PATTERNS OF GENETIC DIVERSITY IN EASTERN NORTH AMERICAN *BETULA* SPECIES AS INFLUENCED BY GLACIAL HISTORY

A. Thomson*, S. Dayanandan, and C.W. Dick
*PhD Candidate, Concordia University

Introduction

- Research interest: Plant evolution and patterns of genetic variation of forest trees
- Phylogeography: subdiscipline of biogeography (Avise 1998)
  - What are the geographic patterns of genetic variation within species???
  - How are patterns influenced by historic factors??
- Phylogeographic studies of temperate trees usually focus on impact of historic glaciations

Introduction

Source:http://www.awendapark.ca/?page_id=82

- LGM: large ice sheets over the northern hemisphere
- Species' ranges greatly reduced
- Small, isolated populations south of ice sheets
- Population bottlenecks and isolation

Introduction

- “Signature” of glacial events found in genetic markers
- Infer past distribution and post-glacial migration patterns
- How much migration has occurred?
- Migration capacity under climate change

Introduction

- Study will examine phylogeographic patterns of eastern North American *Betula* species
  - *B. alleghaniensis*, *B. lenta*, and *B. papyrifera*
  - Chloroplast and nuclear DNA markers
  - Influence of glacial history

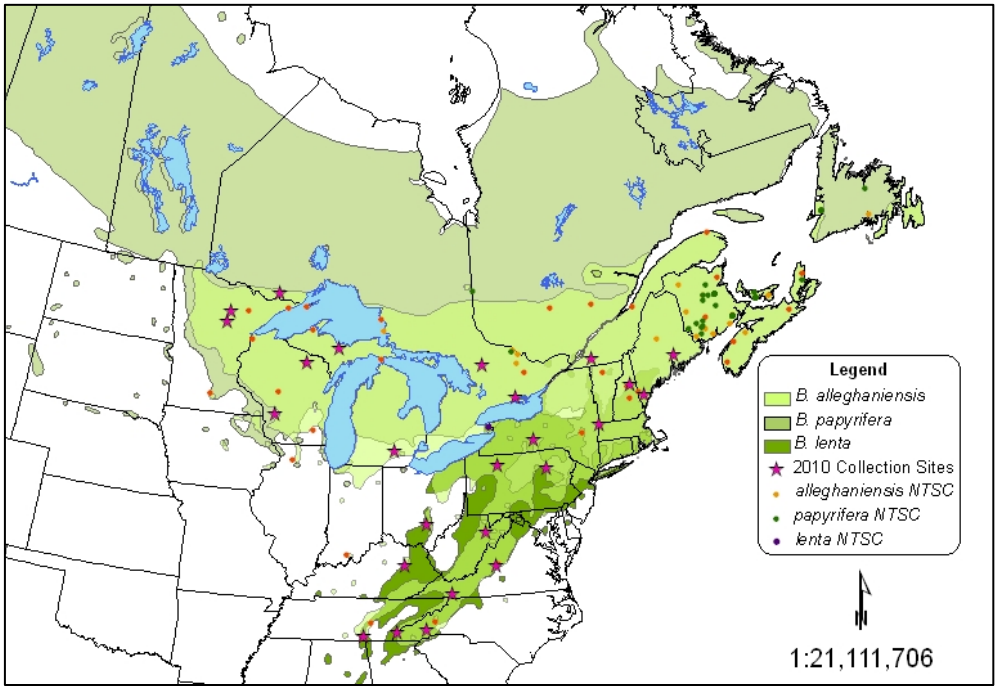
Introduction

Source:http://plants.usda.gov/java/largeImage?imageID=bepa_005_ahp.tif

- Why birch?
- Important species in Canada and the United States
- Little is known about their DNA diversity

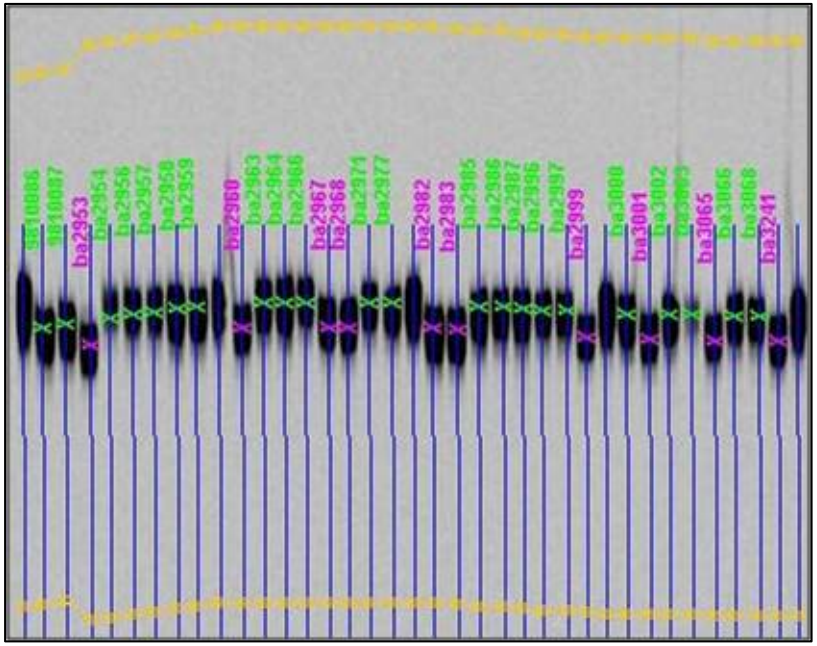
Methods: Population Sampling

- Leaf sampling from natural populations
- 30 individuals per species per site
- 2 or more species per site
- Single-tree sources from NTSC



Methods: Laboratory Procedures

- Cloroplast and nuclear DNA variation
- Chloroplast DNA microsatellites
- Genotyping based on allele-size variation

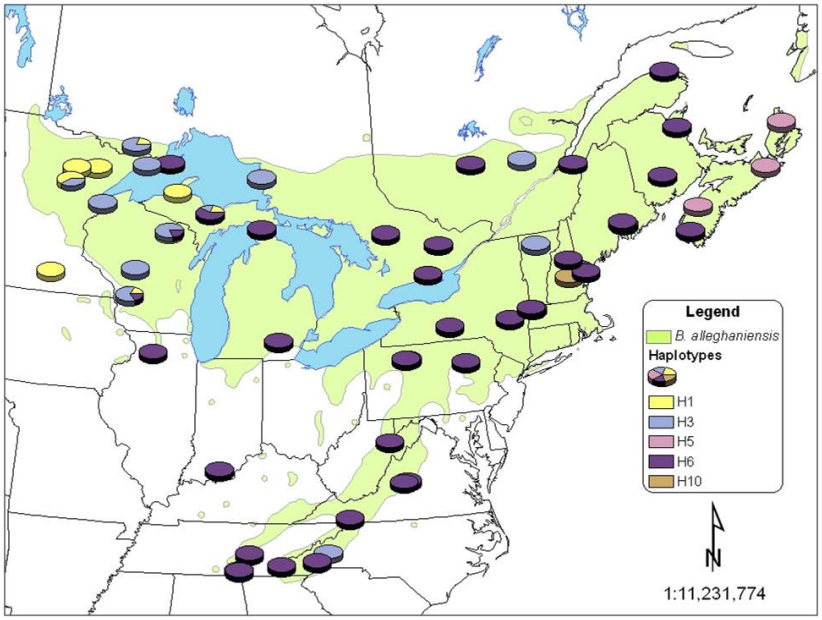


Results: Marker Variability

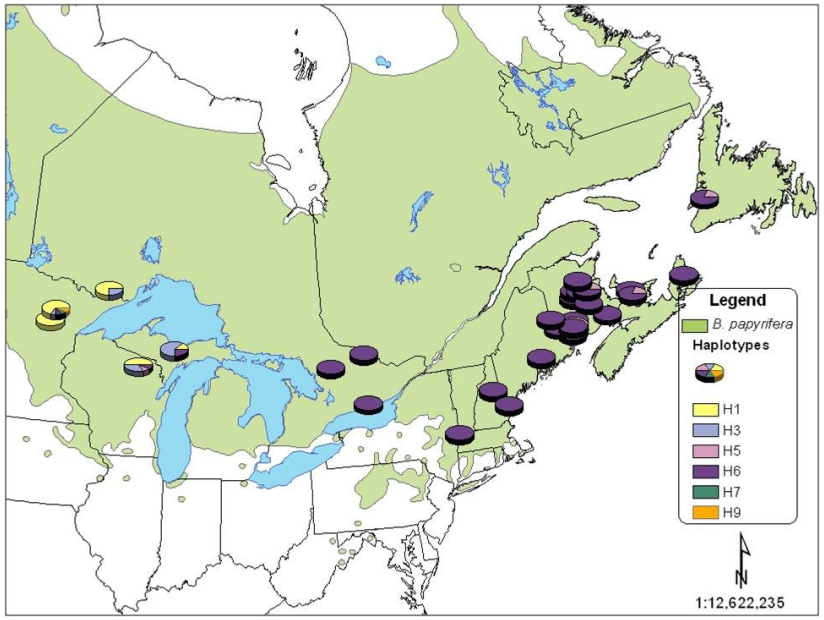
- 3 markers
  - low levels of diversity (2-5 alleles per locus)
- 10 distinct mutli-locus genotypes (haplotypes)
  - 4 common
  - 1 restricted
  - 5 rare (single-individual)

Results: Haplotype Distributions

B. alleghaniensis

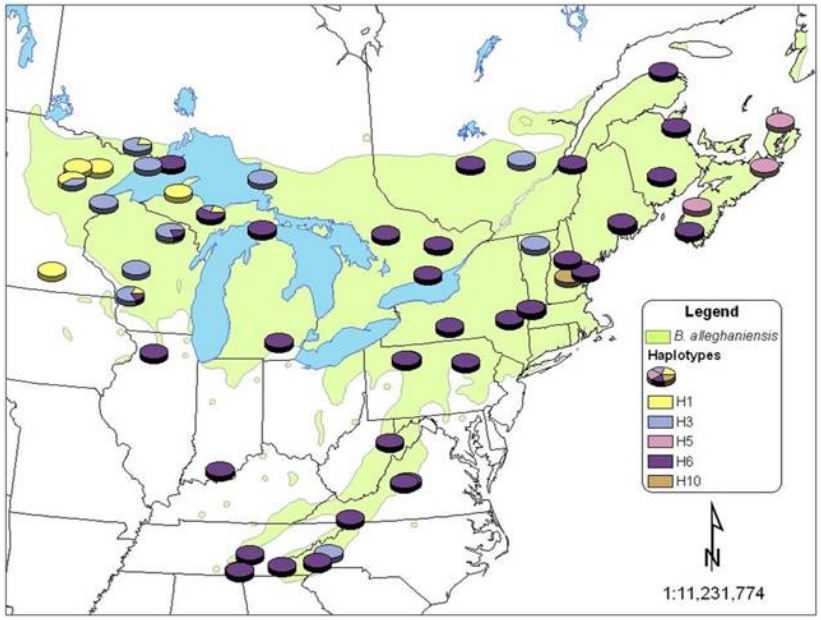


B. papyrifera

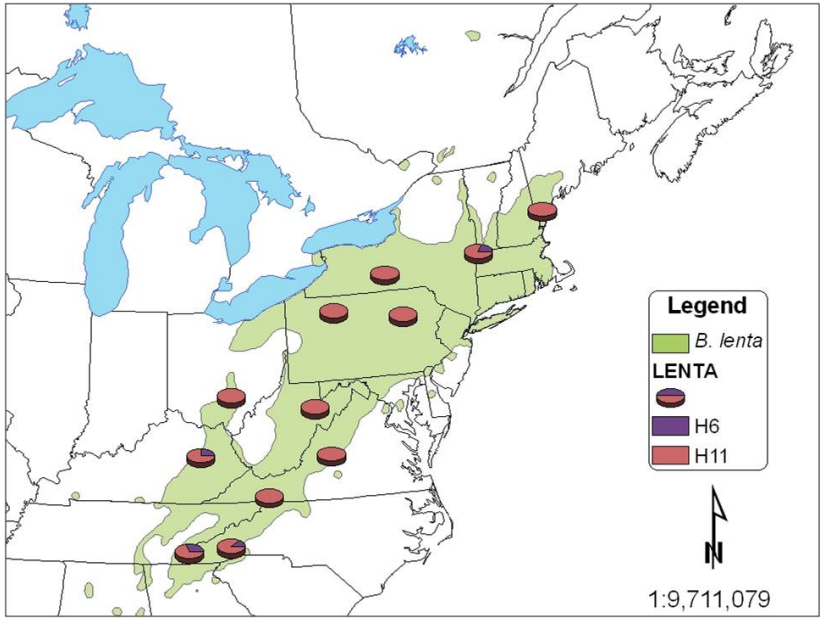


Results: Haplotype Distributions

B. alleghaniensis



B. lenta



Discussion: Glacial History

- *B. lenta* probably colonized from a single southern refugium
- Low diversity due to strong genetic bottlenecks and drift
- Majority of eastern range of *B. papyrifera* and *B. alleghaniensis* from same refugia

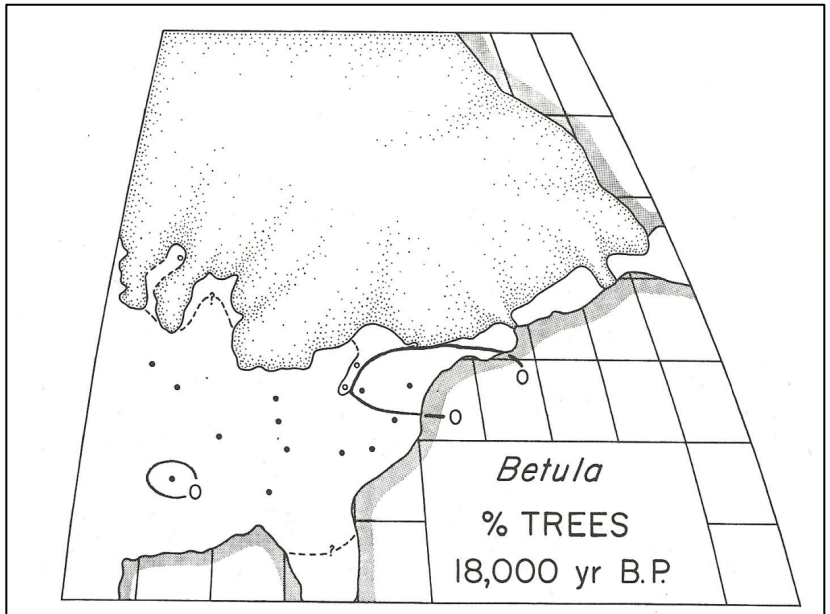
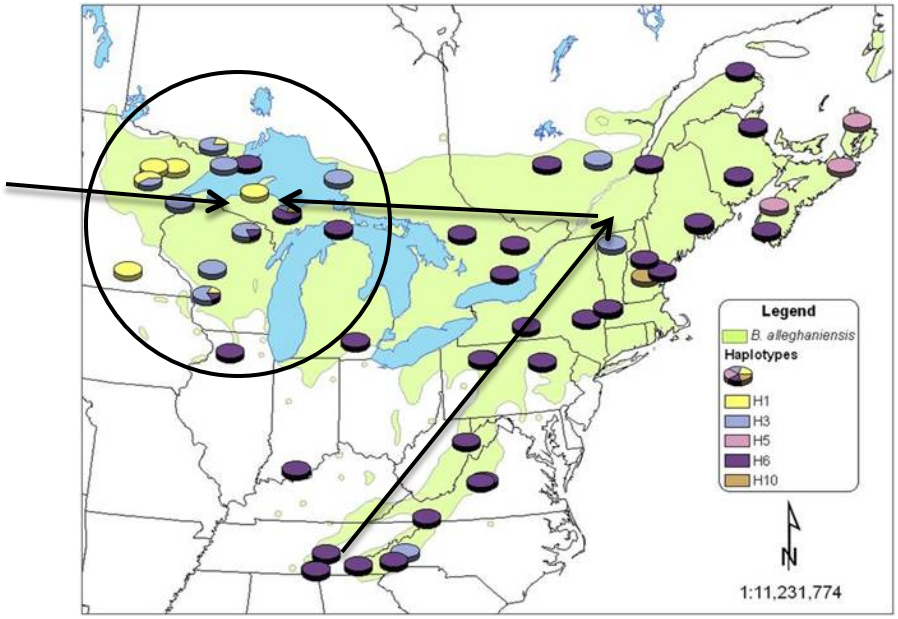


Figure 5.6. Birch (*Betula*). c. Paleo-dominance map for 18,000 yr B.P.

Source: Delcourt and Delcourt 1987

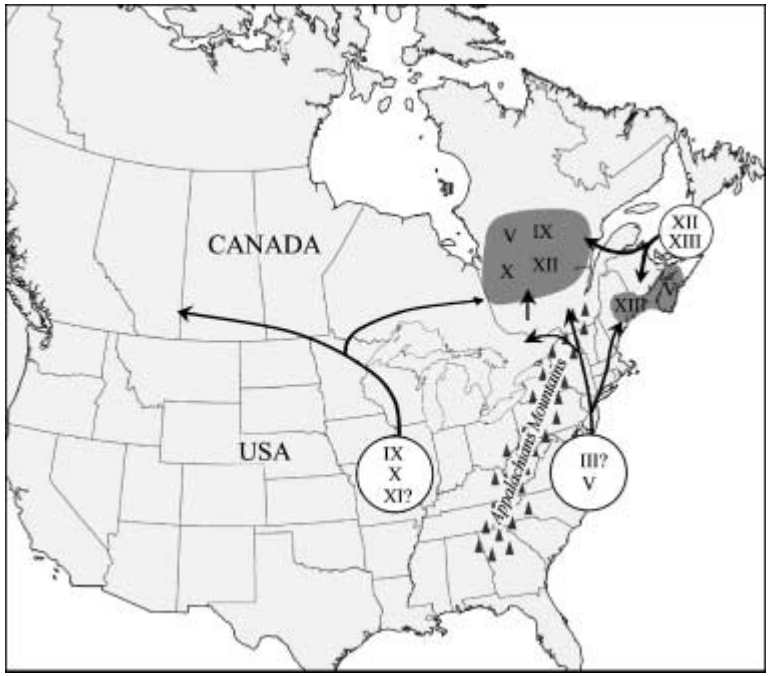
Discussion: Glacial History

- High haplotype diversity in western range (*B. papyrifera* and *B. alleghaniensis*)
- Possible secondary contact between glacial lineages?



Discussion: Glacial History

- Unique haplotype (H5) in Atlantic Canada
  - *B. papyrifera* and *B. alleghaniensis*
- Eastern coastal jack pine and black spruce also genetically distinct (Godbout et al. 2005; Jaramillo-Correa et al. 2004
- Authors suggest an eastern coastal refugium



Source: Goudbout et al. 2005

Discussion: Haplotype Sharing

- *B. papyrifera* & *B. alleghaniensis* share haplotypes in areas of sympatry
- Suggests a history of hybridization and introgression
- Hybridize naturally
- Widespread haplotype sharing also shown for European *Betula* spp. (Maliouchenko et al. 2007)

Discussion: Haplotype Sharing

- *B. lenta* largely generally does not share haplotypes with other species
- Suggests that *B. lenta* has remained largely separated from other species
- Surprising given that *B. lenta* is considered to be one of the parental species of allopolyploid *B. alleghaniensis*

Discussion: Future Direction

- Genotyping additional chloroplast markers
- Examining patterns of nuclear microsatellite variability
- Greater resolution for exploration of geographic structure, introgression, and genetic relationships among species

Acknowledgements

- Dr. S. Dayanandan (Concordia U.)
- Dr. C.W. Dick (U. of Michigan)
- National Tree Seed Center (CFS)
- US Forest Service
- NSERC
- QCBS
- FQRNT

QUESTIONS???