi and lichen.
- **Marine:** including seaweeds of both red and green algae as well as the vascular eel grass.

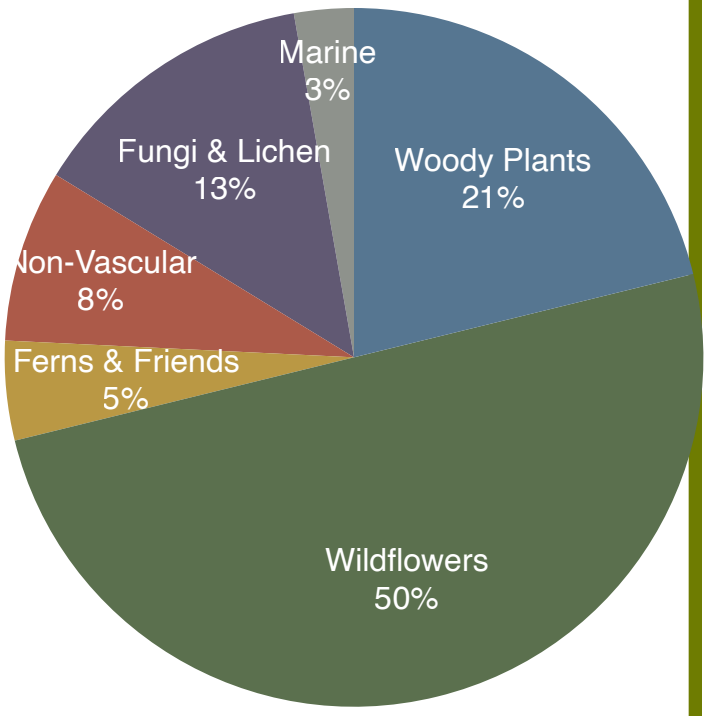
In total, 326 species of flora were identified across all study sites. There were 37 exotic species found, 4 invasive species, and 93 specimens only identified to genus. These unknown species are primarily amongst the wildflowers, non-vascular, and fungi/lichen categories.

Species counts by flora type were as follows:

- 69 Species of Woody Plants
- 163 Species of Wildflowers
- 15 Species of Ferns and Friends
- 26 Non-vascular species
- 44 Species of fungi and lichens
- 9 Marine species

Again observer bias plays a role in these results. Marine species are under-represented due to the researcher's lack of experience identifying these species as well as poor beach access especially on some cliff sites.

Flora Type Breakdown All Sites



COASTAL FLORA - COMMON WOODY PLANTS

WOODY PLANTS			
CONIFEROUS PLANTS	**SCIENTIFIC NAME**	**SRANK**	**#**
WHITE SPRUCE	*Picea glauca*	*S5*	**11**
BALSAM FIR	*Abies balsamea*	*S5*	**7**
BLACK SPRUCE	*Picea mariana*	*S5*	**6**
EASTERN LARCH	*Larix laricina*	*S5*	**3**
DECIDUOUS TREES	**SCIENTIFIC NAME**	**SRANK**	
WHITE BIRCH	*Betula papyrifera*	*S5*	**11**
PIN CHERRY	*Prunus pensylvanica*	*S5*	**10**
RED MAPLE	*Acer rubrum*	*S5*	**9**
GRAY BIRCH	*Betula populifolia*	*S5*	**7**
AMERICAN MOUNTAIN ASH	*Sorbus americana*	*S5*	**7**
TREMBLING ASPEN	*Populus tremuloides*	*S5*	**5**
LARGE-TOOTHED ASPEN	*Populus grandidentata*	*S5*	**2**
SUGAR MAPLE	*Acer saccharum*	*S4*	**1**
NORTHERN RED OAK	*Quercus rubra*	*S4*	**1**
WHITE ASH	*Fraxinus americana*	*S4*	**1**
NON-NATIVE	**SCIENTIFIC NAME**	**SRANK**	
EUROPEAN MOUNTAIN ASH	*Sorbus aucuparia*	*Exotic*	**7**
SHRUBS	**SCIENTIFIC NAME**	**SRANK**	
BAYBERRY	*Myrica pensylvanica*	*S5*	**13**
SERVICEBERRY	*Amelanchier spp.*	*SU*	**12**
VIRGINIA ROSE	*Rosa virginiana*	*S5*	**12**
WINTERBERRY HOLLY	*Ilex verticillata*	*S5*	**11**
WILD RAISIN	*Viburnum nudum*	*S5*	**10**
CHOKECHERRY	*Prunus virginiana*	*S5*	**10**
RED-BERRIED ELDER	*Sambucus racemosa*	*S5*	**9**
WHITE MEADOWSWEET	*Spiraea alba*	*S5*	**9**
COMMON JUNIPER	*Juniperus communis*	*S3-S4*	**7**
MOUNTAIN HOLLY	*Nemopanthus mucronatus*	*S5*	**6**
BLACK CHOKEYBERRY	*Photinia melanocarpa*	*S5*	**6**
BLACK CROWBERRY	*Empetrum nigrum*	*S4*	**5**
SWEET GALE	*Myrica gale*	*S5*	**5**
HEATH PLANTS	**SCIENTIFIC NAME**	**SRANK**	
LATE LOWBUSH BLUEBERRY	*Vaccinium angustifolium*	*S5*	**8**
SHEEP LAUREL	*Kalmia angustifolia*	*S5*	**7**
LARGE CRANBERRY	*Vaccinium macrocarpon*	*S5*	**6**
SMALL CRANBERRY	*Vaccinium oxycoccos*	*S4*	**4**
BERRIES	**SCIENTIFIC NAME**	**SRANK**	
RED RASPBERRY	*Rubus idaeus*	*S5*	**12**
WILD STRAWBERRY	*Fragaria virginiana*	*S5*	**9**
SMOOTH GOOSEBERRY	*Ribes hirtellum*	*S5*	**7**
BRISTLY BLACK CURRANT	*Ribes lacustre*	*S5*	**7**

There are a number of species which commonly grow along our coasts. These include the common krummholzing conifers as well as a number of salt-resistant wildflowers, wind-resistant shrubs and a lot of berry-producing plants.

The follow lists show the species that occurred across more than four sites out of thirteen, with some interesting less common deciduous occurrences included as well.

White spruce is by far the most common conifer, appearing of the majority of sites despite variable soil conditions.

White birch and red maple were found across many sites although rarely in significant populations. Pin cherry and trembling aspen were found on fewer sites but with more occurrences where growing.

Approximately eight species of native shrubs were present across the majority of sites, most of which are tolerant of wind and dry soils. These commonly occurring species can be roughly broken down into three categories based on their preferred habitat.

Coasts: can tolerate high winds, dry soils and direct sunlight.

Forests: can tolerate shade but prefers less wind and more moisture.

Wetlands: tolerates direct sunlight and high winds when growing in a wet substrate.

The heath family also commonly occurs along many coasts as well as many berry producing canes. These species contribute significantly to the availability of food for local wildlife along PEI's shores.

COASTAL FLORA -WILDFLOWERS

NON-WOODY PLANTS				
SHADE-TOLERANT	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**#**
BUNCHBERRY	*Cornaceae*	*Cornus canadensis*	*S5*	**11**
WILD SARSAPARILLA	*Araliaceae*	*Aralia nudicaulis*	*S5*	**10**
FALSE-LILY-OF-THE-VALLEY	*Liliaceae*	*Maianthemum canadense*	*S5*	**10**
STARFLOWER	*Primulaceae*	*Trientalis borealis*	*S5*	**10**
TALL WHITE ASTER	*Asteraceae*	*Doellingeria umbellata*	*S5*	**7**
WHORLED WOOD ASTER	*Asteraceae*	*Oclemena acuminata*	*S5*	**6**
TWINFLOWER	*Caprifoliaceae*	*Linnaea borealis*	*S5*	**6**
LION'S PAW	*Asteraceae*	*Prenanthes trifoliolata*	*S5*	**5**
COMMON LADY'S SLIPPER	*Orchidaceae*	*Cypripedium acaule*	*S5*	**5**
VERONICA	*Plantaginaceae*	*Veronica*	*Invasive*	**5**
PURPLE VIOLET	*Violaceae*	*Viola spp.*	*SU*	**5**
CLINTONIA	*Liliaceae*	*Clintonia borealis*	*S5*	**4**
SMALL WHITE VIOLET	*Violaceae*	*Viola blanda*	*S5*	**4**
SUN-LOVING		**SCIENTIFIC NAME**	**SRANK**	
ASTERS SPP.	*Asteraceae*		*SU*	**13**
GRASSES	*Poaceae*		*SU*	**13**
YARROW	*Asteraceae*	*Achillea millefolium*	*S5*	**12**
ROUGH STEM GOLDENROD	*Asteraceae*	*Solidago rugosa*	*S5*	**11**
BEDSTRAW	*Rubiaceae*	*Galium spp.*	*SU*	**10**
CHICKWEED	*Caryophyllaceae*	*Cerastium spp.*	*SU*	**9**
HAWKWEED	*Asteraceae*	*Hieracium spp.*	*SU*	**8**
SOW THISTLE	*Asteraceae*	*Sonchus spp.*	*Exotic*	**8**
EVENING PRIMROSE	*Onagraceae*	*Oenothera biennis*	*S5*	**7**
CANADA THISTLE	*Asteraceae*	*Cirsium arvense*	*Exotic*	**6**
COMMON PLANTAIN	*Plantaginaceae*	*Plantago major*	*Exotic*	**6**
CURLED DOCK	*Polygonaceae*	*Rumex crispus*	*Exotic*	**6**
DANDELION	*Asteraceae*	*Taraxacum officinale*	*Exotic*	**5**
LAMB'S QUARTERS	*Chenopodiaceae*	*Chenopodium album*	*Exotic*	**5**
CLOVER	*Fabaceae*	*Trifolium spp.*	*Exotic*	**5**
VETCH	*Fabaceae*	*Vicia spp.*	*SU*	**5**
SHEEP SORREL	*Polygonaceae*	*Rumex acetosella*	*Exotic*	**5**
QUEEN ANNE'S LACE	*Apiaceae*	*Daucus carota*	*SNA*	**4**
NARROW-LEAF GOLDENROD	*Asteraceae*	*Euthamia graminifolia*	*S5*	**4**
CANADA GOLDENROD	*Asteraceae*	*Solidago canadensis*	*S5*	**4**
CALICO ASTER	*Asteraceae*	*Symphyotrichum lateriflorum*	*S5*	**4**
NON-WOODY PLANTS				
COASTAL		**SCIENTIFIC NAME**	**SRANK**	
BEACH WORMWOOD	*Asteraceae*	*Artemisia stelleriana*	*Exotic*	**11**
SEASIDE GOLDENROD	*Asteraceae*	*Solidago sempervirens*	*S5*	**10**
SEA ROCKET	*Brassicaceae*	*Cakile edentula*	*S5*	**9**
MARRAM GRASS	*Poaceae*	*Ammophila breviligulata*	*S5*	**9**
BEACH PEA	*Fabaceae*	*Lathyrus japonicus*	*S5*	**7**
STARRY FALSE SOLOMAN'S SEAL	*Liliaceae*	*Maianthemum stellatum*	*S3*	**7**
SILVERWEED	*Rosaceae*	*Argentina anserina*	*S5*	**7**
THIN-LEAVED ORACHE	*Chenopodiaceae*	*Atriplex prostrata*	*S4*	**6**
SEASIDE PLANTAIN	*Plantaginaceae*	*Plantago maritima*	*S5*	**6**
THREE TOOTHED CINQUEFOIL	*Rosaceae*	*Sibbaldiopsis tridentata*	*S4*	**6**
SEABEACH-SANDWORT	*Caryophyllaceae*	*Honckenya peploides*	*S2-S3*	**5**
COMMON SALTWORT	*Chenopodiaceae*	*Salsola kali*	*Exotic*	**5**
COMMON RAGWEED	*Asteraceae*	*Ambrosia artemisiifolia*	*S4*	**4**
CANADA SANDSPURREY	*Caryophyllaceae*	*Spergularia canadensis*	*S4*	**4**
WET-LOVING		**SCIENTIFIC NAME**	**SRANK**	
RUSHES	*Juncaceae*	*Juncus spp.*	*SU*	**8**
SEDGES	*Cyperaceae*	*Carex spp.*	*SU*	**6**
BLUE-FLAG IRIS	*Iridaceae*	*Iris versicolor*	*S5*	**6**

Many of PEI's krummholz sites were farmed within the last century, resulting in a predominance of young first-successional forests along our coasts. The commonly found shade-tolerant species demonstrate that the krummholzing forest edge habitat provides ample shelter from coastal processes. This creates relatively standard Island forest growing conditions even in proximity to the coast. This allows for many common Island forest wildflowers to be commonly present across study sites.

Sun-loving plants had many of the hardest to identify families as well as a large selection of non-native species. Although this makes detailed analysis difficult, it is apparent that numerous species of the goldenrod and aster families are well represented.

Of the coastal plants, beach wormwood, an exotic near-arctic migrant from Asia, is found across almost all sites. Many of the species found on this list can be found across a number of coastal types with the exception of the sand-specialists such as marram grass, the oraches, sea rocket, seabeach-sandwort, and the exotic saltwort.

COASTAL FLORA - FERNS & NON-VASCULAR

FERNS & MORE				
FERNS	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**#**
SPINULOSE WOOD FERN	*Dryopteridaceae*	*Dryopteris carthusiana*	*S4-S5*	**9**
EVERGREEN WOOD FERN	*Dryopteridaceae*	*Dryopteris intermedia*	*S5*	**9**
CINNAMON FERN	*Osmundaceae*	*Osmunda cinnamomea*	*S5*	**8**
BRACKEN FERN	*Dennstaedtiaceae*	*Pteridium aquilinum*	*S5*	**7**
MOUNTAIN WOOD FERN	*Dryopteridaceae*	*Dryopteris campyloptera*	*S4*	**5**
SENSITIVE FERN	*Dryopteridaceae*	*Onoclea sensibilis*	*S5*	**5**
HORSETAILS	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	
WOODLAND HORSETAIL	*Equisetaceae*	*Equisetum sylvaticum*	*S5*	**5**
MOSSES	**TYPE**	**SCIENTIFIC NAME**	**SRANK**	
BROOM MOSS	AGROCARP	*Dicranum spp.*	*SU*	**12**
SMOOTHCAP	AGROCARP	*Atrichum spp.*	*S4-S5*	**10**
HAIRCAP MOSS	AGROCARP	*Polytrichum spp.*	*S5*	**9**
PHOENIX FEATHER MOSS	PLEUROCARP	*Pleurozium schreberi*	*S5*	**8**
ULOTA MOSS	AGROCARP	*Ulota spp.*	*SU*	**7**
HYPNUM MOSS	PLEUROCARP	*Hypnum spp.*	*SU*	**6**
BRYUM MOSS	AGROCARP	*Bryum spp.*	*SU*	**5**
STAIRSTEP MOSS	PLEUROCARP	*Hylocomium splendens*	*S5*	**4**
ELECTRIFIED CAT'S-TAIL MOSS	PLEUROCARP	*Rhytidiadelphus triquetrus*	*S5*	**4**
SPHAGNUM	SPAGHNUM	*Sphagnum spp.*	*SU*	**4**
LIVERWORTS	**TYPE**	**SCIENTIFIC NAME**	**SRANK**	
TREE FRINGEWORT	LEAFY	*Ptilidium pulcherrimum*	*SU*	**6**
CRESTWORT	LEAFY	*Lophocolea spp.*	*SU*	**5**
SCALEWORT	LEAFY	*Frullania spp.*	*SU*	**4**
LICHENS	**TYPE**	**SCIENTIFIC NAME**	**SRANK**	
BOTTLEBRUSH SHIELD LICHEN	FOLIOSE	*Parmelia squarrosa*	*S5*	**13**
BUTTON LICHEN	CRUSTOSE	*Buellia spp.*	*SU*	**11**
HOODED TUBE LICHEN	FOLIOSE	*Hypogymnia physodes*	S5	**11**
BEARDED LICHENS	FRUCTOSE	*Usnea spp.*	*SU*	**11**
CLADONIA SPP.	FRUCTOSE	*Cladonia spp.*	*SU*	**9**
CAMOUFLAGE LICHEN	CRUSTOSE	*Melanelixia spp.*	*S4-S5*	**8**
VARIED RAG LICHEN	FOLIOSE	*Platismatia glauca*	S5	**6**
BOREAL OAKMOSS LICHEN	FRUCTOSE	*Evernia mesomorpha*	*S5*	**6**
STAR-TIPPED REINDEER LICHEN	FRUCTOSE	*Cladina stellaris*	S4-S5	**5**
MEALY PIXIE-CUP	FRUCTOSE	*Cladonia chlorophaea*	S4-S5	**5**
TRUMPET LICHEN	FRUCTOSE	*Cladonia fimbriata*	*SU*	**5**
RAMALINA LICHEN	FRUCTOSE	*Ramalina spp.*	*SU*	**5**
SUNBURST LICHEN	FOLIOSE	*Xanthoria spp.*	*S4-S5*	**4**
REINDEER LICHEN	FRUCTOSE	*Cladina spp.*	SU	**4**
MARINE FLORA		**SCIENTIFIC NAME**	**SRANK**	
EEL GRASS		*Zostera marina*	*SU*	**9**
BLADDER WRACK		*Fucus vesiculosus*	*SU*	**4**

All of the common ferns on this list were generally found growing in the forest habitat inland from the shelter of the krummholz zone. Cinnamon fern was the exception, generally found growing exposed along wet cliffs in high-winds.

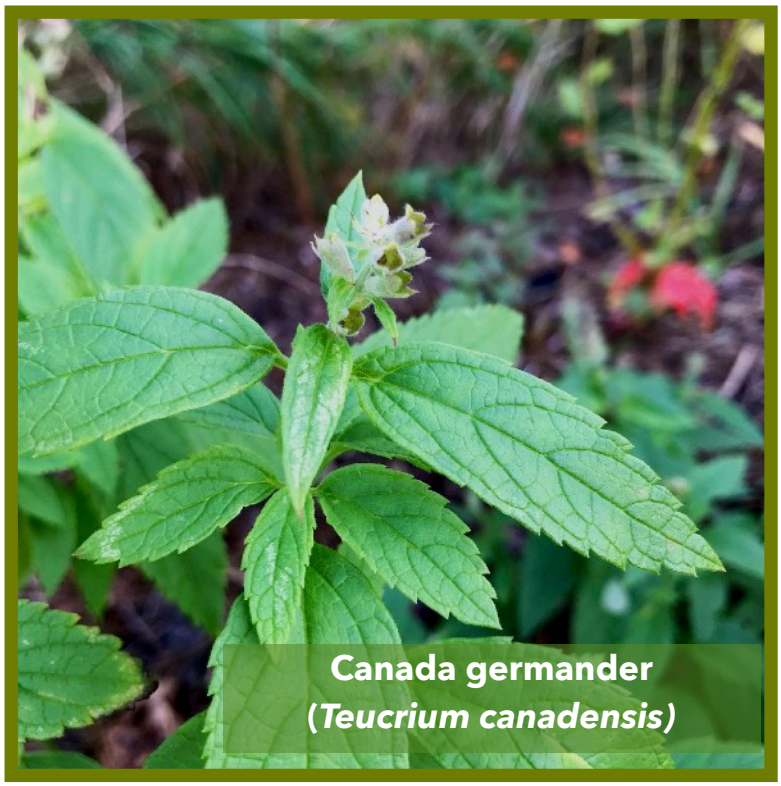
The non-vascular plants were generally only identified to their genera providing some broad trends without much detail. That being said, mosses and liverworts were common occurrences in coastal forests as well as secondary dune heathlands, swales, and clifftop habitats.

Many species of lichens were also difficult to identify beyond their genus, but were prolifically present nonetheless. Occurring in large populations across a number of habitats, lichens are most likely a very important component of the coastal ecosystems.

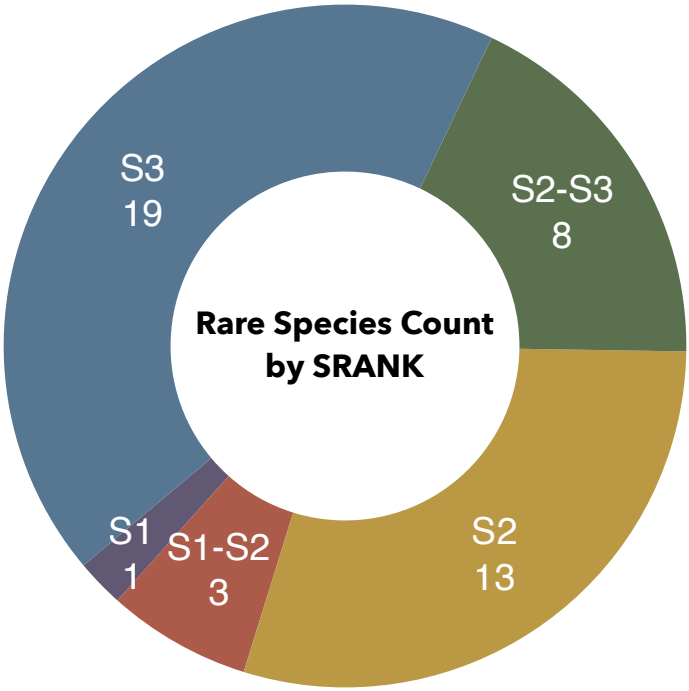
Marine flora are under-represented on this list as many of the species and the basics of identifying these algae were new to the research team. In future studies, it might be advisable to collaborate with a local expert for a better surveying results.

COASTAL FLORA

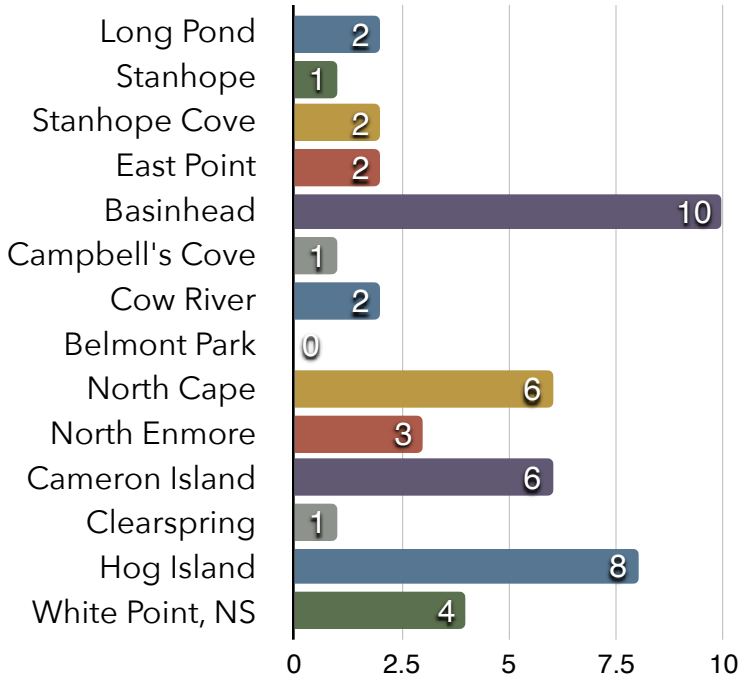
Our coastal habitats can be excellent sites to find rare native species. 25 rare species were found listed by the Atlantic Canada Conservation Data Centre (ACCDC) at the conservation ranks of *S3 - S1*. (UA, 2021) These specimens were growing in a variety of habitats and include species such as pink crowberry, climbing false buckwheat, golden heather, seaside angelica, large-leaved aster, Maryland sanicle, seabeach sandwort, as well as several rare orchids. There were also a number of non-vascular and fungal species which are listed as *SU* or conservation ranking unknown.



Canada germander
(Teucrium canadensis)



Rare Plants By Site



Breaking down rare flora by site begins to reveal some other trends. The sites with the rarest species were generally sites with the least human intervention. These sites include Basin Head, Hog Island, Cameron Island, and North Cape. The national parks sites with a history of farming and high recreational use all have lower rates of rare plant occurrence.

Although Basin Head is a high-traffic area, the secondary dune system and swales, where many of the rare species were found, are relatively unvisited by beach-goers.

COASTAL FAUNA

Coastal habitats can be busy locations for native wildlife. As mentioned previously, many of these sites are home to an incredible array of fruit-producing plants. Many coastal sites boast a dense array of different habitats creating a a highly productive shore which can provide a diversity of food sources as well as nesting/denning sites. (Cox, 2003) During the course of this study, numerous signs of many of our native mammals were found across the majority of the sites, demonstrating the high-use of these habitats.

Data collection for fauna species was conducted in three ways.

Tracks, feeding signs, songs, and sightings were recorded during field surveys. These sightings were not broken into distinct habitats but rather assessed the whole site as one area.

Wildlife cameras were installed at five of the study sites for two week time periods or longer. There were some errors made during installation due to the researcher's inexperience with these devices. Primarily the issues were placement and the sensitivity of the camera. Windy krummholz sites constantly have branches blowing in the wind, which cause many of the cameras to take a large amount of pictures without wildlife present. Over the five sites, more than 204 gigabytes of photos were taken, or approximately 7000 photos. There were many photos with unidentifiable creatures as well as others of squirrel, snowshoe hare, coyote, fox, and raccoon. All photos have yet to be analysed.


Raptor Pellet

ARU in the National Park

Automated Recording Units (ARUs) were installed at most sites during spring and fall. The Campbell's Cove and Belmont Provincial park sites were excluded from ARU data collection. In the case of Belmont Provincial Park, it due to the number of ARUs available to our research team. Campbell's Cove is a publicly used campground and there was no installation area that would have been far enough from camp sites. After talking to the campground owner, it was decided to forego placing a recording unit while the campground was in-use.

So far, only approximately a half of the ARU data has been processed through support and funding from Parks Canada. The spring-time audio data was uploaded to the website, Wildtrax, and processed by Alberta Biodiversity Monitoring Institute. Across the three seasonal sessions of ARU recording, a total of 572.4 GB of data was collected.

This data will continue to be analyzed in future studies of Krummholz. Due to the unfinished processing as well as time constraints, the krummholz fauna data has not been analyzed to the extent of the flora data. Simple species lists have been finished for each site.

Old Beaver Signs at Cow River


Raccoon Print

The table to the right shows the compiled ARU avian data across all sites by descending order of Songs heard. The table below shows the same dataset for non-avian species as well as unidentified species, all avian.

This data does not include ARU recordings from the 2021 winter or Autumn recordings. The ARU data will be combined and tallied with other fauna data in the profile for each study site later in this document.

ARU Spring-Early Summer Non-Avian and Unknown Species

SPECIES	Song #	Call #
AMPHIBIANS		
Spring Peeper	13	0
Green Frog	4	0
MAMMALS		
Red Squirrel	0	8
UNIDENTIFIED		
Unidentified Trill	4	0
Unidentified Warbler	2	0
Unidentified Blackbird	0	1
Unknown Call	0	10
Unidentified Passerine	0	9

ARU Spring-Early Summer Avian Data Across All Sites - Processed by ABMI using Wildtrax-1

SPECIES	Song #	Call #
BIRDS		
Song Sparrow	95	4
Yellow Warbler	70	1
Common Yellowthroat	38	0
Magnolia Warbler	25	0
American Robin	20	6
Alderfly Catcher	13	3
Cedar Waxwing	12	0
Swamp Sparrow	12	0
Red-Winged Blackbird	10	7
Swainson's Thrush	10	0
Mourning Warbler	9	0
White-Throated Sparrow	8	1
Hermit Thrush	7	1
American Redstart	6	0
Black-Throated Green Warbler	6	0
Golden-crowned Kinglet	6	0
Yellow-Rumped Warbler	6	9
Red-eye Vireo	5	0
Belted Kingfisher	4	0
Palm Warbler	4	0
Mourning Dove	3	3
Black and White Warbler	2	0
Black-capped Chickadee	2	2
American Crow	1	54
Bank Swallow	1	1
Common Grackle	1	0
Dark-eyed Junco	1	0
Eastern Wood-Pewee	1	0
Sora	1	0
Willet	1	1
American Goldfinch	0	2
American Wigeon	0	2
Barn Swallow	0	1
Blue Jay	0	8
Boreal Chickadee	0	1
Brown Creeper	0	1
Canada Goose	0	1
Common Raven	0	3
Northern Flicker	0	1
Ring-billed Gull	0	1

SITE SELECTION

Misty Mornings at the Cameron Island Cliffs

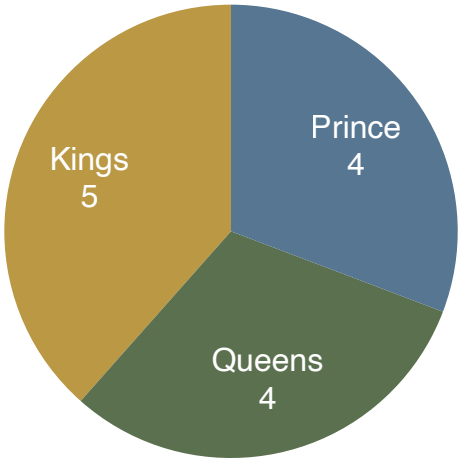
The addition of sites for the second stage of research aimed at gathering a wider-spread of data with the goal of comparing and contrasting diverse sites from across the province.

Care was taken in choosing sites reflecting a diversity of shorelines, conditions, habitats, stewardship and natural histories. Four sites were added; two in Prince county, One in Queens and One in Kings county.

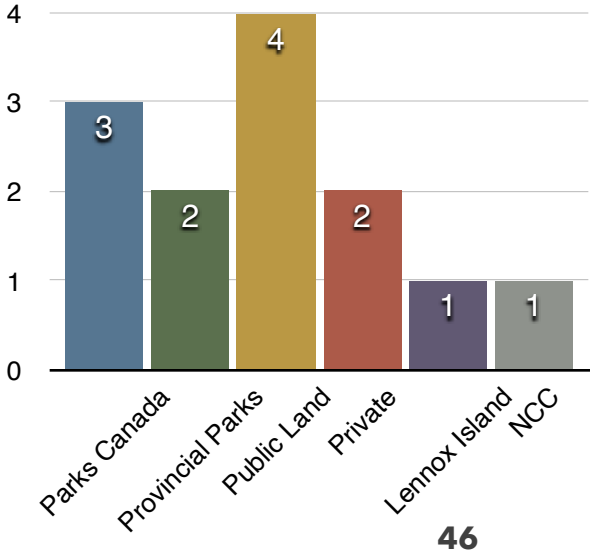
Each site was visited at least three times between Spring and Winter of 2021, minimally once per season. On-site data collection focused on recording and mapping the diversity of habitats and shorelines found, detailing which species of flora were found in which habitats, setting up both Automated Recording Units (ARUs) and wildlife cameras as well as measuring tree heights and wind speeds.

A thirteenth site, Hog Island, added later in the season was permission and transportation was secured. This site was only visited once in October with only roughly 3.5 hours on-site. Although a short visit, we had the chance to explore through the salt marsh and dune system of the northern Hog Island as well as the sheltered forested southern Island.

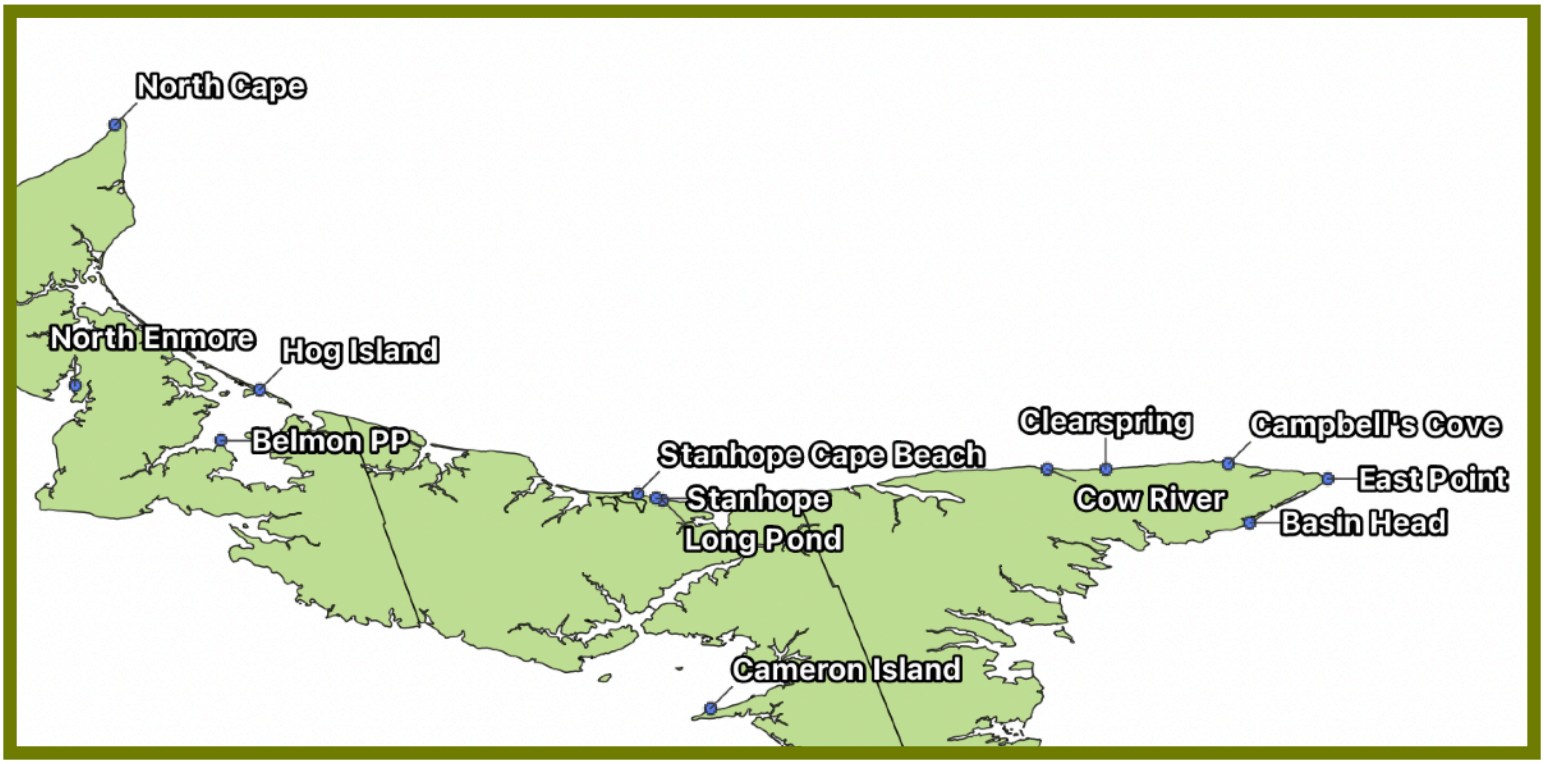
SITES BY COUNTY



LAND STEWARDSHIP



SITE SELECTION

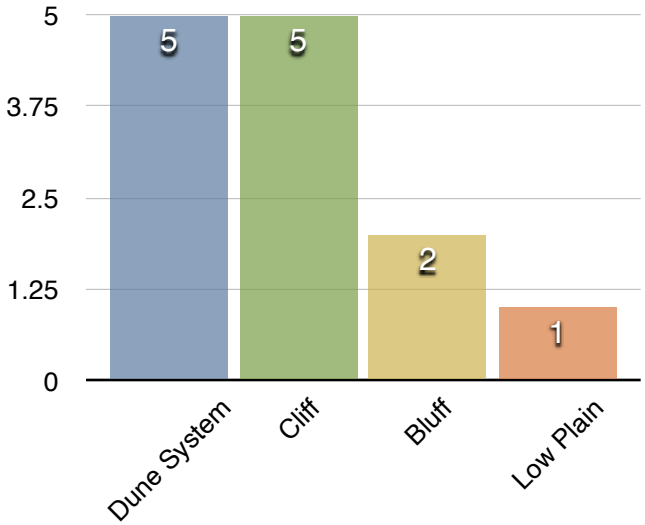


As discussed previously, Prince Edward Island back-shores can be classified into roughly four different categories: dune systems, cliffs, bluffs, and low plains. Although efforts were made to select sites proportionally from each category, several factors made this difficult. According to the previously mentioned report, over 75% of Island coasts are either dune or cliff systems. (Davies, 2011)

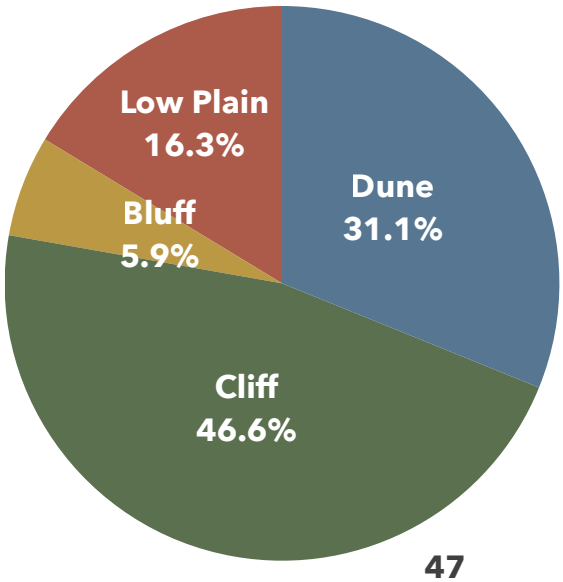
Site were also chosen by location as well as coastal type as the North shore has the strongest winds, a factor required for the Krummholz effect. The sheltered south shore tends to have drastically reduced winds reducing the viability for studying forests shaped by wind.

These factors led to a bias towards northern shore sites which are more often dune or cliff systems. These locations and sites presented the most pronounced Krummholz effect for study.

BACK-SHORE CATEGORIES BY NUMBER OF SITES



ISLAND-WIDE SHORELINE



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FLORA LIST - ALL SITES - WOODY PLANTS

WOODY PLANTS																
CONIFEROUS PLANTS	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
BALSAM FIR	*Pinaceae*	*Abies balsamea*	*S5*				✓	✓		✓		✓	✓	✓		✓	✓
EASTERN LARCH	*Pinaceae*	*Larix laricina*	*S5*						✓			✓	✓				✓
WHITE SPRUCE	*Pinaceae*	*Picea glauca*	*S5*	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
BLACK SPRUCE	*Pinaceae*	*Picea mariana*	*S5*			✓		✓	✓			✓	✓			✓	✓
JACK PINE	*Pinaceae*	*Pinus banksiana*	*S2*					✓				✓					✓
DECIDUOUS TREES		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
RED MAPLE	*Aceraceae*	*Acer rubrum*	*S5*	✓	✓	✓	✓	✓		✓			✓		✓	✓	✓
SUGAR MAPLE	*Aceraceae*	*Acer saccharum*	*S4*													✓	✓
WHITE BIRCH	*Betulaceae*	*Betula papyrifera*	*S5*		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GRAY BIRCH	*Betulaceae*	*Betula populifolia*	*S5*		✓	✓	✓		✓		✓		✓			✓	✓
NORTHERN RED OAK	*Fagaceae*	*Quercus rubra*	*S4*													✓	✓
WHITE ASH	*Oleaceae*	*Fraxinus americana*	*S4*													✓	✓
PIN CHERRY	*Rosaceae*	*Prunus pensylvanica*	*S5*	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
AMERICAN MOUNTAIN ASH	*Rosaceae*	*Sorbus americana*	*S5*	✓	✓	✓	✓	✓	✓				✓				✓
LARGE-TOOTHED ASPEN	*Salicaceae*	*Populus grandidentata*	*S5*						✓		✓						✓
TREMBLING ASPEN	*Salicaceae*	*Populus tremuloides*	*S5*		✓					✓	✓	✓		✓			✓
NON-NATIVE		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
SCOTS PINE	*Pinaceae*	*Pinus sylvestris*	*Exotic*						✓								✓
NORWAY MAPLE	*Aceraceae*	*Acer platanoides*	*Exotic*						✓								✓
JAPANESE HONEYSUCKLE	*Caprifoliaceae*	*Lonicera japonica*	*Exotic*											✓			✓
ENGLISH OAK	*Fagaceae*	*Quercus robur*	*Exotic*								✓						✓
APPLE	*Rosaceae*	*Malus spp.*	*Exotic*											✓			✓
EUROPEAN MOUNTAIN ASH	*Rosaceae*	*Sorbus aucuparia*	*Exotic*		✓	✓	✓			✓	✓		✓	✓			✓
SHRUBS		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
MOUNTAIN MAPLE	*Aceraceae*	*Acer spicatum*	*S5*													✓	✓
WINTERBERRY HOLLY	*Aquifoliaceae*	*Ilex verticillata*	*S5*		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
MOUNTAIN HOLLY	*Aquifoliaceae*	*Nemopanthus mucronatus*	*S5*	✓	✓	✓		✓		✓			✓				✓
SPECKLED ALDER	*Betulaceae*	*Alnus incana*	*S5*		✓					✓			✓				✓
DOWNY ALDER	*Betulaceae*	*Alnus viridis*	*S5*		✓					✓							✓
BEAKED HAZELNUT	*Betulaceae*	*Corylus cornuta*	*S5*								✓					✓	✓
AMERICAN-FLY HONEYSUCKLE	*Caprifoliaceae*	*Lonicera canadensis*	*S5*		✓	✓							✓			✓	✓
RED-BERRIED ELDER	*Caprifoliaceae*	*Sambucus racemosa*	*S5*	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓
WILD RAISIN	*Caprifoliaceae*	*Viburnum nudum*	*S5*		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
HIGHBUSH CRANBERRY	*Caprifoliaceae*	*Viburnum opulus*	*S4*											✓			✓
RED-OSIER DOGWOOD	*Cornaceae*	*Cornus sericea*	*S5*				✓		✓			✓					✓
COMMON JUNIPER	*Cupressaceae*	*Juniperus communis*	*S3-S4*	✓	✓		✓	✓				✓			✓	✓	✓
CREEPING JUNIPER	*Cupressaceae*	*Juniperus horizontalis*	*S2*												✓		✓
BROOM CROWBERRY	*Empetraceae*	*Corema conradii*	*S2*					✓								✓	✓
PINK CROWBERRY	*Empetraceae*	*Empetrum eamesii*	*S2*					✓									✓
BLACK CROWBERRY	*Empetraceae*	*Empetrum nigrum*	*S4*				✓	✓				✓			✓	✓	✓
SWEET GALE	*Myricaceae*	*Myrica gale*	*S5*			✓				✓		✓	✓		✓		✓
BAYBERRY	*Myricaceae*	*Myrica pensylvanica*	*S5*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SERVICEBERRY	*Rosaceae*	*Amelanchier spp.*	*SU*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
RED CHOKEBERRY	*Rosaceae*	*Photinia floribunda*	*S5*						✓	✓					✓	✓	✓
BLACK CHOKEYBERRY	*Rosaceae*	*Photinia melanocarpa*	*S5*	✓	✓	✓	✓					✓				✓	✓
CHOKECHERRY	*Rosaceae*	*Prunus virginiana*	*S5*	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓
SHINING ROSE	*Rosaceae*	*Rosa nitida*	*S4*										✓		✓	✓	✓
VIRGINIA ROSE	*Rosaceae*	*Rosa virginiana*	*S5*	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
WHITE MEADOWSWEET	*Rosaceae*	*Spiraea alba*	*S5*		✓	✓	✓		✓	✓			✓	✓	✓	✓	✓
GROUND HEMLOCK	*Taxaceae*	*Taxus canadensis*	*S4*													✓	✓
WILLOW	*Salicaceae*	*Salix spp.*	*SU*					✓	✓	✓		✓					✓
HEATH PLANTS		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
COMMON BEARBERRY	*Ericaceae*	*Arctostaphylos uva-ursi*	*S3*					✓								✓	✓
LEATHERLEAF	*Ericaceae*	*Chamaedaphne calyculata*	*S4*					✓				✓					✓
CREEPING SNOWBERRY	*Ericaceae*	*Gaultheria hispidula*	*S5*										✓				✓
EASTERN TEABERRY	*Ericaceae*	*Gaultheria procumbens*	*S5*										✓				✓
DWARF HUCKLEBERRY	*Ericaceae*	*Gaylussacia bigeloviana*	*S2*									✓					✓
SHEEP LAUREL	*Ericaceae*	*Kalmia angustifolia*	*S5*		✓	✓		✓		✓		✓	✓			✓	✓
PALE BOG LAUREL	*Ericaceae*	*Kalmia polifolia*	*S4*					✓				✓					✓
COMMON LABRADOR TEA	*Ericaceae*	*Ledum groenlandicum*	*S5*					✓				✓					✓
RHODORA	*Ericaceae*	*Rhododendron canadense*	*S5*									✓					✓
LATE LOWBUSH BLUEBERRY	*Ericaceae*	*Vaccinium angustifolium*	*S5*			✓	✓	✓		✓		✓	✓		✓	✓	✓
LARGE CRANBERRY	*Ericaceae*	*Vaccinium macrocarpon*	*S5*	✓	✓	✓	✓	✓				✓					✓
SMALL CRANBERRY	*Ericaceae*	*Vaccinium oxycoccos*	*S4*					✓	✓				✓			✓	✓
MOUNTAIN CRANBERRY	*Ericaceae*	*Vaccinium vitis-idaea*	*S3*				✓	✓									✓
BERRIES		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
SMOOTH GOOSEBERRY	*Grossulariaceae*	*Ribes hirtellum*	*S5*	✓	✓	✓	✓					✓		✓		✓	✓
BRISTLY BLACK CURRANT	*Grossulariaceae*	*Ribes lacustre*	*S5*		✓	✓	✓		✓	✓	✓			✓			✓
WILD STRAWBERRY	*Rosaceae*	*Fragaria virginiana*	*S5*	✓	✓		✓		✓	✓	✓	✓		✓	✓		✓
ALLEGHANEY BLACKBERRY	*Rosaceae*	*Rubus allegheniensis*	*S5*			✓			✓	✓		✓					✓
CLOUDBERRY	*Rosaceae*	*Rubus chamaemorus*	*S2*									✓					✓
BRISTLY DEWBERRY	*Rosaceae*	*Rubus hispidus*	*S4*			✓							✓				✓
RED RASPBERRY	*Rosaceae*	*Rubus idaeus*	*S5*	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
DWARF RED RASPBERRY	*Rosaceae*	*Rubus pubescens*	*S5*				✓					✓					✓

FLORA LIST - ALL SITES - NON-WOODY

NON-WOODY PLANTS															
SHADE-TOLERANT	FAMILY	SCIENTIFIC NAME	SRANK	1	2	3	4	5	6	7	8	9	10	11	12	13	All
Maryland Sanicle	*Apiaceae*	*Sanicula marilandica*	*S3*													✓	✓
Spreading Dogbane	*Apocynaceae*	*Apocynum androsaemifolium*	*S4*													✓	✓
bristly sarsaparilla	*Araliaceae*	*Aralia hispida*	*S4-S5*					✓									✓
wild sarsaparilla	*Araliaceae*	*Aralia nudicaulis*	*S5*	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓
tall white aster	*Asteraceae*	*Doellingeria umbellata*	*S5*	✓					✓	✓	✓		✓	✓		✓	✓
large-leaved aster	*Asteraceae*	*Eurybia macrophylla*	*S2-S3*													✓	✓
whorled wood aster	*Asteraceae*	*Oclemena acuminata*	*S5*		✓		✓			✓		✓	✓			✓	✓
lion's paw	*Asteraceae*	*Prenanthes trifoliolata*	*S5*		✓		✓	✓		✓			✓				✓
asters	*Asteraceae*	*Symphyotrichum spp.*	*SU*		✓			✓					✓				✓
twinflower	*Caprifoliaceae*	*Linnaea borealis*	*S5*		✓			✓				✓	✓	✓		✓	✓
bunchberry	*Cornaceae*	*Cornus canadensis*	*S5*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
herb robert	*Geraniaceae*	*Geranium robertianum*	*S3-S4*													✓	✓
clintonia	*Liliaceae*	*Clintonia borealis*	*S5*		✓			✓		✓						✓	✓
false-lily-of-the-valley	*Liliaceae*	*Maianthemum canadense*	*S5*	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓	✓
false soloman's seal	*Liliaceae*	*Maianthemum racemosum*	*S4*													✓	✓
wild cucumber root	*Liliaceae*	*Medeola virginiana*	*S4*													✓	✓
green twisted stalk	*Liliaceae*	*Streptopus amplexifolius*	*S4*				✓										✓
nodding trillium	*Liliaceae*	*Trillium cernuum*														✓	✓
ghost pipe	*Monotropaceae*	*Monotropa uniflora*	*S5*		✓					✓							✓
fireweed	*Onagraceae*	*Chamerion angustifolium*	*S5*					✓									✓
Sm. Enchanter's Nightshade	*Onagraceae*	*Circaea alpina*	*S5*		✓		✓									✓	✓
B.L. Enchanter's Nightshade	*Onagraceae*	*Circaea lutetiana*	*S2*													✓	✓
common lady's slipper	*Orchidaceae*	*Cypripedium acaule*	*S5*					✓		✓		✓	✓			✓	✓
veronica	*Plantaginaceae*	*Veronica*	*Invasive*	✓	✓		✓			✓				✓			✓
starflower	*Primulaceae*	*Trientalis borealis*	*S5*	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓	✓
One-flowered Wintergreen	*Pyrolaceae*	*Moneses uniflora*	*S3S4*	✓				✓									✓
One-sided Wintergreen	*Pyrolaceae*	*Orthilia secunda*	*S5*		✓		✓			✓							✓
shinleaf	*Pyrolaceae*	*Pyrola elliptica*	*S5*	✓				✓					✓				✓
creeping buttercup	*Ranunculaceae*	*Ranunculus repens*	*Exotic*				✓				✓			✓			✓
bittersweet nightshade	*Solanaceae*	*Solanum dulcamara*	*Invasive*	✓	✓												✓
small white violet	*Violaceae*	*Viola blanda*	*S5*	✓	✓					✓	✓						✓
purple violet	*Violaceae*	*Viola spp.*	*SU*	✓	✓	✓				✓	✓						✓
SUN-LOVING		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
Queen Anne's Lace	*Apiaceae*	*Daucus carota*	*SNA*	✓	✓	✓						✓					✓
yarrow	*Asteraceae*	*Achillea millefolium*	*S5*	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
pearly everlasting	*Asteraceae*	*Anaphalis margaritacea*	*S5*				✓								✓		✓
Canada thistle	*Asteraceae*	*Cirsium arvense*	*Exotic*	✓	✓	✓			✓			✓		✓			✓
narrow-leaf goldenrod	*Asteraceae*	*Euthamia graminifolia*	*S5*		✓	✓			✓			✓					✓
hawkweed	*Asteraceae*	*Hieracium spp.*	*SU*			✓	✓	✓		✓	✓	✓			✓	✓	✓
ox-eye daisy	*Asteraceae*	*Leucanthemum vulgare*	*Exotic*						✓		✓						✓
pineapple weed	*Asteraceae*	*Matricaria discoidea*	*Exotic*			✓			✓				✓				✓
Goldenrod	*Asteraceae*	*Solidago spp.*	*S4*													✓	✓
Canada goldenrod	*Asteraceae*	*Solidago canadensis*	*S5*						✓	✓	✓	✓					✓
rough stem goldenrod	*Asteraceae*	*Solidago rugosa*	*S5*	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
sow thistle	*Asteraceae*	*Sonchus spp.*	*Exotic*		✓	✓	✓			✓		✓	✓	✓		✓	✓
calico aster	*Asteraceae*	*Symphyotrichum lateriflorum*	*S5*			✓				✓			✓	✓			✓
New York Aster	*Asteraceae*	*Symphyotrichum novi-belgii*	*S5*						✓								✓
dandelion	*Asteraceae*	*Taraxacum officinale*	*Exotic*	✓	✓	✓			✓					✓			✓
meadow goat's beard	*Asteraceae*	*Tragopogon pratensis*	*Exotic*									✓					✓
Asters spp.	*Asteraceae*		*SU*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mustard	*Brassicaceae*	*Brassica spp.*	*Exotic*						✓				✓				✓
Deptford Pink	*Caryophyllaceae*	*Dianthus armeria*	*Exotic*		✓												✓
chickweed	*Caryophyllaceae*	*Cerastium spp.*	*SU*		✓	✓	✓		✓	✓	✓		✓	✓	✓		✓
lamb's quarters	*Chenopodiaceae*	*Chenopodium album*	*Exotic*	✓	✓	✓				✓				✓			✓
St. John's wort	*Clusiaceae*	*Hypericum spp.*	*SU*			✓			✓								✓
clover	*Fabaceae*	*Trifolium spp.*	*Exotic*	✓			✓			✓		✓	✓				✓
white clover	*Fabaceae*	*Trifolium repens*	*Exotic*			✓			✓								✓
yellow clover	*Fabaceae*	*Trifolium aureum*	*Exotic*		✓	✓			✓								✓
rabbit's foot clover	*Fabaceae*	*Trifolium arvense*	*Exotic*		✓				✓								✓
red clover	*Fabaceae*	*Trifolium pratense*	*Exotic*		✓	✓			✓								✓
vetch	*Fabaceae*	*Vicia spp.*	*SU*		✓				✓			✓	✓	✓			✓
lupine	*Fabaceae*	*Lupinus nootkatensis*	*Exotic*			✓											✓
hemp nettle	*Lamiaceae*	*Galeopsis tetrahit*	*Exotic*						✓	✓							✓
heal all	*Lamiaceae*	*Prunella vulgaris*	*S5*						✓					✓			✓
thyme	*Lamiaceae*	*Thymus spp.*	*Exotic*		✓	✓											✓
evening primrose	*Onagraceae*	*Oenothera biennis*	*S5*	✓	✓				✓	✓	✓			✓		✓	✓
Slender Ladies'-tresses	*Orchidaceae*	*Spiranthes lacera*	*S4*					✓									✓
common plantain	*Plantaginaceae*	*Plantago major*	*Exotic*		✓	✓	✓		✓			✓	✓				✓
grasses	*Poaceae*		*SU*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
common timothy	*Poaceae*	*Phleum pratense*	*Exotic*		✓												✓
sheep sorrel	*Polygonaceae*	*Rumex acetosella*	*Exotic*			✓	✓		✓	✓		✓					✓
curled dock	*Polygonaceae*	*Rumex crispus*	*Exotic*	✓		✓			✓	✓			✓	✓			✓
Bindweed	*Polygonaceae*		*SU*													✓	✓
tall buttercup	*Ranunculaceae*	*Ranunculus acris*	*Exotic*				✓										✓
tall meadowrue	*Ranunculaceae*	*Thalictrum pubescens*	*S5*							✓			✓			✓	✓
silvery cinquefoil	*Rosaceae*	*Potentilla argentea*	*Exotic*		✓	✓			✓								✓
bedstraw	*Rubiaceae*	*Galium spp.*	*SU*	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓
Smooth Bedstraw	*Rubiaceae*	*Galium mollugo*	*Exotic*			✓											✓
Common Mullein	*Scrophulariaceae*	*Verbascum thapsus*	*Exotic*			✓											✓
cowwheat	*Scrophulariaceae*	*Melampyrum lineare*	*S5*					✓								✓	✓

FLORA LIST - ALL SITES - NON-WOODY

NON-WOODY PLANTS															
COASTAL		SCIENTIFIC NAME	SRANK	1	2	3	4	5	6	7	8	9	10	11	12	13	All
POISON-IVY	*Anacardiaceae*	*Toxicodendron rydbergii*	*S4*										✓			✓	✓
SCOTCH LOVAGE	*Apiaceae*	*Ligusticum scoticum*	*S4*													✓	✓
SEASIDE ANGELICA	*Apiaceae*	*Angelica lucida*	*S2*											✓			✓
COMMON RAGWEED	*Asteraceae*	*Ambrosia artemisiifolia*	*S4*							✓			✓	✓		✓	✓
BEACH WORMWOOD	*Asteraceae*	*Artemisia stelleriana*	*Exotic*	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
SEASIDE GOLDENROD	*Asteraceae*	*Solidago sempervirens*	*S5*	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓	✓
COLTSFOOT	*Asteraceae*	*Tussilago farfara*	*Exotic*									✓					✓
ROUGH COCKLEBUR	*Asteraceae*	*Xanthium strumarium*	*S3*										✓	✓			✓
SEA ROCKET	*Brassicaceae*	*Cakile edentula*	*S5*	✓	✓	✓		✓	✓	✓			✓	✓		✓	✓
SEABEACH-SANDWORT	*Caryophyllaceae*	*Honckenya peploides*	*S2-S3*	✓					✓	✓			✓	✓			✓
BLUNT-LEAVED SANDWORT	*Caryophyllaceae*	*Moehringia lateriflora*	*S5*		✓	✓			✓								✓
SANDSPURREY	*Caryophyllaceae*	*Spergularia spp.*	*SU*							✓							✓
CANADA SANDSPURREY	*Caryophyllaceae*	*Spergularia canadensis*	*S4*		✓		✓		✓	✓							✓
SALTMARSH SANDSPURREY	*Caryophyllaceae*	*Spergularia salina*	*S4*													✓	✓
ORACHES	*Chenopodiaceae*	*Atriplex spp.*	*SU*							✓				✓		✓	✓
MARITIME SALTBUSH	*Chenopodiaceae*	*Atriplex acadiensis*	*S2-S3*											✓		✓	✓
THIN-LEAVED ORACHE	*Chenopodiaceae*	*Atriplex prostrata*	*S4*	✓	✓				✓	✓			✓	✓			✓
SEA GLASSWORT	*Chenopodiaceae*	*Salicornia maritima*	*S5*											✓			✓
COMMON SALTWORT	*Chenopodiaceae*	*Salsola kali*	*Exotic*	✓	✓					✓			✓	✓			✓
HORNED SEA-BLITE	*Chenopodiaceae*	*Suaeda calceoliformis*	*S2-S3*			✓											✓
GOLDEN HEATHER	*Cistaceae*	*Hudsonia ericoides*	*S1-S2*					✓									✓
WOOLY HUDSONIA	*Cistaceae*	*Hudsonia tomentosa*	*S3*					✓								✓	✓
HEDGE FALSE BINDWEED	*Convolvulaceae*	*Calystegia sepium*	*S5*							✓							✓
BEACH PEA	*Fabaceae*	*Lathyrus japonicus*	*S5*	✓	✓	✓	✓			✓				✓		✓	✓
SEASIDE ARROWGRASS	*Juncaginaceae*	*Triglochin maritima*	*S5*													✓	✓
STARRY FALSE SOLOMAN'S SEAL	*Liliaceae*	*Maianthemum stellatum*	*S3*	✓	✓	✓	✓			✓		✓				✓	✓
SEA LAVENDER	*Plantaginaceae*	*Limonium carolinianum*	*S5*							✓				✓		✓	✓
SEASIDE PLANTAIN	*Plantaginaceae*	*Plantago maritima*	*S5*				✓		✓	✓		✓		✓	✓		✓
MARRAM GRASS	*Poaceae*	*Ammophila breviligulata*	*S5*	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓
SEA LYME GRASS	*Poaceae*	*Leymus mollis*	*S4*	✓										✓		✓	✓
SMOOTH CORD GRASS	*Poaceae*	*Spartina alterniflora*	*S5*										✓	✓		✓	✓
SALTMEADOW CORD GRASS	*Poaceae*	*Spartina patens*	*S5*										✓	✓		✓	✓
CLIMBING FALSE BUCKWHEAT	*Polygonaceae*	*Polygonum scandens*	*S1*											✓			✓
SEA MILKWORT	*Primulaceae*	*Glaux maritima*	*S5*										✓			✓	✓
SEASIDE BUTTERCUP	*Ranunculaceae*	*Ranunculus cymbalaria*	*S4*									✓					✓
SILVERWEED	*Rosaceae*	*Argentina anserina*	*S5*		✓				✓	✓		✓	✓	✓		✓	✓
THREE TOOTHED CINQUEFOIL	*Rosaceae*	*Sibbaldiopsis tridentata*	*S4*		✓		✓		✓			✓			✓	✓	✓
YELLOW RATTLE	*Scrophulariaceae*	*Rhinanthus minor*	*Exotic*				✓					✓					✓
WET-LOVING		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
AMERICAN SWEETFLAG	*Acoraceae*	*Acorus americanus*	*S3-S4*							✓							✓
COMMON COW PARSNIP	*Apiaceae*	*Heracleum maximum*	*S4*													✓	✓
BROAD-LEAVED ARROWHEAD	*Alismataceae*	*Sagittaria latifolia*	*S4*							✓							✓
NODDING BEGGARTICKS	*Asteraceae*	*Bidens cernua*	*S4*							✓							✓
DEVIL'S BEGGARTICKS	*Asteraceae*	*Bidens frondosa*	*S5*	✓													✓
JOE-PYE WEED	*Asteraceae*	*Eupatorium maculatum*	*S5*							✓							✓
SPOTTED JEWELWEED	*Balsaminaceae*	*Impatiens capensis*	*S5*						✓	✓						✓	✓
SEDGES	*Cyperaceae*	*Carex spp.*	*SU*			✓		✓	✓	✓		✓	✓				✓
COTTON-GRASS	*Cyperaceae*	*Eriophorum spp.*	*SU*									✓					✓
TALL BULRUSH	*Cyperaceae*	*Scirpus spp.*	*SU*			✓											✓
ROUND-LEAF SUNDEW	*Droseraceae*	*Drosera rotundifolia*	*S4*					✓				✓					✓
BLUE-FLAG IRIS	*Iridaceae*	*Iris versicolor*	*S5*	✓			✓		✓	✓		✓	✓				✓
RUSHES	*Juncaceae*	*Juncus spp.*	*SU*	✓	✓		✓	✓	✓	✓			✓	✓			✓
AMERICAN WATER HOREHOUND	*Lamiaceae*	*Lycopus americanus*	*S5*							✓							✓
NORTHERN WATER HOREHOUND	*Lamiaceae*	*Lycopus uniflorus*	*S5*	✓						✓			✓				✓
MARSH SKULLCAP	*Lamiaceae*	*Scutellaria galericulata*	*S5*							✓						✓	✓
MAD-DOG SKULLCAP	*Lamiaceae*	*Scutellaria lateriflora*	*S5*							✓			✓				✓
CANADA GERMANDER	*Lamiaceae*	*Teucrium canadense*	*S2*										✓	✓			✓
TURION DUCKWEED	*Lemnaceae*	*Lemna turionifera*	*S5*	✓						✓						✓	✓
GREAT DUCKWEED	*Lemnaceae*	*Spirodela polyrrhiza*	*S3-S4*							✓							✓
IREE-LEAVED FALSE SOLOMAN'S SE	*Liliaceae*	*Maianthemum trifolium*	*S4*									✓					✓
PURPLE LOOSESTRIFE	*Lythraceae*	*Lythrum salicaria*	*Invasive*							✓							✓
FRINGED WILLOWHERB	*Onagraceae*	*Epilobium ciliatum*	*S5*						✓	✓							✓
WILLOWHERB	*Onagraceae*	*Epilobium spp.*	*SU*							✓							✓
TUBEROUS GRASS PINK	*Orchidaceae*	*Calopogon tuberosus*	*S3*					✓				✓					✓
LOESEL'S TWAYBLADE	*Orchidaceae*	*Liparis loeselii*	*S2-S3*					✓									✓
ROSE POGONIA	*Orchidaceae*	*Pogonia ophioglossoides*	*S2*									✓					✓
WATER SMARTWEED	*Polygonaceae*	*Polygonum amphibium*	*S4*							✓							✓
TEARTHUMB	*Polygonaceae*	*Polygonum sagittatum*	*S5*						✓								✓
SWAMP YELLOW LOOSESTRIFE	*Primulaceae*	*Lysimachia terrestris*	*S5*		✓	✓				✓							✓
LESSER SPEARWORT	*Ranunculaceae*	*Ranunculus flammula*	*Exotic*									✓					✓
MARSH CINQUEFOIL	*Rosaceae*	*Comarum palustre*	*S4*							✓							✓
COMMON MARSH BEDSTRAW	*Rosaceae*	*Galium palustre*	*S5*						✓	✓							✓
AVENS	*Rosaceae*	*Geum spp.*	*SU*													✓	✓
NORTHERN PITCHER PLANT	*Sarraceniaceae*	*Sarracenia purpurea*	*S4*									✓					✓
BURREED	*Sparganiaceae*	*Sparganium spp.*	*SU*							✓							✓
NARROW-LEAVED CATTAIL	*Typhaceae*	*Typha angustifolia*	*S4*	✓									✓	✓			✓
BROAD-LEAVED CATTAIL	*Typhaceae*	*Typha latifolia*	*S5*	✓						✓							✓

FLORA LIST - ALL SITES - FERNS & MORE

FERNS & MORE																
FERNS	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
HAY-SCENTED FERN	*Dennstaedtiaceae*	*Dennstaedtia punctilobula*	*S5*											✓		✓	✓
BRACKEN FERN	*Dennstaedtiaceae*	*Pteridium aquilinum*	*S5*	✓			✓	✓		✓	✓		✓			✓	✓
MOUNTAIN WOOD FERN	*Dryopteridaceae*	*Dryopteris campyloptera*	*S4*		✓		✓			✓				✓		✓	✓
SPINULOSE WOOD FERN	*Dryopteridaceae*	*Dryopteris carthusiana*	*S4-S5*	✓	✓		✓		✓	✓		✓	✓	✓	✓		✓
EVERGREEN WOOD FERN	*Dryopteridaceae*	*Dryopteris intermedia*	*S5*	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓
OAK FERN	*Dryopteridaceae*	*Gymnocarpium dryopteris*	*S5*		✓									✓		✓	✓
SENSITIVE FERN	*Dryopteridaceae*	*Onoclea sensibilis*	*S5*		✓					✓		✓		✓	✓		✓
CINNAMON FERN	*Osmundaceae*	*Osmunda cinnamomea*	*S5*				✓		✓	✓		✓	✓	✓	✓	✓	✓
INTERRUPTED FERN	*Osmundaceae*	*Osmunda claytoniana*	*S5*							✓				✓		✓	✓
BEECH FERN	*Thelypteridaceae*	*Phegopteris connectilis*	*S5*				✓									✓	✓
NEW YORK FERN	*Thelypteridaceae*	*Thelypteris noveboracensis*	*S5*													✓	✓
CLUBMOSSES	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
NORTHERN BOG CLUBMOSS	*Lycopodiaceae*	*Lycopodiella inundata*	*S3*					✓									✓
RUNNING CLUBMOSS	*Lycopodiaceae*	*Lycopodium clavatum*	*S5*													✓	✓
ROUND-BRANCHED TREE-CLUBMOS	*Lycopodiaceae*	*Lycopodium dendroideum*	*S5*					✓									✓
HORSETAILS	**FAMILY**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
FIELD HORSETAIL	*Equisetaceae*	*Equisetum arvense*	*S5*			✓			✓			✓					✓
WOODLAND HORSETAIL	*Equisetaceae*	*Equisetum sylvaticum*	*S5*	✓			✓					✓	✓	✓			✓
MOSSES	**TYPE**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
SMOOTHCAP	AGROCARP	*Atrichum spp.*	*S4-S5*	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓
GLOW MOSS	AGROCARP	*Aulacomnium palustre*	*S5*			✓						✓	✓				✓
SILVERY BRYUM MOSS	AGROCARP	*Bryum argenteum*	*S4-S5*							✓							✓
COMMON GREEN BRYUM MOSS	AGROCARP	*Bryum pseudotriquetrum*	*S5*							✓							✓
BRYUM MOSS	AGROCARP	*Bryum spp.*	*SU*	✓			✓	✓							✓	✓	✓
FIRE MOSS	AGROCARP	*Ceratodon purpureus*	*S5*						✓		✓						✓
BROOM MOSS	AGROCARP	*Dicranum spp.*	*SU*	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MNIUM MOSS	AGROCARP	*Mnium spp.*	*SU*									✓					✓
ORTHOTRICHUM MOSS	AGROCARP	*Orthotrichum spp.*	*SU*				✓			✓							✓
PLAGIOMNIUM MOSS	AGROCARP	*Plagiomnium spp.*	*SU*													✓	✓
HAIRCAP MOSS	AGROCARP	*Polytrichum spp.*	*S5*		✓	✓	✓	✓	✓	✓	✓		✓		✓		✓
ULOTA MOSS	AGROCARP	*Ulota spp.*	*SU*		✓		✓	✓		✓			✓	✓	✓		✓
BRACHYTHECIUM SPP.	PLEUROCARP	*Brachythecium spp.*	*SU*											✓		✓	✓
RECURVED BROTHERELLA MOSS	PLEUROCARP	*Brotherella recurvans*	*SU*	✓						✓			✓				✓
STAIRSTEP MOSS	PLEUROCARP	*Hylocomium splendens*	*S5*		✓					✓			✓		✓		✓
HYPNUM MOSS	PLEUROCARP	*Hypnum spp.*	*SU*	✓			✓					✓		✓	✓	✓	✓
PHOENIX FEATHER MOSS	PLEUROCARP	*Pleurozium schreberi*	*S5*	✓	✓	✓		✓		✓		✓	✓	✓			✓
ELECTRIFIED CAT'S-TAIL MOSS	PLEUROCARP	*Rhytidiadelphus triquetrus*	*S5*	✓					✓	✓					✓		✓
SPHAGNUM	SPAGHNUM	*Sphagnum spp.*	*SU*			✓		✓				✓	✓				✓
SPHAGNUM GIRGENSOHNII	SPAGHNUM	*Sphagnum girgensohnii*	*S5*										✓				✓
SPHAGNUM PALUSTRE	SPAGHNUM	*Sphagnum palustre*	*S5*										✓				✓
SPHAGNUM FUSCUM	SPAGHNUM	*Sphagnum fuscum*	*S4-S5*									✓					✓
SHAGGY PEAT MOSS	SPAGHNUM	*Sphagnum squarrosum*	*S5*										✓				✓
LIVERWORTS	**TYPE**	**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
THREE-LOBED WHIPWORT	LEAFY	*Bazzania trilobata*	*S5*										✓				✓
SCALEWORT	LEAFY	*Frullania spp.*	*SU*		✓		✓	✓					✓				✓
CRESTWORT	LEAFY	*Lophocolea spp.*	*SU*	✓	✓					✓			✓			✓	✓
CILIATE FRINGEWORT	LEAFY	*Ptilidium ciliare*	*SU*										✓				✓
TREE FRINGEWORT	LEAFY	*Ptilidium pulcherrimum*	*SU*		✓		✓	✓		✓			✓		✓		✓
COMMON LIVERWORT	THALLOID	*Marchantia polymorpha*	*SU*							✓							✓
FUNGI		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
FLY AMANITA		*Amanita muscaria*	*SU*				✓										✓
LEMON DROPS		*Bisporella spp.*	*SU*							✓							✓
BOLETE		*Boletus spp.*	*SU*		✓	✓	✓			✓					✓	✓	✓
CHANTERELLE		*Cantharellus cibarius*	*SU*							✓							✓
CORAL FUNGI (WHITE)		*Clavarioid Group*	*SU*				✓			✓			✓		✓	✓	✓
ORANGE JELLY FUNGUS		*Dacrymyces spp.*	*SU*										✓	✓			✓
YELLOW JELLY FUNGUS		*Tremella spp.*	*SU*											✓			✓
POLYPORE			*SU*		✓	✓	✓						✓	✓			✓
PUFFBALL FUNGUS			*SU*					✓									✓
EARTHSTAR MUSHROOM			*SU*					✓								✓	✓

FLORA LIST - ALL SITES - FERNS & MORE

LICHENS	TYPE	SCIENTIFIC NAME	SRANK	1	2	3	4	5	6	7	8	9	10	11	12	13	All
Button Lichen	Crustose	*Buellia spp.*	SU		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Candy lichen	Crustose	*Icmadophila ericetorum*	SU												✓		✓
Common script lichen	Crustose	*Graphis scripta*	SU										✓				✓
Eastern ragged-rim lichen	Crustose	*Loxospora ochrophaea*	SU										✓				✓
camouflage lichen	Crustose	*Melanelixia spp.*	S4-S5		✓	✓	✓	✓		✓			✓		✓	✓	✓
Whitewash lichen	Crustose	*Phlyctis spp.*	SU		✓					✓			✓				✓
Tree jelly lichen	Foliose	*Collema Subflaccidum*	S4-S5							✓						✓	✓
Hooded tube lichen	Foliose	*Hypogymnia physodes*	S5	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
freckled tube lichen	Foliose	*Hypogymnia krogiae*	SU										✓				✓
Powder-head tube lichen	Foliose	*Hypogymnia tubulosa*	S4-S5				✓										✓
Starburst Lichen	Foliose	*Imshaugia spp.*	SU		✓							✓		✓			✓
Blue jellyskin	Foliose	*Leptogium cyanescens*	SU													✓	✓
Lungwort Lichen	Foliose	*Lobaria pulmonella.*	S4-S5										✓				✓
Treeflute	Foliose	*Menegazzia spp.*	SU							✓							✓
Bottlebrush Shield Lichen	Foliose	*Parmelia squarrosa*	S5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hammered Shield Lichen	Foliose	*Parmelia sulcata*	S5										✓				✓
orange-cored shawdow lichen	Foliose	*Phaeophyscia rubropulchra*	SU										✓				✓
rosette lichen	Foliose	*Physcia spp.*	SU		✓				✓								✓
Varied Rag Lichen	Foliose	*Platismatia glauca*	S5		✓		✓	✓		✓			✓	✓			✓
Crumpled rag lichen	Foliose	*Platismatia tuckermanii*	SU										✓				✓
Rough Speckled Shield	Foliose	*Punctelia rudecta*	S4-S5		✓					✓						✓	✓
Maritime Sunburst Lichen	Foliose	*Xanthoria parietina*	S4-S5													✓	✓
pin-cusion sunburst lichen	Foliose	*Xanthoria polycarpa*	S4-S5									✓				✓	✓
sunburst lichen	Foliose	*Xanthoria spp.*	S4-S5	✓	✓		✓		✓								✓
burred horsehair lichen	Fructose	*Bryoria furcellata*	SU										✓				✓
Horsehare lichen	Fructose	*Bryoria spp.*	SU	✓			✓	✓									✓
Spiny gray horsehair lichen	Fructose	*Bryoria nadvornikiana*	SU										✓				✓
spiny heath lichen	Fructose	*Cetraria aculeata*	SU					✓									✓
Reindeer Lichen	Fructose	*Cladina spp.*	SU									✓	✓		✓	✓	✓
Green Reindeer Lichen	Fructose	*Cladina mitis*	S4-S5					✓									✓
Gray Reindeer Lichen	Fructose	*Cladina rangiferina*	S5					✓									✓
Star-tipped Reindeer Lichen	Fructose	*Cladina stellaris*	S4-S5			✓		✓				✓			✓	✓	✓
Fishnet Lichen	Fructose	*Cladonia boryi*	S4-S5					✓									✓
Powdered Funnel Lichen	Fructose	*Cladonia cenotea*	SU	✓				✓						✓			✓
Mealy pixie-cup	Fructose	*Cladonia chlorophaea*	S4-S5		✓	✓				✓			✓		✓		✓
British Soldiers Lichen	Fructose	*Cladonia cristatella*	S5				✓	✓									✓
trumpet lichen	Fructose	*Cladonia fimbriata*	SU		✓			✓				✓	✓			✓	✓
Lipstick Powderhorn Lichen	Fructose	*Cladonia macilenta*	SU										✓				✓
giant cladonia	Fructose	*Cladonia maxima*	SU									✓					✓
Smooth-footed cladonia	Fructose	*Cladonia ochrochlora*	S4-S5				✓						✓			✓	✓
red-fruited pixie cup	Fructose	*Cladonia pleurota*	SU			✓		✓								✓	✓
Cladonia spp.	Fructose	*Cladonia spp.*	SU	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓
Dragon cladonia	Fructose	*Cladonia squamosa*	SU							✓			✓				✓
Boreal Oakmoss Lichen	Fructose	*Evernia mesomorpha*	S5	✓		✓	✓					✓	✓	✓			✓
bush lichen	Fructose	*Ramalina americana*	S4-S5									✓					✓
ramalina lichen	Fructose	*Ramalina spp.*	SU			✓	✓		✓	✓				✓			✓
punctured ramalina lichen	Fructose	*Ramalina dilarcerata*	S4-S5					✓									✓
dotted ramalina	Fructose	*Ramalina farinacea*	S4-S5									✓					✓
frayed ramalina	Fructose	*Ramalina roesleri*	SU										✓				✓
bearded lichens	Fructose	*Usnea spp.*	SU	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Woolly Foam Lichen	Fructose	*Stereocaulon tomentosum*	S4-S5												✓		✓
MARINE FLORA		**SCIENTIFIC NAME**	**SRANK**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**All**
winged kelp		*Alaria esculenta*	SU							✓					✓		✓
knotted wrack		*Ascophyllum nodosum*	SU							✓					✓		✓
dead man's fingers		*Codium fragile*	Invasive										✓		✓		✓
Coral weed		*Corallina officinalis*	SU											✓			✓
		Furcellaria lumbricalis	SU											✓			✓
Bladder wrack		*Fucus vesiculosus*	SU					✓		✓				✓	✓		✓
dulse		*Palmaria palmata*	SU							✓				✓			✓
sea lettuce		*Ulva lactuca*	SU										✓				✓
Eel grass		*Zostera marina*	SU	✓	✓			✓	✓	✓	✓		✓	✓		✓	✓

FLORA LIST - ALL SITES - BY FAMILY

VASCULAR PLANTS

Family	Scientifica Name	Common Name	SRANK
Aceraceae	*Acer platanoides*	Norway maple	*Exotic*
Aceraceae	*Acer rubrum*	red maple	*S5*
Aceraceae	*Acer saccharum*	sugar maple	*S4*
Aceraceae	*Acer spicatum*	Mountain Maple	*S5*
Acoraceae	*Acorus americanus*	American Sweetflag	*S3-S4*
Alismataceae	*Sagittaria latifolia*	Broad-leaved Arrowhead	*S4*
Anacardiaceae	*Toxicodendron rydbergii*	poison-ivy	*S4*
Apiaceae	*Angelica lucida*	Seaside Angelica	*S2*
Apiaceae	*Daucus carota*	queen anne's lace	*SNA*
Apiaceae	*Heracleum maximum*	Common Cow Parsnip	*S4*
Apiaceae	*Ligusticum scoticum*	Scotch lovage	*S4*
Apiaceae	*Sanicula marilandica*	Maryland Sanicle	*S3*
Apocynaceae	*Apocynum androsaemifolium*	Spreading Dogbane	*S4*
Aquifoliaceae	*Ilex verticillata*	winterberry holly	*S5*
Aquifoliaceae	*Nemopanthus mucronatus*	mountain holly	*S5*
Araliaceae	*Aralia hispida*	bristly sarsaparilla	*S4-S5*
Araliaceae	*Aralia nudicaulis*	wild sarsaparilla	*S5*
Asteraceae	*Achillea millefolium*	yarrow	*S5*
Asteraceae	*Ambrosia artemisiifolia*	Common Ragweed	*S4*
Asteraceae	*Anaphalis margaritacea*	pearly everlasting	*S5*
Asteraceae	*Artemisia stelleriana*	beach wormwood	*Exotic*
Asteraceae	*Bidens cernua*	Nodding Beggarticks	*S4*
Asteraceae	*Bidens frondosa*	Devil's Beggarticks	*S5*
Asteraceae	*Cirsium arvense*	Canada thistle	*Exotic*
Asteraceae	*Doellingeria umbellata*	tall white aster	*S5*
Asteraceae	*Eupatorium maculatum*	joe-pye weed	*S5*
Asteraceae	*Eurybia macrophylla*	large-leaved aster	*S2-S3*
Asteraceae	*Euthamia graminifolia*	narrow-leaf goldenrod	*S5*
Asteraceae	*Hieracium spp.*	hawkweed	*SU*
Asteraceae	*Leucanthemum vulgare*	ox-eye daisy	*Exotic*
Asteraceae	*Matricaria discoidea*	pineapple weed	*Exotic*
Asteraceae	*Oclemena acuminata*	whorled wood aster	*S5*
Asteraceae	*Prenanthes trifoliolata*	lion's paw	*S5*
Asteraceae	*Solidago canadensis*	Canada goldenrod	*S5*
Asteraceae	*Solidago rugosa*	rough stem goldenrod	*S5*
Asteraceae	*Solidago sempervirens*	seaside goldenrod	*S5*
Asteraceae	*Solidago spp.*	Goldenrod	*S4*
Asteraceae	*Sonchus spp.*	sow thistle	*Exotic*
Asteraceae	*Symphyotrichum lateriflorum*	calico aster	*S5*
Asteraceae	*Symphyotrichum novi-belgii*	New York Aster	*S5*
Asteraceae	*Symphyotrichum spp.*	asters	*SU*
Asteraceae	*Taraxacum officinale*	dandelion	*Exotic*
Asteraceae	*Tragopogon pratensis*	meadow goat's beard	*Exotic*
Asteraceae	*Tussilago farfara*	coltsfoot	*Exotic*
Asteraceae	*Xanthium strumarium*	Rough Cocklebur	*S3*
Asteraceae		Asters spp.	*SU*
Balsaminaceae	*Impatiens capensis*	Spotted Jewelweed	*S5*
Betulaceae	*Alnus incana*	speckled alder	*S5*
Betulaceae	*Alnus viridis*	downy alder	*S5*
Betulaceae	*Betula papyrifera*	white birch	*S5*
Betulaceae	*Betula populifolia*	gray birch	*S5*
Betulaceae	*Corylus cornuta*	beaked hazelnut	*S5*
Brassicaceae	*Brassica spp.*	Mustard	*Exotic*
Brassicaceae	*Cakile edentula*	sea rocket	*S5*
Caprifoliaceae	*Linnaea borealis*	twinflower	*S5*
Caprifoliaceae	*Lonicera canadensis*	American-fly honeysuckle	*S5*
Caprifoliaceae	*Lonicera japonica*	Japanese Honeysuckle	*Exotic*
Caprifoliaceae	*Sambucus racemosa*	red-berried elder	*S5*

FLORA LIST - ALL SITES - BY FAMILY

Caprifoliaceae	*Viburnum nudum*	wild raisin	*S5*
Caprifoliaceae	*Viburnum opulus*	highbush cranberry	*S4*
Caryophyllaceae	*Cerastium spp.*	chickweed	*SU*
Caryophyllaceae	*Dianthus armeria*	Deptford Pink	*Exotic*
Caryophyllaceae	*Honckenya peploides*	Seabeach-Sandwort	*S2-S3*
Caryophyllaceae	*Moehringia lateriflora*	Blunt-leaved Sandwort	*S5*
Caryophyllaceae	*Spergularia canadensis*	Canada Sandspurrey	*S4*
Caryophyllaceae	*Spergularia salina*	Saltmarsh Sandspurrey	*S4*
Caryophyllaceae	*Spergularia spp.*	Sandspurrey	*SU*
Chenopodiaceae	*Atriplex acadiensis*	Maritime Saltbush	*S1-S3*
Chenopodiaceae	*Atriplex prostrata*	Thin-leaved Orache	*S4*
Chenopodiaceae	*Atriplex spp.*	Oraches	*SU*
Chenopodiaceae	*Chenopodium album*	lamb's quarters	*Exotic*
Chenopodiaceae	*Salicornia maritima*	Sea Glasswort	*S5*
Chenopodiaceae	*Salsola kali*	common saltwort	*Exotic*
Chenopodiaceae	*Suaeda calceoliformis*	Horned Sea-blite	*S2-S3*
Cistaceae	*Hudsonia ericoides*	golden heather	*S1-S2*
Cistaceae	*Hudsonia tomentosa*	wooly hudsonia	*S3*
Clusiaceae	*Hypericum spp.*	St. John's wort	*SU*
Convolvulaceae	*Calystegia sepium*	Hedge False Bindweed	*S5*
Cornaceae	*Cornus canadensis*	bunchberry	*S5*
Cornaceae	*Cornus sericea*	red-osier dogwood	*S5*
Cupressaceae	*Juniperus communis*	common juniper	*S3-S4*
Cupressaceae	*Juniperus horizontalis*	creeping juniper	*S2*
Cyperaceae	*Carex spp.*	Sedges	*SU*
Cyperaceae	*Eriophorum spp.*	cotton-grass	*SU*
Cyperaceae	*Scirpus spp.*	tall bulrush	*SU*
Droseraceae	*Drosera rotundifolia*	round-leaf sundew	*S4*
Empetraceae	*Corema conradii*	broom crowberry	*S2*
Empetraceae	*Empetrum eamesii*	pink crowberry	*S2*
Empetraceae	*Empetrum nigrum*	black crowberry	*S4*
Ericaceae	*Arctostaphylos uva-ursi*	common bearberry	*S3*
Ericaceae	*Chamaedaphne calyculata*	Leatherleaf	*S4*
Ericaceae	*Gaultheria hispidula*	Creeping Snowberry	*S5*
Ericaceae	*Gaultheria procumbens*	Eastern Teaberry	*S5*
Ericaceae	*Gaylussacia bigeloviana*	Dwarf Huckleberry	*S2*
Ericaceae	*Kalmia angustifolia*	Sheep Laurel	*S5*
Ericaceae	*Kalmia polifolia*	Pale Bog Laurel	*S4*
Ericaceae	*Ledum groenlandicum*	Common Labrador Tea	*S5*
Ericaceae	*Rhododendron canadense*	rhodora	*S5*
Ericaceae	*Vaccinium angustifolium*	late lowbush blueberry	*S5*
Ericaceae	*Vaccinium macrocarpon*	Large Cranberry	*S5*
Ericaceae	*Vaccinium oxycoccos*	Small Cranberry	*S4*
Ericaceae	*Vaccinium vitis-idaea*	Mountain Cranberry	*S3*
Fabaceae	*Lathyrus japonicus*	beach pea	*S5*
Fabaceae	*Lupinus nootkatensis*	lupine	*Exotic*
Fabaceae	*Trifolium arvense*	rabbit's foot clover	*Exotic*
Fabaceae	*Trifolium aureum*	yellow clover	*Exotic*
Fabaceae	*Trifolium pratense*	red clover	*Exotic*
Fabaceae	*Trifolium repens*	white clover	*Exotic*
Fabaceae	*Trifolium spp.*	clover	*Exotic*
Fabaceae	*Vicia spp.*	vetch	*SU*
Fagaceae	*Quercus robur*	English oak	*Exotic*
Fagaceae	*Quercus rubra*	northern red oak	*S4*
Geraniaceae	*Geranium robertianum*	herb robert	*S3-S4*
Grossulariaceae	*Ribes hirtellum*	Smooth Gooseberry	*S5*
Grossulariaceae	*Ribes lacustre*	Bristly Black Currant	*S5*
Iridaceae	*Iris versicolor*	blue-flag iris	*S5*
Juncaceae	*Juncus spp.*	rushes	*SU*
Juncaginaceae	*Triglochin maritima*	Seaside Arrowgrass	*S5*

FLORA LIST - ALL SITES - BY FAMILY

Lamiaceae	*Galeopsis tetrahit*	hemp nettle	*Exotic*
Lamiaceae	*Lycopus americanus*	American Water Horehound	*S5*
Lamiaceae	*Lycopus uniflorus*	Northern Water Horehound	*S5*
Lamiaceae	*Prunella vulgaris*	heal all	*S5*
Lamiaceae	*Scutellaria galericulata*	Marsh Skullcap	*S5*
Lamiaceae	*Scutellaria lateriflora*	Mad-dog Skullcap	*S5*
Lamiaceae	*Teucrium canadense*	Canada Germander	*S2*
Lamiaceae	*Thymus spp.*	thyme	*Exotic*
Lemnaceae	*Lemna turionifera*	Turion Duckweed	*S5*
Lemnaceae	*Spirodela polyrrhiza*	Great Duckweed	*S3-S4*
Liliaceae	*Clintonia borealis*	clintonia	*S5*
Liliaceae	*Maianthemum canadense*	false-lily-of-the-valley	*S5*
Liliaceae	*Maianthemum racemosum*	false soloman's seal	*S4*
Liliaceae	*Maianthemum stellatum*	starry false soloman's seal	*S3*
Liliaceae	*Maianthemum trifolium*	Three-leaved False Soloman's Seal	*S4*
Liliaceae	*Medeola virginiana*	wild cucumber root	*S4*
Liliaceae	*Streptopus amplexifolius*	green twisted stalk	*S4*
Liliaceae	*Trillium cernuum*	nodding trillium	
Lythraceae	*Lythrum salicaria*	Purple Loosestrife	*Invasive*
Monotropaceae	*Monotropa uniflora*	ghost pipe	*S5*
Myricaceae	*Myrica gale*	sweet gale	*S5*
Myricaceae	*Myrica pensylvanica*	bayberry	*S5*
Oleaceae	*Fraxinus americana*	white ash	*S4*
Onagraceae	*Chamerion angustifolium*	fireweed	*S5*
Onagraceae	*Circaea alpina*	Sm. Enchanter's Nightshade	*S5*
Onagraceae	*Circaea lutetiana*	B.L. Enchanter's Nightshade	*S2*
Onagraceae	*Epilobium ciliatum*	fringed willowherb	*S5*
Onagraceae	*Epilobium spp.*	Willowherb	*SU*
Onagraceae	*Oenothera biennis*	evening primrose	*S5*
Orchidaceae	*Calopogon tuberosus*	Tuberous grass pink	*S3*
Orchidaceae	*Cypripedium acaule*	common lady's slipper	*S5*
Orchidaceae	*Liparis loeselii*	loesel's twayblade	*S2-S3*
Orchidaceae	*Pogonia ophioglossoides*	rose pogonia	*S2*
Orchidaceae	*Spiranthes lacera*	Slender Ladies'-tresses	*S4*
Pinaceae	*Abies balsamea*	balsam fir	*S5*
Pinaceae	*Larix laricina*	eastern larch	*S5*
Pinaceae	*Picea glauca*	white spruce	*S5*
Pinaceae	*Picea mariana*	black spruce	*S5*
Pinaceae	*Pinus banksiana*	jack pine	*S2*
Pinaceae	*Pinus sylvestris*	scots pine	*Exotic*
Plantaginaceae	*Limonium carolinianum*	Sea Lavender	*S5*
Plantaginaceae	*Plantago major*	common plantain	*Exotic*
Plantaginaceae	*Plantago maritima*	seaside plantain	*S5*
Plantaginaceae	*Veronica*	veronica	*Invasive*
Poaceae	*Ammophila breviligulata*	marram grass	*S5*
Poaceae	*Leymus mollis*	Sea lyme grass	*S4*
Poaceae	*Phleum pratense*	common timothy	*Exotic*
Poaceae	*Spartina alterniflora*	Smooth Cord Grass	*S5*
Poaceae	*Spartina patens*	Saltmeadow Cord Grass	*S5*
Poaceae		grasses	*SU*
Polygonaceae	*Polygonum amphibium*	Water Smartweed	*S4*
Polygonaceae	*Polygonum sagittatum*	tearthumb	*S5*
Polygonaceae	*Polygonum scandens*	Climbing False Buckwheat	*S1*
Polygonaceae	*Rumex acetosella*	sheep sorrel	*Exotic*
Polygonaceae	*Rumex crispus*	curled dock	*Exotic*
Polygonaceae		Bindweed	*SU*
Primulaceae	*Glaux maritima*	Sea Milkwort	*S5*
Primulaceae	*Lysimachia terrestris*	Swamp Yellow Loosestrife	*S5*
Primulaceae	*Trientalis borealis*	starflower	*S5*
Pyrolaceae	*Moneses uniflora*	One-flowered Wintergreen	S3S4

FLORA LIST - ALL SITES - BY FAMILY

Pyrolaceae	*Orthilia secunda*	One-sided Wintergreen	*S5*
Pyrolaceae	*Pyrola elliptica*	shinleaf	*S5*
Ranunculaceae	*Ranunculus acris*	tall buttercup	*Exotic*
Ranunculaceae	*Ranunculus cymbalaria*	seaside buttercup	*S4*
Ranunculaceae	*Ranunculus flammula*	lesser spearwort	*Exotic*
Ranunculaceae	*Ranunculus repens*	creeping buttercup	*Exotic*
Ranunculaceae	*Thalictrum pubescens*	tall meadowrue	*S5*
Rosaceae	*Amelanchier spp.*	serviceberry	*SU*
Rosaceae	*Argentina anserina*	silverweed	*S5*
Rosaceae	*Comarum palustre*	Marsh Cinquefoil	*S4*
Rosaceae	*Fragaria virginiana*	wild strawberry	*S5*
Rosaceae	*Galium palustre*	Common Marsh Bedstraw	*S5*
Rosaceae	*Geum spp.*	Avens	*SU*
Rosaceae	*Malus spp.*	apple	*Exotic*
Rosaceae	*Photinia floribunda*	red chokeberry	*S5*
Rosaceae	*Photinia melanocarpa*	black chokeyberry	*S5*
Rosaceae	*Potentilla argentea*	silvery cinquefoil	*Exotic*
Rosaceae	*Prunus pensylvanica*	pin cherry	*S5*
Rosaceae	*Prunus virginiana*	chokecherry	*S5*
Rosaceae	*Rosa nitida*	shining rose	*S4*
Rosaceae	*Rosa virginiana*	virginia rose	*S5*
Rosaceae	*Rubus allegheniensis*	Alleghaney Blackberry	*S5*
Rosaceae	*Rubus chamaemorus*	Cloudberry	*S2*
Rosaceae	*Rubus hispidus*	Bristly Dewberry	*S4*
Rosaceae	*Rubus idaeus*	Red Raspberry	*S5*
Rosaceae	*Rubus pubescens*	Dwarf Red Raspberry	*S5*
Rosaceae	*Sibbaldiopsis tridentata*	three toothed cinquefoil	*S4*
Rosaceae	*Sorbus americana*	American mountain ash	*S5*
Rosaceae	*Sorbus aucuparia*	European mountain ash	*Exotic*
Rosaceae	*Spiraea alba*	white meadowsweet	*S5*
Rubiaceae	*Galium mollugo*	Smooth Bedstraw	*Exotic*
Rubiaceae	*Galium spp.*	bedstraw	*SU*
Salicaceae	*Populus grandidentata*	large-toothed aspen	*S5*
Salicaceae	*Populus tremuloides*	trembling aspen	*S5*
Salicaceae	*Salix spp.*	willow	*SU*
Sarraceniaceae	*Sarracenia purpurea*	northern pitcher plant	*S4*
Scrophulariaceae	*Melampyrum lineare*	cowwheat	*S5*
Scrophulariaceae	*Rhinanthus minor*	yellow rattle	*Exotic*
Scrophulariaceae	*Verbascum thapsus*	Common Mullein	*Exotic*
Solanaceae	*Solanum dulcamara*	bittersweet nightshade	*Invasive*
Sparganiaceae	*Sparganium spp.*	Burreed	*SU*
Taxaceae	*Taxus canadensis*	ground hemlock	*S4*
Typhaceae	*Typha angustifolia*	Narrow-Leaved Cattail	*S4*
Typhaceae	*Typha latifolia*	Broad-leaved Cattail	*S5*
Verbenaceae	*Verbena hastata*	blue vervain	*S1*
Violaceae	*Viola blanda*	small white violet	*S5*
Violaceae	*Viola spp.*	purple violet	*SU*
Zosteraceae	*Zostera marina*	Eel grass	*SU*
Ferns and Allies			
Family	**Scientifica Name**	**Common Name**	**SRANK**
Dennstaedtiaceae	*Dennstaedtia punctilobula*	hay-scented fern	*S5*
Dennstaedtiaceae	*Pteridium aquilinum*	bracken fern	*S5*
Dryopteridaceae	*Dryopteris campyloptera*	mountain wood fern	*S4*
Dryopteridaceae	*Dryopteris carthusiana*	spinulose wood fern	*S4-S5*
Dryopteridaceae	*Dryopteris intermedia*	evergreen wood fern	*S5*
Dryopteridaceae	*Gymnocarpium dryopteris*	oak fern	*S5*
Dryopteridaceae	*Onoclea sensibilis*	sensitive fern	*S5*
Equisetaceae	*Equisetum arvense*	Field Horsetail	*S5*
Equisetaceae	*Equisetum sylvaticum*	Woodland Horsetail	*S5*
Lycopodiaceae	*Lycopodiella inundata*	Northern Bog Clubmoss	*S3*

FLORA LIST - ALL SITES - BY FAMILY

LYCOPODIACEAE	*Lycopodium clavatum*	RUNNING CLUBMOSS	*S5*
LYCOPODIACEAE	*Lycopodium dendroideum*	ROUND-BRANCHED TREE-CLUBMOSS	*S5*
OSMUNDACEAE	*Osmunda cinnamomea*	CINNAMON FERN	*S5*
OSMUNDACEAE	*Osmunda claytoniana*	INTERRUPTED FERN	*S5*
THELYPTERIDACEAE	*Phegopteris connectilis*	BEECH FERN	*S5*
THELYPTERIDACEAE	*Thelypteris noveboracensis*	NEW YORK FERN	*S5*

AVIAN LIST - HOG ISLAND - FIEP DE BIE

Malpeque Bay- Hog Island birds Oct. 15, 2021 by Fiep de Bie

Species	Count	Location	Observation type	Observation date
Common Eider	17	Hog Island and Malpeque Bay	Traveling	15-okt-2021
White-winged Scoter	25	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Black Scoter	12	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Greater Yellowlegs	3	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Herring Gull	2	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Common Tern	10	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Red-throated Loon	6	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Northern Gannet	14	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Double-crested Cormorant	20	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Great Blue Heron	6	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Northern Harrier	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Merlin	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Blue Jay	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
American Crow	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Black-capped Chickadee	3	Hog Island and Malpeque Bay	Traveling	15-okt-2021
American Robin	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Dark-eyed Junco	3	Hog Island and Malpeque Bay	Traveling	15-okt-2021
White-throated Sparrow	1	Hog Island and Malpeque Bay	Traveling	15-okt-2021
Yellow-rumped Warbler	8	Hog Island and Malpeque Bay	Traveling	15-okt-2021