



Exploring the Importance of Krummholz Forests

A PEI Forested Landscape Priority Place Project

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Environment and
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BACKGROUND



Much as been written about the quality and quantity of the forests of Prince Edward Island when explorers and settlers arrived from Europe. In 1534, Jacques Cartier sent word back to the French king that he found trees “wonder-fully fair”, describing cedars, pines, white elms, ash, willows and many others unknown to him.

John Stewart, in his 1806 book *An Account of Prince Edward Island in the Gulf of St. Lawrence, North America*, wrote:

“The timber of the Island is allowed to be much better than the like species of the neighbouring parts of the Continent, being of a finer and closer grain and texture not so subject to shakes and defects; the pines, black birch, beech and maple are also larger than they are generally found on the adjacent part of the continent.”

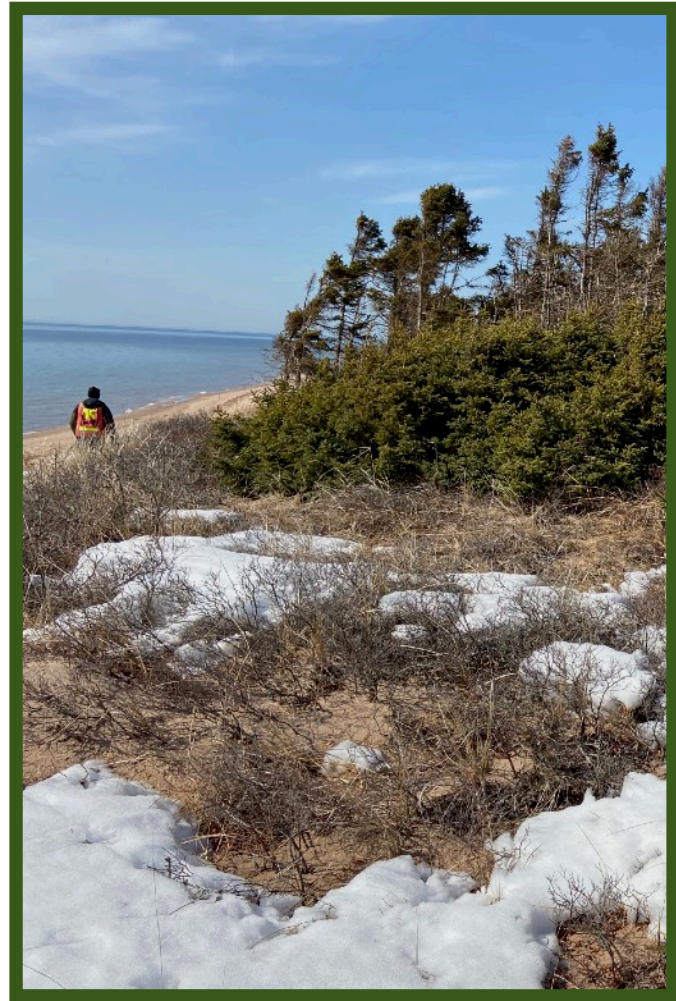
We also have a good, general idea the present forest. The province commissions a new series of aerial photos every ten years and it looks at what we have growing, looking at both species mix and height. In addition, there have been publications such as *A Mapping of the Present and Past Forest-types of Prince Edward Island* by D. G. Sobey and W. M. Glen that paint a picture of our forests.

But important components of our forest have not been studied to the same extent as have our upland hardwoods, our wetland forests, and our forests and plantations on disturbed land. One of these lesser-studied components is our stunted coastal forest.

WHAT IS A KRUMMHOLZ?

This study specifically looks at the type of forest commonly known as krummholz, still relatively common along the north shore of Prince Edward Island. Krummholz is a German word that combines **krumm** (crooked, bent, twisted) and **holz** (wood). In Germany, it is also called knieholz (knee timber) a reflection on the shortness of the trees in these areas. It is referred to as **twisted wood, crooked wood, tangled wood**, and many other colourful descriptions. These wooded areas full of stunted and deformed trees are common in mountainous landscapes along the tree line. The constant pounding of the wind causes the trees to remain short.

While mountainous landscapes are conspicuously absent in this province, our coastal conditions on the north shore are equally as harsh in the winter. Our dominant winter winds come from the northwest across the Gulf of St. Lawrence. These salt-laden winds act as natural pruners, the same as if we were creating bonsai or shearing Christmas trees. The tender growing tips are almost completely dried out, leaving plants that are bushy but stunted. Krummholz plants tend to grow more horizontally than vertically, forming dense mats. They can also grow incredibly slowly and live longer than the same species growing in more protected areas.



Many areas along the north shore of the province, especially throughout the National Park, have excellent examples of krummholz. These areas are mostly white spruce, but sometimes they include balsam fir and Eastern larch. In our province, it is not unusual to see fir growing on the north shore in large, low spreading patches. In Newfoundland and Labrador, these areas are called tuckamore, and can include lots of larch growing very low to the ground. They often lack much branching on the windward side due to the drying winter winds and the salt spray. As you move farther away from the shore, the trees tend to get taller, and after a while you start entering a more mixed forest.

And these areas are not new. A March 2004, publication by Douglas G. Sobey and William M. Glen looked at the history of Island forests. **The Forest Vegetation of the Prince Edward Island National Park and the Adjacent Watershed Areas Prior to European Settlement - as Revealed from a Search and Analysis of the Historical and Archival Literature, Phase 2: Analysis and Discussion** found noted that: "On coastal cliffs and banks white spruce occurred as an almost impenetrable strip of stunted, broken and damaged trees, and further inland from this spruce zone, there was general wind damage to trees. White spruce also occurred as scattered clusters of trees on dune 'flats.'" That is just as true today as it was in the past.

THE KRUMMHOLZ STUDY

This research stemmed from a long history of interest in these distinct ecosystems from birding experiences at East Point. This area is one of the prime birding spots in the province, especially during the spring and fall migrations. These tangly woods can be full of large flocks of migrants such as yellow-rumped warblers and cedar waxwings, and the predators that soon find them. They use these areas either before they head north across the Gulf or as safe landing spot on the return migration.

I was also inspired by time spent with Parks Canada staff in the Cavendish area after Dorian. There was severe damage all along the north shore, but in some areas of established you could see little damage. These forests were definitely doing their job of slowing the wind and protecting forests further away from the coast.

This study looks to develop a better understanding of krummholz and the roles they play in our Island environment. These areas of high winds and dry soil are full of short trees, but trees do not make up all of the life occupying the sites. While we were dealing with a late start to this project that meant there was already snow on the ground, we still found dozens of other plant species through the areas. Again, the same was true of the lack of migratory birds - it was simply due to timing. We are hoping to address both of these issues in future work on these sites during the period from May to October, which will allow for much more collection of both plant and animal information.

We selected six sites with some form of krummholz, and two sites with coastal forests. We attempted to have all of these on land that was under long-term control - either Parks Canada or the province of PEI. We did select one area on private land (with permission of the landowner) as it contained one of the best examples of krummholz and is one of the prime birding spots in the province. Using protected lands allows for the possibility of doing long-term research on the same sites without having to worry about those areas being cleared for agriculture or housing developments.



THE KRUMMHOLZ STUDY

Throughout the late winter and early spring, we visited dozens of sites to try to find ones that would be most useful for the research. Some were too small, some were too close to ones already selected, and some were quite difficult to access due to either too much snow or clay roads that were starting to thaw or were unploughed. We looked at some of the Island Nature Trust and Nature Conservancy of Canada properties, but they didn't fit with our needs.

Staff with Parks Canada were very helpful in locating sites within the National Park that would be suitable for our study. As well, they loaned us five Autonomous Recording Units and helped us become familiar with this equipment. Each site had the ARUs up for at least two weeks. While we are aware that this is not the prime time to be using this equipment, it is important to gather information on wildlife throughout the year, not just in the breeding season or when birds are migrating through in the spring and fall. We haven't gone through all the days of recordings but that is something we will be doing as time permits.

Whenever we were on one of the six krummholz sites or one of the two coastal forest sites, we were collecting information on the following:

- what plants were growing there that we could see
- the relative health of those plants
- how much dead wood was on the site
- how tall were trees at the shoreline, the middle, and the end of the study area
- what wildlife species were observed
- what signs of wildlife were observed

We had hoped to work with the UPEI Climate Lab's coastal monitoring sites, but that did not happen. It is still something worthy of pursuing in any future research.



WHY THESE AREAS TEND TO BE OVERLOOKED



There are four main reasons for the lack of attention placed on krummholz. The first is that they are difficult to traverse. Few of us ever go through a leisurely walk in a krummholz. Much like the areas of wild rose near Blooming Point that I once made the mistake of walking through, these areas are challenging, so they get few visitors. In general, what we don't see and understand, we don't value. It really took me seeing a flock of 120 black-capped chickadees using the East Point area on their fall migration to begin to realize how important these areas are. Then by studying the plants, I realized that many were not found in the forest habitats that I am familiar with.

The second reason is that they are often seen as directly competing with cottages and other developments. We value - and rightly so - the beautiful views from the north shore. The incredible sunrises and sunsets, the seemingly never-ending and always-changing water, even natural events such as hurricanes and lightning storms all seem to be more beautiful along the shore. Krummholz is often seen as a deterrent to development, nowhere near as friendly and enticing as a lawn.

The third reason is that they generally lack commercial value. We see value in large conifers that we can use for building supplies, value in hardwoods for furniture making or fuelwood, even value in smaller conifers that we can use for wood chips. Even though it might not actually make economic sense given the time and/or cost to grow them, these trees are worth money. When looking at an area of krummholz, it is easy to think that they have no economic value, which in some ways is correct.

The fourth reason is that they are not nearly as beautiful as a healthy Acadian forest, even to those familiar with how complex and resilient they are. While I agree that there is beauty in everything, there is something quite special in seeing a stand of large hemlock, yellow birch, and sugar maple that can literally take your breath away. In comparison, a krummholz can appear to be the sketchy gang of unkempt guys that you see but want to avoid. It appears that you could get caught up in it and never quite make it out. The trees are bent and twisted and really look nothing like the same species that are growing in more protected areas.

WHY KRUMMHOLZ ARE WORTHY OF OUR ATTENTION AND PROTECTION

Coastal forests are important components of our Island ecosystem. The often-relentless winter winds pound the vegetation along our north shore, limiting the sizes and species of plants in the area. But instead of seeing these areas as impoverished, we really need to embrace their richness.

The krummholz acts as a screen, and is made up of plants that can tolerate harsh conditions. It reduces wind speed and catches salt spray. As you move farther away from the shore, the trees tend to get taller, and after a while you start entering more of a mixed forest with larger trees.

If you wanted to construct something to accomplish the same results, it would look like a short, tight fence along the shore with succeeding rows of slightly taller and more open fencing. At a certain point away from the shore, you wouldn't need any protection.



But instead of fencing, we have dynamic ecosystems that provide a great many ecological benefits. They store carbon, not just in the trees but in the many other plants that can occupy these sites. This includes hardy taller shrubs such as bayberry, wild rose, serviceberry, red-berried elder, willow, and wild raisin, as well as smaller plants such as bunchberry, starflower, and wood ferns.

Even though the conditions for growing plants are quite harsh, with sandy soil containing low levels of organic matter, high winds, salt spray, and full sun, there can still be a lot of diversity present.

Creeping juniper is one of our native junipers that can be found in these areas. It is a low-growing shrub with cones that look like berries, and is well adapted to tough growing conditions. All junipers produce "berries" that can be used in the production of gin. The dense, light-green growth protects the soil and provides hiding spots for a variety of small wildlife species.

Black crowberry is another low, creeping evergreen that can be found on the edges of krummholz. It is in the heather family, with short, light-green leaves and black berries. Crows and many other birds, as well as small mammals, feed on the berries.

Another ground-hugging woody plant found in these areas is large cranberry, with tart red fruit that provide food for both wildlife and humans.

In addition to the diverse plant life, these areas are often rich in birds and mammals. The dense growth provides a perfect spot for birds to hide from predators, while mammals use the areas for both hunting and hiding.

Instead of seeing these areas as wastelands that serve no purpose, we need to look at their true values. They provide wildlife habitat, store carbon, and help slow erosion, and make it possible to grow less-hardy trees that would not survive without this protection.

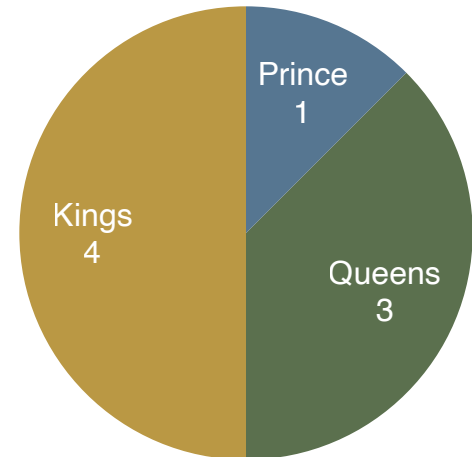
All in all, these are remarkable areas that don't get nearly the credit that they deserve. We need to see them as what they are, instead of what they are not.

SITE SELECTION AND STEWARDSHIP

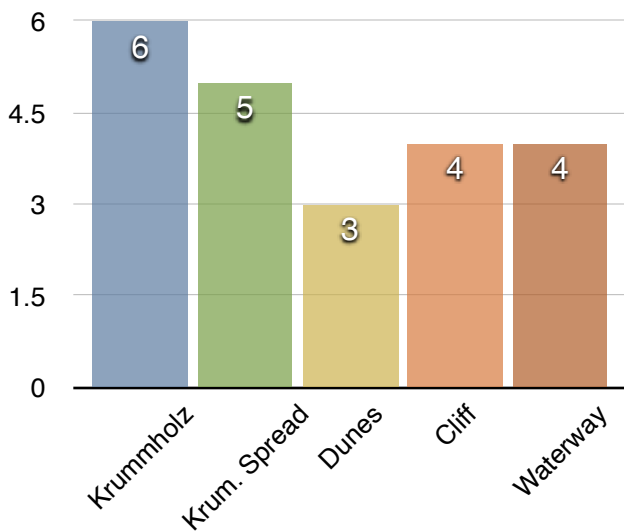


When selecting sites, we looked for a diversity with krummholz forests of varying ages, species composition, habitat, and wind strength. Due to the winter period in which the study was done, we also had to consider efficient accessibility. During the scouting phase we found a large number of potential study sites across the Island. This was done by first looking over provincial mapping data and aerial records to target specific areas and then field visits to assess the various sites for study. The eight chosen sites all had a diversity of unique merits, a relatively Island-wide geographic spread, as well as varying ages, histories and compositions. Areas not covered in this study include the south shore and north cape region.

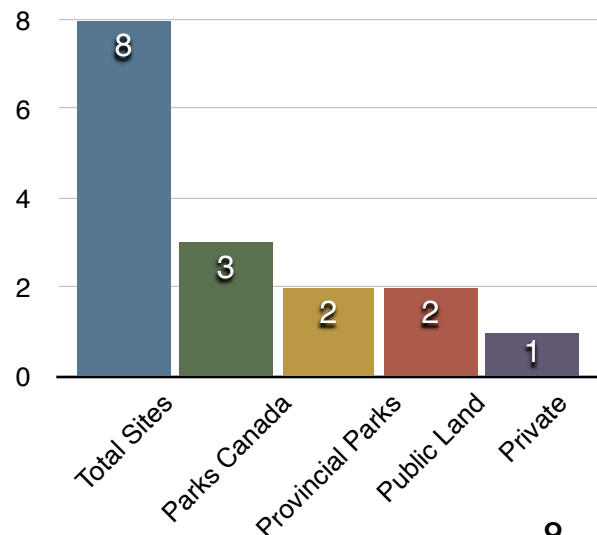
SITES BY COUNTY



ECOLOGICAL FEATURES



LAND STEWARDSHIP



SUMMARY OF SITES

SITE 1 - LONG POND

STEWARD: PARKS CANADA

COUNTY: QUEENS

KRUMMHOLZ: YES

Located in the National Park, Long Pond features a nearby waterway and a distinct lack of park infrastructure in the surrounding area. The shore front is composed of medium-sized dunes with marram grass, dense shrubbery and wind-shaped spruce.

SITE 2 - STANHOPE

STEWARD: PARKS CANADA

COUNTY: QUEENS

KRUMMHOLZ: YES

Another National Park site which has been more recently disturbed by park improvements. It was also farmed right up to the dunes until sometime after 1935.

SITE 3 - STANHOPE CAPE BEACH

STEWARD: PARKS CANADA

COUNTY: QUEENS

KRUMMHOLZ: YES

Partially farmed, this site has long been a site for beach access through the dunes. The coastal edge of this woods has over 75% die-off of the Krummholz trees.

SITE 4 - EAST POINT

STEWARD: PRIVATE

COUNTY: KINGS

KRUMMHOLZ: YES

This private land has been continually forested since at least 1900. The site is located along the northeastern tip of the Island, exposed on two fronts to high winds. It also has unique flora throughout.

SITE 5 - BASIN HEAD

STEWARD: PEI PUBLIC LAND

COUNTY: KINGS

KRUMMHOLZ: YES

This site is a unique due to its tree composition being dominated by black spruce which are protecting wet and sandy areas covered in reindeer lichens and native low-growing shrubs.



SITE 6 - CAMPBELL'S COVE

STEWARD: PROVINCIAL PARKS

COUNTY: KINGS

KRUMMHOLZ: NO

This site lacks any real Krummholz development. It was heavily farmed before becoming a Provincial Park. Field visits found micro-krummholz patches developing near the edges as well as around an old log in the mowed grass.

SITE 7 - COW RIVER

STEWARD: PEI PUBLIC LAND

COUNTY: KINGS

KRUMMHOLZ: YES

This forest is located atop a slumping cliff. It was farmed until after 1935 after which it regenerated with old field white spruce. A small ATV trail was found cut into the property.

SITE 8 - BELMONT

STEWARD: PROVINCIAL PARKS

COUNTY: PRINCE

KRUMMHOLZ: NO

Another heavily farmed site until it became a Provincial Park. This site was interesting due to its northern exposure with high winds and yet no substantial Krummholz development.

NEXT STEPS



One thing about krummholz research is that very little has been done outside of mountainous regions. Instead of an overwhelming amount of information, very little was available. This is especially true of coastal krummholz.

More information needs to be gathered on these sites, especially in the way of plant surveys and wildlife populations throughout the seasons. Breeding bird survey, migration surveys in the spring and fall, and plant surveys conducted throughout the growing season would be very useful. Installing trail cams could help to gather this data.

It would also be useful to have a hand-held wind speed detector to do walk-throughs, perhaps even recorded at different heights, to measure the reduction in wind speed as you proceed through the krummholz.

In addition, it would make sense to purchase software for analysing data recorded on the ARUs, almost 900 hours worth of recordings.

Further study and analysis of erosion rates to ascertain krummholz effects moving forward would help to inform about this forest type's role in coastal protection.

It would also be interesting to see how to actually go about creating krummholz, especially in areas of the National Park that were once farmed. Can we speed up the natural process?

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- The Tuckamore of Newfoundland and Labrador, video: <https://www.youtube.com/watch?v=de-P5IEkPng>
- Bush-like Tree one of Labrador's oldest, CBC article <https://www.cbc.ca/news/canada/newfoundland-labrador/bush-like-tree-one-of-labrador-s-oldest-1.957771>

A

- *Abies balsamea* (Balsam Fir)
- *Acer pensylvanicum* (Striped Maple)
- *Acer rubrum* (Red Maple)
- *Acer saccharum* (Sugar Maple)
- *Acer spicatum* (Mountain Maple)
- *Alnus incana* (Speckled Alder)
- *Alnus viridis* (Green Alder)
- *Amelanchier bartramiana* (Mountain Juneberry)
- *Amelanchier canadensis* (Swamp Serviceberry)
- *Amelanchier fernaldii* (Fernald Serviceberry)
- *Amelanchier laevis* (Smooth Serviceberry)
- *Andromeda polifolia* (Bog Rosemary)
- *Arctostaphylos uva-ursi* (Bearberry)
- *Aronia melanocarpa* (Chokeberry)

B

- *Betula alleghaniensis* (Yellow Birch)
- *Betula papyrifera* (White Birch)
- *Betula populifolia* (Gray Birch)
- *Betula pumila* (Dwarf Birch)

C

- *Chimaphila umbellata* (Pipsissewa)
- *Clematis virginiana* (Virgin's Bower)
- *Comptonia peregrina* (Sweetfern)
- *Cornus alternifolia* (Alternate-leaved Dogwood)
- *Cornus canadensis* (Bunchberry)
- *Cornus rugosa* (Roundleaf Dogwood)
- *Cornus stolonifera* (Red Osier Dogwood)

D

- *Dasiphora fruticosa* (Shrubby Cinquefoil)
- *Diervilla lonicera* (Bush Honeysuckle)



F

- *Fraxinus americana* (White Ash)
- *Fraxinus nigra* (Black Ash)

G

- *Gaultheria hispidula* (Creeping Snowberry)
- *Gaultheria procumbens* (Wintergreen)

H

- *Hamamelis virginiana* (Witch Hazel)
- *Hypericum prolificum* (Shrubby St Johnswort)

I

- *Ilex mucronata* (Mountain Holly)
- *Ilex verticillata* (Winterberry)
- *Isotrema macrophyllum* (Dutchman's Pipe)

J

- *Juglans cinerea* (Butternut)
- *Juniperus horizontalis* (Creeping Juniper)
- *Juniperus communis* (Ground Juniper)

L

- *Larix laricina* (Eastern Larch)
- *Linnaea borealis* (Twinflower)
- *Liriodendron tulipifera* (Tulip Tree)
- *Lonicera canadensis* (American Fly Honeysuckle)

M

- *Malus pumila* (Common Apple)
- *Mitchella repens* (Partridgeberry)
- *Morella pensylvanica* (Northern Bayberry)
- *Myrica gale* (Sweet Gale)



O

- *Ostrya virginiana* (Ironwood)

P

- *Pinus banksiana* (Jack Pine)
- *Pinus resinosa* (Red Pine)
- *Pinus rigida* (Pitch Pine)
- *Pinus strobus* (Eastern White Pine)
- *Populus grandidentata* (Large-toothed Aspen)
- *Populus nigra* (Lombardy Poplar)
- *Populus tremuloides* (Trembling Aspen)
- *Prunus pensylvanica* (Pin Cherry)
- *Prunus virginiana* (Chokecherry)

Q

- *Quercus rubra* (Red Oak)

R

- *Rhus typhina* (Staghorn Sumac)
- *Ribes glandulosim* (Skunk Currant)
- *Ribes hirtellum* (Smooth Gooseberry)
- *Ribes lacustre* (Bristly Black Currant)
- *Ribes triste* (Swampe Red Currant)
- *Rosa carolina* (Carolina Rose)
- *Rosa virginiana* (Virginia Rose)
- *Rubus hispidus* (Bristly Dewberry)
- *Rubus pubescens* (Dwarf Red Raspberry)
- *Rubus vermontanus* (Green Mountain Blackberry)

S

- *Salix bebbiana* (Bebb's Willow)
- *Salix candida* (Sage-leaved Willow)
- *Salix discolor* (Pussy Willow)
- *Salix eriocephala* (Missouri Willow)
- *Salix humilis* (Prairie Willow)



S

- *Salix lucida* (Shining Willow)
- *Salix petiolis* (Meadow Willow)
- *Salix pyrifolia* (Balsam Willow)
- *Sambucus nigra* (Common Elderberry)
- *Sambucus racemosa* (Red-berried Elderberry)
- *Sibbaldia tridentata* (Three-toothed Cinquefoil)

T

- *Taxus canadensis* (Canada Yew)
- *Thuja occidentalis* (Eastern White Cedar)
- *Toxicodendron rydbergii* (Poison Ivy)
- *Tsuga canadensis* (Eastern Hemlock)

U

- *Ulmus americana* (American elm)

V

- *Vaccinium macrocarpon* (Large Cranberry)
- *Vaccinium myrtilloides* (Velvetleaf Blueberry)
- *Vaccinium oxycoccos* (Small Cranberry)
- *Viburnum lantanoides* (Hobblebush)
- *Viburnum nudum* (Wild Raisin)
- *Viburnum trilobum* (Highbush Cranberry)

