NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Envirothon New Brunswick

Forestry Workshop

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Your Best Resources:

Forestry Study Guide

Covid webinars

Envirothon NB website

Envirothon NB

Study Guide
Forestry

Things we will cover today

- Tree Identification
- Forest Ecology
- Forest Management / Silviculture
- Forest Measurements (continued)
- Forest Health / Climate Change

TREES OF THE ACADIAN FOREST

Identification CD

NOVA SCOTIA

White spruce (*Picea glauca*)

Other common name(s): Cat spruce, pasture spruce, skunk spruce

Life expectancy: 100 to 200 years

Mature height: 18 to 24 metres

Mature stem diameter: 30 to 60 cm at DBH

Shade tolerance: Intermediate

Timber value(s): Pulpwood, lumber, boxes and crates, general construction.

Wildlife value(s): Provides habitat for moose, snowshoe hare, red squirrel, spruce grouse, and many songbirds.

Indigenous uses: Different parts of the tree used for medicinal purposes. Resin used for patching holes and waterproofing seams in canoes, pails, and other water- resistant objects. Roots used for sewing or lashing many objects including baskets, canoes, snowshoes.

TREE-VIA: Black bears will peel away the bark of white spruce to get at the sweet sapwood. This often kills the tree. The common names cat spruce and skunk spruce come from the pungent odour of the needles when crushed White spruce is the provincial tree of the province of Manitoba.

Needles

- Needles are four cornered, 1 cm to 3 cm long
- Will roll easily between thumb and index finger
- Sharp pointed
- Blue-green in colour

Cones

- Cones 3-6 cm long
- Cone scales pliable when squeezed

Bark

- Thin, scaly, ash-brown to silver
- Inner bark streaked with rust-brown layer

Adapted from:
Nova Scotia
Trees of the Acadian Forest

Other common names

Life expectancy

Size (height, diameter)

Shade tolerance

Wildlife value

Indigenous uses

Aid to Identification

Canada

NB Softwood Trees Species (10)

Balsam fir

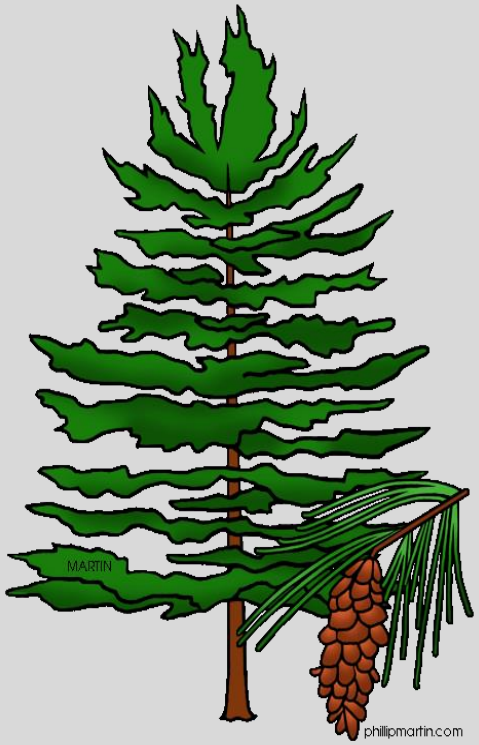
Eastern hemlock

Eastern white cedar

Tamarack (larch)

Pines (jack, red, and white)

Spruces (black, red, and white)



Softwood key for trees of Acadian Forest

NB Hardwood Trees Species (20)

Ashes (black, green, white)
Basswood
American beech
Birches (grey, white, yellow)
Butternut
White elm
Ironwood
Maples (red, silver, striped, sugar)
Oaks (bur, red)
Poplars (balsam, largetooth, trembling)

Hardwood key for trees of Acadian Forest

Tree Identification

Leaves / foliage

Simple leaf

Compound leaf

Tree Identification

Twigs

Buds opposite

Buds alternate

Tree Identification

Bark

Yellow birch

White birch

Balsam fir

Tree Identification

Fruits and cones

Dichotomous Key

A tool used in plant or animal identification.

Definition: A dichotomous key is a series of questions, and each question is a choice between two characteristics. The identity of the tree you are identifying is determined by choosing the characteristics that best apply.

Dichotomous keys for native softwood and hardwood species of the Acadian Forest are in the forestry study guide

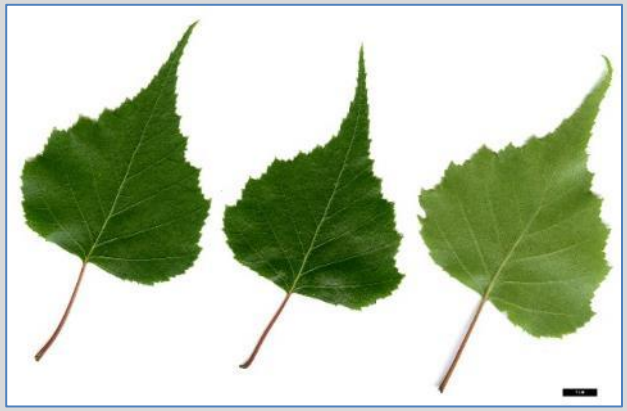
Dichotomous key

Leaf Key for Hardwood Trees of the Acadian Forest Region

1. Leaves opposite 2
2. Leaf simple 3
2. Leaf compound 6
3. Five distinct lobes, leaf edge wavy, leaf sinuses "u-shaped" ..... *Sugar maple*
3. Three to five lobes, leaf edge toothed 4
4. Underside of leaf not silvery, leaf edge double toothed ..... *Striped maple*
4. Underside of leaf silvery 5
5. Leaf sinuses deeply lobed and "u"-shaped *Silver maple*
5. Leaf sinuses notched "v-shaped" ..... *Red maple*
6. Leaf compound 7
7. 5-9 leaflets, leaflets stalked, egg-shaped to lance-shaped leaflets, leaf edge smooth or wavy ..... *White ash*
7. 7-11 leaflets, leaflets not stalked, finely and sharply toothed leaf edge ..... *Black ash*
7. 5-9 leaflets on a hairy central stalk, hairy underneath, leaf edge smooth towards base of leaf and toothed towards tip ..... *Green ash*

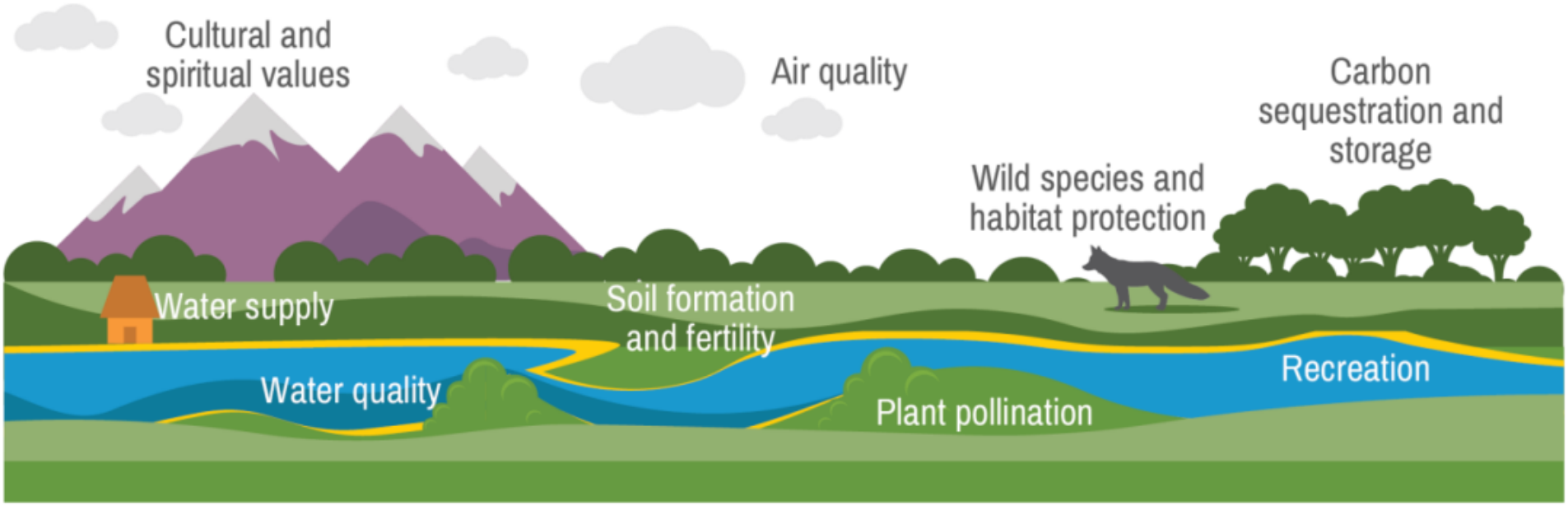
1. Leaves not opposite 8
8. Leaf compound, 11 to 17 finely toothed leaflets ..... *Butternut*
8. Leaf simple 9

Tree Identification Exercise



Forest Ecology

Our Forests Provide



Goods: Timber, food, fuel, bioproducts

Ecological functions: Carbon storage, nutrient cycling, clear air, clean water, wildlife habitat

Social and cultural: Recreation (hunting, fishing, hiking, et.) spirituality, traditional uses

Forest Succession

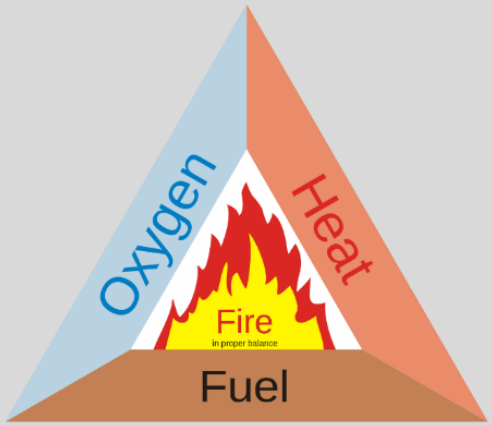
Late successional: stand	Species are usually long lived, tolerant to shade and can often sustain itself
Disturbance:	Fire, insects, floods, wind, other natural disasters, human
Early-successional:	Species well adapted to colonizing disturbed sites Shade intolerant, fast growing, generally shorter-lived
Mid-successional:	Gradual replacement of early successional species
Cycle repeats:	

Forest Fires

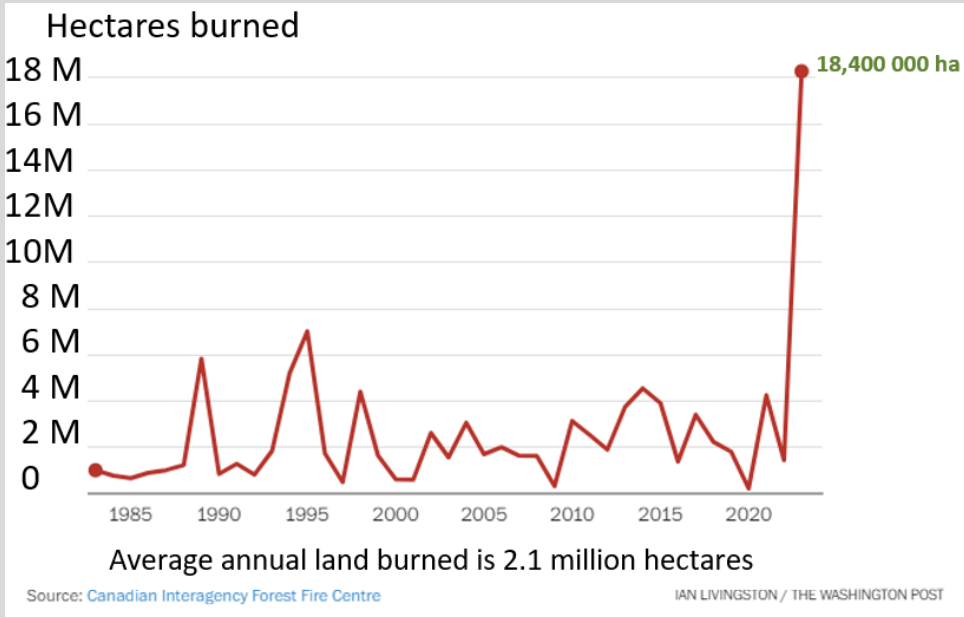
Natural part of forest ecosystem in many parts of Canada
Many ecosystems well adapted (boreal forest)

Since 1990, average of 2.6 million hectares in Canada

Fort McMurray (2016)	0.6 million hectares
British Columbia (2017)	1.2 million hectares
Miramichi Fire (1825)	1.6 million hectares
Canada (October 24, 2023)	**18.4 million hectares**



Fire Triangle



Forest Succession in the Boreal Forest

Boreal species

Trembling aspen
Balsam fir
Black spruce
White spruce
Tamarack
Jack pine
White birch
Balsam poplar

Natural Resources Canada

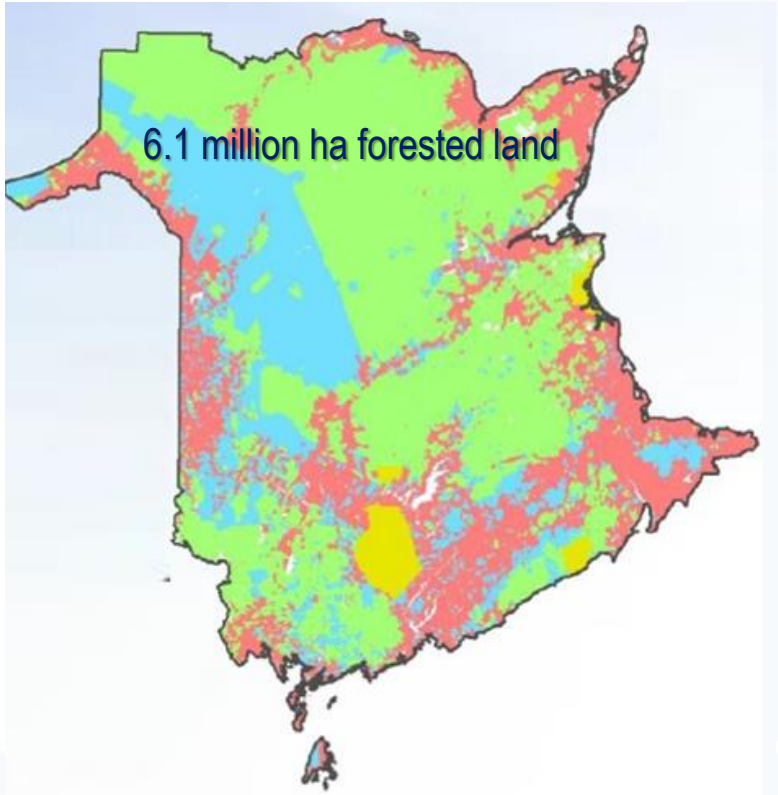
Forest Management

Forest Management / Silviculture

Forest NB video

https://www.youtube.com/watch?v=qMucZvbbzJI

Forestry in New Brunswick



Crown Land	50 %
Industrial freehold	18 %
Private woodlots	30 %
Federal	2 %

Forest Industry

	Canada	New Brunswick
Forested	347 M ha	6.1 M ha
Jobs	1 in 185	1 in 24
Economy	$ 34.8 billion	$1.4 billion
GDP	1.2%	3.6 %
Harvested	0.2%	1.3%
Insects	5.1%	0.0%
Fire	1.0%	0.007%
Third party certified	45.6%	70%

In some parts of northern New Brunswick, over half the jobs forestry related

Silviculture

The **art and science** of controlling the establishment, growth, composition, health, and quality of forest vegetation to meet owner objectives.

A silviculture system covers all management activities related to growing forests — planning, harvesting, replanting and tending the new forest.

Two main systems: **Even-aged management**
Uneven-aged management

Even-aged stands

Even-aged stand
(BC Ministry of Forests)

Trees in **even-aged** stands are of the same age or almost the same age. Natural even-aged forests occur after a major disturbance such as fire or insect epidemics such as spruce budworm. Even-aged stands typically have a well-developed canopy with a regular top at a uniform height.

Even-aged stand can develop from the following silvicultural systems:

- Clearcut
- Patch cut
- Seed tree cut
- Coppice
- Shelterwood cut

Clearcut

- Removal of all commercial trees (max. 100 ha, avg. 35 ha).
- Buffers along watercourses and to protect wildlife and species at risk are identified prior to harvest. Protection of natural regeneration (if present).

Patch cut

- Less than 1 hectare
- Removal of all merchantable trees
- Create edge habitat for wildlife species
- Buffers along watercourses and to protect wildlife and species at risk are identified prior to harvest. Protection of natural regeneration (if present).

Seed tree cut

In a seed tree system the entire cutting unit is managed as it is with clearcut systems. However, for a designated period, those trees selected for providing seed are not harvested. As seed trees are left to supply seed for the next crop, the best trees should be selected to encourage desirable genetic traits.

Coppice

The coppice system is an even-aged silvicultural system through which the main regeneration method is though vegetative propagation -- **suckers** from the existing root systems or **sprouts** from cut stumps. This system is limited to hardwood species management.

Trembling aspen suckers (roots)

White birch sprouts (stump)

Shelterwood cut

The objective of the shelterwood system is to open up the canopy in order to release pre-existing regeneration or to create favourable conditions for the establishment of new regeneration. Trees selected as leave-trees in shelterwood systems should be:

- larger, dominant trees
- windfirm trees
- desirable species (shade tolerant)
- desirable physical characteristics

Uneven-aged stands (selection management)

- Minimum of three distinct age classes
- Requires long-lived shade tolerant species
- Intervention every 15 to 20 years
- Regeneration in openings created by removal of large trees
- Maintains forest cover
- Wildlife habitat

Uneven-aged stands have at least three well-represented and well-defined age classes, differing in height, age, and diameter. Often these classes can be broadly defined as: regeneration (or regeneration and sapling), pole, and mature. (BC Ministry of Forests)


Uneven-aged management
sugar bush stand

Reforestation

All provincial and territorial lands that are harvested for commercial timber in Canada must be regenerated either naturally or by planting or seeding.

In New Brunswick, about one third of harvested areas on Crown land is planted.

Since 1976, New Brunswick has had a tree improvement program. Today, all seedlings planted in New Brunswick are produced from genetically improved seed.

White spruce and black spruce are most commonly planted species with Norway spruce, red spruce, jack pine, and white pine also planted but in lesser quantities.

Hardwood species are not planted for reforestation (deer and moose browsing)

Pre-commercial thinning

- **Precommercial thinning (spacing)**
  - Trees are young – no commercial value
  - Objective is to ensure good forest composition by improving growth of selected trees

Commercial thinning

- Trees are generally older but have not yet reached maturity.
- Products are usually pulpwood and firewood. Older commercial thinnings will produce some sawlog material.
- Objectives are to ensure a good forest composition, and improve the quality and growth of residual trees.

Silvicultural Characteristics of Trees

Why is this important?
Here are some characteristics to consider

- Shade tolerance
- Longevity
- Rooting characteristics
- Frequency of seed production
- Insect and disease resistance
- Growth rate

- Tree form / wood quality

Shade tolerance

Intolerant to shade

- Require direct sunlight for vigorous growth. They are often pioneer species that colonize a site after disturbance.
- Many boreal species shade intolerant
- Examples: trembling aspen, white birch, tamarack, jack pine

http://www.sfmn.ales.ualberta.ca/SFMN-fr/Publications/~/media/sfmn/ReseauGestionDurable/Research/Documents/RN_Fr35_CompetitionLumiere.ashx

Intermediate shade tolerance

- These species grow well under partial shade.
- Examples: red oak, white pine, yellow birch

https://fr.wikipedia.org/wiki/R%C3%A9g%C3%A9n%C3%A9ration_naturelle

Shade tolerant

- These species are capable of establishment and growth under dense shade.
- Examples: beech, sugar maple, balsam fir, red spruce, hemlock, cedar

Sample questions

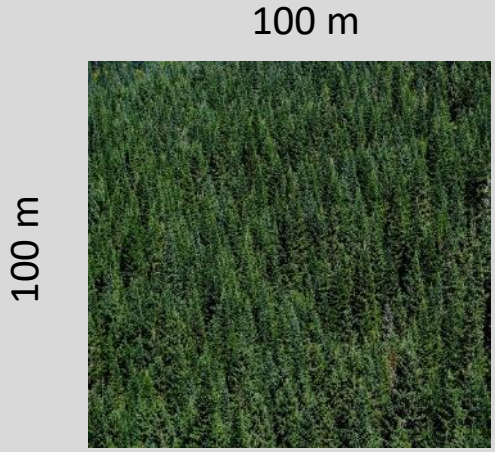
- Name two species that are tolerant to shade and two that are intolerant to shade and give an example showing why knowing shade tolerance of trees is important.
- Name three silvicultural systems that will result in an even-aged forest.
- Name four silvicultural characteristics you should consider when deciding on how to manage a forest stand.

Forest Measurements

- General Information
- Air Photos
- Tree Measurements
  - Age
  - Diameter
  - Height
- Stand Measurements
  - Density
  - Basal Area
- Handouts: Sample questions

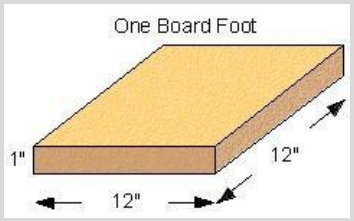
Some important facts to remember

1 hectare = 100 m x 100 m (10,000 m^2)



Lumber is measured in board feet (fbm) – foot board measure

1 board foot = 144 in^3



1 cubic metre = 1mx1mx1m

Air photos

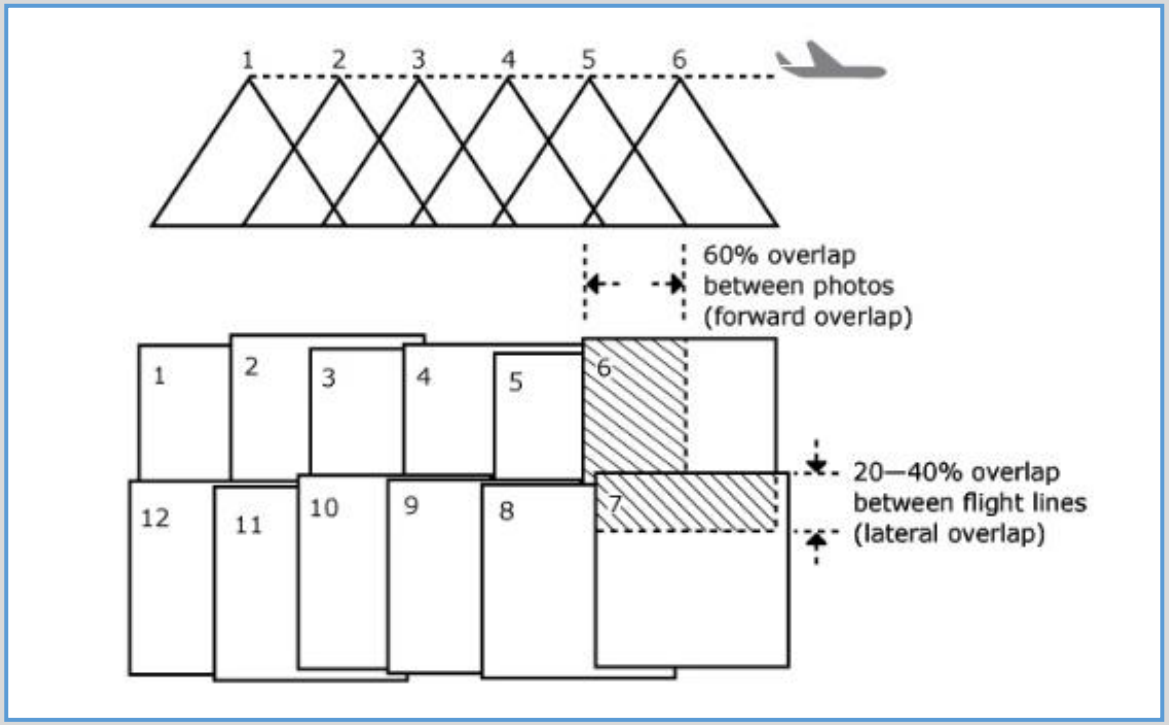


Photo interpretation

Stereoscope

In order to view aerial photos in 3D, two photos are needed that show the same object from different perspectives. A stereoscope is the instrument used to “bring together” the two images and allow the viewer to see in 3D.

Photo interpretation

Softwood stands
Hardwood stands
Mixedwood stands
Roads
Streams
Beaver ponds
Cutovers
Wetlands
Lakes

Power lines
Buildings
Fields

Department Natural Resources & Energy

Flight Line & Photo #

Date

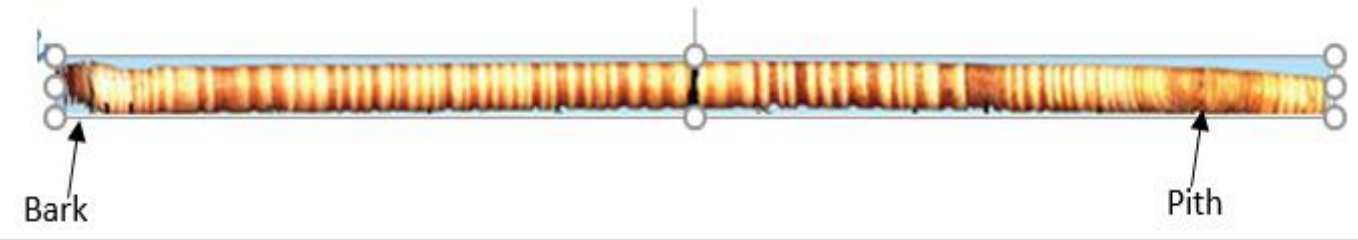
Map Reference

Scale of photo
1: 12 500
1cm = 12 500 cm
1cm = 125 m

Tree measurements

Measuring age of tree

- Stump
  - Count growth rings
  - Each growth ring is 1 year growth
- Live tree
  - Use increment borer
  - Measure at DBH (1.3 meters above ground)
  - Must go past centre of tree
  - Must hit centre of tree (pith)



Tree measurements

Measuring diameter of tree

Measured at dimeter breast height (DBH) 1.3 m above the ground.

This height for measuring DBH was chosen because:

1. Easy to reach
2. Avoids butt swell
3. Ensures consistency

Calipers faster but less accurate (measure to diameter classes)

Example: 11.0 cm to 12.9 cm is 12 cm diameter class

Diameter tape is slower but more accurate

Must use correct scale: Diameter
Circumference

Measuring diameter of tree

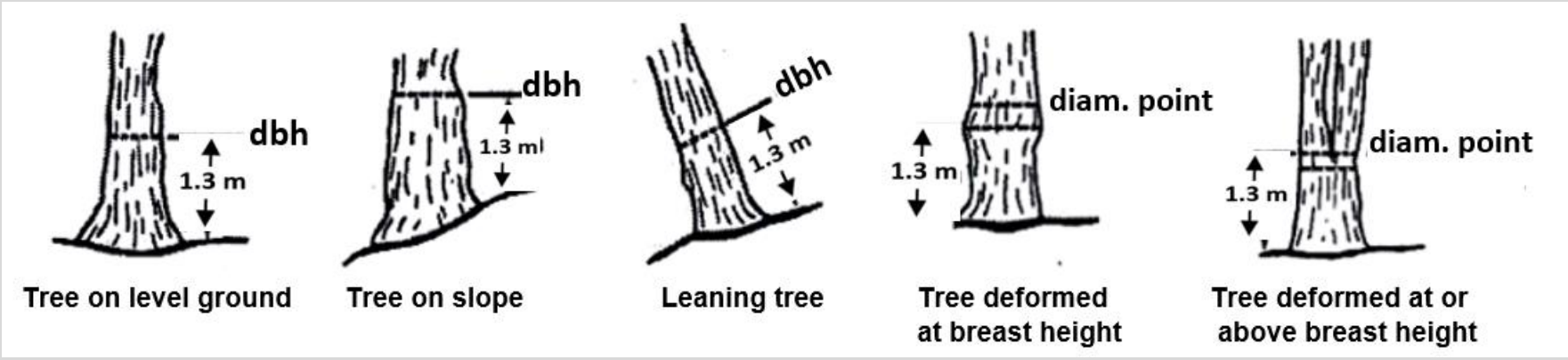
There are instances where diameter should not be measured at 1.3 meters above ground

Trees with deformities (bumps, swellings or depressions) located at 1.3 meters should be measured above the deformity.

Forked trees

a) Fork occurs above 1.3 meters, measure DBH at the smallest point below the fork.

b) Fork occurs below 1.3 meters, measure as two separate trees above swell caused by fork



Tree measurements

Measuring height of a tree using a Suunto hypsometer

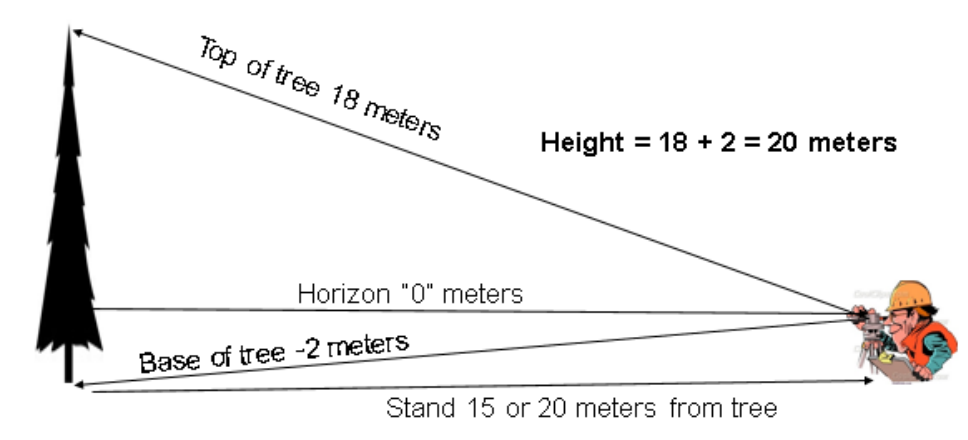
Stand 15 or 20 meters from tree

Horizontal line should read “0”

Use correct scale

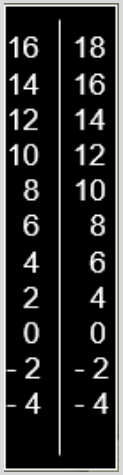
Take reading at top of tree (usually + ve)

Take reading at base of tree (usually – ve)



Add absolute value of the numbers to obtain height

Example 18 meters to top and -2 meters to base = height of 20 meters



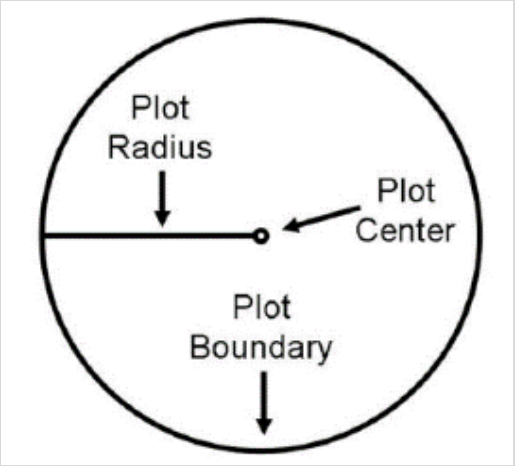
Using the percent scale

From a measured distance <=30 meters, sum the absolute value of the sightings to the top and base of the tree (for example, 60% to the top and -10% to the base =70% total. Then, multiply this number by your distance from the base of the tree (for example, 70% x 25 meters from tree = 17.5 meter tree).

Stand measurements

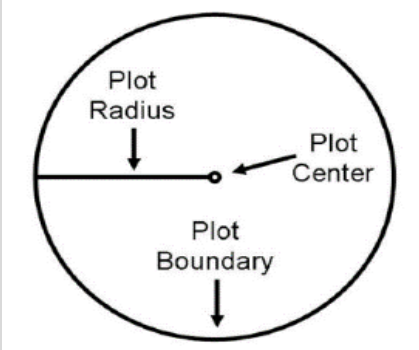
Measuring stand density

- Number of trees per surface area
- Trees/hectare
- Done through sampling



Circular plots are often used to determine density. The size of the sample plot depends on the number of stems to be counted. For example, the density of a young balsam fir thicket could be 50 000 stem/ha while the density of planted trees in a plantation could be 2000 planted trees/ha. Using the proper plot size is critical when sampling for density.

Stand measurements



Measuring stand density (sampling)

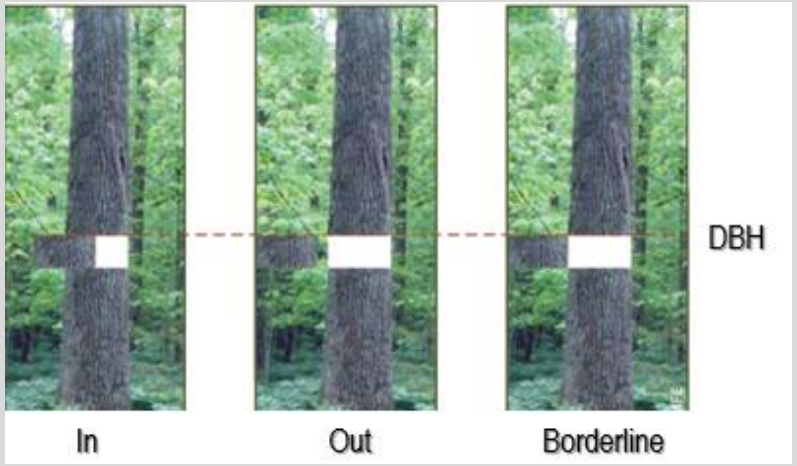
For example, a 5m^2 sample plot would be appropriate to determine the number of stems in an area to be pre-commercially thinned. The 5m^2 plots represents 1/2000 of a hectare, so to calculate the number of stems/ha, the average of stems counted in the sample plots would be multiplied by 2000.

Another example would be to determine density of an area that had been planted or one that had been thinned. A 5m^2 plot would not be practical because it would sample too few trees. In this case, a 40 m^2 (1/250 of hectare) plot would be more realistic.

Stand measurements

Basal area

- Use prism
- Basal Area Factor (BAF) (2 m^2/ha)
- Prism displaces image of tree
  - **IN**: Displaced image and tree overlap
  - **OUT**: Displaced image and tree do not overlap
  - **BORDERLINE**: Measure every second tree



Each tree that is "IN" represents 2 m^2/ha

Tree: cross-sectional area of tree at DBH

$$A = \pi r^2$$

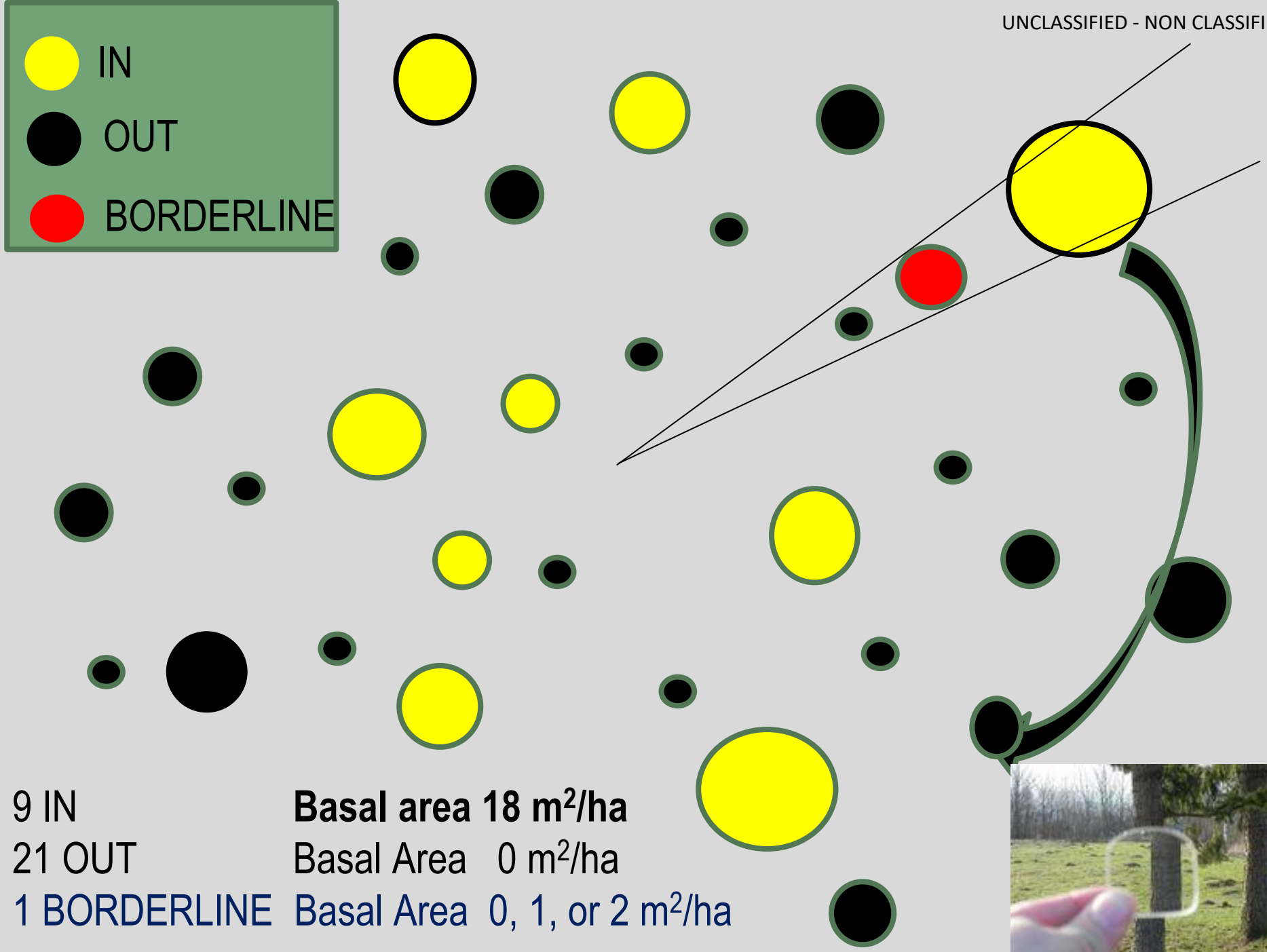
Area = $3.14(15cm)^2$

= $3.14 \times 225cm^2$

= $706.50\ cm^2$

= **$0.07065\ m^2$**

Stand: Sum of basal areas of all trees in stand expressed on a per hectare basis. (m^2/ha)



9 IN **Basal area 18 m^2/ha**

21 OUT Basal Area 0 m^2/ha

1 BORDERLINE Basal Area 0, 1, or 2 m^2/ha

Sample Questions

How many square meters in 1 hectare

Prism with BAF 2m^2/ha

Is this tree IN or OUT?

How much basal area does it represent?

How many board feet?

Density is measured in:

trees/ha
m^2/ha
percent (%)
trees

Forest Health

A healthy forest is one that maintains and sustains desirable ecosystem functions and processes. Healthy forests provide:

Goods and products

Ecological functions

Social and cultural

Urban forest

Threats to the forest

Biotic: Damage caused by living organisms (insects, diseases, birds, mammals, etc.)




Abiotic: Damage not caused by living organism (wind, wildfire, ice, precipitation, humidity, temperature, pH, salinity, etc.)



Native insects

Spruce budworm

Forest tent caterpillar

White pine weevil

Spruce budworm

Adult (moth)

Larvae (caterpillar)

Damage

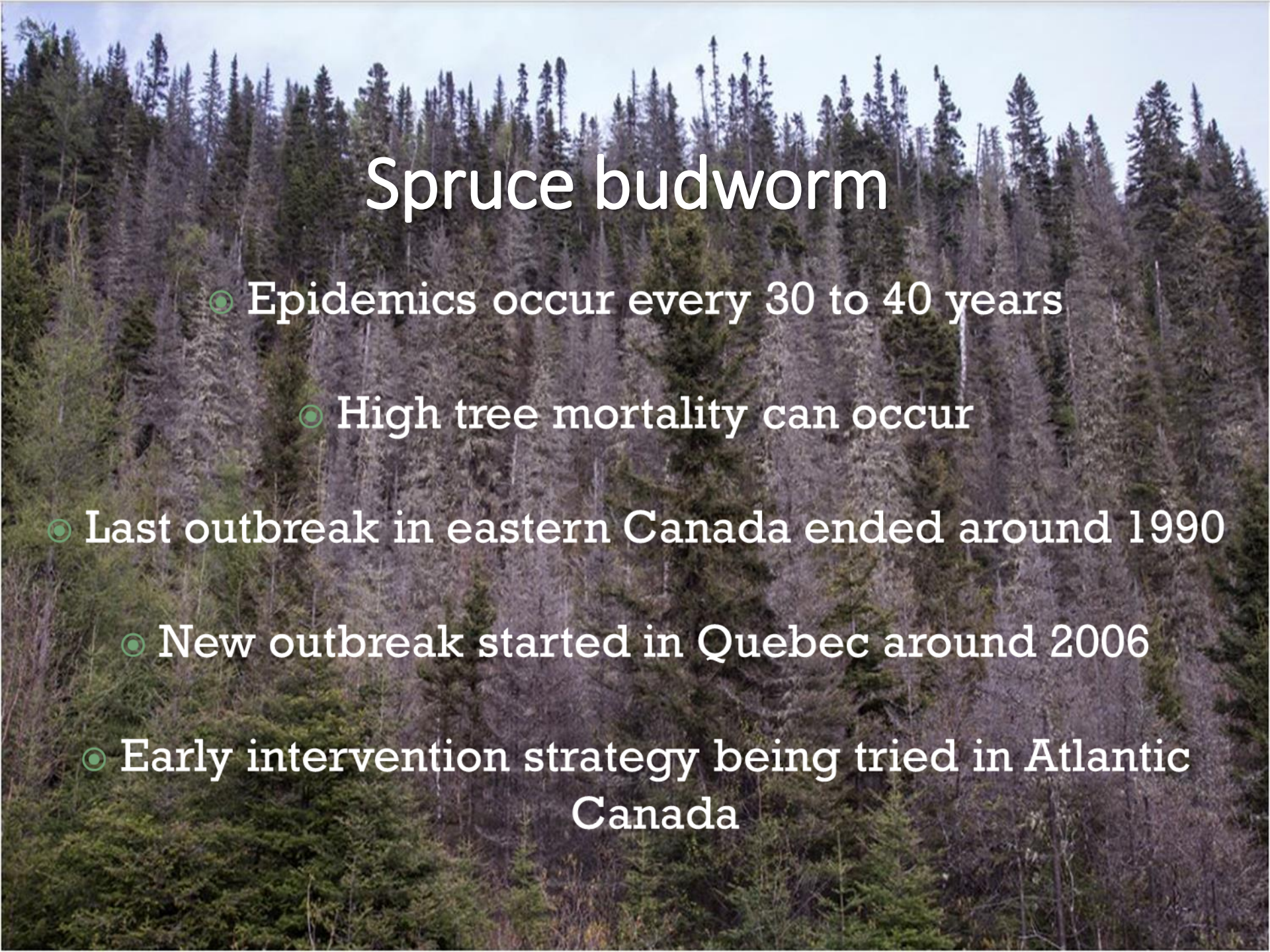
Dispersal (migration) event
Campbellton 2016

Native insect – been around a long time

Host species: balsam fir & spruces

Older stands more vulnerable

Uncontrolled outbreaks can lead to serious tree mortality



Spruce budworm

- Epidemics occur every 30 to 40 years
- High tree mortality can occur
- Last outbreak in eastern Canada ended around 1990
- New outbreak started in Quebec around 2006
- Early intervention strategy being tried in Atlantic Canada

Forest tent caterpillar

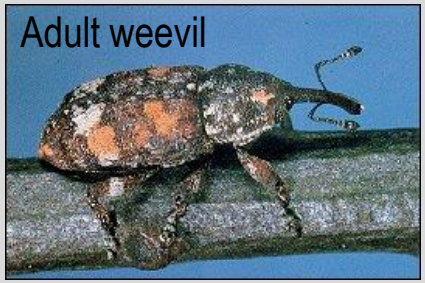
Eastern tent caterpillar

Forest tent caterpillar

Forest tent caterpillar

Egg masses on twig

White pine weevil



White pine

Spruce

Exotic insects and diseases of trees

Emerald ash borer

Beech bark disease

Butternut canker

Spongy moth (formerly known as gypsy moth)

Emerald ash borer

Discovered Windsor Ontario and Detroit Michigan in 2002

Native to Asia

Infests all species of North American ash trees (not mountain ash)

99 % of ash trees are killed are killed within 6 – 10 years of being infested

"s"-shaped galleries

"d"-shaped exit holes

Larvae

Woodpecker damage

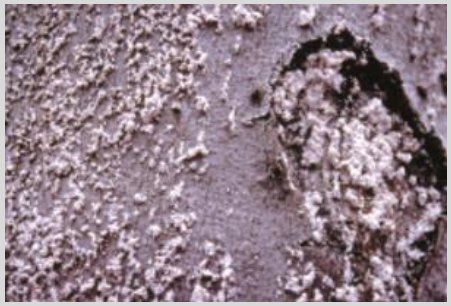
Beech bark disease

Clear beech

Early stages (waxy secretions)

Advanced stages

Scale insect



Waxy secretion of insect

Fungal fruiting bodies

Butternut canker

Disease caused by fungus

Identified in 1967 (Wisconsin)

Spread by spores (water, animals)

Killed up to 90% of butternut trees in parts of US

Listed as Endangered by SARA in 2005

Spongy moth

Introduced in 1869 near Boston MA

Native to Europe and Asia

Widespread in eastern North America and California

Maritime Provinces, Quebec and Ontario

Feeds on wide range of species

Climate Change

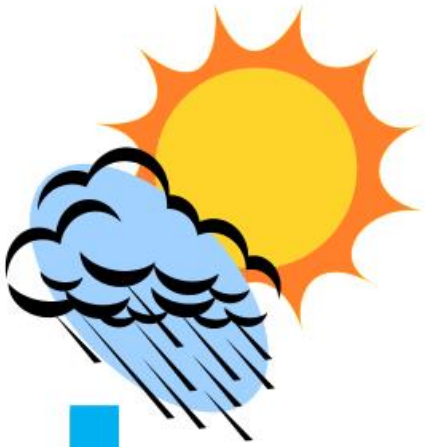
Is already having effect on Canada's forests

- Changes in precipitation
- Changes in temperature
- Greater risk of fires
- Severe weather events
- Invasive pests
- Forest production
- Forest composition

Taylor, A.R., Boulanger, Y. Price, D.T, Cyr, D., McGarrigle, E. Rammer, W., Kershaw, J.A., 2017. rapid 21st century Climate change projected to shift composition and growth of Canada's Acadian Forest Region. Forest Ecology and Management 405: 284-294.

Forest Regions of Canada

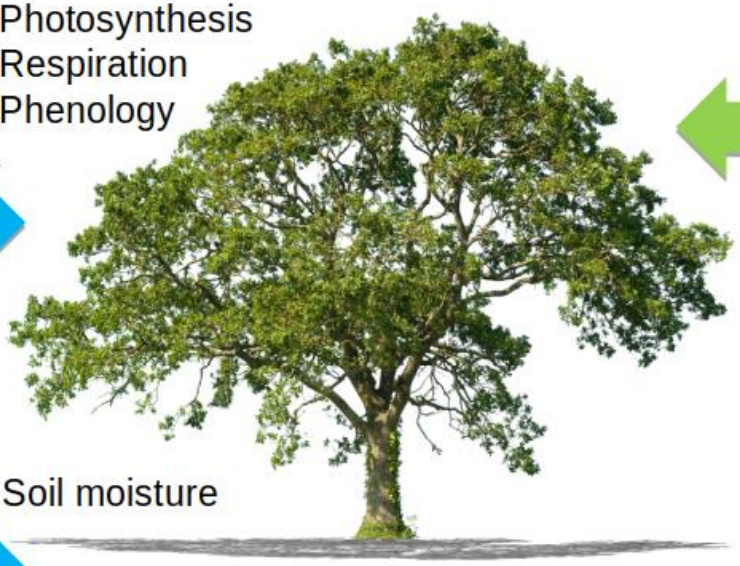
How will climate change affect our forest?



Direct

Direct

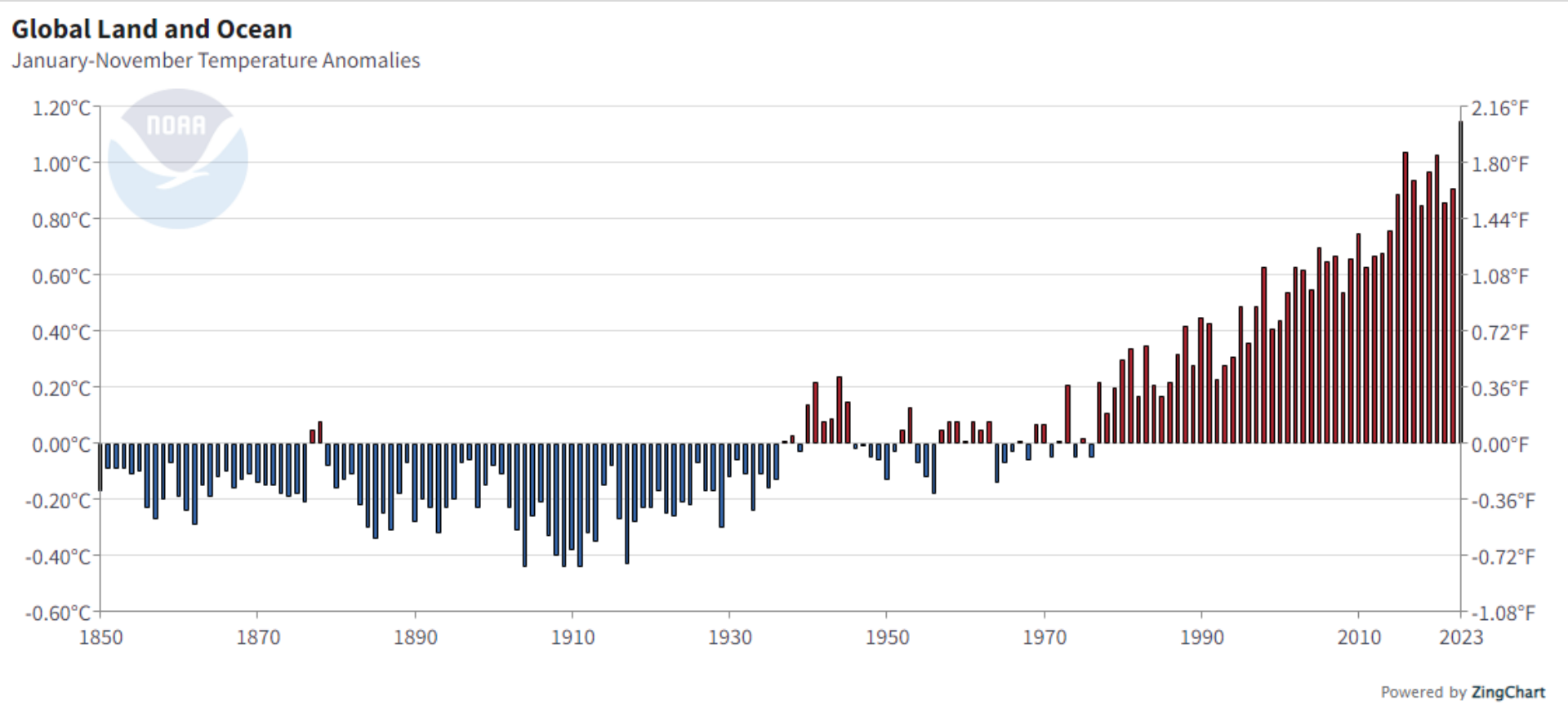
- Photosynthesis
- Respiration
- Phenology



- Soil moisture

Indirect

Trees interact with their environment

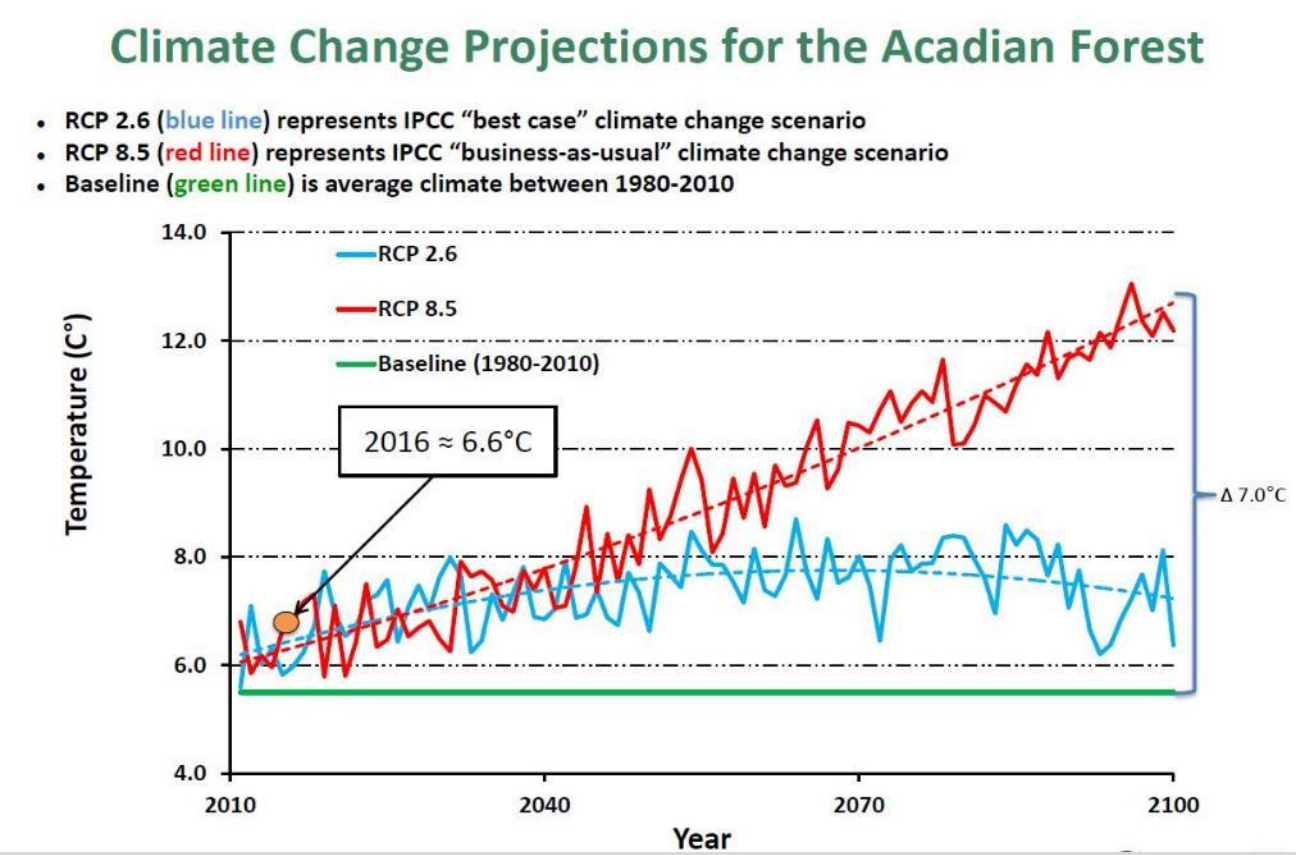


January–November in the Northern Hemisphere ranked warmest on record at 1.50°C (2.70°F) above average. Both the ocean-only and land-only temperatures also ranked highest on record for the Northern Hemisphere year-to-date period. January–November in the Southern Hemisphere also ranked warmest on record at 0.81°C (1.46°F) above average. The ocean-only temperature ranked record-high while average land-only temperature ranked third highest on record for the Southern Hemisphere.

National Oceanic and Atmospheric Association (NOAA)

Climate Change Scenarios

Four pathways/scenarios: (RCP 2.6, RCP 4.5, RCP 6.0, RCP 8.5)
RCPs provide temperature projections derived from atmospheric GHG concentrations
Used by researchers when modeling climate change effects
RCP 2.6: GHG levels maintained at current levels and start decreasing toward end of century
RCP 8.5: GHG continue to rise at current rates (business as usual)

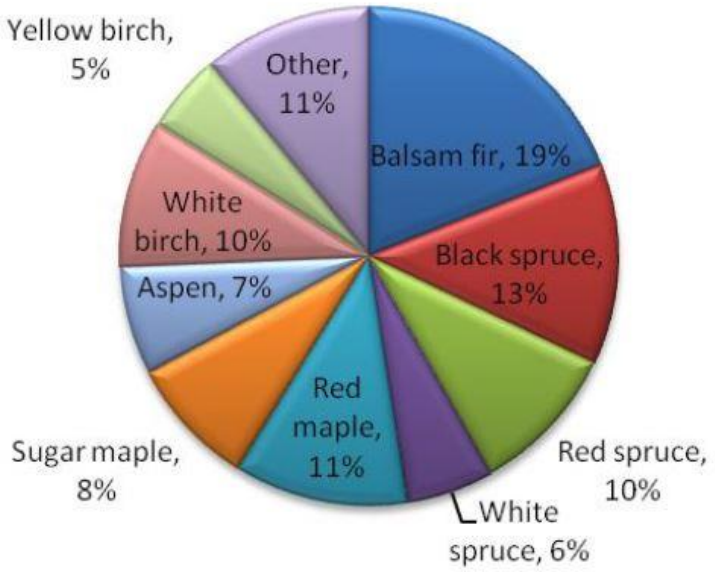


Climate Change and Acadian Forest

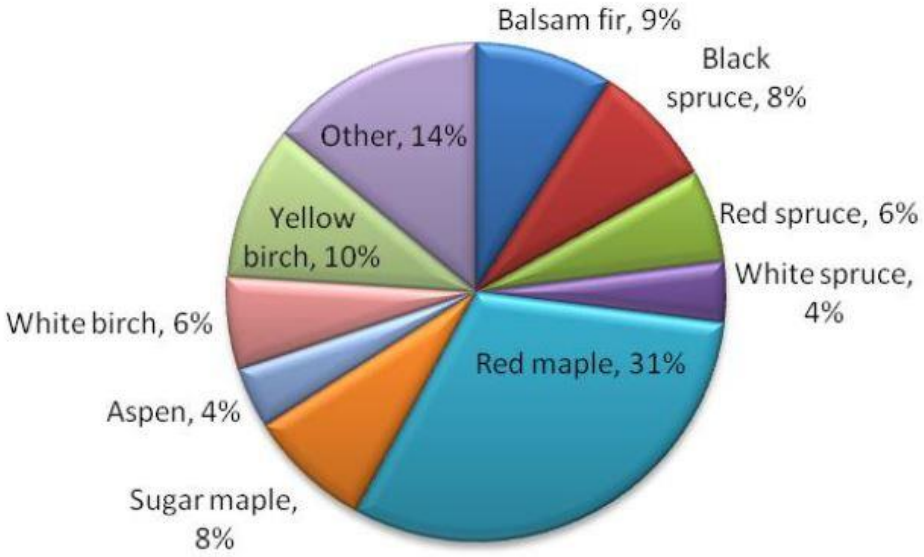
Projections of forest composition

Results

Current forest composition



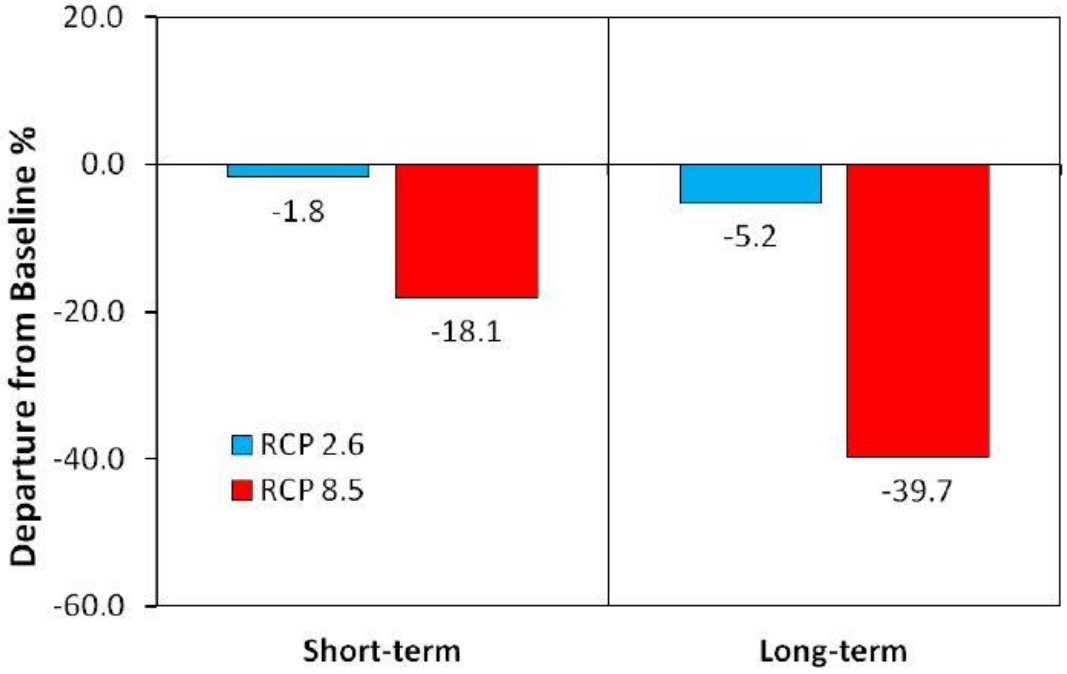
Projected composition by 2100 under RCP 8.5



Climate Change and Acadian Forest

Projections of forest growth

Results



- No significant change under RCP 2.6
- Substantial decline in forest growth during latter part of 21st century under RCP 8.5
- This decline may be temporary as species composition adjusts

Climate Change and Acadian Forest

Precipitation

Expected remain roughly same. Fewer rain days but more intensive events

Temperature

Increase in temperature, more drought, greater susceptibility to fire

Forest composition

Favour trees better adapted to warmer, dryer conditions

Forest productivity

Decrease in productivity due mainly to lag effects.
Some native species will not grow as well. It will take time for species migrating into area to replace native species.

Susceptibility to insects and diseases

Warmer temperatures will make it possible for new forest pests to survive in our environment


That’s all!