

## The Lulu Island Provenance of *Pinus contorta*

LAURENCE ROCHE

### *Introduction.*

Lulu Island lies in Lat.  $49^{\circ} 20' N.$ , Long.  $123^{\circ} 15' W.$  It is separated from Vancouver, B.C. by the North Arm, and bounded on the south by the main channel of the Fraser River. A large portion of the Island is bogland which is usually covered with dense stands of contorta pine. There are no stands of other species on the Island.

### *Soil.*

The Island is composed chiefly of delta deposits laid down during the post-Pleistocene by the Fraser River debouching into the strait of Georgia (Johnson 1921). The westernmost edge of the bog lies within five miles of salt water. The depression in which the peat has accumulated apparently had its origin in abandoned river channels, formed as the river changed its course upon the upbuilding delta. During its earlier development, the bog was subjected to periodic inundation as is evidenced by the thick deposits of silt underlying the peat and its presence throughout much of the bog (Hansen 1940).

### *Ecology.*

The bog surface has been modified by grazing, cultivation and fire, and since the last war, by drainage to facilitate house building. However some areas have retained their natural condition. These areas support the typical plant association of the British Columbia bog areas, that is, the *Pinus contorta*—*Ledum groenlandicum*—*Sphagnum capillaecium* association. *Ledum groenlandicum* (Labrador tea) is found everywhere in dense thickets. *Betula* is in abundance in some areas, and *Vaccinium oxycoccus* and *Myrica gale* are also usually present.

Pollen analysis of bogs of the Pacific Coast similar to that of Lulu Island have shown that contorta pine is usually the pioneer species and most abundant arboreal invader (Hansen 1944).

### *Climate.*

The following table for a 15 year period is from the records of the weather station of Vancouver Airport. This data is valid for the Lulu Island area (Chapman 1952).

TABLE

Station : VANCOUVER AIRPORT										Latitude : 49° 11' N.			
Years : 15					Altitude : 22'								
J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Total	
Average Extreme													
Highest Temp. ....	51	54	68	74	78	82	80	76	66	57	53		
Mean Maximum .....	41	45	56	63	68	72	71	66	57	49	44		
Average Extreme													
Lowest Temp. ....	16	22	33	38	44	48	48	39	32	26	19		
Mean Minimum ....	30	33	41	46	51	55	54	50	44	37	34		
Mean Temp. ....	35	39	49	55	60	64	63	58	50	43	39		
Total Precipitation ...	4.94	5.06	3.74	2.53	2.01	1.43	1.11	1.15	1.96	4.80	5.12	6.47	
% of Annual Total												40.32	
Per Month .....	12.3	12.5	9.3	6.3	5.0	3.6	2.8	2.9	4.8	12.0	12.6	16.0	
Number of Days													
With Precipitation	18	16	13	10	8	6	7	9	16	18	19		
Prob. of Precipitation	58%	50%	44%	31%	24%	19%	22%	30%	51%	60%	61%		
Snow .....	6.2	4.8	1.2							1.0	4.3	17.5	
% to Total Precip. ...	12.4	9.5	3.2							2.0	6.5	4.3%	
Relative Humidity :													
A.M. ....	93	91	89	88	87	89	90	92	92	91	91		
P.M. ....	85	78	67	63	65	62	62	72	80	84	88		
Sunshine .....	68.9	92.4	127.8	192.8	246.1	268.7	292.7	244.3	204.7	113.5	68.8	42	

It will be seen that the climate of Lulu Island is very similar to that found over a large portion of Ireland, where the average temperature for winter months is  $44^{\circ}$  F. to  $45^{\circ}$  F. in the West, and  $41^{\circ}$  F. to  $42^{\circ}$  F. in the East, with July temperatures of  $60^{\circ}$  F. to  $61^{\circ}$  F. in the South and  $57^{\circ}$  F. in Donegal. Average precipitation on the Island is 40.32 inches which approximates very well with the precipitation over four-fifths of Ireland (G. P. Haughton 1957).

*Present condition of the stands.*

It is likely that within a short time few if any stands of contorta pine will be left growing on Lulu Island. Since the last war there has been a boom of speculative building. Large areas have been cleared of trees for this purpose, and also for the purpose of cranberry culture, which is an important industry along the coast of Washington and Oregon. The stripping of peat deposits has also hastened the destruction of the pine stands.

The writer has visited the Island on several occasions with Mr. Gordon Roche, the seed merchant. Practically all the contorta pine in this area is under twenty years and under five inches in diameter at breast height. Owing to repeated fires no mature stands now remain. The typical stand is dense and even aged (Fig. I) and generally every tree is infected by western gall rust (*Cronartium barknesii*). The most



Fig. I—Stand of *P. contorta* on Lulu Island bog. Note dense thicket of Labrador tea (*Ledum Groenlandicum*) in foreground.



Fig. II—Vigorous early growth of *P. contorta* on Lulu Island.

noticeable result of rust-infection is the stimulation of the host to abnormal tissue development resulting in malformed organs, or parts of the host, such as galls, swollen stems, stunting and leaf casting. There is little doubt that the disease retards growth, and deforms a very large number of trees. Trees free of the disease are taller and generally more vigorous than infected trees.

Contorta pine is an early seed producer, and it appears to be particularly so in this area. Trees as young as five years bear cones, and because of the accessibility of the cones, seed collecting has been principally from young trees, and older trees of stunted growth. This, of course is common practice regards lodgepole pine, and, whatever the provenance, practically all the seed supplied to Ireland throughout the years has been collected from similar stands. Seed collected from taller trees, such as those of the Ladner stands mentioned below, would be much more expensive than the lodgepole pine seed supplied to date.

Early growth appears to be rapid (Fig. II) but after about ten years there is an obvious lack of vigour in the stands, and in some instances they appear in check. Form is generally good, particularly so in Ladner, an area which though not on Lulu Island, can be considered of the same provenance because of its proximity and similar bog type and climate. The Ladner stands lie approximately 3 miles south-east of Lulu Island and are bounded to the north by the south arm of the Fraser river and to the south by highway ‡‡10. An interesting feature of the trees on the Ladner bog is that they appear to be completely free of western gall rust. They are also older and taller than the stands on Lulu Island. These trees lack the heavy branching and contorted form of the extreme coastal type of *P. contorta*. (Fig. III).



Fig. III—Stand of *P. contorta* on Ladner bog.

#### *Genetic Improvement.*

Seasonal variations in temperature and rainfall are considered the most important climatic factors limiting geographic distribution of a given species (Daubenmire 1956). Thus it is desirable, when considering the introduction of an exotic, to select that provenance which approximates as closely as possible the climatic conditions of the new habitat. The Lulu Island provenance of contorta pine is therefore of importance in Irish silviculture.

Genetic Improvement may be considered under two headings: Inter-specific hybridisation, (Duffield 1954), and hybridisation between provenance, (Bannister 1959).

A fertile hybrid between the Rocky Mountain provenance of lodgepole pine (*P. contorta* var. *latifolia* Englem.) and Jack pine (*P. banksiana* Lamb.) has been produced at the Eddy Arboretum, Institute of Forest Genetics, Placerville, California. It has been shown that this hybrid is distinctly superior on the average to lodgepole pine in vegetative vigour. (F. I. Richter 1949). This hybrid is named *Pinus murraybanksiana*. A more desirable cross, from the point of view of obtaining a hybrid for propagation under Irish conditions, would be *P. contorta* var. *contorta* x *P. banksiana*, utilizing the Lulu Island provenance.

*Pinus murraybanksiana* occurs spontaneously in Alberta where it produces cones in the third or fourth year (Moss 1949). Duffield and Richter (1953) suggest that it may be a valuable tree for pulpwood production and should be tested in England and Ireland, and those parts of Australia and New Zealand where lodgepole pine has been successful.

A recent work has indicated that there are several regional forms of *P. contorta* exhibiting geographic unity and heritable differences, and meriting recognition as sub-species, (Critchfield 1957). The sub-species are as follows:

Coastal region:

*Pinus contorta* Douglas ex Loudon ssp. *contorta*.

Mendocino White Plains:

*Pinus contorta* ssp. *bolanderi* (Parl.) Stat. Nov.

Rocky Mountains:

*Pinus contorta* ssp. *latifolia* (Engelm. ex Wats.) Stat. Nov.

Sierra Nevada:

*Pinus contorta* ssp. *Murrayana* (Balf.) Stat. Nov.

Critchfield points out that the coastal sub-species, which is of chief interest under Irish conditions, and includes the Lulu Island provenance, is effectively isolated from the two major inland sub-species by a distributional gap. This gap can be bridged by the forest geneticist and the good growing qualities of the coastal sub-species combined with the more desirable form of the inland type.

Interspecific hybridisation and hybridisation between provenances are but two of the many techniques available to the tree breeder for the improvement of a species. But they are extremely useful and Bannister has pointed out their value in relation to the improvement of *P. radiata* in New Zealand, a problem very similar to that of *P. contorta* in Ireland.

Of the two approaches hybridisation between provenances offers greater possibilities for improvement of lodgepole pine in Ireland, as development of methods to mass-produce large amounts of seed should be simpler than for the between-species crosses. However a careful study of the  $F_2$  species hybrids now being produced at Placerville, California by open pollination of the artificial  $F_1$  hybrids would certainly be worthwhile.

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