

# **PART 1:**

## **PLANTATIONS**



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The part describes the results of some of the plantations established by the Government of Newfoundland between 1938-52 at Tilton, Conception Bay North, Marysvale, and small plantations established between 1970-1990 by various government and volunteer organizations and private citizens. Environmental influences affecting tree growth and the natural regeneration plantations are also described.

## CONCEPTION BAY NORTH

### Broad Cove

Under the heading of Western Bay Area, an early progress report<sup>1</sup> refers to this as one of four plantations about two miles apart from Broad Cove to Western Bay. The report does not describe individual sites at the time of planting, only that, generally, the sites are ‘...open barren with a heavy cover of *kalmia* and *blueberry* bushes, and is very much exposed to all winds.’

The Broad Cove plantation is roughly 40 ha and was planted in 1950 with 150,000 bare-root stock provided by the National Tree Nursery at Salmonier. Most of the plantations are on a slight slope with an eastern aspect.

Doyle’s report noted that the sites were not fenced and there was heavy mortality due to grazing, exposure and poor soil. Consequently, the report concluded that ‘*These plantations must be considered failures.*’ On the contrary, the plantations are generally successful, considering the yield of timber in the pine plantations is several times that of the naturally regenerating native forests adjacent to them. The Broad Cove plantation is by far the best of them - albeit obviously suffering from climatic stress of late.

The Broad Cove site is relatively flat to gently sloping with good soils for tree growth. However, on the negative side, there is a relatively high water table for several months of the year. Consequently, the cold, wet seepage gleysol subsoil prevents pine roots from penetrating deeply (as they normally do on dry sites). In addition, with soil frost penetrating deeply, the extent of crown dieback is symptomatic of winter dessication which becomes more serious as the stand ages. In recent years, with longer, warmer summers relatively milder winters, most of the tree crowns are showing signs of recovery due to the better soil climate.

The high water table also encourages a tall shrub understorey of shrubs (*Rhodora*, withyrod (*Viburnum cassinoides*), *Kalmia*, etc.). In fact, on the east side, the bog is expanding into the plantation - a process known as paludification (water-logging) - which is weakening the pine trees but promoting an unusually tall and dense understorey of *Rhodora* (up to 2 m tall). The shrub understorey effectively prevents natural regeneration and makes it difficult for planting tree species. Of course, on the positive note, the flowering shrub understorey, dominated by *Rhodora*, put on a spectacular show for visitors in early summer.

In the best parts of the plantation, stand density is

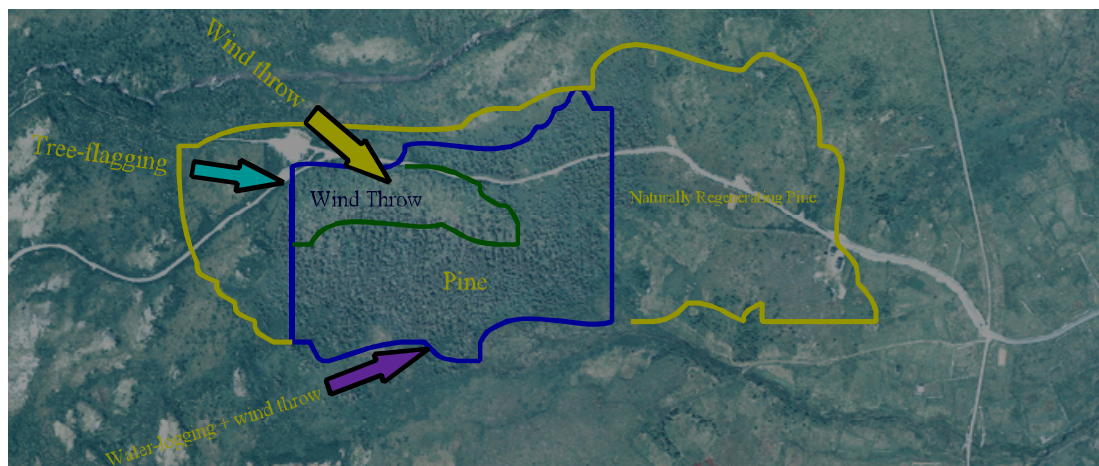
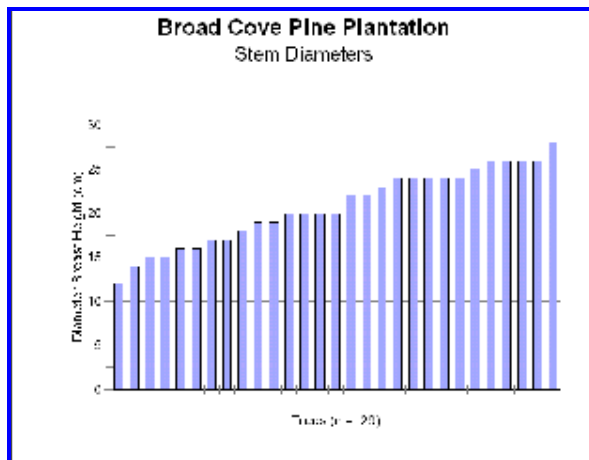


Broad Cove Pine plantations showing a high-shrub understorey dominated by *Rhodora* which developed after thinning

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<sup>1</sup>J.A.Doyle. Report of Reforestation in Newfoundland - 1937-1952. pp 8.

variable from 1,500-3,000 trees  $\text{ha}^{-1}$ . Top height class is 11-13 m. Stem diameter at breast height ranges between 14-28 cm - the average being 21 cm. The trees generally have good clean boles for at least 5 m and, with minimal compression wood, are suitable for rough, structural lumber. However, considering the rapid technological advances in wood processing, notably composites and plastics, the form of the tree will be of little consequence. The plantation was brashed and poorly deformed and sick trees were judiciously culled periodically.



Broad Cove: Blue line shows the original plantation (established in 1947-50) with bare-root stock. Yellow outline shows the approximate limit of naturally regenerated pine from the plantation's trees. Northwesterly winds, funnelled into the valley, have caused severe wind throw, while persistent westerlies cause tree-flagging, and relatively benign south-westerlies easily topple trees in paludified (water-logging) sites beside a stream.

Circular statistical analysis shows that winds from three directions exert a different impact on the plantation. Crown deformation by persistent westerly winds is distinctive throughout the stand as shown in the adjacent photo.



Crown deformation of pine trees is indicative of a persistent westerly wind.

Within the last decade or so, wind throw has increased considerably. The most serious wind throw is on the northwest part of the plantation. Even so, the nature of wind throw is more *endemic* (i.e., a few trees wind thrown at a time) than *catastrophic* (i.e., an entire stand of trees is flattened) per se. The worst of the wind-thrown area on the north west side was salvaged and the site cleaned up.

Throughout the centre of the plantation, wind throw is very sporadic and accounts for less than 1% mortality of the trees. Judging from the age of fallen trees, endemic wind-throw has been going on for at least a couple of decades and seems to have abated somewhat in recent years. Southwest winds caused most of the wind throw. Rarely do northerly winds cause wind-throw.

Within the last decade or so, expansion of the bog on the southern edge of the plantation has become a problem. The process is called paludification (water-logging). There are two effects of paludification: firstly, it promotes a taller and more vigorous shrub understorey (dominated by Rhodora) and development of grass fen community within the pine stand; secondly, the new level of the water table, literally at the surface, is destabilizing pine trees, most with larger than usual stem diameters. Northwestern winds have been gradually enlarging the blow down. The upturned root plates are effectively changing course of the stream further into the

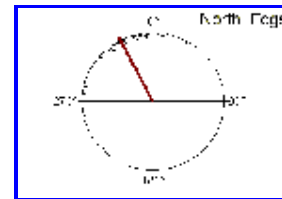


The development of typical fen grass community (bottom left) and a taller than usual shrub understorey dominated by 1.5-2m tall Rhodora

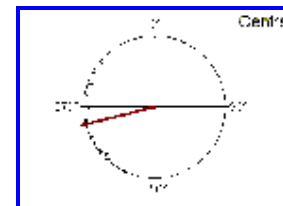
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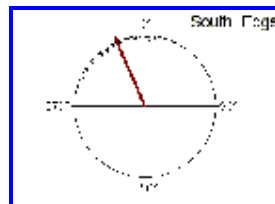
A combination of dieback and gradual erosion of the pine stand by wind throw is a consequence of paludification.



Observations 25  
Mean vector ( $\bar{A}$ ) 333  
Length of mean vector ( $r$ ) 0.84  
Circular standard deviation 34



Observations 22  
Mean vector ( $\bar{A}$ ) 256  
Length of mean vector ( $r$ ) 0.75  
Circular standard deviation 43.24



Observations 20  
Mean vector ( $\bar{A}$ ) 336.45  
Length of mean vector ( $r$ ) 0.94  
Circular standard deviation 20.46

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The principal reason for both the progressive crown dieback (despite their obvious recovery in recent years) and susceptibility to wind throw is primarily the subsurface seepage gleysols as a consequence of uneven and shallow subsurface drainage patterns.

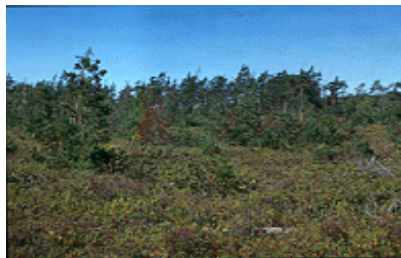
By comparison, most of the pine stands on the north side of the road, are located on a freely draining slope and therefore, having drier and deeper soils, trees withstand the brunt of northerly winds. In compensating for a higher degree of exposure, the trees concentrate growth downward into a larger root mass, a shorter and much more tapered bole, and a streamlined crown with a great deal more foliage. The result is a stand of trees with a smaller stature and rougher form. Also, birch and balsam fir are



The root plate reveals a seepage gleysol which prevents deep-rooting, leading to early wind-throw.



Vigorous natural regeneration spreading from the Broad Cove pine plantation



There is considerable dieback of older naturally regenerated pine which may be related to the phytotoxicity of some native shrubs, climatic stress or both.

common among the pines on the north slope, another indication of a drier site.

Natural regeneration of pine extends 100 m westward and over 0.5 km eastward. In fact, one healthy naturally regenerated pine tree about 10 years old, was found within 100 m of the main highway (about 1 km from the plantation). Natural regeneration began when years old.

the plantation was about 20

An important feature of naturally-regenerated pine saplings as young as 4-5 years old, is their propensity to produce cones with viable seed. This not only adds greatly to the extent of natural regeneration, but may speed up the process of better acclimatization through successive generations.

Many pine saplings have been transplanted into neighbourhood gardens, where they have become a valuable addition to the community landscape for aesthetics and wind breaks. The younger regeneration is generally very healthy. However, some of the older and taller naturally regenerated pine (about 10 years old) have died off. The reason is not known. However, winter dessication appears to be the primary cause and soil diseases the secondary cause - in other words poor adaptability to the local environment.

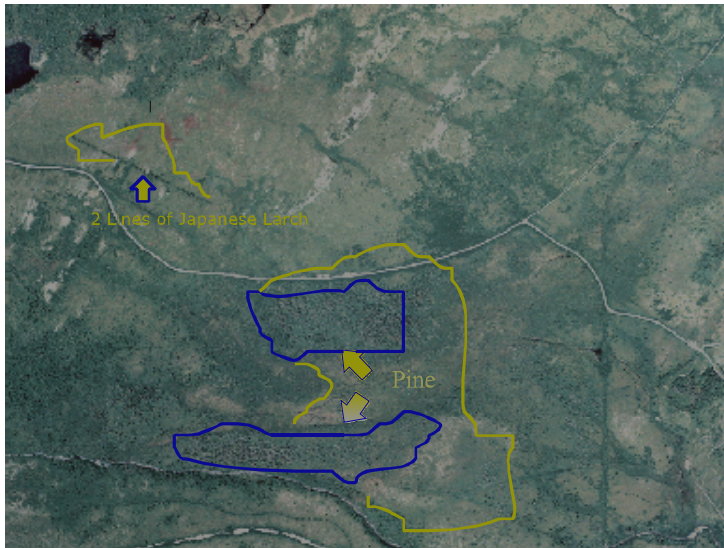


An approximately 7 year-old, cone-bearing pine sapling

Climatic stress, making seedlings less resistant to diseases and insects, is common when introducing exotic species to cold, insular climates. For example, in the Faeroe Islands and Iceland, which have a similar climate and weather to Broad Cove, initial trials with exotic pine and spruce often give poor results. In many cases, poor performance is almost always linked to seed sources from unsuitable provenances.

## Blackhead

There are two sections to the pine plantation about a kilometre east of Blackhead. Unlike the other plantations, these are located on the slopes on either side of Blackhead Brook.



Blackhead Plantations: The long straight line (top left) are two rows of Japanese larch planted in 1983 by Mr. Hudson as a shelterbelt for his blueberry farm; blue lines indicate pine plantations established in 1950 with bare-root stock provided by the National Tree Nursery at Salmonier. Yellow marks the approximate outer limit of naturally regenerating Japanese larch and pine from there respective plantations

The height and diameter breast height distribution of the stands is much the same as at Broad Cove. And while there is not the same degree of wind throw as at Broad Cove, crown damage from the weight of glaze (freezing rain) and more severe crown deformation has an obvious effect on tree form. The presence of dense alder thickets suggests that seepage gleysols may be limiting the penetration of pine root mass, which inevitably shortens the rotation age.

Natural pine regeneration beyond the plantation, especially among the 2-3 m tall alder thickets, is quite extensive and healthy and die back is not quite so obvious as at Broad Cove. In fact, the height and older age class of the pine regeneration indicate that Blackhead Valley on the whole, apart from freezing rain, has a climate more conducive to pine. Also, as the photo shows, on the whole the pine plantations have better yields than adjacent natural woodlands the same age and older. In fact, since the plantation was established 50 years ago, the natural vegetation for the most part has not progressed beyond heath, alder thickets and scrub.



The pine plantation at Black Head. The foreground indicates that the landscape around the plantation has changed little - except for a higher proportion of alder thickets.

Of particular interest are two rows of Japanese larch planted about 15 years ago by Mr. Hudson.

As the aerial photo shows, the plantation is straight as a rod for about 0.5 km. Considering a 100% survival rate, it is a credit to Mr. Hudson's expert and careful planting skills. Apparently, Mr. Hudson planted the larch to provide shelter for a blueberry farm.



The height is between 6-8 m for its entire length. The obvious strong flagging of the tree crowns indicates persistent, moderately strong prevailing southwesterly winds averaging  $7-10 \text{ m s}^{-1}$  during the growing season. This means that the shelter belt is quite effective in protecting the blueberry flowers in the eastern sections of the fields and less effective on the western flank. There is quite a bit of natural regeneration of Japanese larches. Less than a dozen trees actually produce cones - the most precocious of them being the trees at the west end of the planting. The principal cone bearing tree has been topped, presumably by natural causes, and is poorly deformed.



These Japanese larch trees are the most precocious seed-producers in the plantation.



A close up of abundance of cones on Japanese larch.

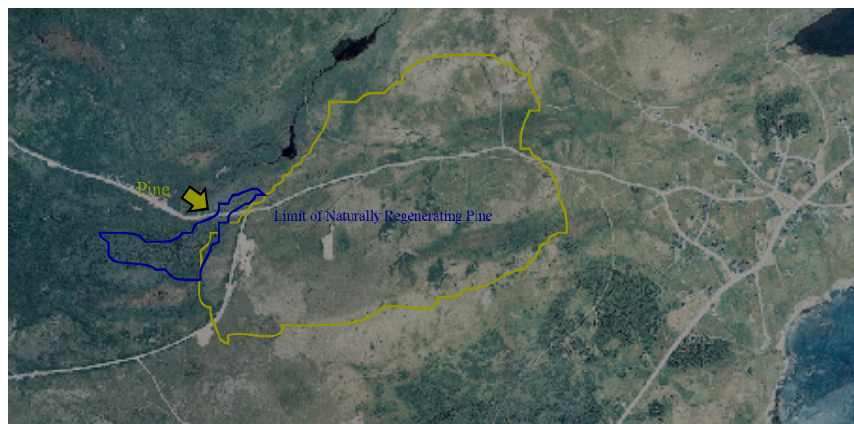
Judging from the distribution of seedlings, and the scarcity of cones, it is the parent of most of the seedlings which have become established up to 400 m northward of the plantation. Natural Japanese larch regeneration also extends up to 15-20 m on the windward side and is generally mixed in with natural regeneration of local tamarack. But the best, oldest and most prolific natural regeneration of Japanese larch is in lee of the eastern end of the plantation. The regeneration extends out to about 20 m northward from the plantation (no seedlings were found on the opposite side). The rate of growth in 1999 for 4-5 year-old naturally regenerated Japanese saplings ranges between 0.4-0.7 m. At this rate of growth, within 10 years, the plantation will have at least doubled in size with the top height of naturally regenerated Japanese larch being at least 5 m - that is, almost as tall as the plantation is now. Furthermore, since it is well known that larch thrives in the company of grasses, it is not surprising that Japanese larch regeneration is better where there is a higher proportion of grass in the vegetation dominated by blueberry shrubs.



The arrow indicates the greatest distance from the plantation where naturally regenerating Japanese larch was found in 1999.

## Western Bay

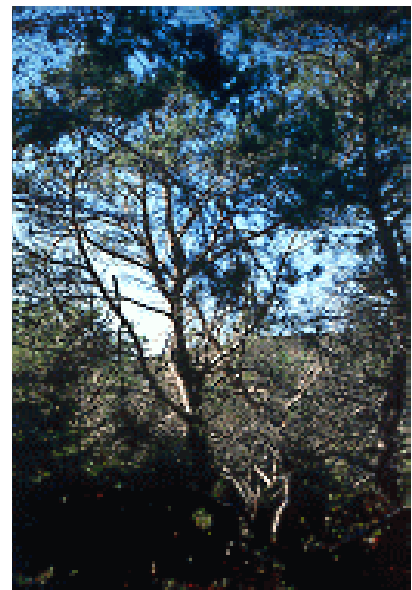
For the most part, the plantation is best described as a confusing jumble of wind throw and distorted hulks. This plantation is located on a steep slope exposed to strong, persistent up-slope winds funnelled down the valley from the west. Apart from strong crown flagging as result of the strong winds the contortions of the crown and large broken branches reflect a high frequency of severe freezing rain and wet snow loading. At first sight, the plantation appears to be a disaster case.



The permanent flagging (the photo was taken on a calm day) at the top of the tree indicates persistent, brisk westerly winds.

Despite the effects

of harsh weather, the relative size and volume of wood produced by the boles is impressive compared to other pine plantations of the same vintage. In fact, as the photos above show, the plantation, for all its warts, has far outproduce the natural forest - a point not lost on the people who have extracted pine logs for their own use.



The contorted trunk and branches of this pine tree indicate a high frequency and heavy loading of freezing rain.

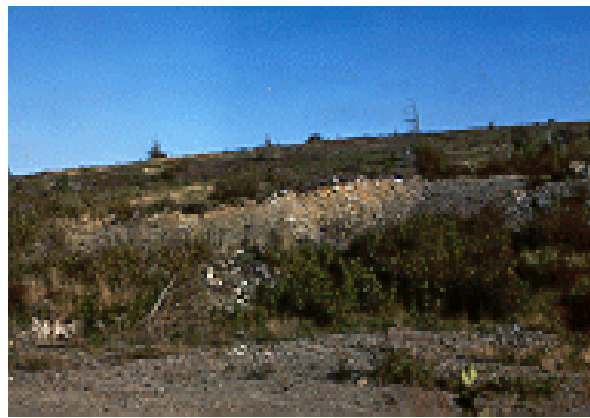
The reason being that while windiness is a bit of a setback, the steep slope, with a westerly aspect and well-drained, reasonably good soils, compensate somewhat for the windiness. From a sawyer's point of view, most of the boles would make inferior lumber because of heavily branched trunks and a relatively high incidence of compression wood. The same can be said of the trees in local natural forests. But for fuel wood and perhaps, what is more important, as a nurse canopy for more valuable under-planted species, the plantation is actually quite useful.

As with other pine plantations, natural regeneration of pine outside the plantation began at an early age - some of it almost to the point of producing useful timber.

Natural regeneration of Scots pine compliments that of tamarack for a 1 km eastward onto the heath barrens, roadside embankments and burrow pits. A few have sprouted up in the graveyard about 1 km eastward. But the greatest concentration of natural pine regeneration is in dense alder thickets close to the plantation. As is common in other the plantations, pine saplings start out with healthy vigorous growth in alder thickets.



A mix of naturally regenerating Scots pine, tamarack and balsam fir on the heath.



Natural regeneration of pine along roadbanks and burrow pits.

Unfortunately, the pine saplings begin dying off when reach a height of 4-5 m. It is obvious that the beneficial effects which the nitrogen-fixing alders have on other tree species do not work well with naturally regenerating pine.

The primary causes of the dieback need to be investigated. Part of the reason could be that alder leaf-mold provides an ideal habitat for pine bark beetles and diseases to flourish. However, since needles show signs of abrasion, one must also consider climatic factors such as winter-burn, glaze and frost damage to early flushing as a primary cause of mortality or at least weakening the saplings and reducing their tolerance to diseases and insects.



Natural regeneration of Scots pine among the alder thickets.



Early dieback of natural regeneration of pine in an alder thicket.