A Biophysical Survey of the Williams Lake-Purcell's Cove Backlands, Halifax County, Nova Scotia

September, 1992

I. INTRODUCTION

This study was undertaken to provide baseline data on the biophysical characteristics of that parcel of terrain located between Williams Lake to the north, Halifax City Limits (to the south of Flat Lake) to the south, McIntosh Run to the west, and Purcell's Cove Road to the east.

Specifically, geologic structures, surficial materials, and vegetation were documented and analyzed with respect to their ecological attributes and functional relationships. Outstanding, representative, and unusual or rare structures, ecosystems, or species, if present, were evaluated for their significance.

II. METHODOLOGY

The biophysical landscape documentation and identification of significant elements incorporated (1) literature review, (2) aerial photography interpretation, and (3) field reconnaissance.

Before actual photo-interpretation was undertaken, the aerial photography was scanned to gain an appreciation of the diversity of patterns of landscapes, ecosystems, and/or vegetation so as to design an appropriate field reconnaissance program and also to determine the "scale" at which to survey for the necessary data. This initial scanning indicated that the study area was extremely diverse in the sense of very small, dissected entities, yet in most cases formed a very distinctive, broader pattern.

The aerial photo-interpretation component utilized (1) 1975 1:63,360 colour infrared photography for delineation of biophysical units and (2) 1981 1:10,000 colour photography for the delineation of vegetation types (forested stands, wetlands, non-forest areas). The information generated was mapped directly on 1:10,000 aerial photos.

The aerial photo-interpreted information was verified by field reconnaissance. Representative vegetation units were inventoried, via transects, in which detailed vegetation information (species composition of various vegetation layers, abundances, heights, etc.) and more general physical habitat information (degree of slope, aspect, surficial deposits, etc.) was gathered. Rare and unusual ecosystems, species, structures were documented if found during fieldwork.

Scale: 1:63,360

∴ STUDY AREA

The field data, aerial photo information, and literature review were analyzed and synthesized into ecosystem types and ground plant communities. Results are in tabular form, with a discussion of the ecological attributes and importance of the results following.

III. RESULTS

The Williams Lake study area was a difficult area to delineate and map ecologically significant parameters. This was due to : (1) natural disturbances over large areas of the study area and (2) the diversity of micro-topography. Viewed from aerial photographs, broad patterns of landscape are discernable and can be described generally. When one tries to delineate smaller, more detailed polygons, it becomes much more difficult to draw boundaries. This situation was particularly true from a physiographic perspective. The whole area, from the aerial photo, was viewed as a single unit--a rather smooth but distinctive pattern of parallel ridged micro-topography with little relief (an elevation range of 35-68m), the ridges being separated by narrow swales (a broad flat around Purcell's Pond is distinguishable from the remainder of the area). However, on the ground differences in topography are readily discernable when travelling perpendicular to the orientation of this ridge-swale complex. One would need extremely detailed topographic mapping (1-2 metre contour intervals) to map this micro-topography adequately and accurately. For this reason, no physiographic mapping was undertaken, but is documented in the discussion section of this report.

Similarly, the extensive barrens complex of the study area proved difficult to map. Anthropogenically disturbed areas, such as harvested areas are usually fragmented into small discernible units due to such factors as ownership boundary lines, specific species or forest stands being harvested, etc.

In extensive, natural undisturbed areas or extensive areas that have been altered by catastrophic natural disturbances such as windthrow or fire, the succeeding vegetation pattern is generally rather uniform with minor variations, as is the case here. In this study an attempt was made to distinguish between barren (less than 10% tree species cover) and semi-barren (between 10-40% tree species cover), and between coniferous, mixedwood, and deciduous semi-barrens.

An additional problem with respect to the vegetation classification of this study area was the use of obsolete aerial photographs. Since the time of the latest photos--1981-several fires have taken place. As well, at the time of the photos, the area in general was covered by very young vegetative growth. Since then rapid growth of existing stands and initiation of new stands have taken place. It is thus recommended that the study area be re-photo-interpreted and remapped when new aerial photographs become available.

With the above in mind, the following is a vegetation inventory for the Williams Lake study area.

Lake Williams and Area Biophysical Inventory

Vegetation Inventory Legend

(Based on 1981 Colour 1:10,000 Photos)

Example:	bS^5 bF^5 3 4	% Species Comp.	.Aver. Stand Height	. Aver.Stand Density
	Hm . 3 . 4	Plant Assoc.	.Stand Cond.	.Successional Status

Species Composition

bS	–	Black Spruce	rM	–	Red Maple
jP	–	Jack Pine	rO	–	Red Oak
wP	–	White Pine	wB	–	White Birch
ltA	–	Large-toothed Aspen			

Height Classes

1	1 – 20 Feet
2	21 – 40
3	41 – 60
4	61 – 80
5	81 – 100
6	Uneven

Density Classes

1	0 – 25 %
2	26 – 50
3	51 – 75
4	76 – 100
5	Uneven;Patchy

Ground Plant Associations

fM	Feather Mosses
Ww	Wood Fern-Wood Sorrel
KaVa	Lambkill – Blueberry
GpVa	Teaberry – Blueberry

Successional Status

E	Early Successional
M	Midsuccessional
NC	Near-climax
C	Climatic Climax

Condition Classes

1	Regeneration following a disturbance, 10 yrs.	1A	No regeneration following a disturbance
2	Young, normal growth 11 to 30 yrs., height class 1 or 2	2A	Young, retarded growth due to poor site and/or overstocking, height class 2
3	Young to mature, normal growth, 31 to 60 yrs., height class 2 and 3	3A	Young to mature, retarded growth due to poor site and/or overstocking, height class 2
4	Mature, good growth, healthy 61 to 80 yrs., height class 3 and 4	4A	Forest cover affected by exposure, shallow soils, exposed bedrock, and/or other site factors, height class 2 to 4
5	Mature, good growth, healthy, 81+ yrs., height class 4 to 6	5A	Overmature, showing signs of decadence height class 4 to 6
6	Old growth, climax vegetation		

Vegetation Units Classification

1. $\frac{bS^{9}\ rM^{1} \cdot 3 \cdot 3}{KaVa \cdot 3 \cdot M}$

2. Deciduous Semi-barren

3. Coniferous Semi-barren

4. $\frac{rM^{5}\ yB^{2}\ wB^{2}\ rO^{1} \cdot 3 \cdot 4}{Ww \cdot 4 \cdot M}$

5. $\frac{bS^{7}\ rM^{3} \cdot 6 \cdot 5}{KaVa \cdot 2\text{-}4 \cdot M}$

6. Barren (jP + rM wB gB ltA)

7. $\frac{bS^{4}\ rM^{3}\ wB^{1}\ rO^{1}\ wP^{1} \cdot 6 \cdot 5}{Ka\ Va \cdot 2\text{-}4 \cdot M}$

8. $\frac{bS^{5}\ rM^{4}\ wB^{1} \cdot 3 \cdot 4}{fM \cdot 3\text{-}4 \cdot M}$

9. Barren

10. $\frac{yB^{3}\ rM^{3}\ wB^{1}\ rO^{1}\ bS^{1}\ wP^{1} \cdot 2\text{-}3 \cdot 4}{Ww \cdot 3 \cdot M}$

11. $\frac{rM^{3}\ wB^{2}\ rO^{2}\ bS^{2}\ wP^{1} \cdot 1\text{-}2 \cdot 4}{Ww/KaVa \cdot 2 \cdot M}$

12. Barren

13. Barren

14. Barren

15. Coniferous Semi-barren (jP)

16. Bog

17. Bog

18. Bog

19. $\frac{rM^{5}\ wB^{3}\ bS^{1}\ rO^{1} \cdot 1\text{-}2 \cdot 4}{Ww/KaVa \cdot 2 \cdot M}$

20. Fen

21. Coniferous Semi-barren (bS)

22. $\frac{rM^{8}\ wB^{2} \cdot 3 \cdot 4}{Ww \cdot 3 \cdot M}$

23. $\frac{rM^{6}\ wB^{2}\ rO^{1}\ bS^{1} \cdot 3 \cdot 4}{Ww \cdot 3 \cdot M}$

24. Coniferous Semi-barren

25. $\frac{\mathrm{jP^{6}\ bS^{3}\ rM^{1}} \cdot 3 \cdot 4}{\mathrm{KaVa/fM} \cdot 3 \cdot \mathrm{E}}$

26. $\frac{\mathrm{bS^{5}\ rM^{4}\ jP^{1}} \cdot 3 \cdot 3}{\mathrm{KaVa/fM} \cdot 3 \cdot \mathrm{M}}$

27. $\frac{\mathrm{bS^{5}\ rM^{3}\ wB^{2}} \cdot 3 \cdot 4}{\mathrm{fM/Ww} \cdot 3\text{-}4 \cdot \mathrm{M}}$

28. Coniferous Semi-barren (bSjP)

29. Mixedwood Semi-barren

30. Mixedwood Semi-barren

31. Barren (jP+rMwBgB)

32. Bog

33. $\frac{\mathrm{bS^{6}\ jP^{4}} \cdot 3 \cdot 5}{\mathrm{KaVa/fM} \cdot 3 \cdot \mathrm{E}}$

34. Coniferous Semi-barren (jP)

35. $\frac{\mathrm{jP^{5}\ bS^{4}\ rM^{1}} \cdot 2 \cdot 3}{\mathrm{KaVa} \cdot 3 \cdot \mathrm{E}}$

36. $\frac{\mathrm{rM^{6}\ bS^{2}\ wP^{2}} \cdot 3 \cdot 4}{\mathrm{Ww} \cdot 3 \cdot \mathrm{M}}$

37. $\frac{\mathrm{bS^{5}\ jP^{3}\ rM^{2}} \cdot 2 \cdot 3}{\mathrm{KaVa} \cdot 2 \cdot \mathrm{E}}$

38. $\frac{\mathrm{bS^{4}\ jP^{3}\ rM^{3}} \cdot 2 \cdot 4}{\mathrm{KaVa} \cdot 2 \cdot \mathrm{E}}$

39. Coniferous Semi-Barren (jP+bS)

40. $\frac{\mathrm{bS^{5}\ jP^{5}} \cdot 3 \cdot 5}{\mathrm{KaVa} \cdot 3 \cdot \mathrm{E}}$

41. $\frac{\mathrm{rM^{5}\ bS^{2}\ jP^{2}\ wB^{1}} \cdot 6 \cdot 5}{\mathrm{KaVa/Ww} \cdot 2\text{-}4 \cdot \mathrm{E}}$

42. Fen

43. Mixedwood Semi-barren (jPbSrMwB)

44. $\frac{\mathrm{bS^{4}\ jP^{3}\ rM^{3}} \cdot 6 \cdot 5}{\mathrm{KaVa} \cdot 2\text{-}4 \cdot \mathrm{E/M}}$

45. Coniferous Semi-barren (jP)

46. Barren

47. Barren

48. $\frac{\mathrm{rM^{5}\ wB^{3}\ rO^{1}\ jP^{1}} \cdot 2 \cdot 4}{\mathrm{Ww} \cdot 2 \cdot \mathrm{M}}$

49. bS Swamp

50. Bog

51. $\frac{jP^7\ bS^3 \cdot 2 \cdot 4}{KaVa \cdot 2 \cdot E}$

52. Mixedwood Semi-barren

53. bS Swamp

54. Bog

55. bS Swamp

56. bS Swamp

57. Mixedwood Semi-barren

58. Coniferous Semi-Barren (jP+bS)

59. Coniferous Semi-barren (jP+bS)

60. Barren

61. Fen/Bog Complex

62. Bog

63. $\frac{bS^6\ rM^2\ jP^2 \cdot 2 \cdot 4}{KaVa \cdot 2 \cdot M}$

64. Fen/Bog Complex

65. Coniferous Semi-barren

66. Coniferous Semi-barren

67. $\frac{rM^6\ bS^4 \cdot 3 \cdot 4}{Ww/fM \cdot 3 \cdot M}$

68. $\frac{rM^{10} \cdot 2 \cdot 4}{Ww \cdot 2 \cdot M}$

69. $\frac{bS^7\ rM^3 \cdot 3 \cdot 5}{fM/KaVa \cdot 3 \cdot M}$

70. Coniferous Semi-barren

71. Mixedwood Semi-barren

72. Coniferous Semi-barren

73. bS Bog

74. $\frac{bS^6\ jP^3\ rM^1 \cdot 6 \cdot 5}{KaVa \cdot 2.4 \cdot M}$

75. Bog

76. Coniferous Semi-barren

77. $\frac{bS^{9}\ rM^{1} \cdot 3 \cdot 3}{KaVa \cdot 4 \cdot M}$

78. $\frac{bS^{8}\ jP^{1}\ rM^{1} \cdot 3 \cdot 3}{KaVa \cdot 4 \cdot M}$

79. Coniferous Semi-barren

80. Barren

81. Deciduous Semi-barren

82. jP Bog

83. Deciduous Semi-barren

84. $\frac{rM^{8}\ rO^{1}\ gB^{1} \cdot 1 \cdot 4}{Ww \cdot 2 \cdot M}$

85. Deciduous Semi-barren

86. Bog

87. Barren (jP)

88. $\frac{bS^{9}\ jP^{1} \cdot 3 \cdot 3}{fM/KaVa \cdot 4 \cdot M}$

89. $\frac{jP^{8}\ bS^{2} \cdot 1 \cdot 4}{KaVa \cdot 2 \cdot E}$

90. $\frac{bS^{7}\ rM^{2}\ jP^{1} \cdot 3 \cdot 4}{fM \cdot 4 \cdot M}$

91. $\frac{bS^{4}\ rM^{3}\ jP^{1}\ wB^{1}\ rO^{1} \cdot 6 \cdot 4}{KaVa/fM \cdot 3/4 \cdot M}$

92. $\frac{jP^{4}\ rM^{2}\ wB^{2}\ gB^{2} \cdot 1 \cdot 4}{KaVa \cdot 2 \cdot E}$

93. Deciduous Barren

94. Mixedwood Semi-barren

95. Deciduous Semi-barren

96. Bog

97. Bog

98. $\frac{wP^{5}\ bS^{3}\ rM^{2} \cdot 3 \cdot 3}{GpVa}$

99. Bog

100. MixedwoodSemi-barren

101. Barren

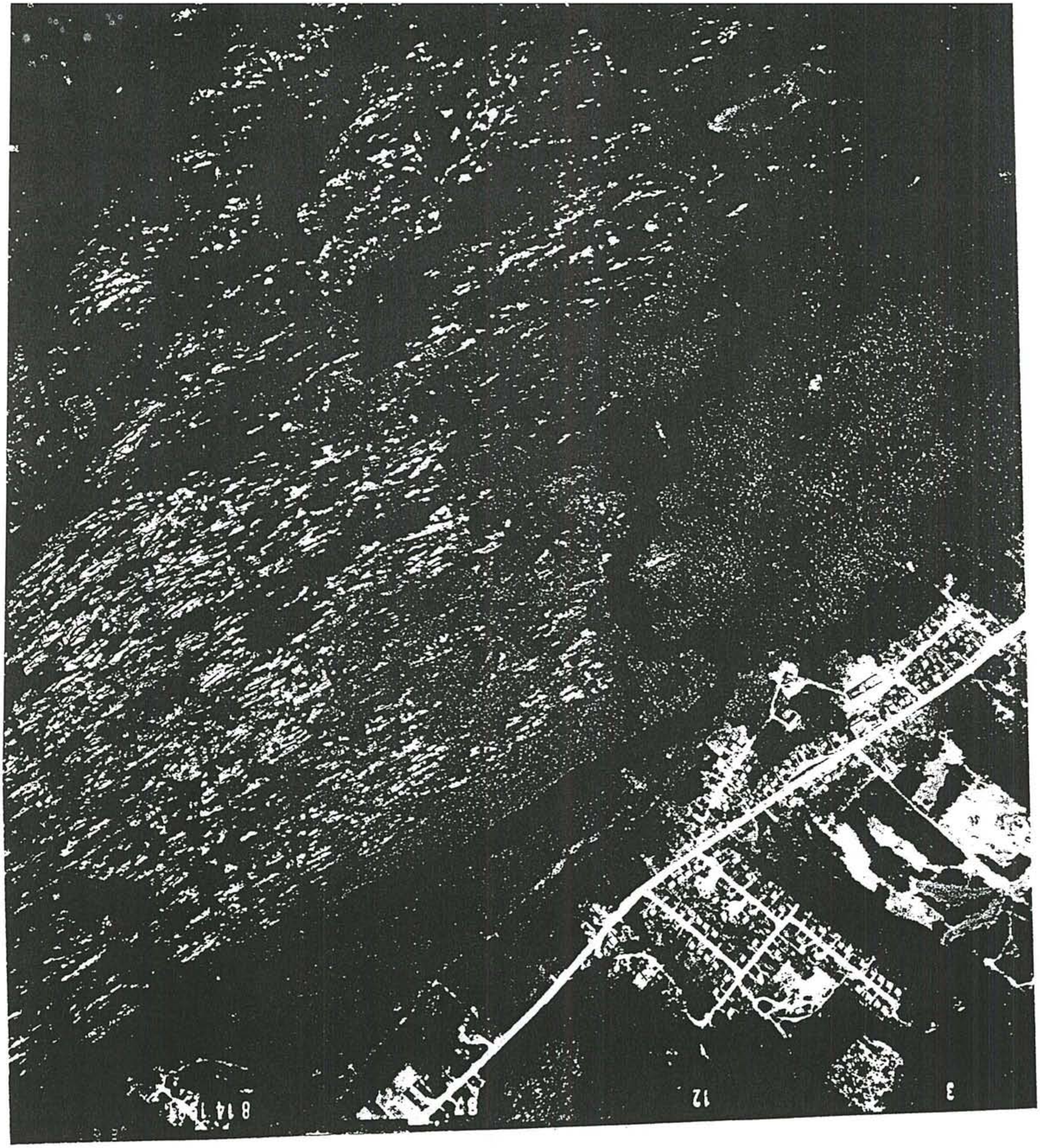
102. Coniferous Semi-barren

103. Bog

104. Deciduous Semi-barren

Scale: 1:10,000

Scale : 1:10,000



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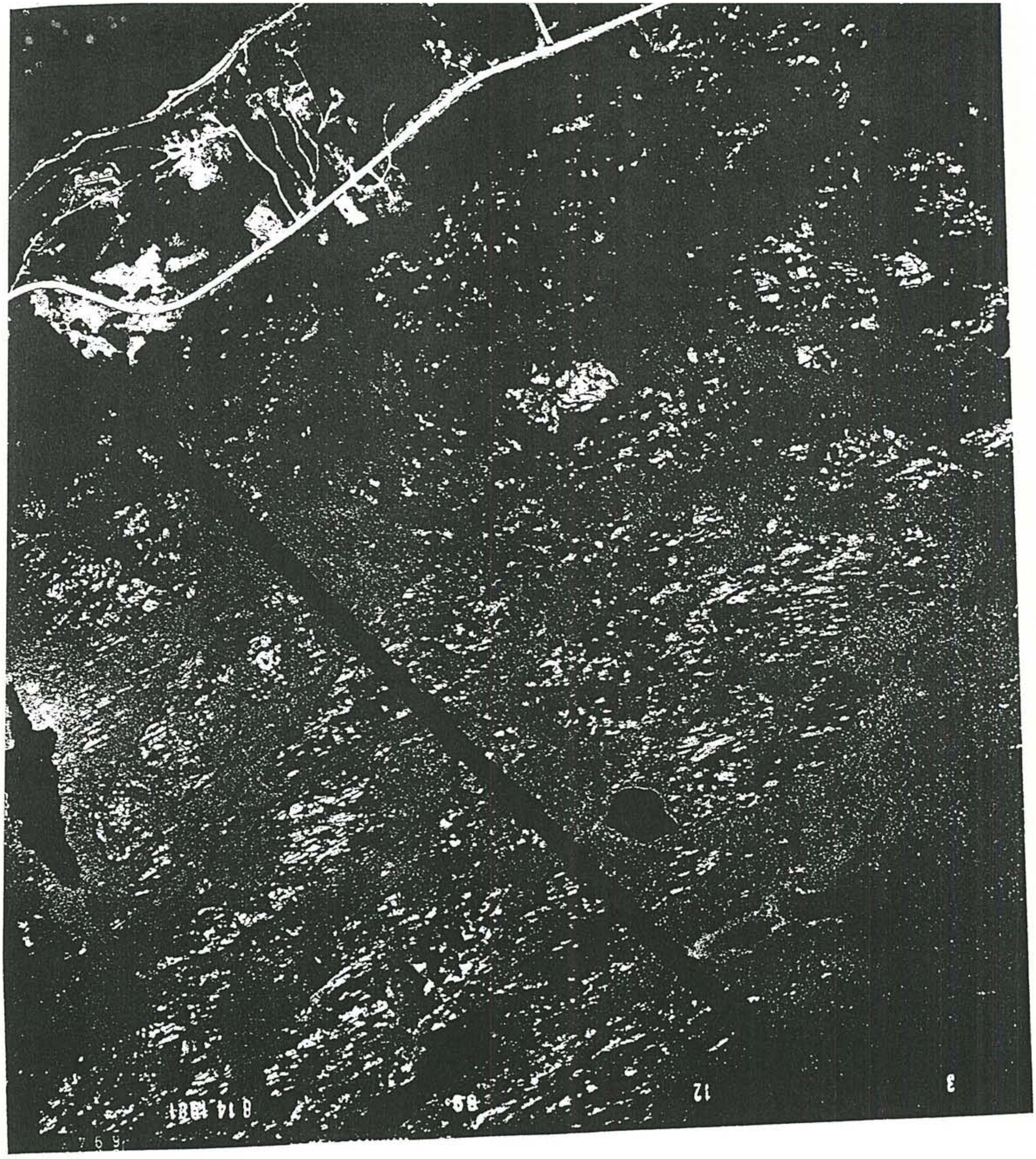

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IV. DISCUSSION

GEOLOGY/GEOMORPHOLOGY:

The study area is underlined by Devonian muscovite-biotite granite. The evolution of the area's landscape goes back to the late Precambrian-Early Paleozoic era (<500 million years before present) when slate and quartzite bedrock was originally formed as deep deposits under water. Later these strata were uplifted to the surface and folded. During the Devonian period (between 350-400 million years ago) massive blocks of granite were thrust up underneath the slate and quartzite bedrock and in many cases intruded into these rocks along lines of weakness. However, the granites were still well below the surface of the land. Subsequent erosion of the landscape, especially during the last ice age--the Pleistocene (12,000-10,000 years ago)--has removed much of the slates and to a lesser extent, the quartzites, exposing the granite.

This landscape evolution has resulted in a typical exposed granite landscape, as observed within this study area--low, rounded hills and/or a ridge-swale complex, both as a rule less than 20 metres in elevation above the surrounding level terrain. The swales or depressions are generally shallow and broad compared to the ridges. The ridges within the study area have, for the most part, been denuded of soil and smoothed by glacial action. A significant number of the ridges, however, deviates somewhat from the typical "shapeless, low granite ridge"; rather they are quite elevated and precipitous.

Granite country is almost always assured to be littered with surface boulder--in many cases as large as houses. This study area is no exception--large to medium sized boulders are found in abundance over much of the area. There are some areas, however, that are, uncharacteristically, relatively free of boulders.

VEGETATION

The Williams Lake study area is overwhelmingly dominated by barren/semi-barren ecosystems.

1. Barren

The barren is, for the most part, the typical ecosystem of the granitic ridges and bald knobs found throughout the area. These barrens are usually in an elevated situation and very dry and hot because of exposure to sun and wind. The ridges, for the most part, have a NNW-SSE orientation with a gently sloping east side (15 degrees) and a more steeply sloping (55 degrees) to precipitous west side. The actual ridges are bare of vascular vegetation with the exception of small depressions and crevasses/joints in the bedrock. Here, growing on very coarse, quartz sands, one finds a plant community of black crowberry (*Empetrum nigrum*), broom crowberry (*Corema conradii*), a great variety of reindeer lichens (*Cladonia* spp.), three-finger cinquefoil (*Potentilla tridentata*), *Orthotrichum* or *Grimmia* moss species (?), blueberry (*Vaccinium angustifolium*), huckleberry (*Gaylussacia baccata*), and jack pine (*Pinus banksiana*) seedlings.

The actual bedrock is sparsely covered by crustose lichens, Umbilicaria spp., and Stereocaulon spp.

The swales between the barren bedrock ridges (but considered part of the barren as well) is usually 1-4 metres in width and covered with a regenerating complex of red maple (Acer rubrum), white and grey birch (Betula papyrifera and B. populifolia), large toothed aspen (Populus grandidentata), black spruce (Picea mariana), and jack pine. The shrub layer, 0.5-1 metre in height, consists of huckleberry, lambkill (Kalmia angustifolia) and blueberry with minor components of downy alder (Alnus crispa), chokeberry (Aronia spp.), witherod (Viburnum cassinoides), shadbush (Amelanchier spp.) and rhodora (Rhododenron canadense). Herbaceous species include bracken fern (Pteridium aquilinum) and bunchberry (Cornus canadensis).

It was observed in many situations, both on the barrens and in more advanced semi-barren (nearly a forest stand), that the jack pine had a strong affinity to the interface between the barren bedrock outcropping and vegetated swale where there was little competition from other tree species due to the very shallow, dry soil. As one proceeds further into the swale (dry to moist, deeper soils) a drastic decrease in the abundance of jack pine occurs due to intense competition from other xeric/mesic species.

2. Semi-barren

Basically, these ecosystems, having evolved form treeless barren, are gradually being colonized by "fire" tree species--jack pine, black spruce, red maple, white and grey birch, large-toothed aspen, and to a lesser extent, red oak (Quercus rubra). The shrub layer also succeeds from the huckleberry-dominated plant community of the barrens to the more, somewhat shade tolerant lambkill-blueberry plant community under an increasingly denser overstory tree canopy. As the canopy closes, more herbaceous species enter the ecosystem--wood fern (Dryopteris spinulosa), wood sorrel (Oxalis montana), twinflower (Linnaea borealis), wild-lily-of-the-valley (Maianthemum canadense), bunchberry, goldthread (Coptis trifolia), and snakeberry (Clintonia borealis) are the dominant species.

3. Coniferous Forests

Coniferous forests, consisting of admixtures of black spruce and jack pine (with minor components of deciduous species), occupy much of the southern part of the study area. These forests are in varying stages of succession-from early successional pure jack pine and mixedwood forests to near-climax black spruce and black spruce-white pine forests. In the first two situations, black spruce and, to a lesser extent, white pine regenerate in gaps under the existing canopy and thus begin to move succession along towards a climax or steady stage situation. These coniferous forests are the result of fire.

The ground plant community of the coniferous forest is dominated by either a needle carpet or moss plant community. The moss community is dominated almost exclusively by the feather mosses--Pleurozium schreberi, Dicranum spp. and Hypnum cupressiforme--and the liverwort, Bazzania trilobata.

4. Jack Pine Bog

Vegetation unit 82 and, to a lesser extent, V.U.73, displayed a rather unusual situation--jack pine, growing in a poorly drained bog. A possible explanation for this occurrence is that a severe, deep-burning fire ravaged the bog during an extremely dry season and readily seeded in from adjacent jack pine areas before competition from other species could again control the site. During field reconnaissance, the bog was very damp and the ground was dominated by a thick carpet of peat or bog moss (Sphagnum spp.), as well as cinnamon fern (Osmunda cinnamomea) and sedges (Carex spp.). A variety of shrubs, two metres in height were competing with jack pine and black spruce. These shrubs included lambkill, Labrador-tea (Ledum groenlandicum), shadbush, sweet gale (Myrica gale), huckleberry, false holly (Nemopanthos mucronata), witherod, blueberry, chokeberry, and Canada holly (Ilex verticillata).

There is little mention in the literature of this variant jack pine ecosystem. Although the investigator has observed various pines in dry raised bogs, jack pine growing in a wet bog situation is a first!

5. Other Ecosystems

Several other scattered, smaller forested ecosystems are present in the study area but time did not permit field investigation. The aerial photo-interpretation suggests that these areas are not unique or rare.

V. OBSERVATIONS

The following observations, made during the field reconnaissance of the Williams Lake study area are general in nature and would require further in-depth studies to confirm their accuracy and their significance with respect to the ecology of the barrens and jack pine forest ecosystem.

(1) The variety and abundance of non-vascular plants, ie. crustose lichens and fruticose lichens such as Cladonia, Cladina, Stereocaulon spp. on the barren bedrock ridges.

(2) The apparent dominance of huckleberry over other ericaceous shrubs in jack pine barrens and jack pine-dominated semi-barrens--either a function of a special ecological connection between the two or huckleberry is more of an "intensive fire species" than other ericads.

(3) The environmental gradient between barren ridges and adjacent swales and the presence and spatial distribution of jack pine.

VI. RECOMMENDATIONS

There seems to be sufficient reason for some form of protection for the entire Williams Lake study area--the rareity of the jack pine ecosystem in the province and genetic differences among jack pine populations.

Jack pine occurs as natural forest stands in Nova Scotia--both as pure and mixed stands. In a mixed stand, it associates readily with black and white spruce, balsam fir, and a variety of intolerant hardwoods, most notably red maple, white and grey birch and the aspens. In Nova Scotia, jack pine represent only 0.3% of the forest landscape (Bailey and Wellings, 1980) and 0.2% of the gross merchantable softwood volume in the province. The following table represents the area in hectares of forest species associations which contain at least 20% jack pine (Barteaux and Bailey, 1984).

	Forest Species Assoc.	Hectares	General Locality
1.	white pine, jack pine	1,085	Cumberland, Colchester
2.	spruce, jack pine	2,710	Halifax, Cumberland Colchester, Guysborough
3.	spruce, jack pine grey birch	1,310	Cumberland, Colchester
4.	jack pine	1,310	Victoria, Guysborough
5.	red pine, jack pine	3,280	Cumberland, Colchester
6.	spruce, balsam, fir jack pine	1,265	Guysborough
Total of total population forest land (3,772,000)		10,960	

There is great variability amongst jack pine populations, both in stem and crown form. This is due to marked genetic differences among provenances or geographic origins as a result of climatic adaptation. Growth, cold hardiness, and disease resistance is related to environmental gradients of photoperiodism and in the length and temperature of the growing season. The result of this phenomenon is that the genetic resources or genetic pools of jack pine found in different physiographic regions of the province may be significant. Research should be initiated to determine if there are genetic variation amongst the jack pine populations in the province. Personal observations suggest that the jack pine found along Atlantic coastal areas and those found on the clay plains of Cumberland County certainly inhabit different biogeoclimatic zones. If jack pine is to be part of future forest management schemes in the province, this alone should be enough to warrant the Williams Lake study area to be protected as a genetic pool source. As well, jack pine ecosystems may have particular flora/fauna (both macro- and micro-) associated with it. No research has been undertaken in this area in Nova Scotia.

VII APPENDIX 1 - Ecological Attributes of Jack Pine

Jack pine (*Pinus banksiana* Lamb.) is a two-needled hard pine in a subgenus *Pinus*, section *Pinus*, and subsection *contortae*.

Throughout its natural range (with a concentration in north-central Canada) jack pine is considered to be a short-lived, shade intolerant, pioneer species that almost always grows in even-aged stands. This is due mainly to its development after fire, which kills herbaceous, shrub and tree competition while at the same time preparing a suitable seedbed and opening the serotinous cones of jack pine. Fire exposes natural soil and eliminates lateral and overtopping competition for the jack pine seedling.

Jack pine cones are serotinous; that is, the seed cones remain closed on the tree indefinitely until the heat of a fire melts the binding resin and their opening and dispersal of seeds. The melting point of the resin in jack pine cones is about 50 degrees celsius (Moore, 1984). Only rarely will a jack pine cone shed its seeds without the aid of fire.

Germination and establishment of jack pine can occur on a variety of seedbeds, from organic wetlands to clay loam soils. Optimum sites for jack pine, however, are acidic, coarse-textured, dry to very dry surficial deposits--areas on which most other tree species find difficulty in establishing themselves. These optimal or favourable sites include, in particular, areas of shallow soil over bedrock, rock outcrops and bald rock ridges.

Jack pines also respond well in admixtures with other "fire species", particularly black spruce, red maple, white birch, grey birch, and the aspens.

The life-span of jack pine is approximately 80-100 years, depending on site conditions and geographical location, at which time, jack pine stands tend to open up and deteriorate due to individual deaths caused by blowdown, excessive rot, and/or diseases and pests.

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