

Rory Eckenswiller

White Oak (*Quercus alba*) Dispersal Within “The Land Between” Central, Ontario

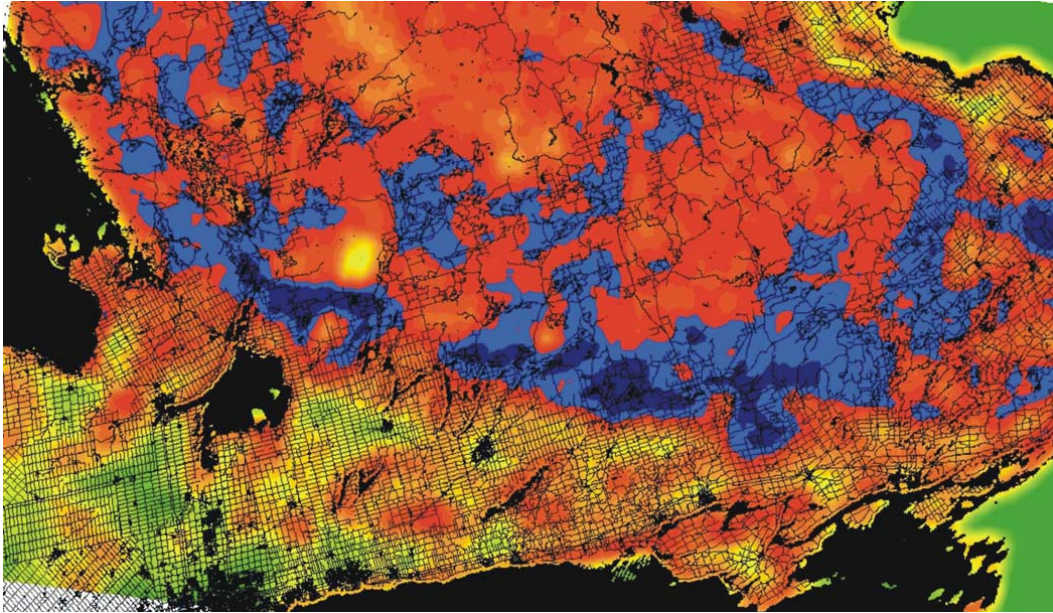
Prepared for:  
Prof. Colin Taylor (Trent University – GEO 440)  
Leora Bermann (TLB)  
Barb Woolner (T.C.C.B.E)  
Monday, April 14, 2008

## **Introduction**

“There is no other ecotone in Ontario with so many varieties of physiography in its mosaic, packed into such a narrow band.” (Alley et.al., 2005)

The Land Between (TLB) is one of Ontario’s most unique landscapes. In this area of Central Ontario, the granite rock of the Canadian Shield meets the limestone rock of the St. Lawrence Lowlands. This area is unique as it is a transition zone, or what ecologists call an ecotone which has highly mixed patterns due to an overlap of representative elements from ecosystems at each extent. Whereas traditional ecoregions are classified based on uniformity of the characteristics found within the identified area (Alley et.al., 2005). Although an exact boundary of TLB ecotone has yet to be finally determined due to the need for more research, preliminary analysis of its transitional nature (changes in elevation, climate, densities of roads, wetlands and water pockets, the density and interspersions of habitat types, and the range overlaps of many species) indicates that it encompasses an area which spans from Georgian Bay in the west, to the Frontenac Access (Kingston and Perth) in the east, and the Algonquin Dome to the north and the Oak Ridges Moraine to the south (see full descriptions in sections below and Figure 1 and 2).

The Land Between is characterized by granite and limestone outcrops/barrens, connected and high densities of aquatic pockets and a constant and repeating pattern of habitats from high to low and wet to dry.



(Alley et.al., 2005)

Figure 1. Areas of greatest vegetation community interspersions in south-eastern Ontario using the Simpson's Index (dark blue corresponds to areas of greatest density-change in vegetation communities at a 25kmx24km grid)



(Alley et.al., 2005)

Figure 2. Elevation change and boundary of The Land Between

White oak (*Quercus alba*) is quite abundant throughout the eastern United States but diminishes in distribution throughout much of southern Ontario (Little, 1971). White oak is historically known to be present within TLB, however, little is known about its present distribution within TLB and the exact edge of its northern range limit. The presence of white oak within TLB is unique because white oak is a species known to grow on deep soils of varied type, however TLB is characterized by the prevalence of barrens and so has very shallow soils (generally <15cm) or bare bedrock, making growing conditions sub-optimal (Farrar, 1995). Due to the white oaks range being terminated in TLB, and that other white oak populations are not found for many kilometres to the south, it is thought that the population within TLB may have unique characteristics due to the possibility that it may be a totally disjunct population from those to the south and may therefore have distinct genetics, distribution vectors and evolution.

The objectives of this project, which were outlined by the KHC, are as follows;

- Where are white oaks found in TLB?
- Is there a pattern to the distribution of the white oak population?
- Is the population distinct or disjunct from populations further south?
- What are the majorities or dominant species associated with white oak in areas of white oak presence within TLB?
- What are possible vectors to the evolution and occurrence of white oak populations in TLB?

The objectives of this project will be met through understanding background literature of TLB and white oaks. As well, personal interviews of people involved in projects within TLB and those who have had experience with the flora of the area will be conducted in order to determine present locations of white oak within TLB. Mapping of TLB and white oaks will be done through the use of ARCGIS.

There are many stakeholder involved in this project. The host organization is the Kawartha Heritage Conservancy (KHC), and the project manager is Leora Berman. The Kawartha Heritage Conservancy is a regionally based land trust and charity dedicated to conserving the natural and cultural heritage of the Kawartha Lakes (KHC, 2008). The

Trent Centre for Community Based Education is also a stakeholder in the project and was responsible for facilitating the work between the KHC and myself. Professor Colin Taylor of Trent University was also part of the project and supervised the work being completed.

### **Study Area - The Land Between**

The Land Between covers a large geographic region in central Ontario. It is located between Kingston and Perth to the east, Gravenhurst to the west, Peterborough to the south and Bancroft to the north (see figures 2).

TLB is rich in cultural heritage, portions of First Nations traditional travel corridors and fisheries, abandoned European villages, battlefields, cedar rail fences, cemeteries, and roads and trails can be found within in the area (TLB, 2008). TLB was first used as an east-west travel corridor by the First Nations who traversed the lands and waters, especially through what is now known as the Trent-Severn Waterway (TLB, 2008). The First Nations also used the land for hunting wildlife and created an economy for fish from the plentiful lakes and rivers in the area (TLB, 2008). There was a brief settlement of Europeans in the area who cleared land for agriculture, mining and lumber production; however their settlement didn't last long as the area proved mostly unproductive for these resources (TLB, 2008).

TLB is sparsely populated with most small towns located along its boundary. Most of the residents are seasonal cottagers with few being permanent residents. Those permanent residents within the area mostly rely on a nature-based tourism industry with the secondary economy being the provision of basic necessities (construction, distribution and public services) for those who inhabit the area. These businesses are the two main local economies (TLB, 2008). Statistics Canada reports that 50% of the permanent inhabitants of TLB are over the age of 50 (TLB, 2008). Other industries which second, tourism and recreation, include public services and construction (TLB, 2008).

The natural heritage of TLB is quite unique as it is a complex but irregular shape of land which encompasses elements from the Canadian Shield and St. Lawrence Lowlands, yet has features that are entirely unique to the region. It is characterized by exposed granite rock on the northern side, and "stepping stones" of limestone plains

along the southern side (TLB, 2008). Intertwined between the rock outcrops are many wetlands, lakes and rivers.

TLB ecotone is produced by the transitions of physical characteristics which include physical structure and formation, change in elevation, climate and plant hardiness, habitat interspersion and species interactions (TLB, 2008).

The physical structure and formation of TLB is characterized by three transition of four areas of surficial geology (Alley et.al., 2005). The northern section of TLB is characterized by mineral tills, with granite barrens, limestone plains and glacial tills present in a north to south direction (see figure 3 and 4) (Alley et.al., 2005).

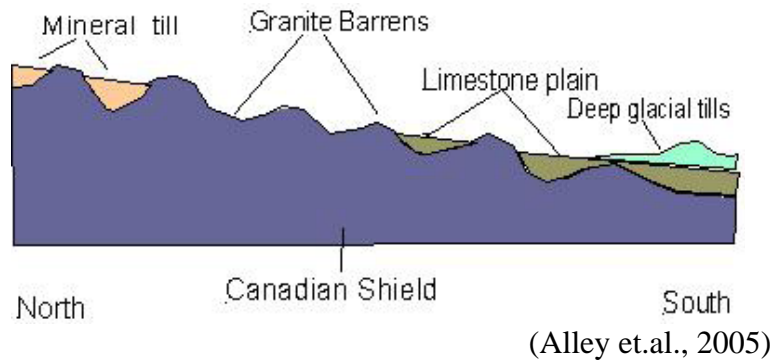
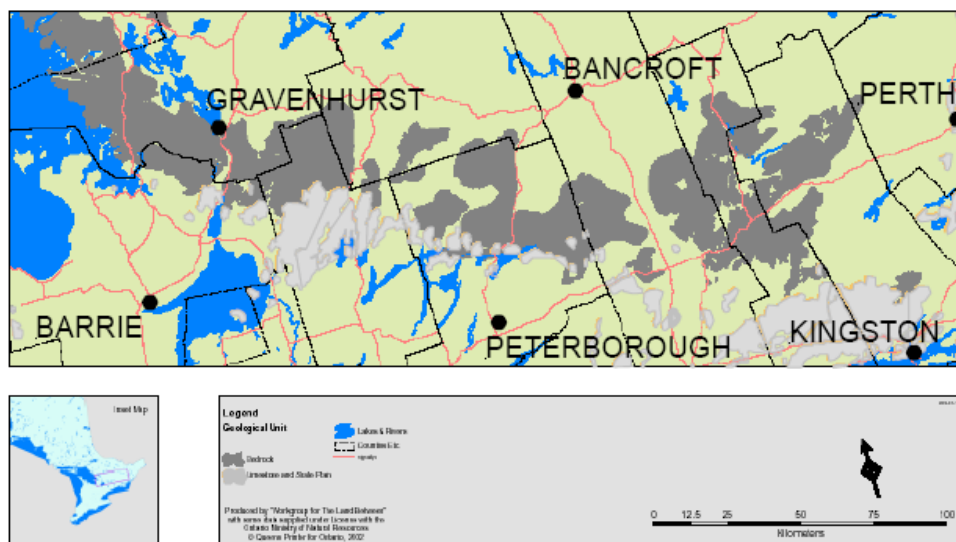


Figure 3. Cross section of the surficial geology of The Land Between



**Granite barrens (dark gray) and limestone plains (light gray).**

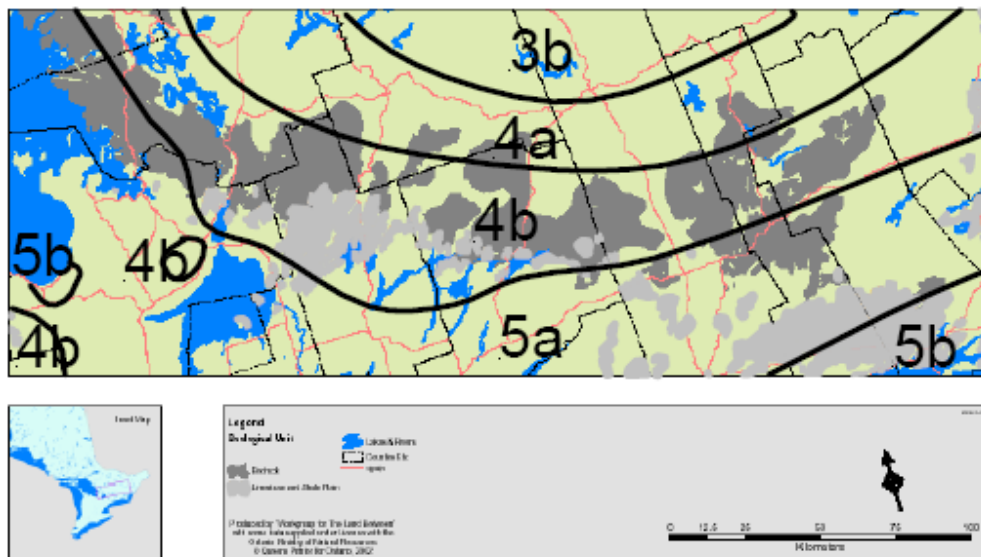
(Alley et.al., 2005)

Figure 4. Granite barrens and limestone plains found within The Land Between

The different chemical characteristics of the surficial geology creates either acidic or basic soil and water properties (Alley et.al., 2005). The granite barrens produce acidic water and soils (where present, tend to be <15 cm deep), and the marble of the Canadian shield, mineral till, limestone plains and glacial tills produce basic water and soils (Alley et.al., 2005). The Land Between is a meeting point for these waters. What effect this has on vegetation has not been investigated, however it is known that white oak prefers calcareous soils/alkaline conditions.

There is a very broad change in elevation from the northern end of TLB to the southern end of TLB which correspond with the transition from the Canadian Shield and Algonquin Dome (north) to the St. Lawrence Lowlands (south) (see figure 2 for elevation change) (Alley et.al., 2005). The pattern of transition is quite irregular as TLB is more rugged than the St. Lawrence Lowlands and not as regularly rugged as the Canadian Shield (Alley et.al., 2005).

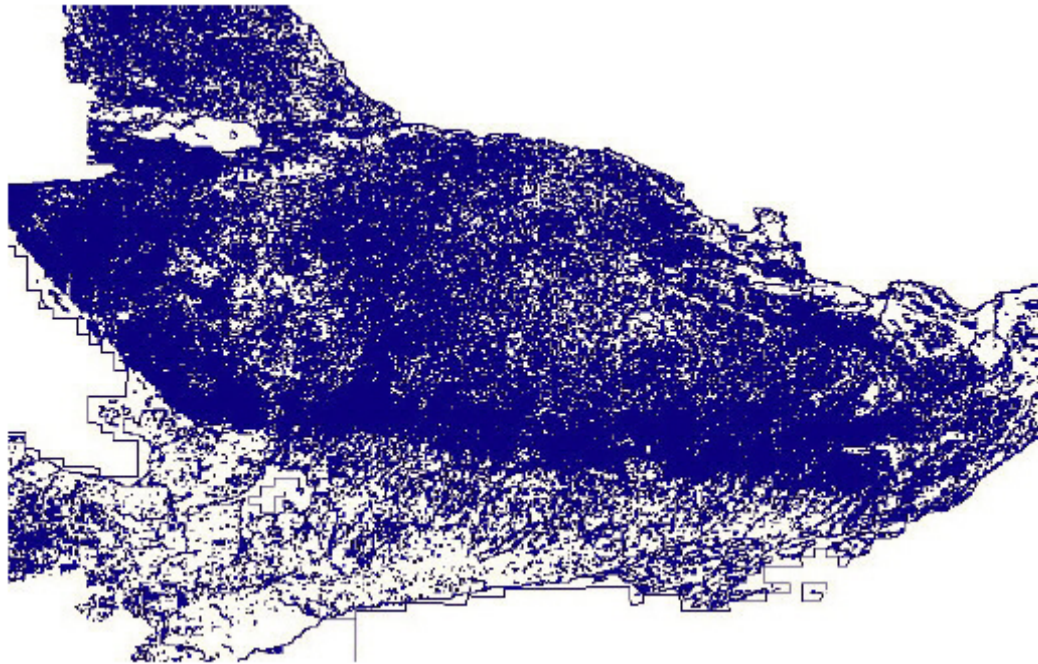
TLB encompasses three major plant hardiness and climatic regions. From north to south TLB includes zones 4a, 4b and 5a (see figure 5) (Alley et.al., 2005). Plant hardiness and climatic zones are determined by Agriculture and Agrifood Canada and reflect changes in overall temperature and precipitation values (Alley et.al., 2005).



(Alley et.al., 2005)

Figure 5. The Land Between zones of plant hardiness in relation to granite barrens and limestone plains

Another significant transition found within TLB which accentuates its natural uniqueness is its habitat interspersion and aquatic shoreline densities. TLB provides sources of water for Georgian Bay and Lake Ontario being near the “top” of the watershed in central Ontario (Alley et.al., 2005). TLB encompasses the highest density of water shorelines in the province of Ontario; this is portrayed in figure 6 with the blue displaying shoreline density (Berman, 2007).



(Berman, 2007)

Figure 6. Water shoreline density of south-eastern Ontario, source: Queens Printer for Ontario, Ministry of Natural Resources

The final element which makes TLB naturally unique is the species interactions within the boundary and transitions of species composition. TLB is an area where many species either reach their northern or southern distributions. As well there are many bird and herpetile species which are very strongly associated with TLB ecotone. These birds include; broad winged hawk, whippoorwill, golden winged warbler, great crested fly catcher, common night hawk, field sparrow, and yellow throated vireo (Bermnn, 2008). Herpetiles whose core ranges correlate with TLB are Blanding’s Turtle, Wood Turtle, Stinkpot, and Five lined skink. Mammals upon which their southern ranges terminate

within TLB include; grey wolf, black bear, marten, fisher, moose, and southern red-backed vole (Dobbyn, 1994). Many other taxa reach their northern limits of distribution including Chorus frogs, and specifically white oak trees.

### **Species of Study-White Oak**

The white oak reaches its northern distribution limit in southern Ontario and southern Quebec, yet it is characteristic of many broadleaved forest types (Brunton, 1997). White oaks may also be found in open, scrubby regenerated fields and few known white oak savannahs. Within Ontario there are two confirmed white oak savannahs, one is located in Longford Township, and the other has been identified in the Kingston area has recently been purchased by the Thousand Island Land Trust (Berman, 2008). Within the Ontario Crown Land Conservation Reserves, a white oak site with savannah type species and structure is noted to be found in the County of Lennox-Addington. In regions of southern Ontario and Quebec the white oak has been deemed provincially rare (Farrar, 1995).

The white oak is characterized by round lobbed leaves, with pale grey bark which often has a reddish cast and is scaly, and produces an acorn fruit which is broadly bowl shaped (see figures 7 and 8) (Farrar, 1995).



<http://www.umaine.edu/umext/mainetreeclub/FactSheets/WhiteOak.htm>

Figure 7. White oak leaf, acorn and twig



[http://www.donnan.com/images/White\\_Oak\\_fall.jpg](http://www.donnan.com/images/White_Oak_fall.jpg)

Figure 8. White oak tree in fall colours

The wood of the white oak is very hard and strong and often a light brown in colour (Farrar, 1995). White oaks are moderately shade tolerant, can grow in a variety of soil textures and depths, can grow up to 35m in height and 120 cm in diameter, and can live for hundreds of years (Farrar, 1995). Species associated with white oak vary from species such as white ash, sugar maple, basswood, Eastern white pine, Eastern hemlock, hickory, black cherry and other oaks (Farrar, 1995). It should be noted that white oak can often be misidentified with Burr Oak (*Quercus macrocarpa*) as both species are very similar and grow in similar conditions (Brunton, 1995).

Within TLB white oak species were found with flora and fauna of both closed canopy species as well as with savannah species. Data taken from field notes by Mike McMurty of the NHIC, displayed that white oaks within TLB grow with closed canopy species such as red maple, white birch, sugar maple and white pine, but also with savannah species such as *Poa compressa* (Canada Blue grass), *Panicum depauperation* (Poverty grass) and *Panicum acamination*. These observations display that there may have been historic white oak savannahs found on TLB that have now succeeded and grown over, however more data is required in order to make any concrete conclusions.

With the white oak in TLB being found on varying sites, with most being in what is understood as sub-optimal growing conditions, it makes one think that this population may have distinct characteristics than those found in the deep rich soils of southern Ontario. It is recommended to look at the genetic markings of this population versus those to the south.

### **Where are White Oaks found in “The Land Between”?**

Present white oak trees within TLB were determined from coordinates taken from years of field notes by Mike McMurty (Natural Areas Ecologist) and Don Southerland (Zoologist) of the Natural Heritage Information Centre (N.H.I.C.) in Peterborough, Ontario. Mike and Don are renowned botanists and ecologists in all of Ontario and have traversed much of the province including across TLB. Therefore this data composition may be the most current and comprehensive account for the eastern section of TLB. However data from private land sites and in remote areas would supplement and complete the set. Forest resource inventory (FRI) maps, at small scales with site specific accounts, could not be obtained to determine where historic or present stands of white oak may be located within TLB. As well it should be noted that an inventory of tree species in the western half of TLB is quite difficult due to the smaller amount of accessible sites (Crown Lands and Parks) compared to the eastern half. This could be detrimental to data collection as private land owners are weary of agency or government botanists on their property to look for white oak or the white oaks may have been harvested for their timber value.

Known and current white oaks within TLB have been mapped using the coordinates from (NHIC) field notes and others and can be seen in figure 9.

## The Land Between Limestone Plains and Granite Barrens With Present White Oak Sites

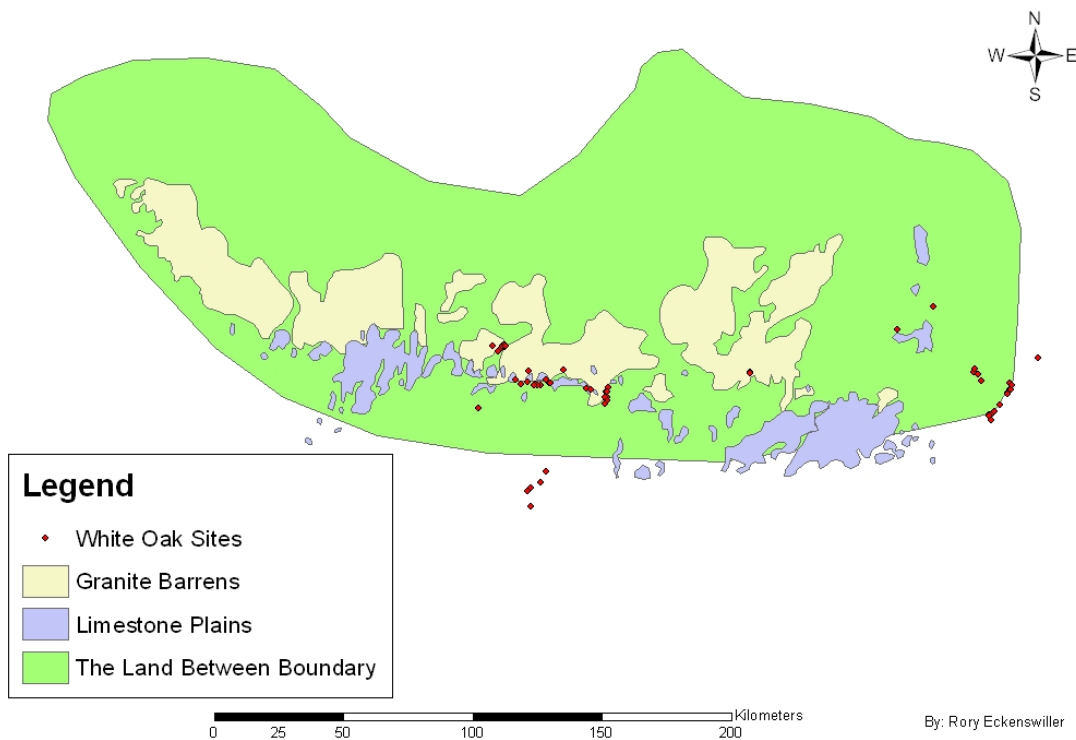


Figure 9. Present white oak sites and presence of granite barrens and limestone plains

From figure 9 it can be seen that populations of white oak do exist within TLB and those found in the centre of TLB are mainly found at the contact zone of limestone and granite outcrops, however are more accurately located on the limestone showing a preference for alkaline conditions. When compared to the other populations of white oak which occur on deeper soils just beyond TLB it appears that those meta-populations within TLB may be distinct from the population found a significant distance south of TLB and the population found in the eastern section of TLB and outside of TLB's boundary. It may also be possible that the eastern population may be more characteristically similar to the populations found in the Ottawa Valley and Southern Quebec as documented by Brunton in 1995.

This hypothesis is also supported by the quaternary geology of TLB. The population of white oak found in the central portion of TLB is found in limestone, dolostone, sandstone, shale, arkose, and sandstone geology of soil unit 51a. The eastern

population does not appear to be found on limestone based geology (parent material) but further investigation should be made in order to determine if this population grows on different parent material and has possibly has distinct characteristics. (See figure 10 for quaternary geology of TLB and white oak sites)

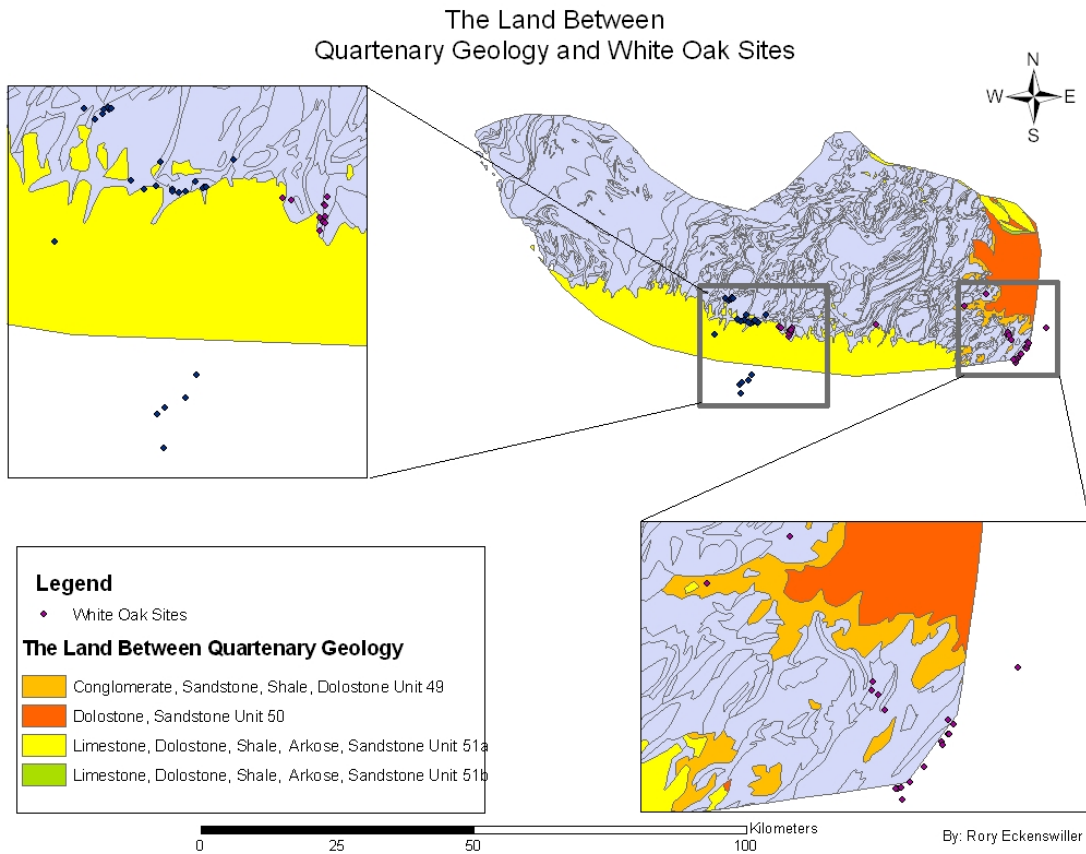


Figure 10. Present white oak sites and quaternary geology of The Land Between

White oak sites within TLB are characterized by limestone plains (when assessing the maps created) but some field notes from the NHIC comment on some white oaks being found on granite outcrops. The white oaks within TLB were found to be growing with various species within the overstory, understory, shrub, and herbaceous layers (McMurty, 2008). Field surveys of the present white oak site could not be completed due to the seasons the study was completed in, but would be an asset in determining possible reasons for the white oak distribution in TLB.

## Distribution and Evolution of White Oaks within “The Land Between”

White oak is found throughout much of eastern North America but its distribution range terminates within TLB and throughout much of southern Ontario and southern Quebec, again appearing as a disjunct population to the meta-populations below. The North American distribution of white oak, present white oak locations and TLB boundary can be seen in figure 11.

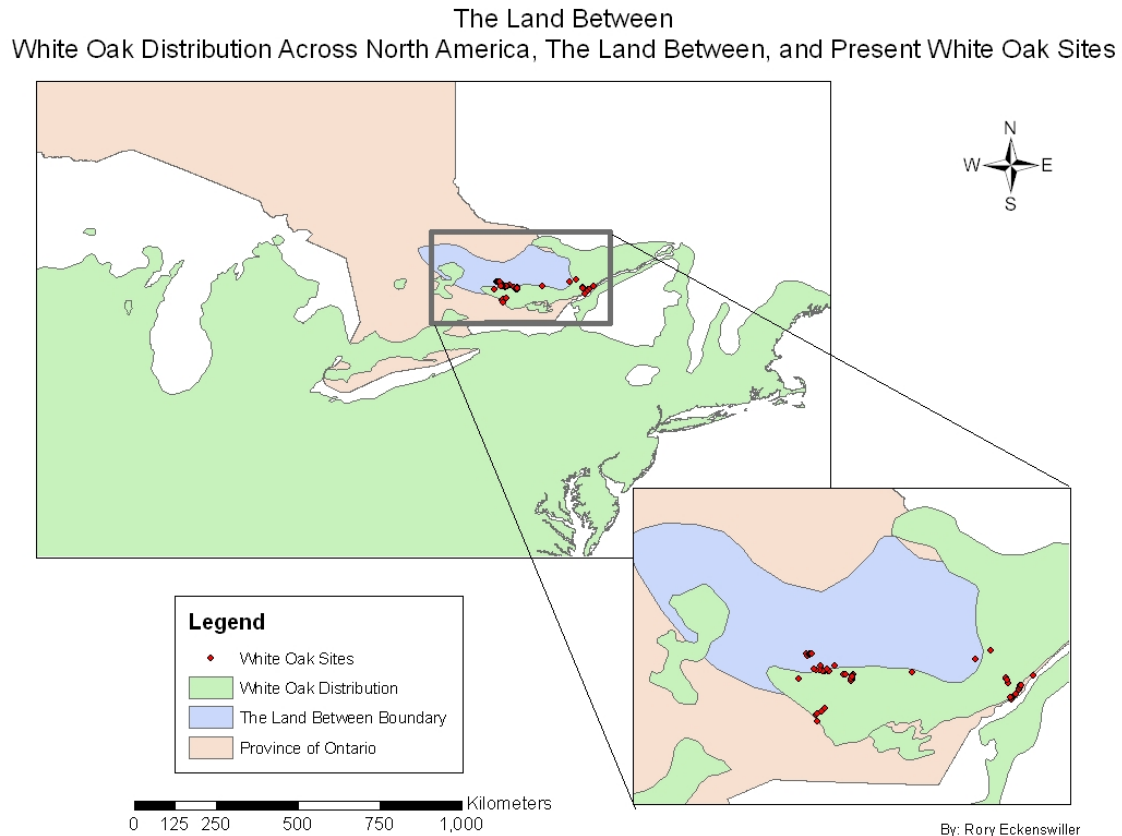


Figure 11. Present white oak sites, The Land Between boundary and course scale white oak distribution throughout North America (from Little, 1971)

It should be noted that present white oak sites within TLB were found to be beyond the course assessment of the white oaks northern distribution. Therefore this project has been able to refine the understanding of the white oaks distribution relative to the northernmost population polygons and support a more detailed level of analysis to discover the uniqueness of this small population.

How white oaks have been transported and grown in TLB has not been studied. One possibility for the white oaks existence in TLB may be due to species migration down the St. Lawrence River, then north up the Ottawa Valley and then distributed westerly inland to TLB (Brunton, 1995). Brunton states that these northern populations of white oak found at the edge of granite barrens may be “part of a relict community” which may have originated in the hypsothermal period several thousand years ago when the climate of Ontario was much warmer than it is today, and have remained isolated in small populations (Brunton, 1995).

Another possible hypothesis for white oaks being present within TLB may be that First Nations people who first inhabited TLB, and used the region as a key hunting grounds and may have planted the tree species in order to attract wildlife, such as deer and bear, who feed on the acorns produced by the white oak (Berman, 2008).

After completing a thorough literature analysis of white oak distribution very little information was found on how or why white oaks were distributed within TLB. One interesting discovery however was a possible reason for the lack of expanding populations do to poor distribution by rodents. Studies have shown that rodents such as eastern grey squirrels prefer to store intact acorns from red oak trees rather than acorns from white oak trees (Smallwood et. al., 2001). Rodents prefer to store the red oak acorns because they germinate later than the white oaks acorns and therefore are less perishable (Smallwood et. al., 2001). This study provides insight into why white oaks may not be expanding their ranges within TLB, as transportation of seeds to new locations is not as plentiful as other oak species and as Red Oak does not have the same level of restrictive habitat preferences.

### **Future Outlook For White Oak Regeneration**

Field research of white oak sites could not be completed to include in this report due to the study taking place over the winter season. Therefore species associations, soil chemistry and conditions, and regeneration of white oak at sites of white oaks within TLB and surrounding areas could not be studied in depth. Micro-habitat characteristics and assessments of white oak regeneration would complement this report nicely and may also provide insight into possible additional white oak locations or whether or not white

oaks in the region are regenerating, proliferating, expanding and why or whether climate change, loss of habitat or over harvest by wildlife is effecting white oak populations.

It is known that climate change is effecting white oaks as warmer springs have allowed for white oaks to be able to sprout their tender shoots earlier than usual, but flash freezes after the shoots have begun to grow has caused sever decline in white oak leaf production (Oak Ridge National Laboratory, 2008). A study by the Oak Ridge National Laboratory on a stand of white oaks in Tennessee concluded that “The Easter Freeze” of 2007 had severe growth effects on leaf re-growth of white oak in the following year (Oak Ridge National Laboratory, 2008). This was due to decreased carbon and nutrient uptake in the previous year because of the flash freeze (Oak Ridge National Laboratory, 2008). A lack of leaf growth could have further environmental impacts due to less carbon being extracted from the atmosphere and being returned as oxygen through photosynthesis (Oak Ridge National Laboratory, 2008). These flash freezes, or extreme cool temperatures, after white oaks grow shoots, could be mimicked in TLB as changing weather patterns affected by the Westerlies coming off of Georgian Bay and influenced by Lake Ontario are producing warmer temperatures with unseasonal freezes. This could have severe impacts on the white oak populations within TLB.

Another hypothesis on why white oak populations may be restricted or declining in TLB is competition. American Beech trees are in decline, and wildlife such as deer, and bear graze heavily on beech nuts. With a decline in beech trees wildlife may graze more heavily on white oak acorns and therefore decrease the chances of regeneration.

## **Conclusions**

The coarse analysis of the northern range of white oak, from digitized range maps produced by Little, 1971 seems to show the central Ontario portion as being separated. Furthermore, white oak distributions within TLB are quite localized and appearing to thrive in pockets where conditions have allowed these meta-populations to become accustomed and successful. It appears then that there is patterns to the distributions within TLB in that, from the data collected white oaks within TLB are at a larges distance from other white oak sites to the south, and appear on shallower soils. A more thorough collection of present white oak sites and site specific field research needs to be conducted,

including the investigation of FRI maps, Ecological Land Classification maps, Life Science Inventories of provincial lands, and other forestry data, in order to make any concluding statement of the pattern of white oak distribution within TLB and outside TLB. Therefore, although seemingly distinct, it could not be determined whether the white oaks of TLB differ in genetics, proliferation, and site requirements from populations to the south and east (Ottawa Valley). DNA analysis of white oaks within TLB could be compared to white oaks of the Ottawa Valley and southern Quebec, and Southern Ontario to determine if this population is disjunct.

Species associated with white oaks of TLB range from those of a closed canopy forest to those of savannah type habitats. The presence of savannah type species infers that these areas may have historically been white oak savannahs; however further field research and finding additional historical accounts are needed in order to determine the possible presence of historic white oak savannahs.

Although it is unclear of the evolution of white oak in TLB many hypothesis have been stated and brought to light. Population distribution and vectors to evolution and proliferation may be better assessed as further field research is conducted noting site conditions and overall distribution patterns. It may also be useful to see historic logging records from saw mills to determine whether white oak was prevalent in TLB and heavily harvested.

It can be concluded that the white oak present within TLB is at its northern limit in Ontario, and the populations here are found within habitats that differ dramatically to those in the south. Therefore, further research into their significance and uniqueness is warranted and important for their stewardship, management and preservation, as well as may prove a good parameter for monitoring effects of climate change in Ontario.

## References

Alley P., Porchuck B., and Berman L., 2005 The Land Between as an Ecotone accessed on April 1, 2008 from [http://www.thelandbetween.ca/downloads/the\\_land\\_between\\_as\\_an\\_ecotone.pdf](http://www.thelandbetween.ca/downloads/the_land_between_as_an_ecotone.pdf)

Brunton, D.F., 1997 Trail and Landscape: White Oak (*Quercus alba*) in Southeastern Ontario and the Ottawa District. Ottawa Field Naturalists Club vol. 31:3 pp85-140

Dobbyn J. (S), 1994 Atlas of the Mammals of Ontario. Federation of Ontario Naturalists Don Mills, Ontario, Canada

Farrar J.L., 1995 Trees In Canada Fitzhenry and Whiteside Limited and Canadian Forest Services U.S.A pp 256

Kawartha Heritage Conservancy, 2008 website accessed on April 1, 2008 from <http://www.kawarthaheritage.org/index.htm>

Little E.L. Jr., 1971 Atlas of United States Trees Volume 1: Conifers and Important Hardwoods. U.S. Department of Agriculture and Forest Services Washington D.C.

McMurty, M. Natural Areas Ecologist, Natural Heritage Information Centre Peterborough Ontario. Personal Interview February 2008

Oak Ridge National Laboratory, 2008 Killer freeze of `07 illustrates paradoxes of warming climate. United States Department of Energy- Oak Ridge Laboratory

Smallwood P.D., Steele M.A., Faeth S.H., 2001 The Ultimate Basis of the Caching Preferences of Rodents, and the Oak-Dispersal Syndrome: Tannins, Insects, and Seed Germination. *American Zoologist* vol. 41 pp 840-851

Southerland, D. Zoologist, Natural Heritage Information Centre - Peterborough Ontario. Personal Interview February 2008

The Land Between, 2008 Kawartha Heritage Conservancy and Couchiching Conservancy website accessed on April 1, 2008 from [www.thelandbetween.ca](http://www.thelandbetween.ca)

## **Acknowledgements**

A big thank-you to the following people as without their help this project would not have been possible. Thanks Again!

- Leora Berman (KAWARTHA HERITAGE CONSERVANCY)
- Barb Woolner (TCCBE)
- Mike McMurty (NHIC)
- Don Southerland (NHIC)
- Brian Curran (GIS HELP)
- Colin Taylor (TRENT UNIVERSITY)