Forest disturbance regimes and current issues in forestry

Celebrating the Windy Forests of Mi'kma'ki

Presentation by David Patriquin

PDF of the presentation slides &

Some “Useful Links” are available at

www.nsforestnotes.ca/misc/nns

Credit: Eleanor Wynn on Extinction Rebellion Mi'kma'ki / Nova Scotia
Dec 30, 2021

Last Hope Encampment
Beals Meadow
Ann. Co.

THE WABANAKI FOREST

By **Rebecca Jacobs**, Posted on October 26, 2021

You may have noticed that over the past year, we have begun to refer to the forest in the Maritimes as the Wabanaki-Acadian Forest, or simply the Wabanaki Forest. **You may be wondering where this name comes from or why we've made this change.**

In Canada, climate justice cannot be separated from Indigenous reconciliation and the work of decolonization. That is why Community Forests International is continually learning ways to centre Indigenous justice within our work to protect and restore these special forests — all while working to deepen our partnerships with Indigenous Nations, organizations, and communities.

5.6 RE-PRESENTING THE WAPANE'KATI FOREST REGION

When I look again at the maps identifying the distribution of the current Acadian Forest range and the lands of the Wapane'kati (known as the Wabanaki Confederacy),

- Shalan Joudry

I am again struck by the similarities in the boundaries.

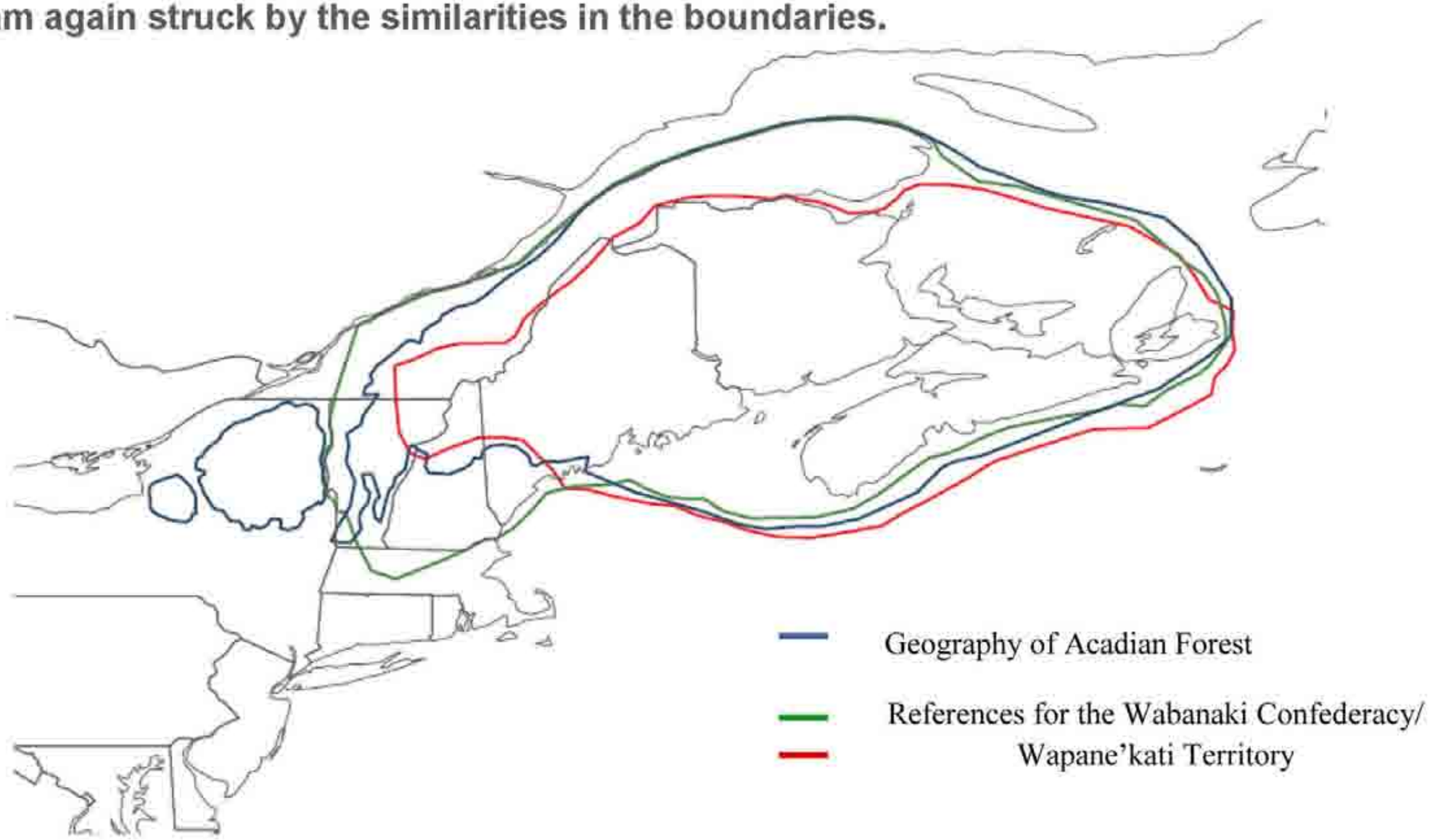


*Figure 9 Map of Eastern Turtle Island showing the approximate geographic boundaries of the "Acadian Forest" (*from the Nature Conservancy's delineations in Simpson (2008)) and the Wabanaki Confederacy (from Speck (1915) and Morin (1988))

From: **Puktewei: Learning from fire in Mi'kma'ki (Mi'kmaq Territory)**
Shalan Joudry,MES Thesis, Dalhousie University, 2016 (with permission)

Forest disturbance regimes and current issues in forestry

Celebrating the Windy Forests of Mi'kma'ki

What's ahead

1. **Some background: forest succession, disturbance**

2. **Two Major Issues forests & forestry in NS**

3. **The Celebration: Natural History of our Windy Forests**
& how that relates to and informs the two major issues

4. **Discussion**

Fast-growing shade-intolerant (or "light-tolerant") tree species dominate

Slow-growing shade-tolerant (or "light intolerant") tree species dominate

NSOFP: 80 *Old Forest* 125 *Old Growth*

Development Stage

Initiation | Stem exclusion | Stratification | Understorey | Old Growth

Stand-replacing disturbance

~0.5 ha to km^2

RIs:100s to 1000s of years*

RI is the "Return Interval"

e.g. due to wind, fire, disease/pests

spruce budworm outbreaks, 30-40 year intervals*

Gap Disturbance

typically wind induced

24-126 m^2**

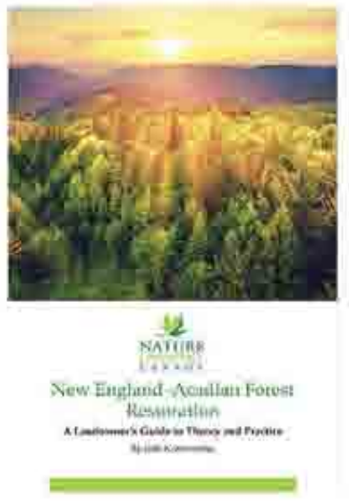
RI for Low Secerity Windthrow: 71yrs*

0-10 years | 10-40 years | 40-80 years | 80-150 years | 150+ years

Early successional | Late successional

Figure 2. Generalized forest development stage and age class definitions for New England–Acadian Forest restoration. Adapted from Thomas[35] and Oliver[36], and published with permission from the USDA Forest Service, 2017.

Base figure from ***New England–Acadian Forest Restoration: A Landowner's Guide to Theory and Practice by Josh Noseworthy***
Nature Conservancy of Canada, Frederickton, N.B. 2018(with permission)



*Taylor et al., 2020 Env Rev 28: 387-414 ** Seymour et al., 2002 For. Ecol. Manage 155: 357-357

Stem Exclusion (managed forest)

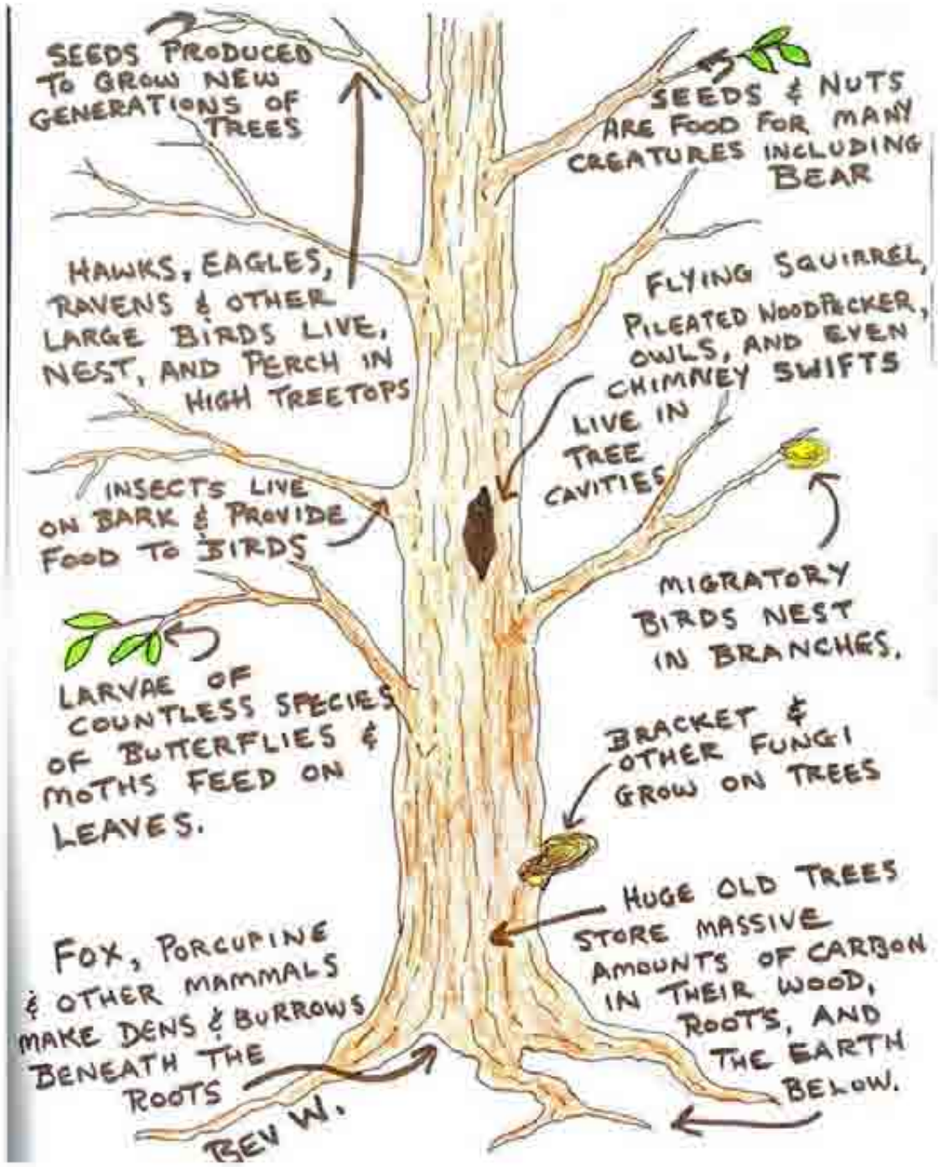
Old Growth mixed forest (Sandy Lake)

Gap in eH/yB Old Growth (Sandy Lake)

Stand-level Wind Disturbance from Hurricane Juan (Sep 27, 2003)

The Future of our Big Trees/Old Forest

Big trees for sawmills



Big Trees for Ecosystem Services

(e.g., Biodiversity, Carbon Storage, Water Purification, Recreation...)

The future depends on
- how much of the Big trees/Old Forest goes to sawmills & how much is retained for Ecosystem Services.

Currently...

Legend

Forestry

Forestry

Development Class

Establishment

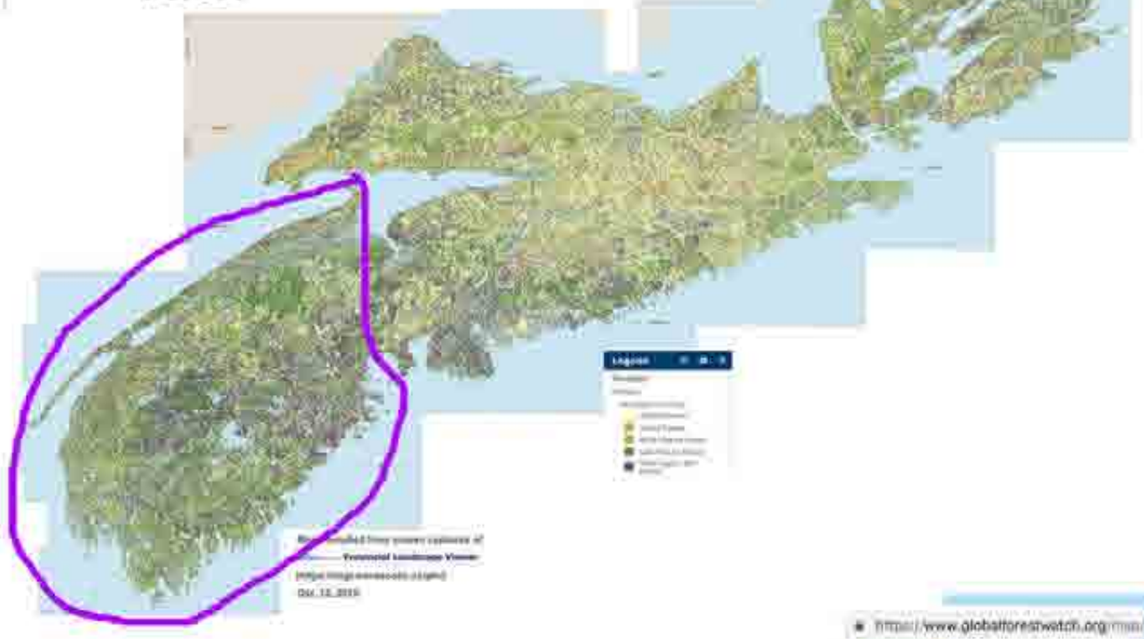
Young Forest

Mature Forest

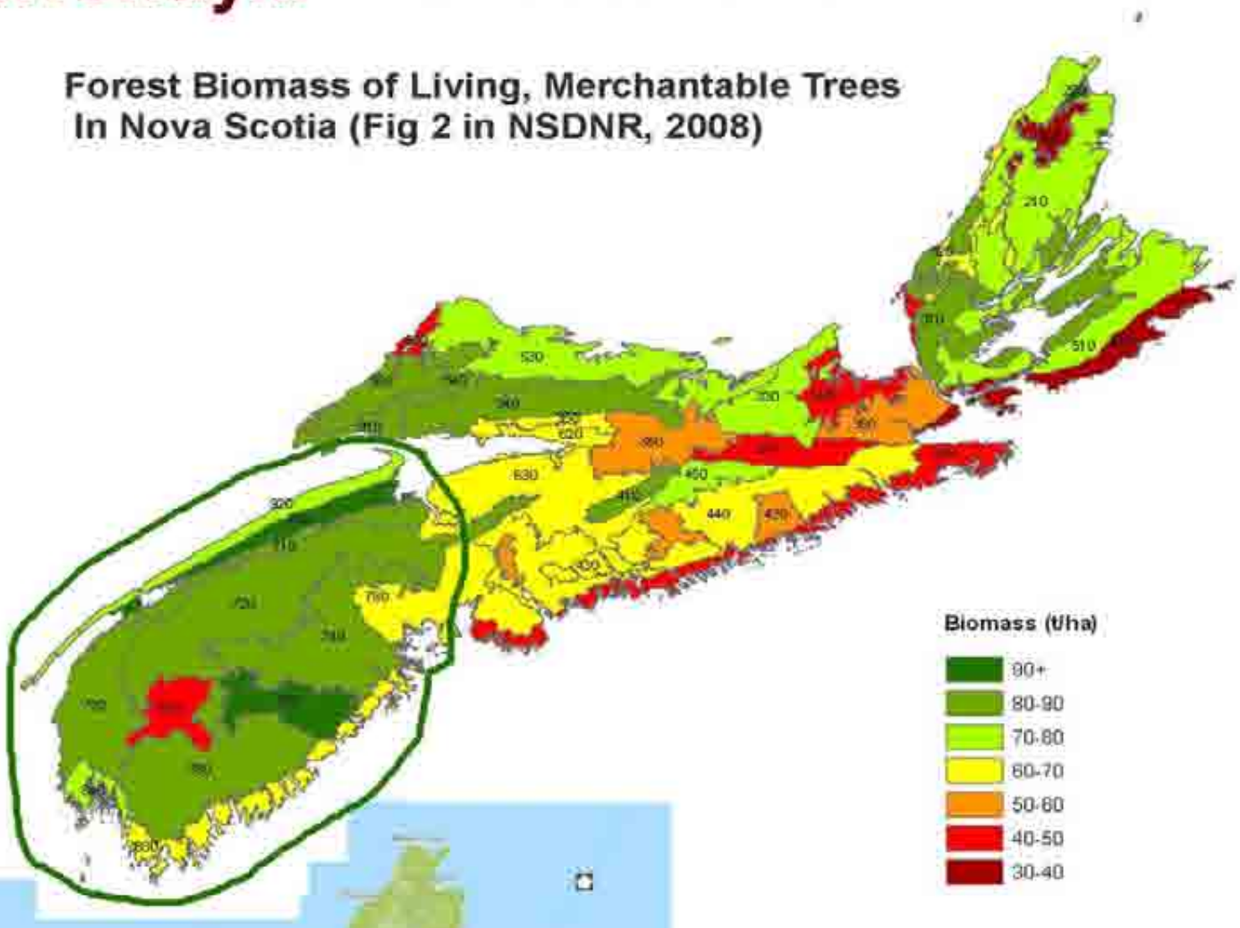
Multi-aged/Old Forest

Forest Development Class (NSL&F 2018)

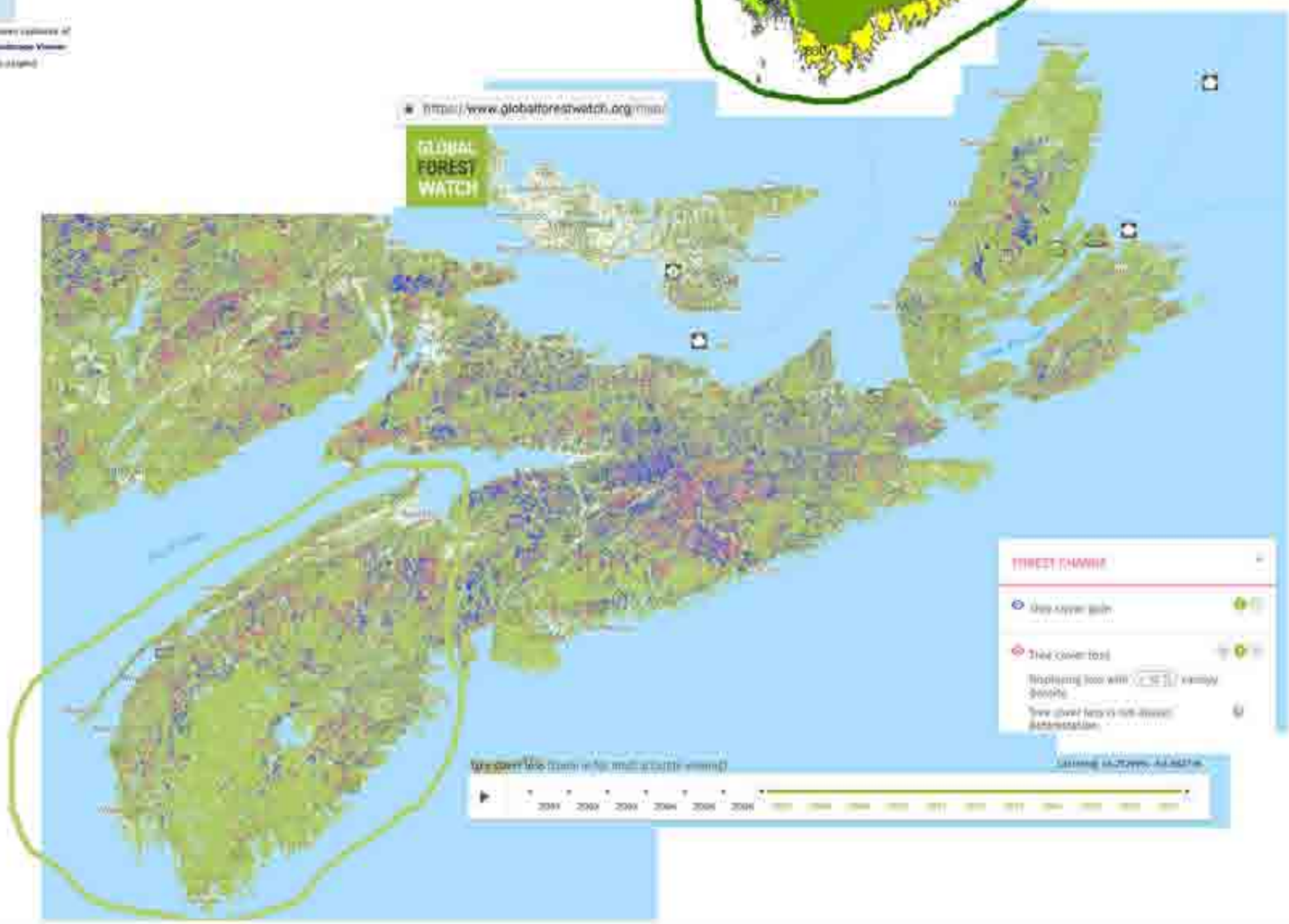
Old Forest (80 yrs +)



Forest Biomass of Living, Merchantable Trees In Nova Scotia (Fig 2 in NSDNR, 2008)



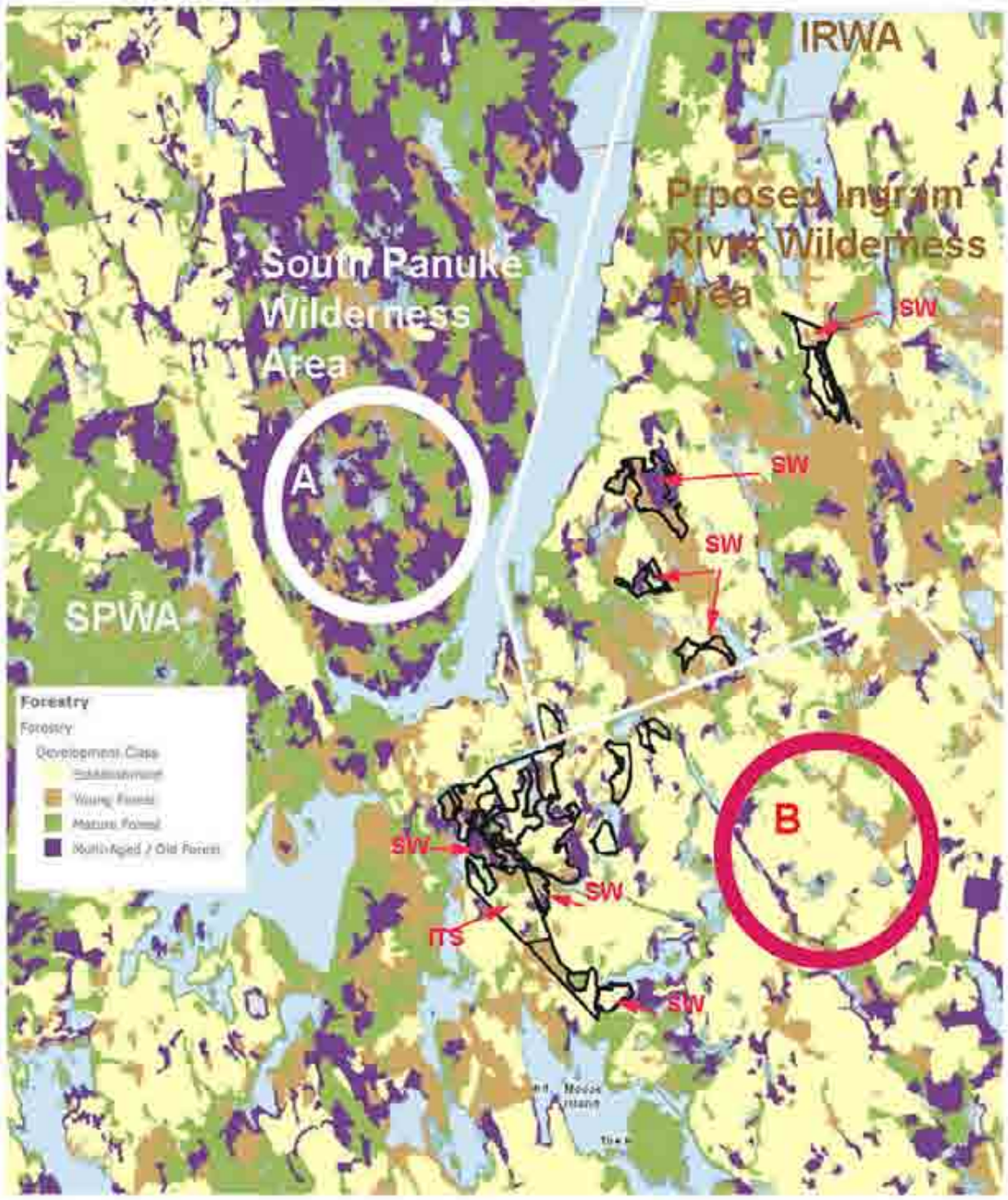
GLOBAL FOREST WATCH



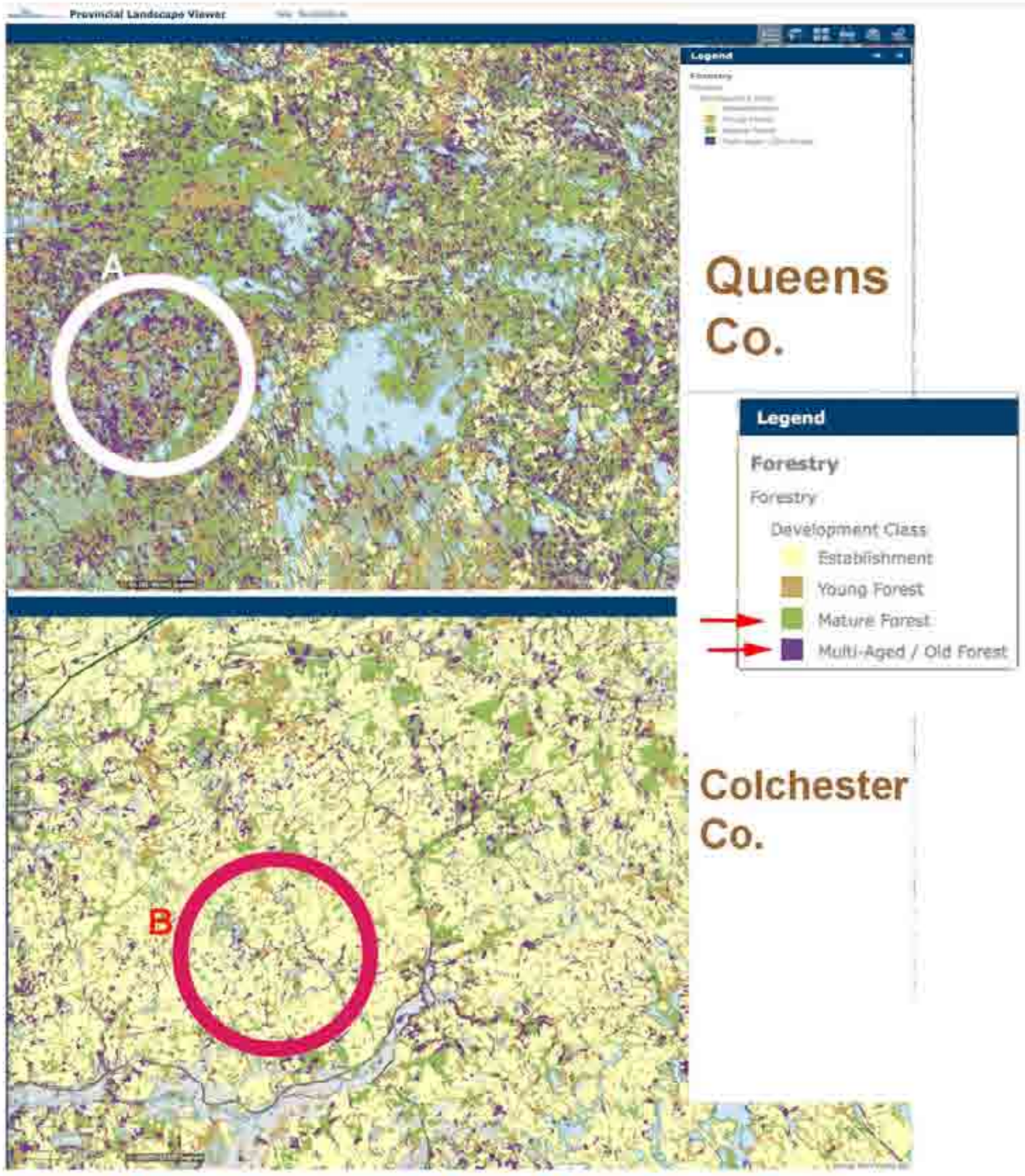
2006-2007

‘High-grading at the Landscape Level”

high grading – the removal of only the best trees from a stand, often resulting in a poor quality remaining stand and poor seed for the next generation (From the Glossary of Key Terms for the NS Woodlot Home Study Module 2)



Forest Development Class in South Panuke Wilderness Area & adjacent Crown land working forest. Harvest polgons shown. SW=Shelterwood, ITS = Individual Tree Selection Circles are ~2 km diameter



Forest Development Class Maps for an area in Queens Co. (top) and just east of Truro (bottom). Diameter of circle approx 30 km

Why have we not been more concerned about the loss of Old Forest?

Wood Products

Monitor by Registry of Buyers

(Publicly available)

OLD FORESTS

Monitor by aerial surveillance

In general, DNR/L&F/NRR does not cite info on extent of our Old Forests

Mapping of Forest Development Stage *is* available as a layer on the NS Provincial Landscape Viewer (NSPLV)

The Harvest Plan Map Viewer does NOT reference NSPLV layers.

Ecological Services

-Carbon Sequestration & Storage

Monitored, but Accounting Issues

lack of transparency

- Biodiversity

lack of data on biodiversity and any links to Old Forests

- & many more (erosion control, water purification,, health & recreation...)

"2022 Bird Study"

nature ecology & evolution

ARTICLES

https://doi.org/10.1038/s41559-022-01737-8

Check for updates

OPEN

Forest degradation drives widespread avian habitat and population declines

Matthew G. Betts[1✉], Zhiqiang Yang[2], Adam S. Hadley[3], Adam C. Smith[4], Josée S. Rousseau[5], Joseph M. Northrup[6], Joseph J. Nocera[7], Noel Gorelick[8] and Brian D. Gerber[9]

In many regions of the world, forest management has reduced old forest and simplified forest structure and composition.

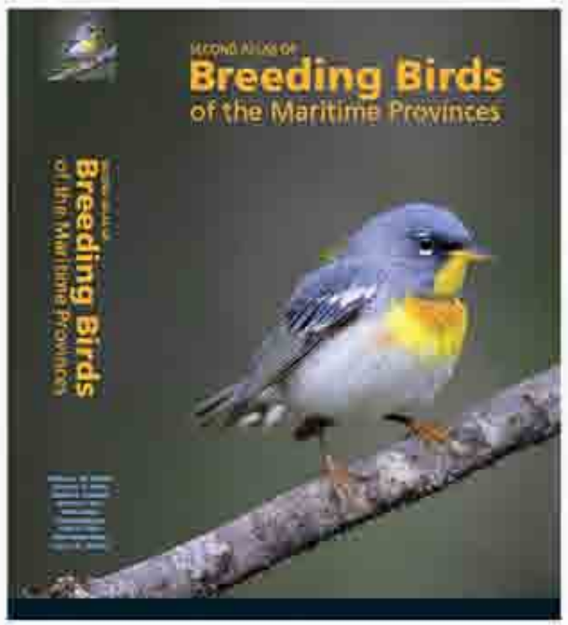
We hypothesized that such forest degradation has resulted in long-term habitat loss for forest-associated bird species of eastern Canada... which, in turn, has caused bird-population declines.

Despite little change in overall forest cover, we found substantial reductions in old forest as a result of frequent clear-cutting and a broad-scale transformation to intensified forestry.

... breeding habitat loss occurred for 66% of the 54 most common species from 1985 to 2020 and was strongly associated with reduction in old age classes.

... Forest degradation may therefore be a primary cause of biodiversity decline in managed forest landscapes.

Blackburnian Warbler
Photo by William H. Majoros, on Wikipedia



"1389 Citizen Scientists"

Response to public concerns & small forest contractors:
The Independent Review of Forest Practives by Prof Bill Lahey &Co.
(Sep, 2017-Aug 2018)

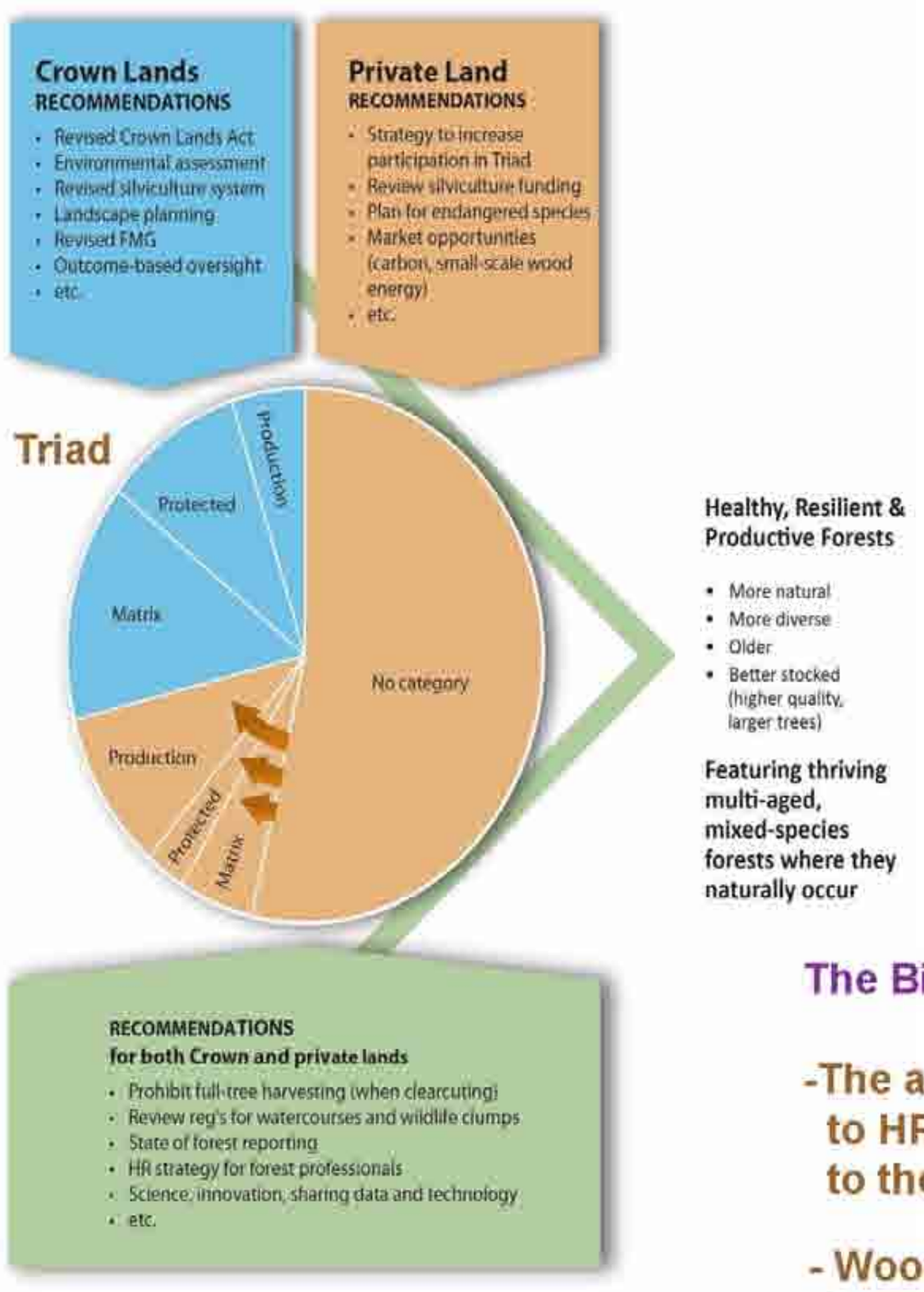


Figure 1 Visualizing the FPR as an integrated whole

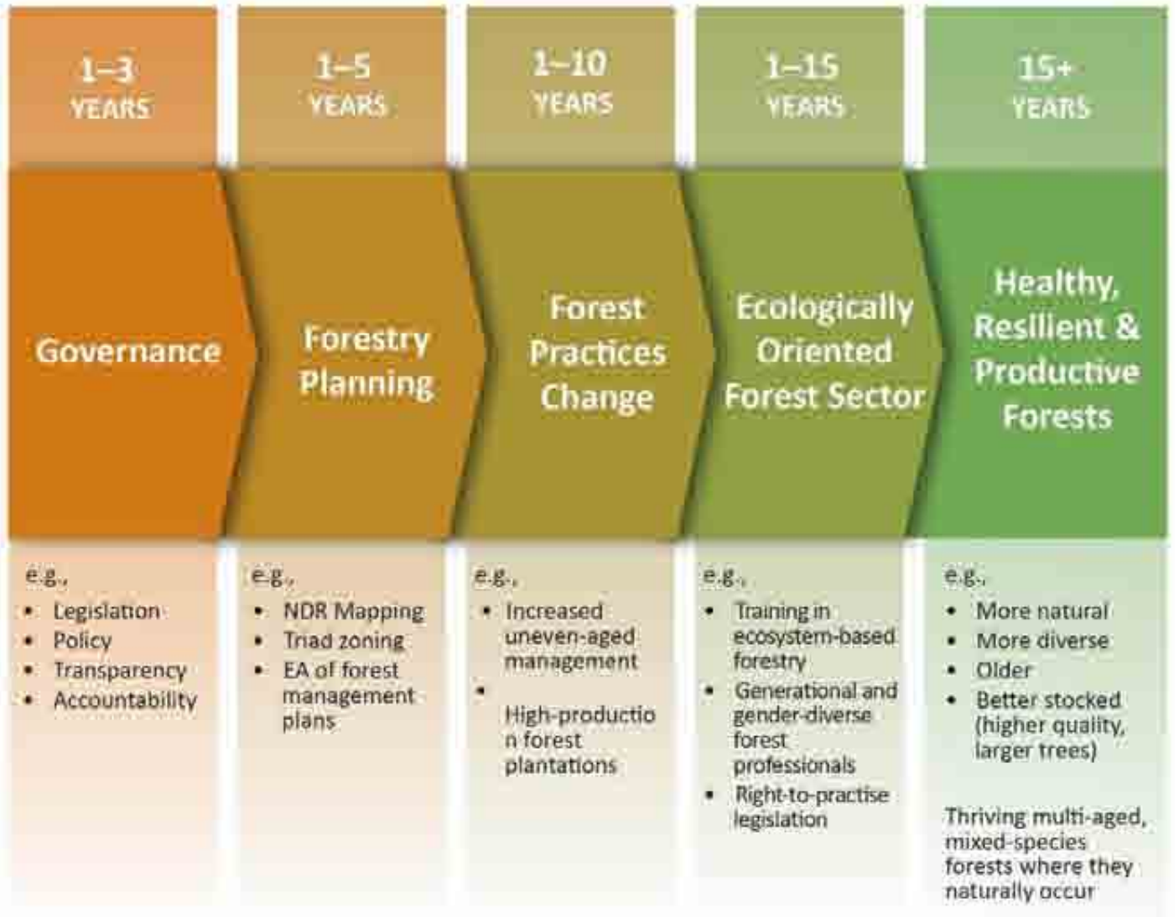


Figure 2 Logic model for implementation of the FPR

The Big Unknowns:

- The assignment of existing Old Forest to HPF (High production Forestry) & to the EM (Ecological Matrix)

- Wood supply from Crown land HPF & EM lands in sucessive years

Figures are from **Independent Evaluation of Implementation of the Forest Practices Report for Nova Scotia** by William Lahey (2021)

From the Lahey recommendations

16. DNR, with Crown licensees, must take immediate and sustained action – including by conducting or commissioning appropriate scientific research, engaging interested parties in collaborative problem-solving forums, and adopting precautionary measures – to be responsive to concerns about the potential adverse impact of forestry on Crown lands on the following interests:

    a. Sensitive soils, particularly on Crown lands in the western region
    b. Bird populations
    c. Tourism operations and developmental plans
    d. Outdoor recreation activities, including established trails
    e. Protected Areas

17. Steps should be taken to improve the abundance and conservation of old forests, including the following:

    a. Implementation of ecological forestry, with emphasis on long-rotation stand development and multi-aged stand structures...
    b. Accelerated and improved data collection on the existence of old forests across all unprotected Crown lands...
    c. Reconsideration of the area-proportion targets in the Old Forest Policy, as well as potential inclusion of other tree species in the climax group (e.g., red oak, red maple)..
    d. Addition of old-forest restoration targets alongside the old-forest protection targets in the policy...
    e. Development of a silvicultural manual for old-forest restoration...

The Big Unknowns:

-The assignment of existing Old Forest to HPF (High production Forestry) & to the EM (Ecological Matrix)

- Wood supply from Crown land HPF & EM lands in sucessive years

→ Does cover by Old Forest

- Continue to decline?

- Stay the same?

- Increase?

The facts and the figures and the models related to wood supply & cover by Old Forest must be made available in the public domain and the analyses if not conducted, should be readily reviewable by, independent 3rd parties.

We need that in the decision-making process & we need it in the monitoring processes.

We need such transparency for rigour, public trust, & for the biggest experiment yet on Triad Forestry to succeed.

nature ecology & evolution

ARTICLES

https://doi.org/10.1038/s41559-022-01737-8

Check for updates

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Forest degradation drives widespread avian habitat and population declines

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Forest Ecology and Management 510 (2022) 120103

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Perspectives: Thirty years of triad forestry, a critical clarification of theory and recommendations for implementation and testing

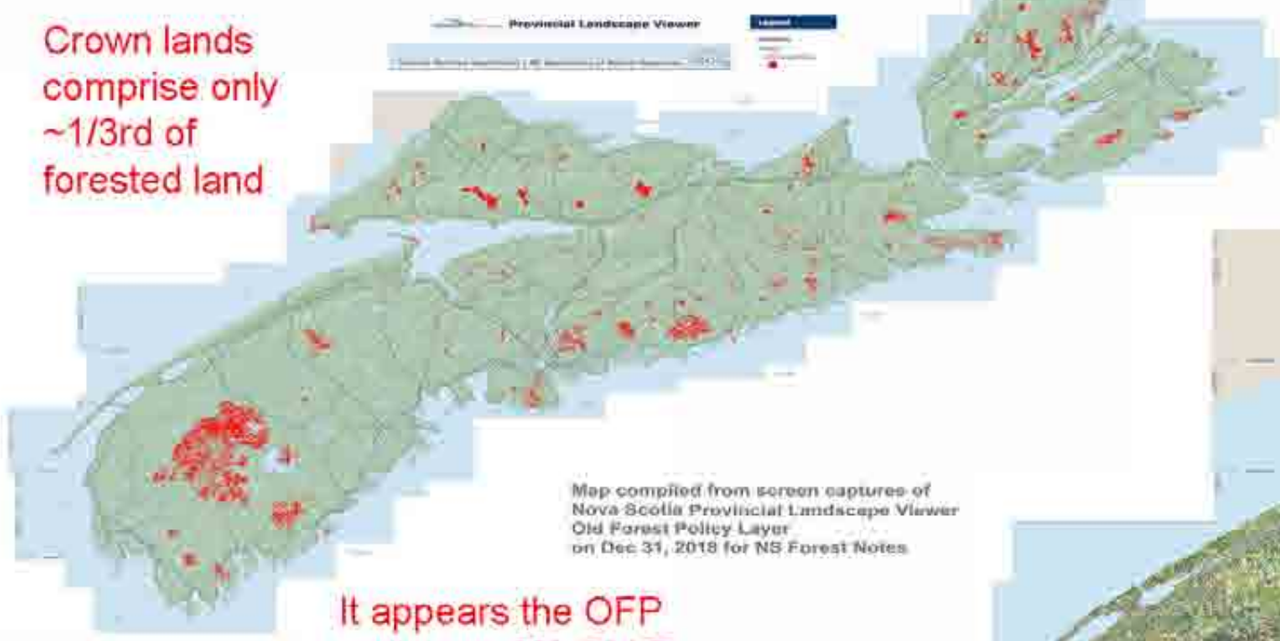
Austin Himes[a,*], Matthew Betts[b], Christian Messier[c,d], Robert Seymour[e]

OLD FOREST POLICY PRTECTION

~10% of Crown lands;
~1/2 is less than 80 years old

<<1% is now Old Growth

Crown lands comprise only ~1/3rd of forested land



Map compiled from screen captures of Nova Scotia Provincial Landscape Viewer Old Forest Policy Layer on Dec 31, 2018 for NS Forest Notes

It appears the OFP protects <3% Old Forest in NS

from

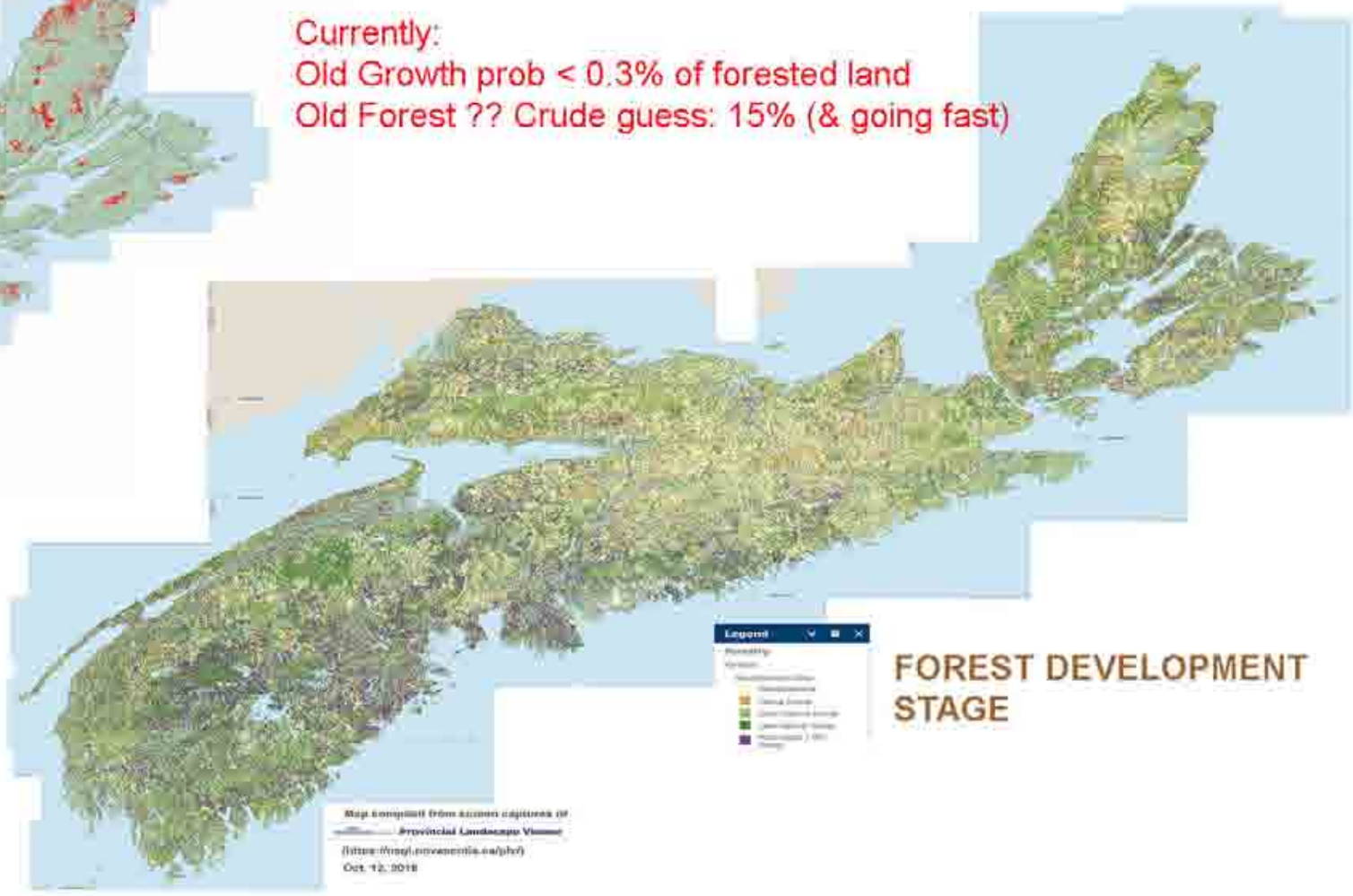
Old-growth forests of the Acadian Forest Region
A. Mosseler, J.A. Lynds, and J.E. Major in Environmental Reviews 11: S47–S77 (2003):

we estimate that **40–50% of the pre-settlement forested landscape may have been occupied by OG forest.**

it seems reasonable to suggest that at least **20–25% of our forest be maintained in these late-successional OG forest types, perhaps 10–12% within protected areas and 10–12% within the working forest.**

What is an appropriate goal for % of forested land as Old Forest?

Currently:
Old Growth prob < 0.3% of forested land
Old Forest ?? Crude guess: 15% (& going fast)



FOREST DEVELOPMENT STAGE

from:

Natural disturbance regimes for implementation of ecological forestry: a review and case study from Nova Scotia, Canada DA MacLean et al., 2021 in Environmental Reviews

2.3.2. Landscape-level decisions

At the landscape level, natural disturbance regimes are used to guide the abundance and distribution of different stand ages across the landscape, which bear directly on annual sustainable harvest...

Under a 100-year return interval, approximately 37% of the landscape would be composed of stands greater than 100 years TSD [Time Since Disturbance), and 5% of the landscape would be over 300 years TSD

Major Concern 2000...2018: Clearcutting

Stop Clearcutting Nova Scotia 1

911 views May 23, 2017 World-Class Forestry - Nova Scotia Style

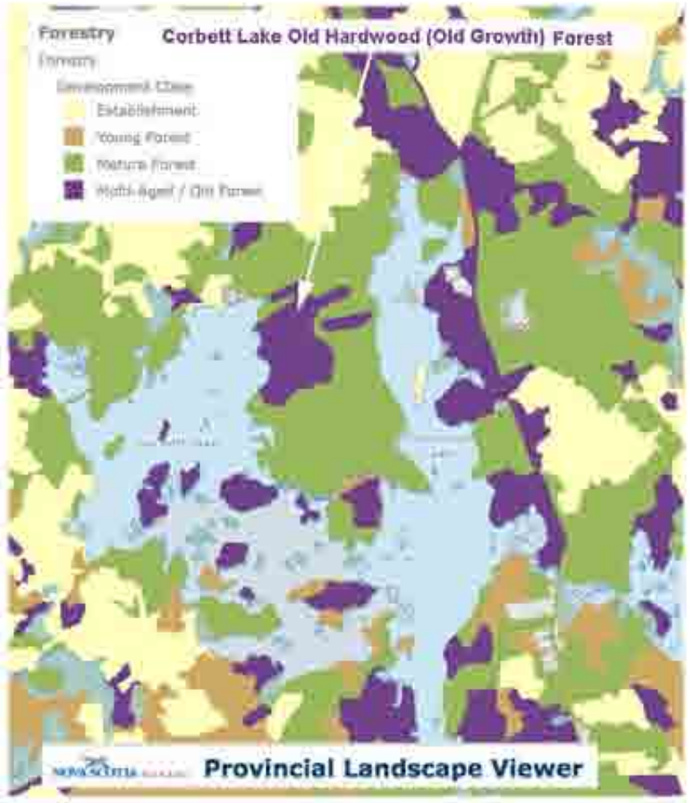
NSDNR Minister MacDonell at rally on oct 29, 2010: "There's gonna be a reduction in clearcutting in Nova Scotia." View video

Forest Funeral Oct 2017

Emerging Concern 2018... Loss of Big Trees/Old Forest

Uniform Shelterwood Harvest

‘High-grading at the Landscape Level”



Corbett Lake Old Hardwood Forest

AP068499 Beals Meadow

From Day 176 at the Last Hope camp

The days have been beautiful, immersed in the flow of the season as new birds arrive — hello, Red-eyed vireo — and the plants of the forest floor leaf out and bloom. The Golden seal are done, Painted trillium in full fig. The first Lady slipper we've seen in flower was the less common white form...

..we took a trip up the road to check there were no signs of cutting about to happen on the parcels by Cranberry Lake. ***Thirty hectares were approved for clear cutting*** *there but, according to the government, if the cut isn't started by June 1st, the harvest prescription will be changed from full on clearcut to something more ecological, based on the new Silvicultural Guide to the Ecological Matrix. So far the prescription shown on the Harvest Plan Map Viewer for AP068502A and B is still Variable retention 10 and 30%. It will be interesting to see what it is changed to.*

The thing is, though, that when you see those remaining patches of standing forest in context, it is hard to imagine any prescription that takes ecological health into account allowing for any further tree removal. The scale of the clearcutting that has taken place on this part of the South Mountain is hard to believe until you see it. Gone are the sheltering forests. Gone the nesting sites, the hollow trees for wildlife, the shaded trunks for lichens, the ferny floor. In their place a sun-beaten, wind-scoured, fire-prone expans e of short-lived trees scrabbling for existence on soil that has given up its carbon to the atmosphere.

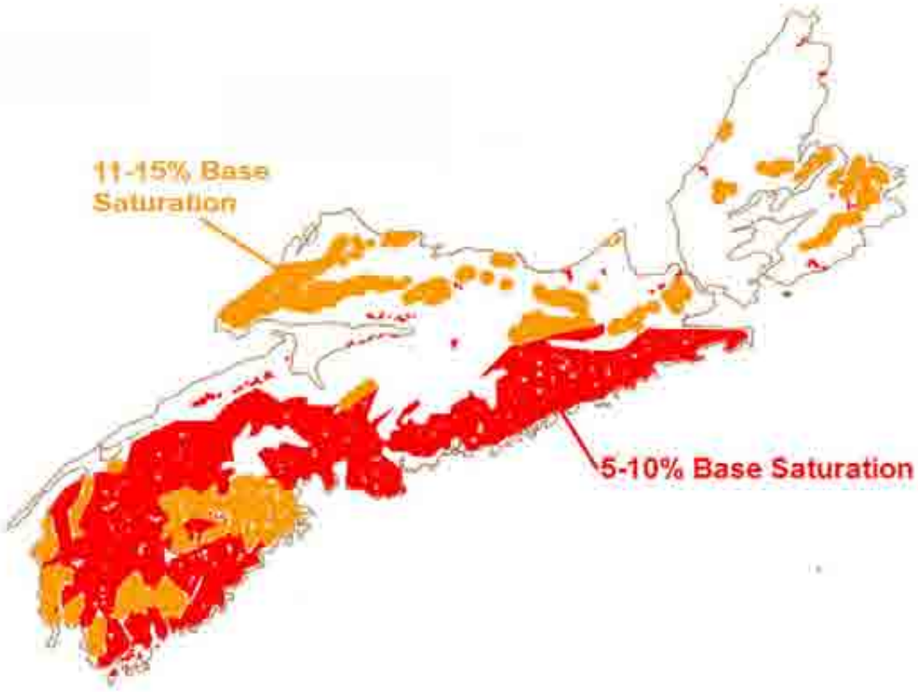
It is time to save what we can. *Sure, celebrate the progress represented by implementing one small element of Lahey's recommendations, but don't for a minute forget the big one: protecting and enhancing ecosystem health must from now on be the "overarching priority" in how this province manages its forests.* ***We need landscape level planning now, before any further damage is done.***

- Nina Newington on Extinction Rebellion Mi'kma'ki / Nova Scotia
May 26, 2022

Forests & Forestry in NS: Issue # 2

Low calcium / highly acidic / high aluminum soils on 60%+ of our landscape

A result of acid rain, logging & inherently poorly buffered soils

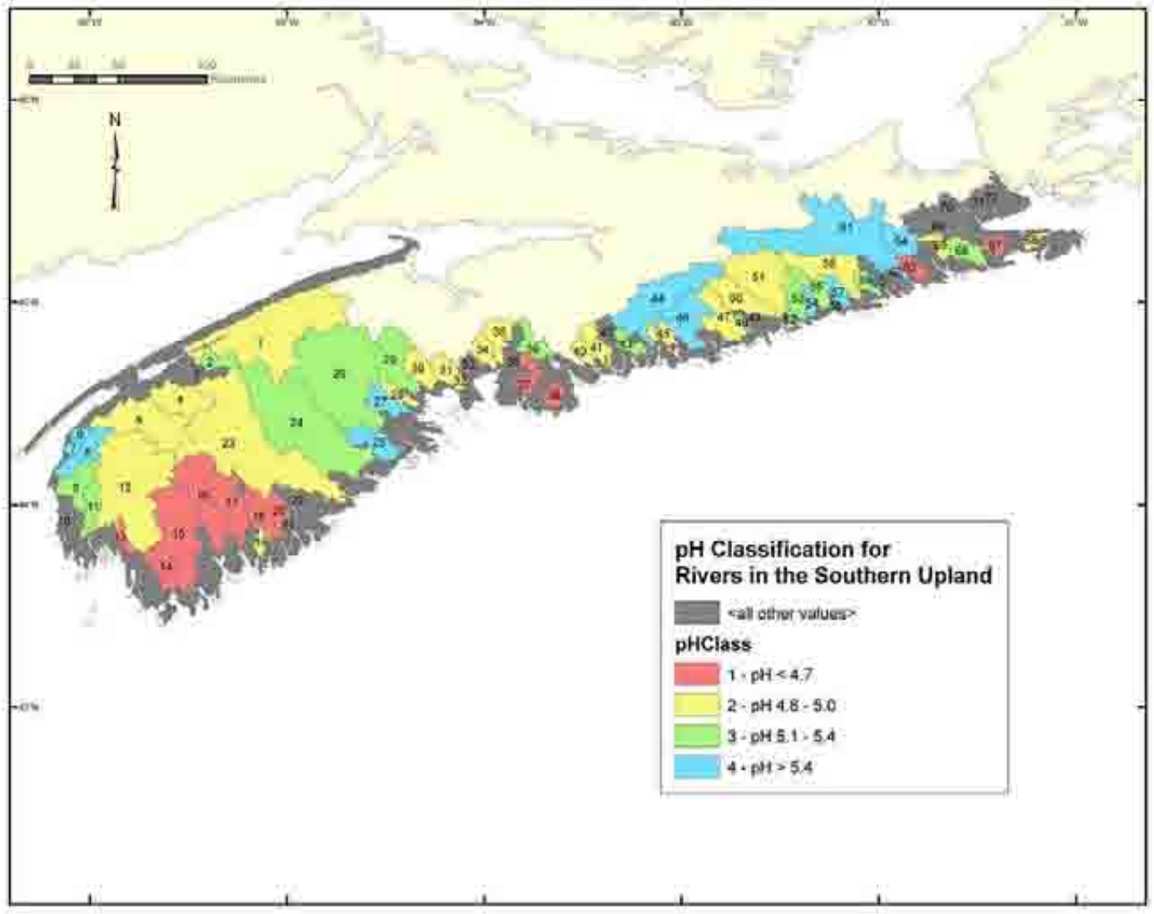


Sketch after Fig 3 in **A Simple Geospatial Nutrient Budget Model for Assessing Forest Harvest Sustainability across Nova Scotia, Canada**
by Kevin Keys et al., 2016 Open Journal of Forestry, 2016, Vol 6, pages 420-444.

Some of the Impacts on Terrestrial Life

- reduced growth/productivity of trees
- increase in disease, pests on plants
- habitat no longer suitable for some species plants & animals
- thinner egg shells (birds)
- aquatic aluminum levels exceed WHO guidelines for human health certain areas (testing of well waters advised)

The Map below shows watersheds of the endangered Southern Upland salmon populations and the average pH of surface waters.

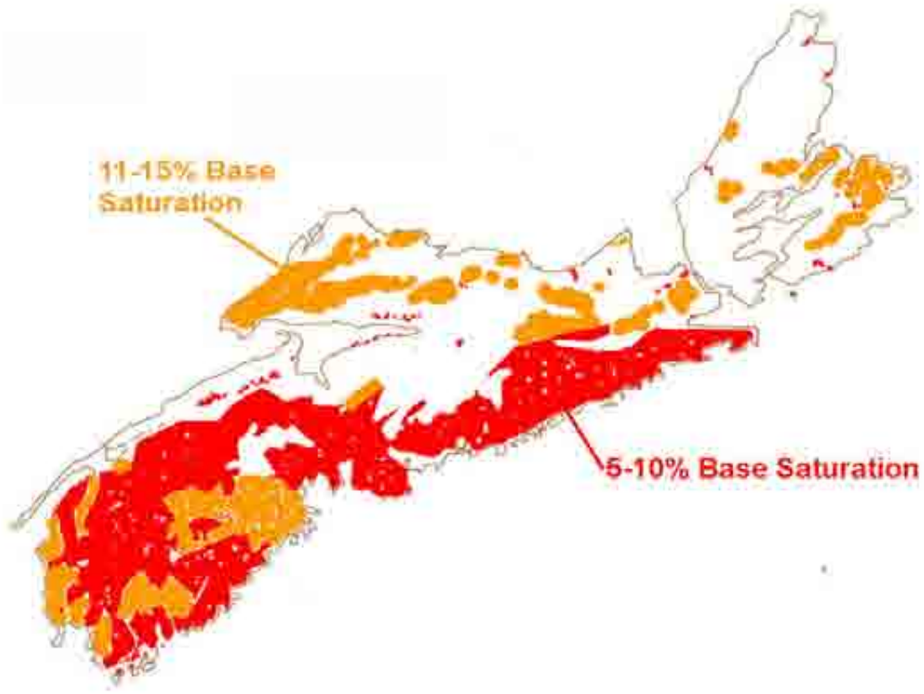


Classification of mean annual pH for rivers in the Southern Upland region
(Fig 16 in DFO. 2013. Recovery Potential Assessment for Southern Upland Atlantic Salmon. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/009)

"Salmon populations in extremely acidified systems ([RED] pH <4.7) are thought to be extirpated (13 rivers), reduced by 90% in moderately impacted systems ([YELLOW] pH = 4.7-5.0; 20 rivers), reduced by about 10% in slightly impacted systems (pH = 5.1-5.4; 14 rivers), and apparently unaffected when pH >5.4 (13 rivers) based on research in the 1980s."

Forests & Forestry in NS: Issue # 2

Low calcium / highly acidic / high aluminum soils on 60%+ of our landscape



Sketch after Fig 3 in **A Simple Geospatial Nutrient Budget Model for Assessing Forest Harvest Sustainability across Nova Scotia, Canada**
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Mitigation / Reversal

Aquatic biologists/ salmon & trout associations:
Aquatic---> Terrestrial Liming

Forestry (DNR/L&F/NRR):
- Fertilization of HPF (proposed)
- For EM: adjust harvests according to nutrient budgets

Transboundary
- Legislate further reductions in acidifying emissions
- Personal: reduce our "Acid Rain Footprints"


Bedford Basin
Sandy Lake


Sackville
Lower Sackville
Atlantic Superstore
Access Nova Scotia Sackville
Sackville Business Park
Cobequid Community Health Centre
Bedford
Sandy Lake
Sandy Lake Park
MD Centre
Charles P. Allen High School
Bedford
DeWolf Park
Bedford Basis


Sackville
Marsh Lake

Upper Peverill's Brook

Marsh Lake

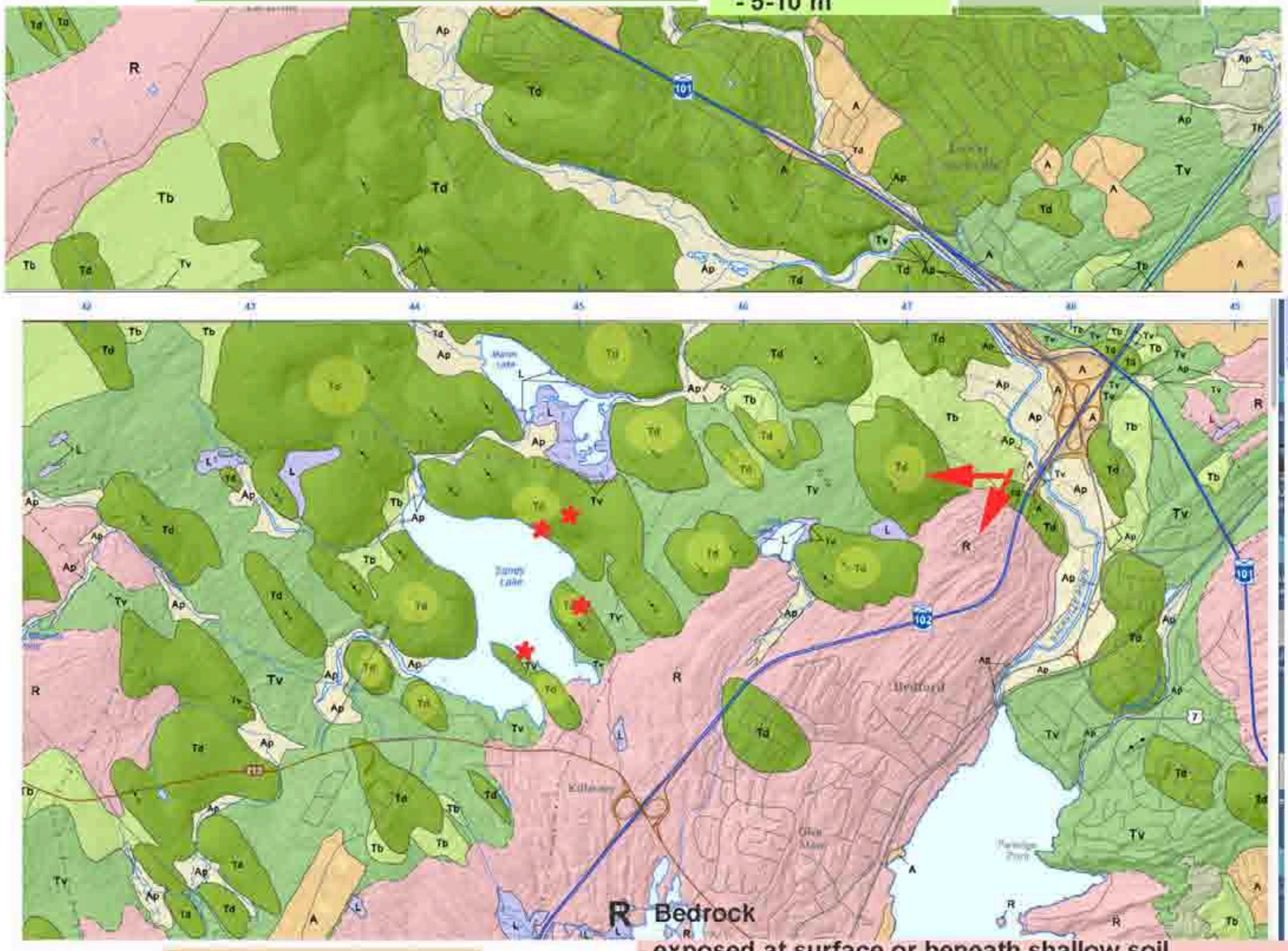
Forest, Wetlands
Streams, Lakes

Jack Lake

Td Drumlins - Elongate landforms with long axes parallel to ice flow, composed of up to 3 tills

Tb
Blanket till
-sand with clasts
- 5-10 m

Tv
Veneer till
-0.5 to 5 m



Ap - Alluvial
(stream deposits)

L - Lacustrine
(freshwater deposits)

***Old Forest Assessments**

NSWFS Oct 13

A -Anthropogenic

R Bedrock
- exposed at surface or beneath shallow soil
- may include minor fluvial, lacustrine and till deposits
- exposed surface is glacially scoured with ice movement feature such as striae,
- obvious strike ridges seen on the Lidar hillside image represent durable rocks with individual formations

From NSDNR Open File Map ME 2011-009
Surficial Geology Map D, J, Utting 2011

NOVA SCOTIA CANADA **Provincial Landscape Viewer**

Help NovaScotia.ca

Legend

Forestry

Forestry

Development Class

- Establishment
- Young Forest
- Mature Forest
- Multi-Aged / Old Forest

Marsh Lake

Sandy Lake

Killarney

Symonds Rd

Farmers Dairy Lane

Granville Rd

Monarch

Story Crt

Clearcut 2013

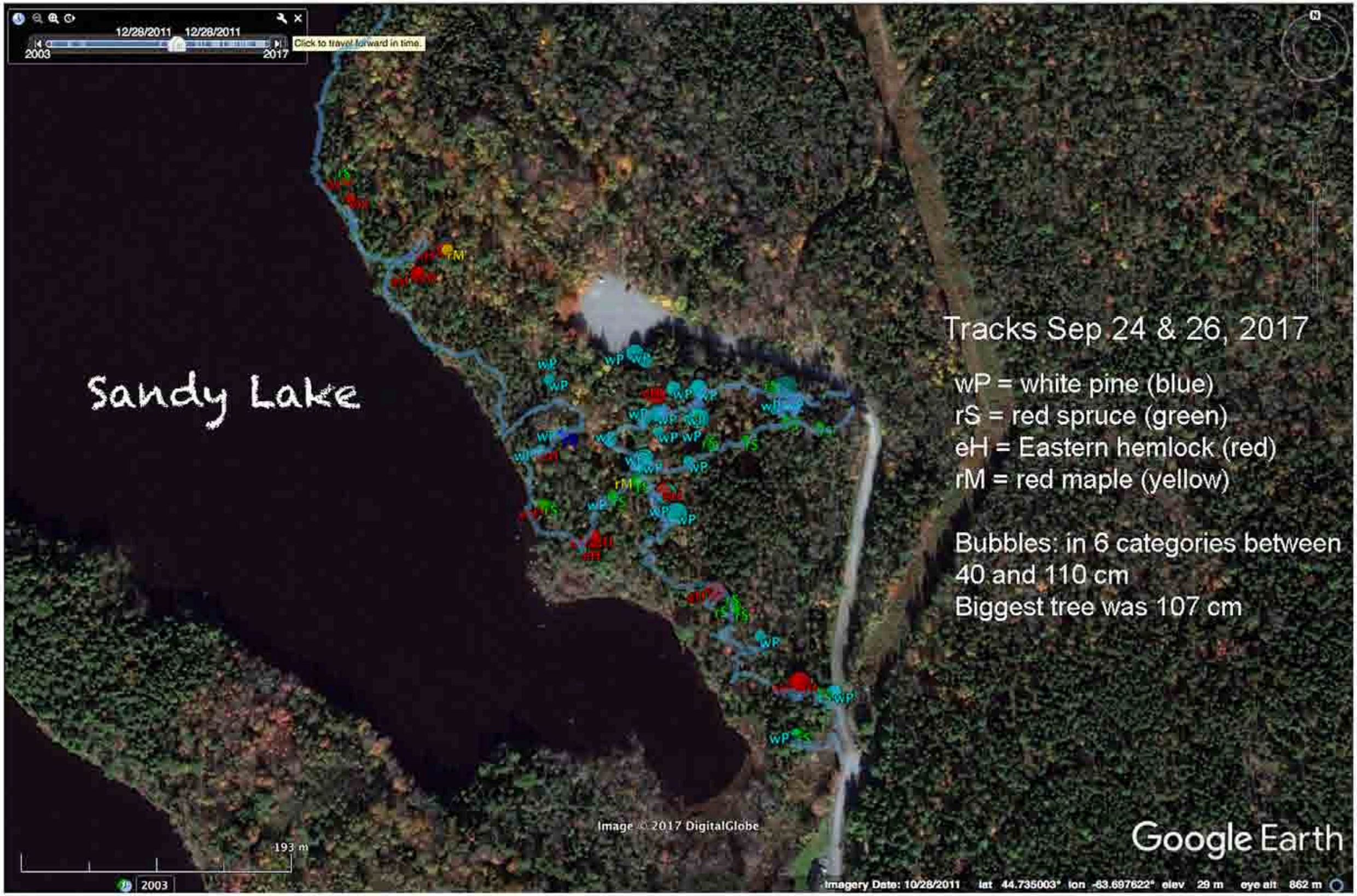
44.722 -63.667 Degrees

Service Nova Scotia and Internal Servi

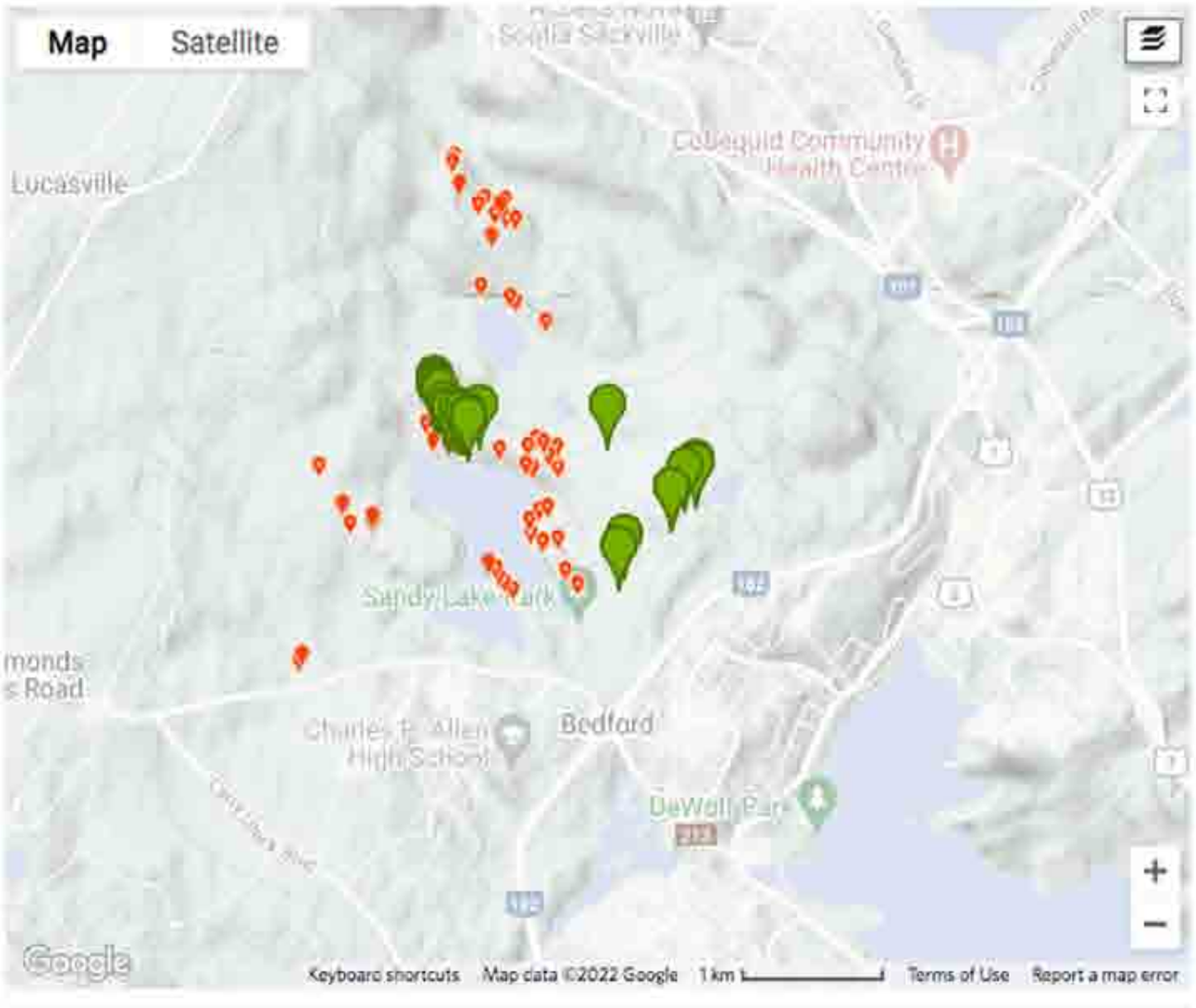

Marsh Lake
Sandy Lake
Jack Lake
Bedford
Aquatic tracks
Lake Stations
Land tracks
HRM conceptual boundary
Expanded
Google Earth
1425 m
2003


SONY
Carl Zeiss
50x


Some Citizen Science
Big Trees: 20”/50 cm dbh & greater
- I measure &/or estimate any tree
that looks at least 19” (48 cm) dbh
- Diameter = Circumference/3.14
- Record: Species, Lat & Long,
Diameter, Photos
- Include GPS track or sampling area
as appropriate


12/28/2011 12/28/2011
2003
2017
Click to travel forward in time.
Sandy Lake
Tracks Sep 24 & 26, 2017
wP = white pine (blue)
rS = red spruce (green)
eH = Eastern hemlock (red)
rM = red maple (yellow)
Bubbles: in 6 categories between 40 and 110 cm
Biggest tree was 107 cm
Image © 2017 DigitalGlobe
193 m
2003
Google Earth
Imagery Date: 10/28/2011 lat 44.735003° lon -63.697622° elev 29 m eye alt 862 m

Big Trees of Sandy Lake & Environs (Bedford, Nova Scotia)



Stats

Totals

202
Observations »

14
Species »

1
People »

Recent observations View All »

Grid List

Yellow Birch (*Betula alleghaniensis*) Research Grade

Notes

Two trunks, bigger one est'd dbh: 20"

Projects (3)

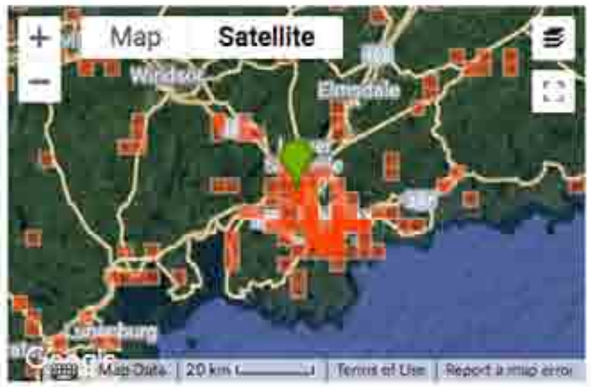
Add to a Project

- Nova Scotia Wild Flora
- Birches of Sandy Lake & Environs (Bedford, NS)
- Big Trees of Sandy Lake & Environs (Bedford, Nova Scotia)

jackpine22
1,321 observations

Observed:
Dec 12, 2020 · 1:38 PM AST

Submitted:
Dec 13, 2020 · 7:09 AM AST

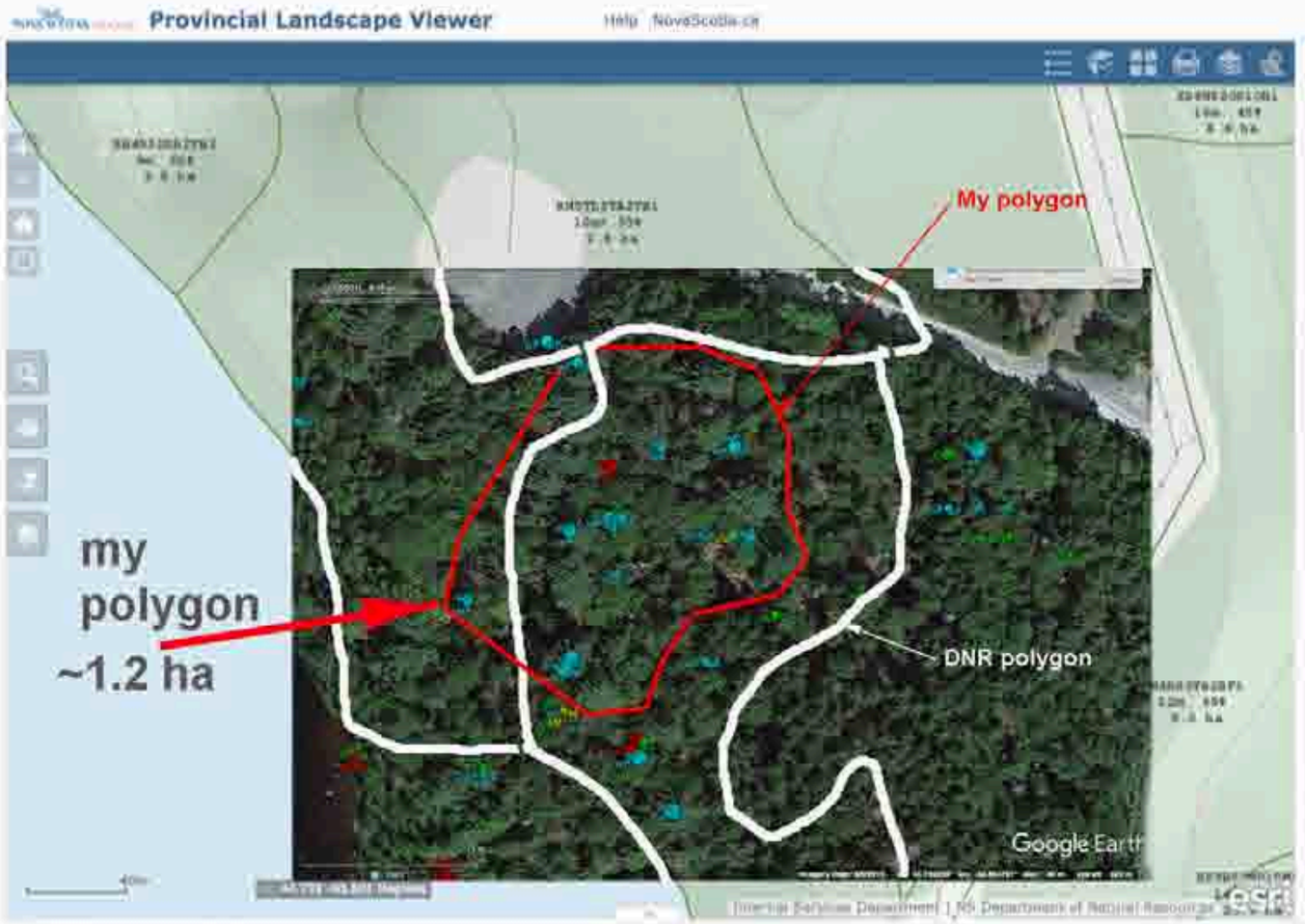


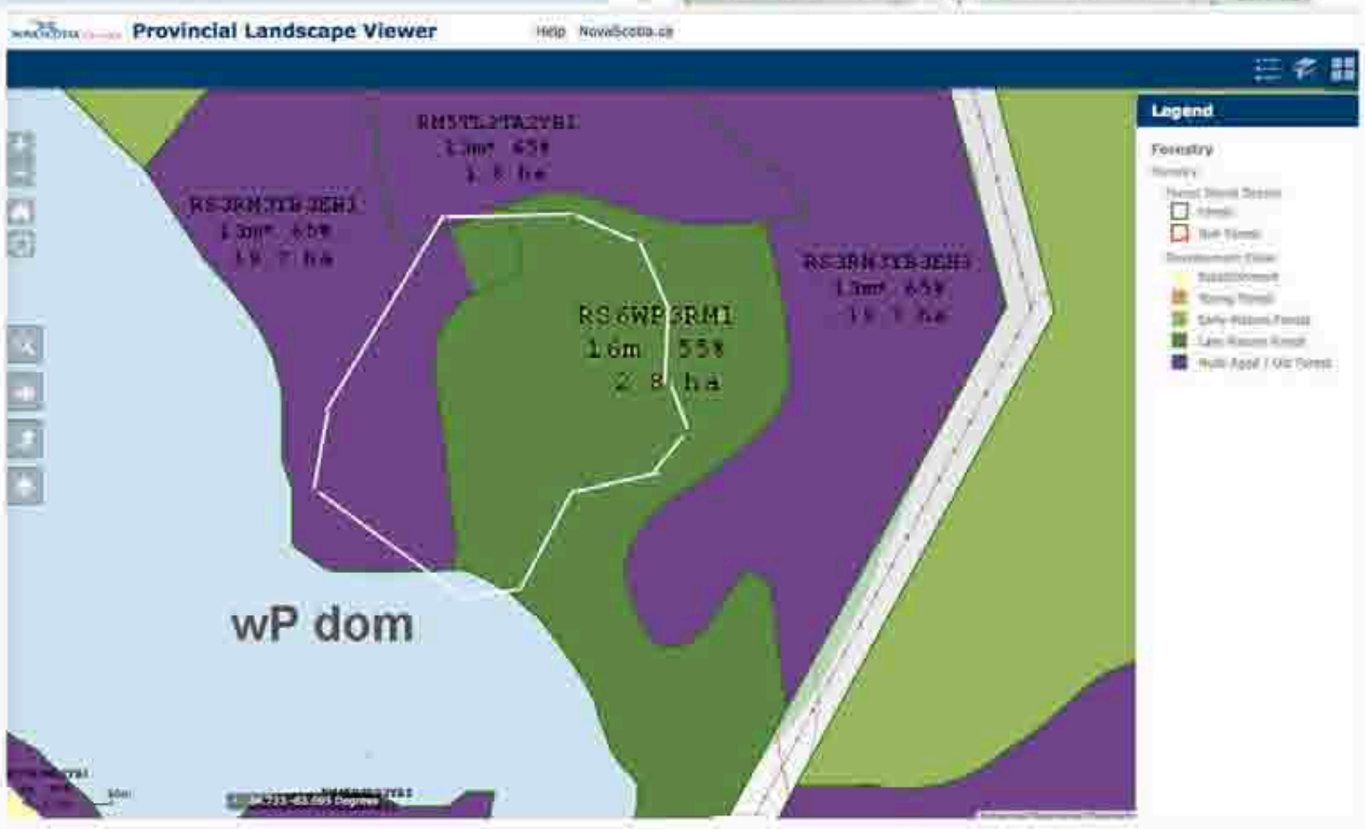
Bedford, NS, Canada Details

Yellow Birch (*Betula alleghaniensis*) Research Grade

Notes

In riparian area.
Circumference 62"=19.7" dbh
(estimated 22")


Provincial Landscape Viewer
Help NovaScotia.ca
My polygon
my
polygon
~1.2 ha
DNR polygon
Google Earth


Provincial Landscape Viewer
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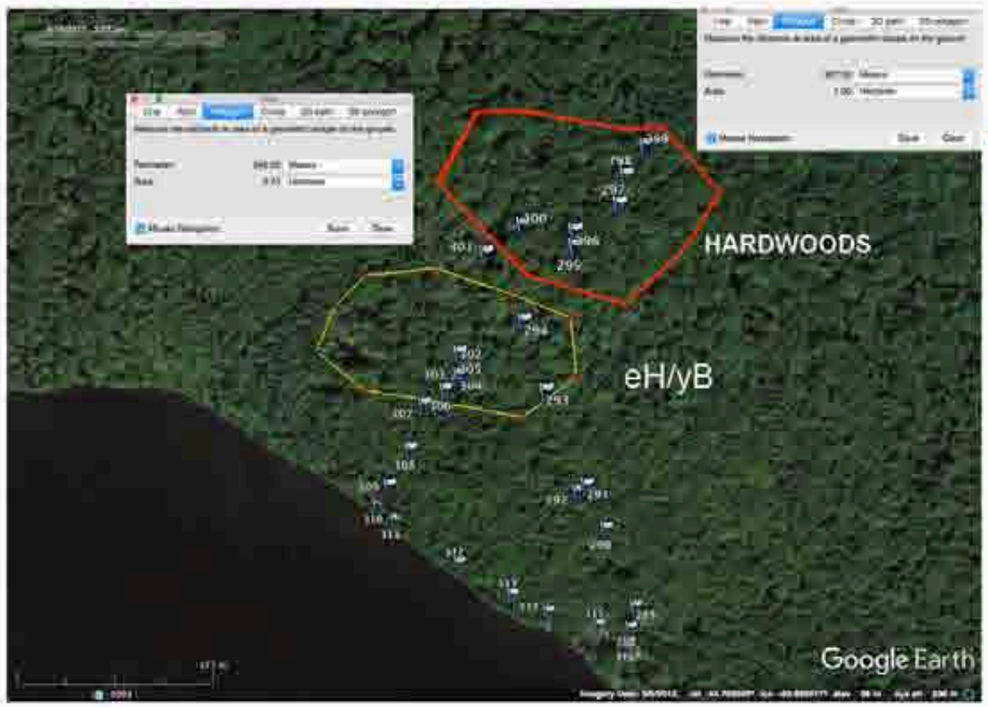
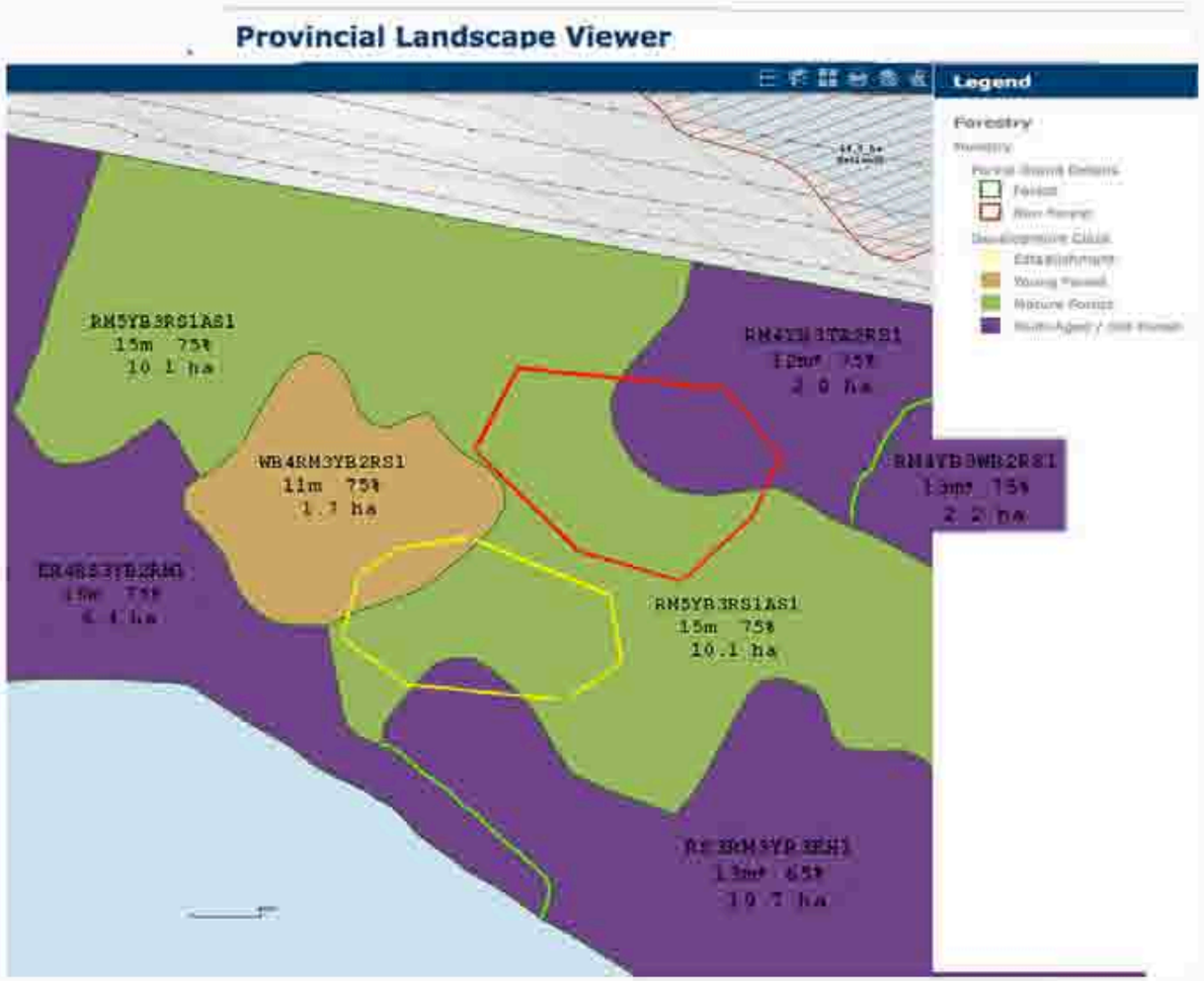




OFP2012

A **forest stand** where 30% or more of the basal area is in trees **125 years** or older, at least half of the basal area is composed of climax species, and total crown closure is a minimum of 30%.

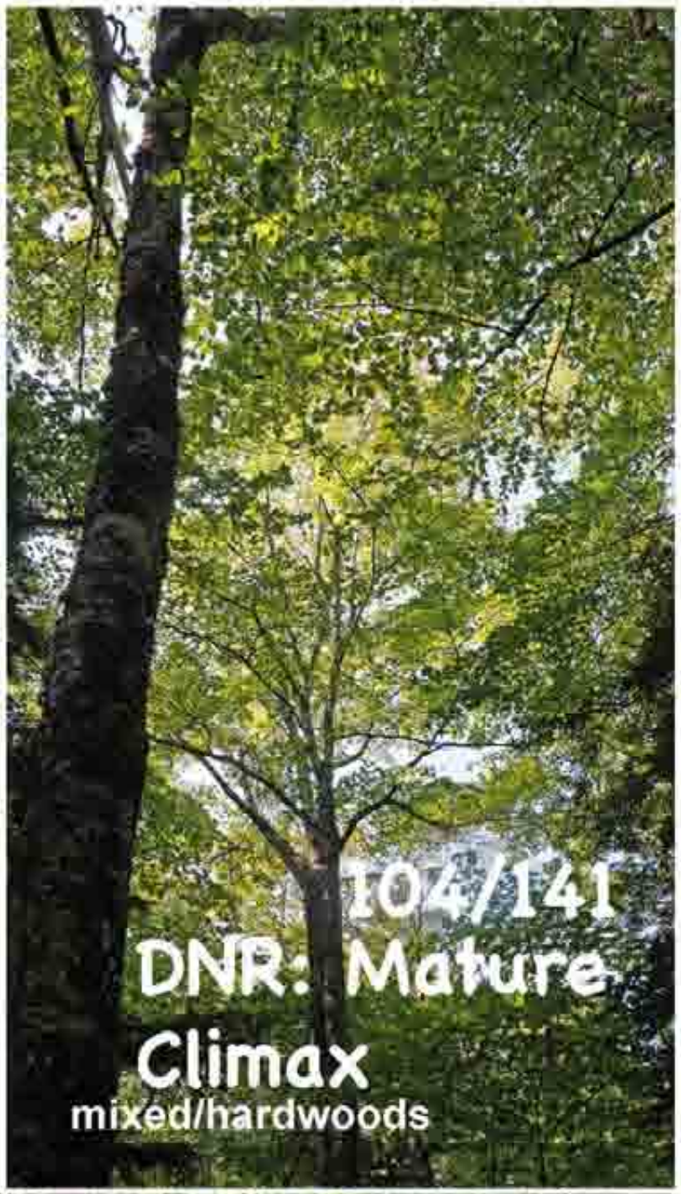
OGFP2021

Old-growth forest areas are herein defined according to the vegetation types, and the **old-growth ages in the table below**, as well as the history of past human interventions that have affected ecological continuity...no forest areas that have received a silvicultural treatment or timber harvest within 30 years of the date of approval of this Policy will be designated to be protected, ... A forest area is considered to be old growth if it is **larger than 1.0 hectare** in area and 20% or more of the basal area is greater than or equal to the reference age for that forest type.

FEC Forest Group[a]	FEC Vegetation Types[a]	Old-Growth Age[b]
Tolerant Hardwood	TH1, TH2, TH3, TH4, TH5, TH6, TH7, TH8	140
Spruce-Hemlock (red spruce dominant)	SH3, SH4, SH5, SH6, SH7	125
Spruce-Hemlock (hemlock dominant)	SH1, SH2	140
Mixedwood	MW1, MW2, MW3	125
Spruce-Pine	SP4, SP5. SP7, SP9	125
Wet Coniferous	WC1, WC2, WC5, WC8	100
Coastal (black spruce or balsam fir dominant)	CO1, CO4	100
Coastal (red spruce, white birch, or red maple dominant)	CO3, CO5, CO6	125
Highland (balsam fir or white spruce dominant)	HL1, HL2	100
Highland (yellow birch dominant)	HL3, HL4	140
Cedar[c]	CE1	110
Wet Deciduous	WD3, WD4, WD6, WD8	115
Floodplain	FP1, FP2, FP3	125
Karst	KA1, KA2	125

Collin Gray of Mersey Tobeatic Research Institute cores a tree at Sandy Lake to age it.

We conduct DNR Old Forest Assessment on 3 stands Oct 12, 13, 2017



Old Growth:

- fewer but bigger trees

- younger trees also present...gaps, multilayered

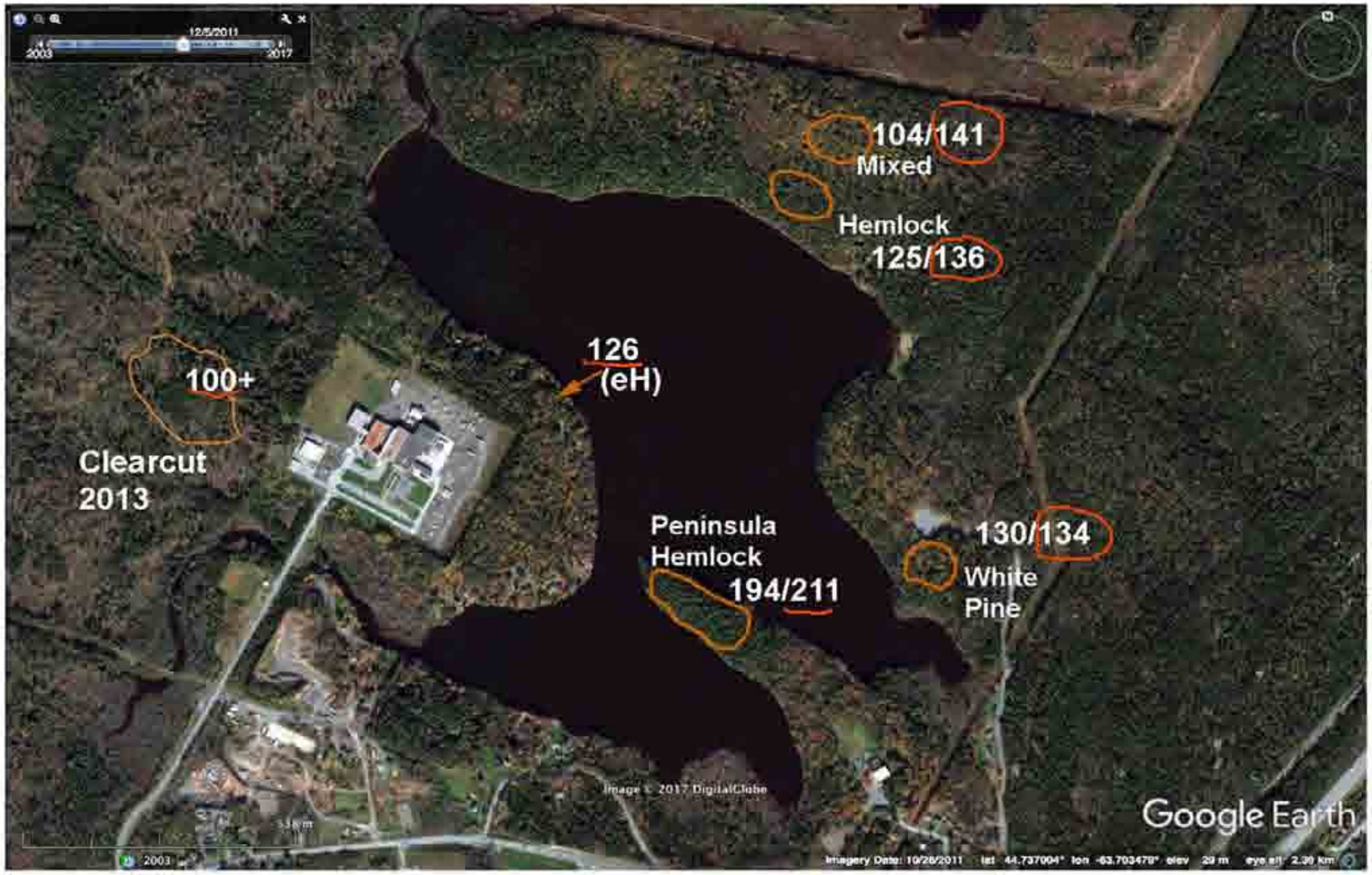
-lots of deadwood: snags & CWD; cavities

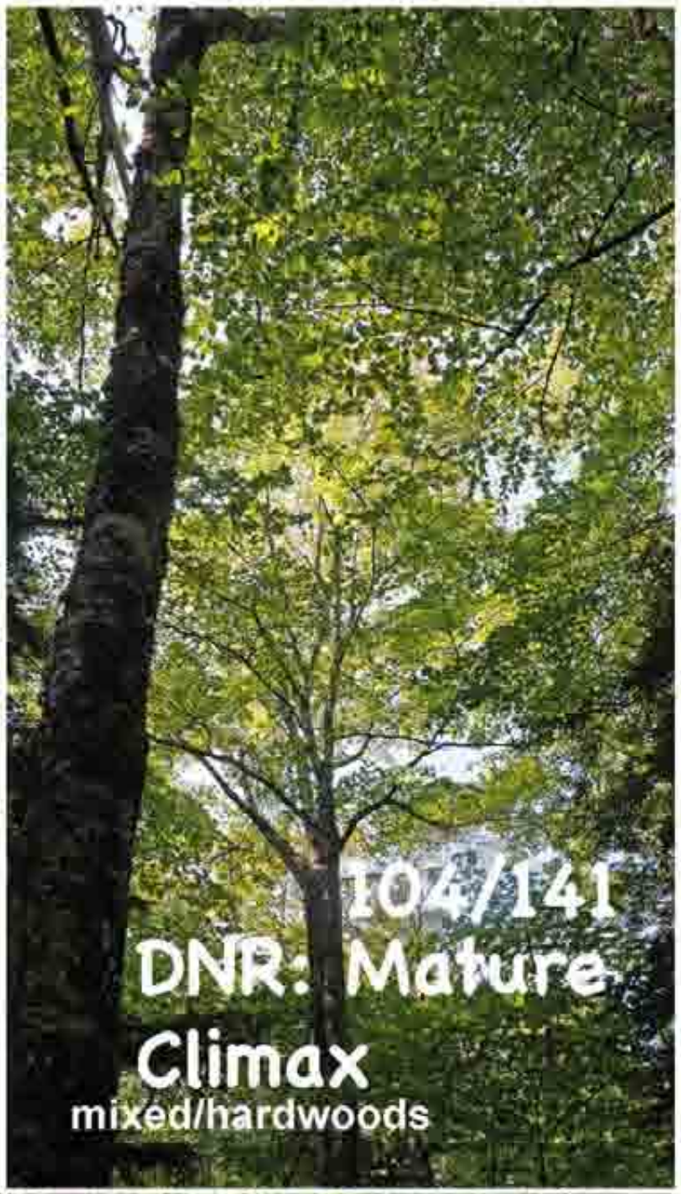
- trees with lichens, moss

- "spongy duff", beetles...

**forest floor not level but with "pits & mounds"

- Andrew Whitman of the Manomet Center for Conservation Sciences (Mass,) & Shawn Fraver of the University of Maine's School of Forest Resources cited by Joe Rankin in: "Old Growth" Forests Defined by Key Ecological Characteristics, Dec 20,2016 on http://www.forestsformainesfuture.org


12/5/2011
2003
2017
104/141
Mixed
Hemlock
125/136
126
(eH)
100+
Clearcut
2013
Peninsula
Hemlock
194/211
130/134
White
Pine
Image © 2017 DigitalGlobe
Google Earth
2003
Imagery Date: 10/28/2011 lat 44.737004° lon -63.703478° elev 29 m eye alt 2.30 km



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"One other telltale feature of an old growth forest is] the forest floor itself, said Whitman and Fraver. It's not, by any means, level. Instead it's characterized by dips and mounds.

"Not coincidentally they're more or less the size of a large tree's root ball and its accompanying soil.

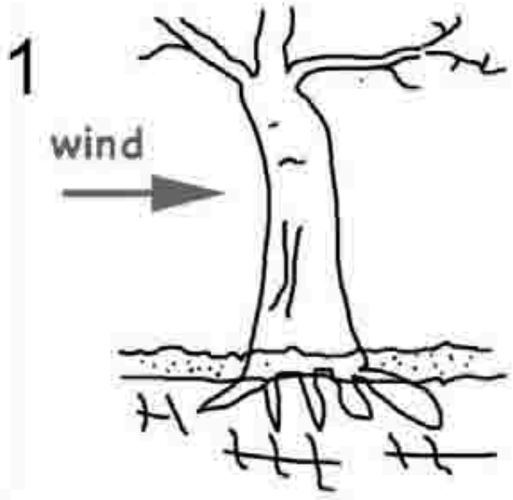
"This "pit and mound" topography occurs when old big trees are blown down, their roots upended. The mound is created by the exposed root ball, the hollow is where it once was.

"Gradually, over decades, the root rots and both the mound and pit are colonized by mosses, ferns, wildflowers and young trees.

"It could take an old field a thousand years to get that pitand mound topography," said Whitman. "In managed forests you rarely get that, because large trees are cut before they can fall down"

"The lack of pit and mound topography is a good indication that the land was once smoothed by the plow, even if it wasa century or two ago. For Fraver, there's one pretty sure indication that a forest wouldn't qualify it as old growth".

Dr. Elena Ponomarenko shows participants in the MTRI Old Forest Conference (Oct 19-21, 2016) how to read the forest floor to uncover past disturbances and forest types



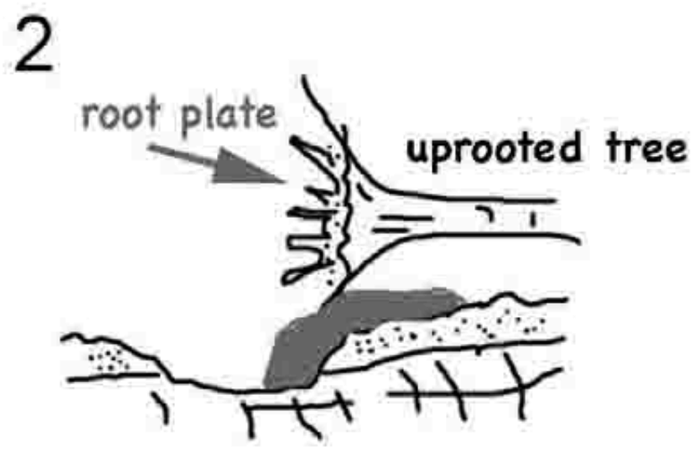
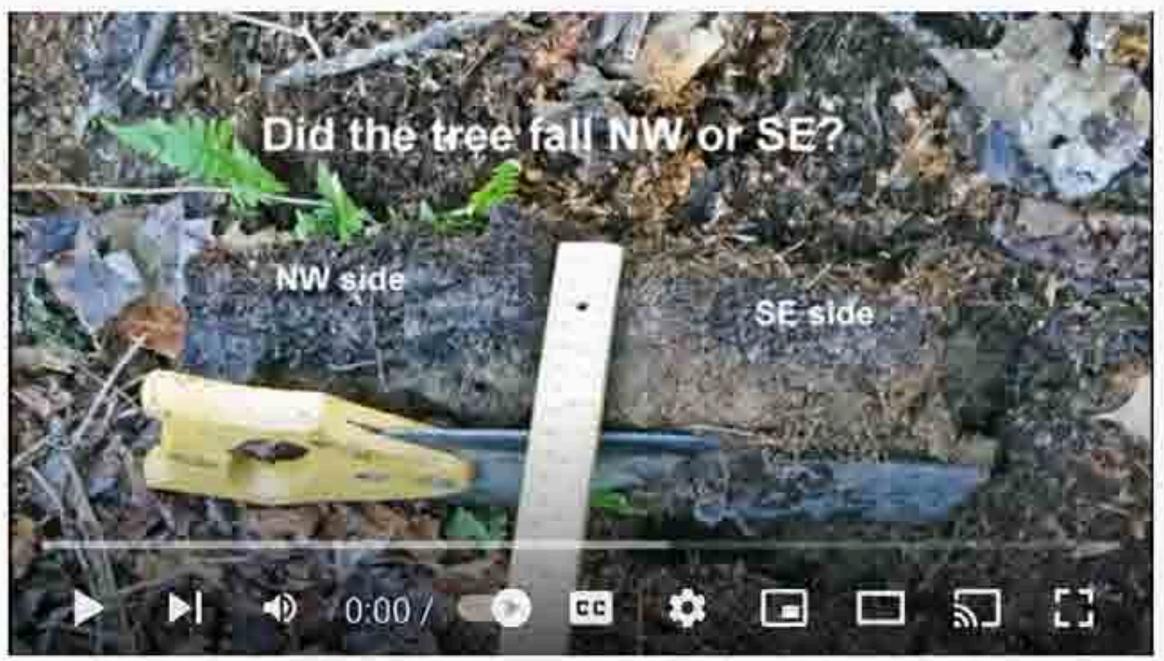
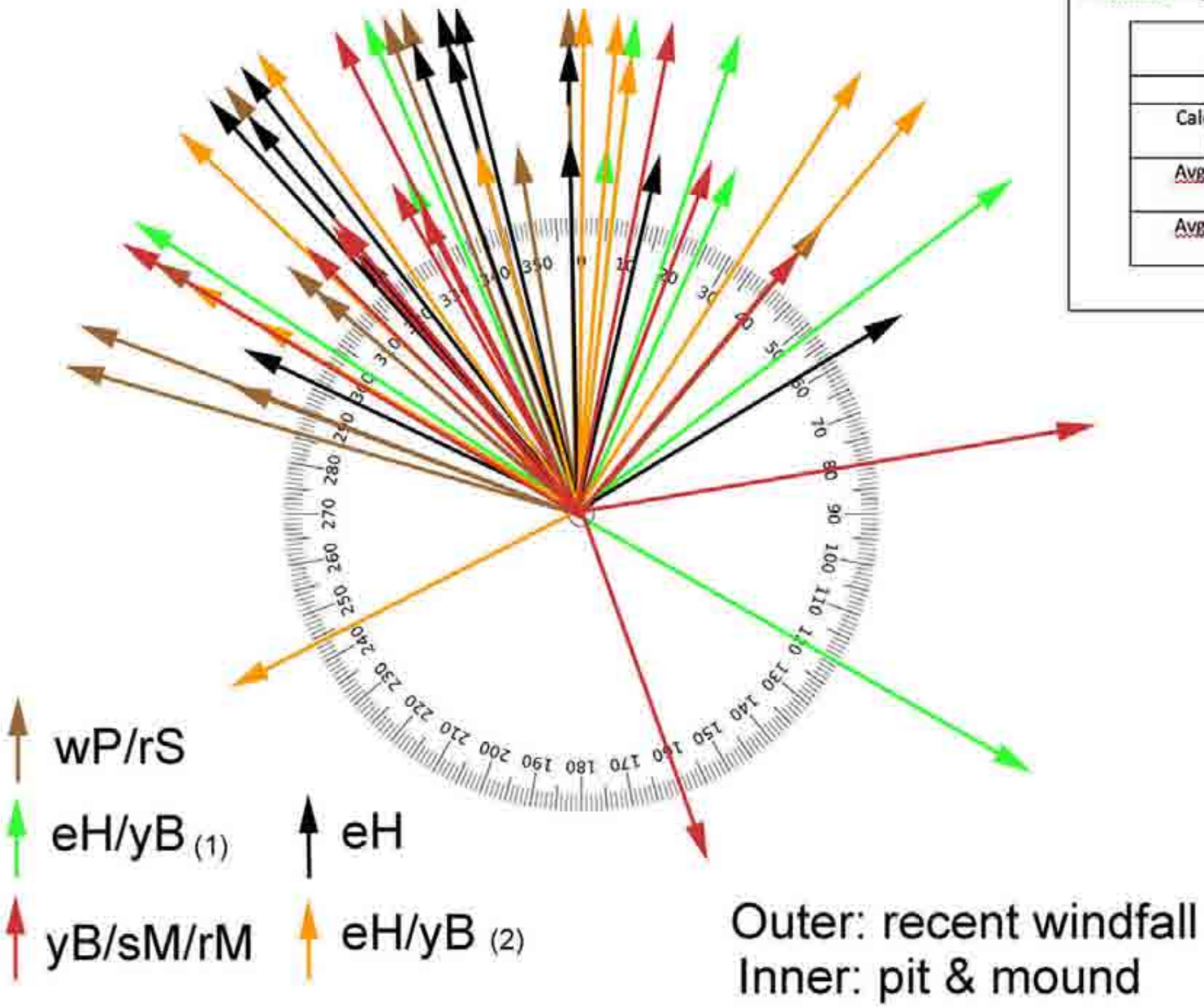


Diagram after Łukasz Pawlik 2013. **The role of trees in the geomorphic system of forested hillslopes** — A review *Earth-Science Reviews* 126: 250-265



Pit and mound: Inferring direction of tree-fall

Blowdown initiated by hurricane Juan

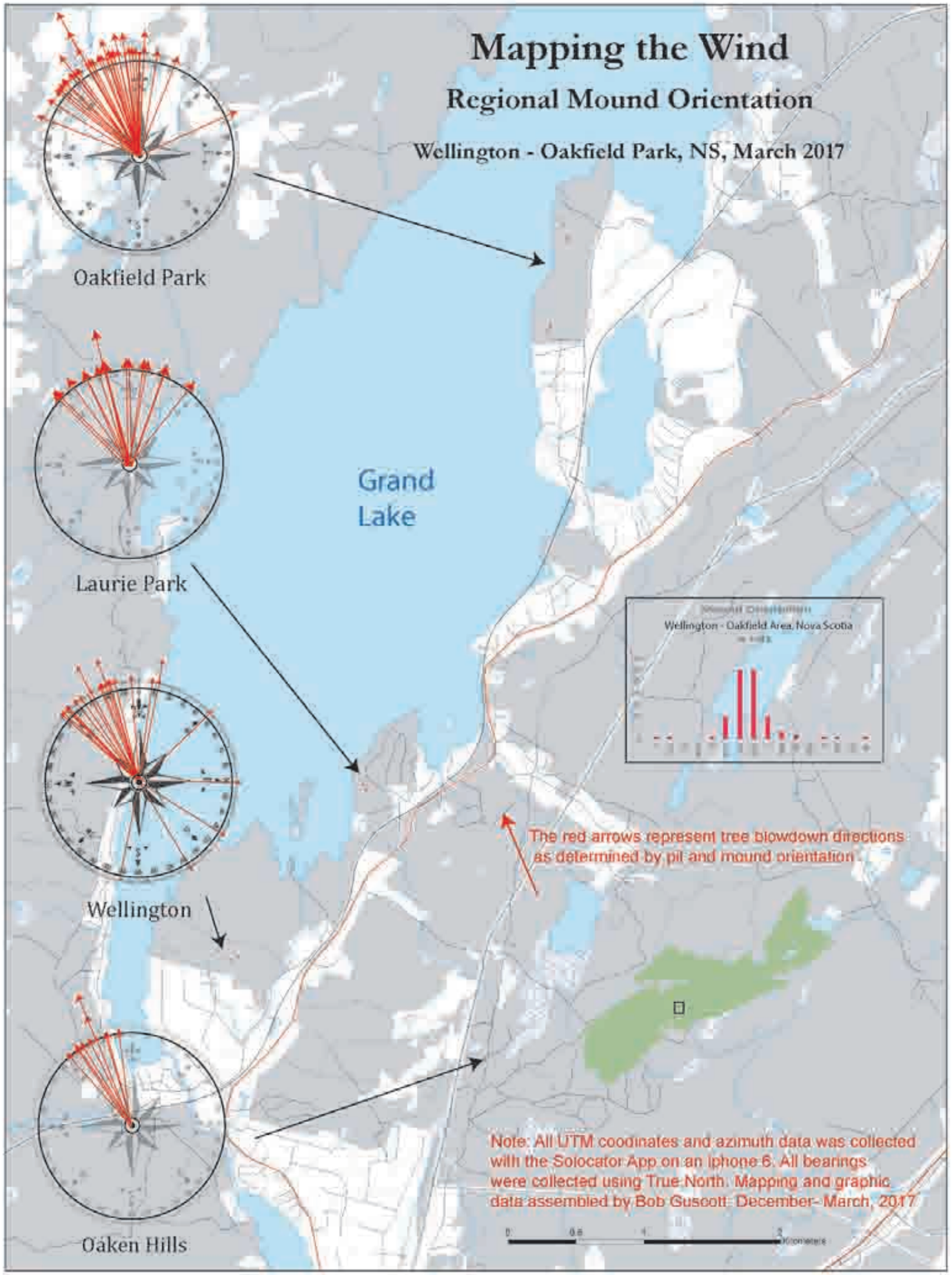


Mound density and widths at three old forest sites at Sandy Lake

Mound width is the dimension perpendicular to the inferred direction of the uprooted tree stem. i.e. it is the longest dimension of a mound.

Mound density is the number of mounds traversed over three, 25 meter transects, i.e. over 75 m all told. The 3 transects began at a single pit. The first or mid-transect was oriented in the "guesstimated" average direction of windfalls; the second transect was oriented approximately 30 degrees to one side of the first transect and the third at approximately 30 degrees to the other side. Mounds were classified as either H (high, approx. 50 cm +) or L (low, typically 10-30 cm height) as they were crossed.

Site: / Variable	White Pine	Hemlock	Mixed/ Hardwood
No. mounds/75 m:	10H, 14L	14H, 11L	8H, 9L
Calculated avg distance between H mounds:	7.5 m	5.36 m	9.38 m
Avg width of H mounds:	3.14 m (n=3) range: 2.6-3.6 m	3.63 m (n=6) range: 2.7-4.8 m	4.22 m (n=6) range: 3.5-4.5 m
Avg width of L mounds:	2.67 m (n=4) range: 1.9-3.2 m	3.05 m (n=4) 2.1-4.3 m	-


Mapping the Wind
Regional Mound Orientation
Wellington - Oakfield Park, NS, March 2017
Oakfield Park
Laurie Park
Grand Lake
Wellington
Oaken Hills
Wellington - Oakfield Area, Nova Scotia
The red arrows represent tree blowdown directions as determined by pit and mound orientation.
Note: All UTM coodinates and azimuth data was collected with the Solocator App on an iphone 6. All bearings were collected using True North. Mapping and graphic data assembled by Bob Guscott: December- March, 2017

How old are the mounds?

Roughly, it is the age of the oldest trees on the mounds + 10-20 years

140 +(10-20) = 150 to 160 and 2017-(150-160) = **1857 to 1867**

Mounds under The Peninsula hemlocks ~2015-(220-230) = **1785-1795**

Historical Storms

1759: A violent storm on November 3rd hit Halifax (Elliott 1979)...

1775: The "Hurricane of Independence" swept from North Carolina to Nova Scotia between September 2 and 9

** **1798 Smith (1802) referred to a "Great Storm"...September**

1811 A Hurricane...(fall)

1813: Violent gale hit the province on November 13th

1817 Hurricane strikes Cape Breton Island

1821 "The Long Island Hurricane" of September 1–4

1822 A severe March thunderstorm

1851 Yankee Gale

** **1862 A hurricane blew in the Antigonish area...October**

** **1869 "The Saxby Gale" of October 5th**

** **1872 The Jackson Gale**

** **1873 "The August Gale", also known as "The Nova Scotia Storm".**

1889 A cyclone touched down in Bellisle, Annapolis Co...June

List from Taylor et al., 2020 A review of natural disturbances to inform implementation of ecological forestry in Nova Scotia, Canada Environ. Rev. 28: 387–414

How common...?

Woodlands shaped by past Hurricanes

(originally published in Forest Times November 1979)
By David Dwyer, Forester

Department of Natural Resources and Renewables

(photo NSNR&R 2003)

"Many of our forest stands in Nova Scotia are a result of past hurricanes. Mounds on the forest floor -the result of uprooted trees – indicate this. The age of trees growing on these mounds give a good indication of when the storm occurred. These stand ages compare well with the written records of past storms...

"A common age of forest stands in Nova Scotia is 100 years. The origin of many of these stands is the blowdown resulting from Saxby's Gale.[1869] No doubt the Nova Scotia Storm of 1873 is a contributing factor too. George MacLaren writes in his Pictou Book that the storm of August 24, 1873 "... was probably one of the most severe and destructive that has visited our coast in years". He calls it "The Big Blow." "

As a guide for the future this chart shows what could be called storm and storm-free periods in Nova Scotia's past. Predictions are risky, but assuming a pattern does exist, storms might be expected within a few years of 1986, 2030 and 2035.

Note: Dwyer's 100 years in 1979 = 138 years in 2017 , i.e. in the range of the ages at 3 Sandy Lake stands in 2017

How common...?

Cooks Brook, NS, Oct 6, 2018
Conform Limited/NSWOOA Field Day

2ft+ dbh red spruce, hemlock and yellow birch; some red maple; occasional sugar maple and ash.

Max Age sawed trees: "About 140 years"

Inferred treefall orientation: (mounds): 298-357 deg (n=8)

Mound **eH/yB**

Mini-Forwarder/"light touch"

An Old-Growth Forest Policy for Nova Scotia:
Version 8, 2021-10-14

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Cedar[c]	CE1	110
Wet Deciduous	WD3, WD4, WD6, WD8	115
Floodplain	FP1, FP2, FP3	125
Karst	KA1, KA2	125

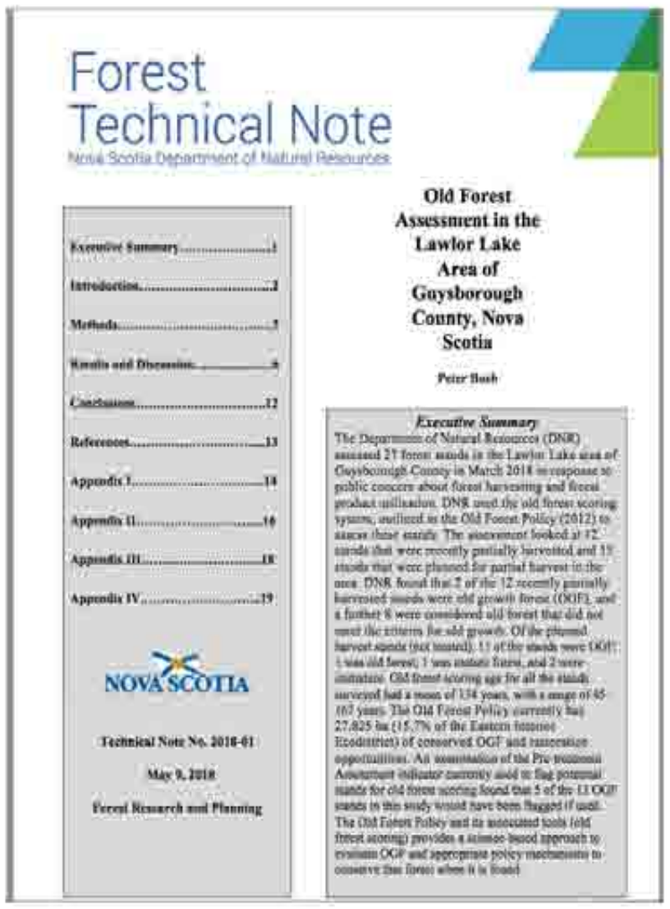
Proposed: a change from a single age of 125 years old for six "Climax Species" (OFP 2012) to a range of ages (OGFP 2021) going from 10O to 140 years old depending on the Forest Group.

– The critics were right — old-growth forest being cut in Nova Scotia
Nina Corfu for CBC News, May 17, 2018

In the report, Natural Resources forester Peter Bush concluded that two of 12 forest stands that were partially harvested by Port Hawkesbury Paper earlier this year in the Lawlor Lake area of Guysborough County contained old-growth forest.

It also found that eight of 15 stands in the queue to be cut also contained old-growth forest.

Danny George raised the alarm about cuts of Old Growth hardwoods in the Loon Lake area in Feb, 2018



Forest Technical Note

Nova Scotia Department of Natural Resources

Old Forest Assessment in the Lawlor Lake Area of Guysborough County, Nova Scotia

Peter Bush

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NOVA SCOTIA

Technical Note No. 2018-01

May 9, 2018

Forest Research and Planning

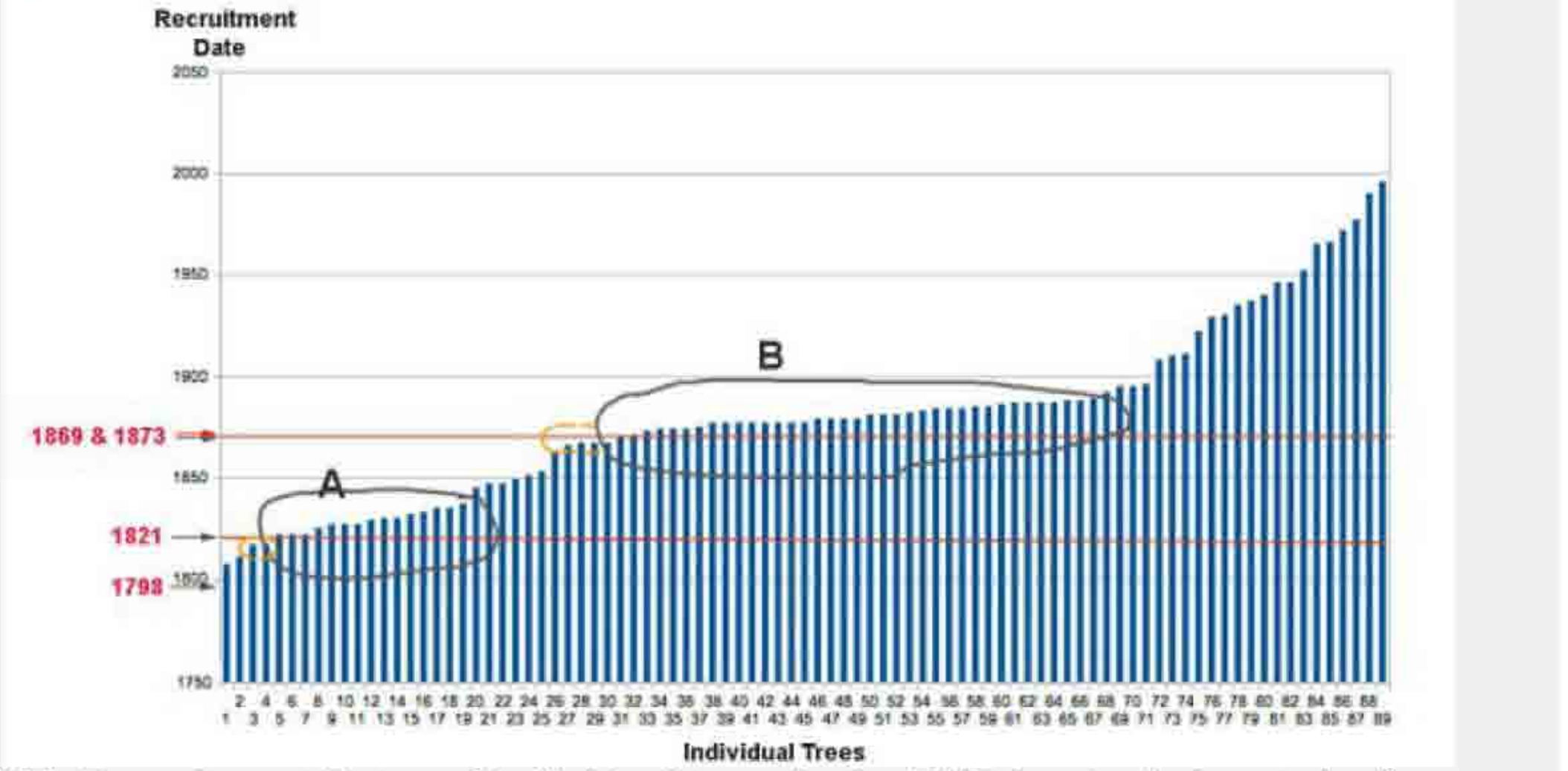
Executive Summary

The Department of Natural Resources (DNR) assessed 27 forest stands in the Lawlor Lake area of Guysborough County in March 2018 in response to public concern about forest harvesting and forest product utilization. DNR used the old forest scoring system, outlined in the Old Forest Policy (2012) to assess these stands. The assessment looked at 12 stands that were recently partially harvested and 15 stands that were planned for partial harvest in the area. DNR found that 2 of the 12 recently partially harvested stands were old growth forest (OGF), and a further 6 were considered old forest that did not meet the criteria for old growth. Of the planned harvest stands (not tested), 11 of the stands were OGF, 1 was old forest, 1 was mature forest, and 2 were immature. Old forest scoring age for all the stands surveyed had a mean of 134 years, with a range of 65-167 years. The Old Forest Policy currently has 27,025 ha (15.7% of the Eastern Interior Ecodistrict) of conserved OGF and conservation opportunities. An examination of the Pre-treatment Assessment indicator currently used to flag potential stands for old forest scoring found that 5 of the 13 OGF stands in this study would have been flagged if used. The Old Forest Policy and its associated tools (old forest scoring) provides a science-based approach to maximize OGF and appropriate policy mechanisms to conserve this forest when it is found.

Appendix III: Old forest scoring results

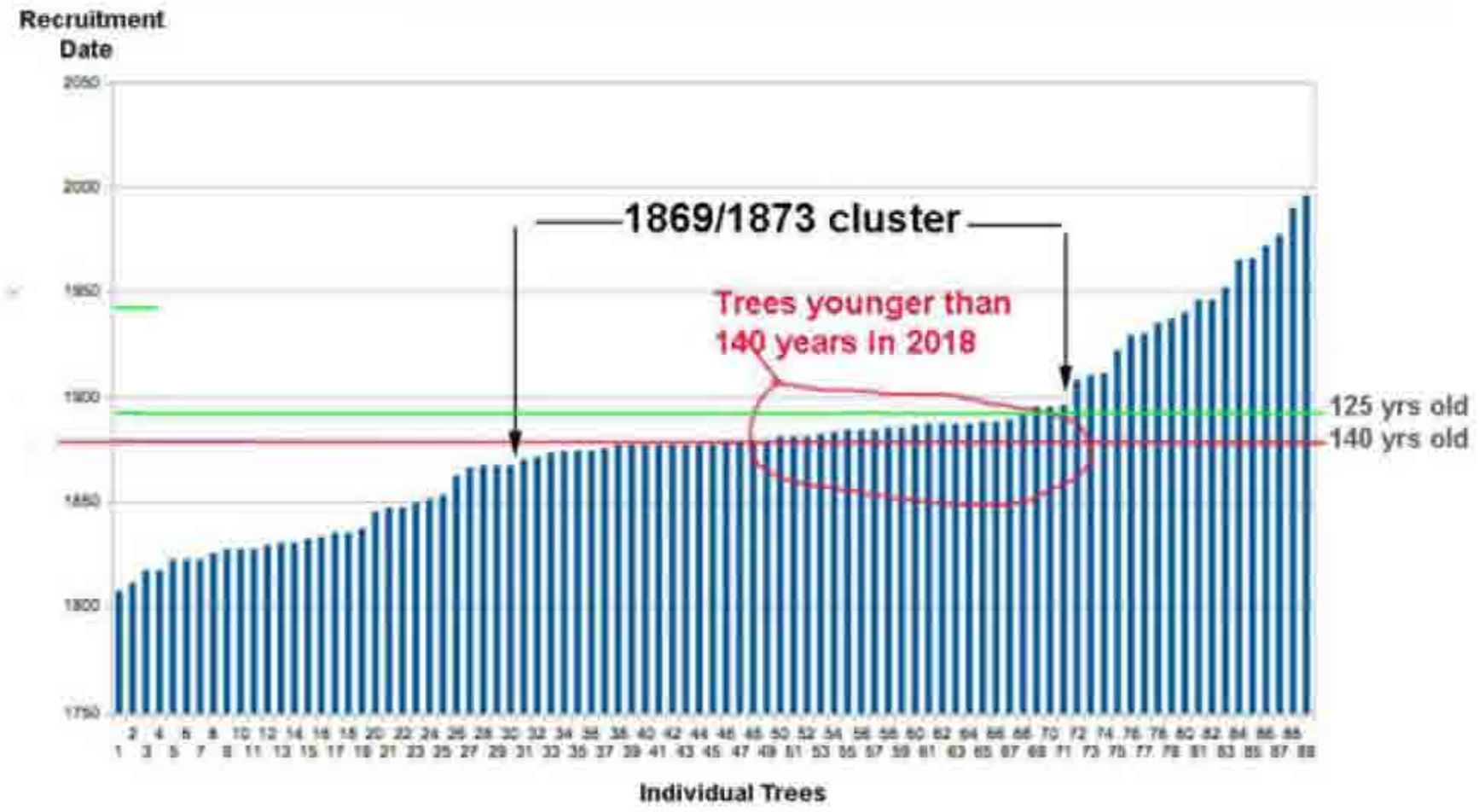
Stand	Old Forest	Age	OF score	Age Score	Primal Value	Dia-meter	Total Bole Standing and Fallen	Over-story	Stand Structure	# 40 cm trees per ha	# 50 cm trees per ha	# 60 cm trees per ha	CLIMAX %
1	OGF	136	70	30	10	15	5	5	5	68	26	6	54.5
2	OLD	130	68	30	10	15	3	5	5	27	20	6	25.6
3	OGF	136	65	30	10	15	0	5	5	42	21	6	51.5
4	OGF	137	50	30	10	0	0	5	5	32	5	2	54.3
5	OLD	147	50	30	10	0	0	5	5	36	11	3	32.7
6	OLD	164	50	30	10	0	0	5	5	29	11	5	46.7
7	OLD	136	53	30	10	0	3	5	5	44	12	5	44.9
8	OLD	171	65	30	10	15	0	5	5	41	24	9	43.8
11	OGF	133	65	30	10	15	0	5	5	63	20	10	75.7
13	OLD	131	53	30	10	0	3	5	5	15	11	2	23.3
14	OLD	130	50	30	10	0	0	5	5	31	3	0	37.5
17	MATURE	101	55	20	10	15	0	5	5	30	21	6	27.9
18	MATURE	122	40	20	10	0	0	5	5	19	5	5	44.4
19	IMMATURE	45	14	0	10	0	0	2	2	0	0	0	6.0
22 A	OLD	133	53	30	10	0	3	5	5	44	19	4	39.2
22 B	OGF	178	60	40	10	0	0	5	5	49	13	0	61.3
23	IMMATURE	67	28	5	10	0	3	5	5	5	0	0	0.0
24	IMMATURE	79	30	10	10	0	0	5	5	5	0	0	3.0
26	OGF	142	55	30	10	5	0	5	5	82	13	2	68.1

Data from **Old Forest Assessment in the Lawlor Lake Area of Guysborough County, Nova Scotia** by Peter Bush, NSDNR. 2018 "This report presents the detailed findings of an old forest assessment of 27 forest stands in the Lawlor Lake area of Guysborough County, Nova Scotia. The assessment was undertaken in March of 2018 in response to public concern about forest harvesting and forest product utilization in the area.



ABOVE: Recruitment Dates of individual trees in the DNR Lawler Lake study (from Bush 2018) ordered left to right from earliest Recruitment Date to the most recent. Dates in red correspond to storms cited by Dwyer 1979. The envelopes circle plateaus suggestive of a suite of recruitment associated with (A) the 1821 storm, and (B) the 1869 and 1873 storms together. The orange circles to the left are trees that would be included if a few years were added to the recruitment dates to allow the time required to breast height. All of these trees were hardwoods – yellow birch, sugar maple, red maple.

Data from **Old Forest Assessment in the Lawlor Lake Area of Guysborough County, Nova Scotia** by Peter Bush, NSDNR. 2018 "This report presents the detailed findings of an old forest assessment of 27 forest stands in the Lawlor Lake area of Guysborough County."



Most of the trees in the 1869-1873 cluster are at least 125 years old, but about half are not 140 years or older. So if the critical age were raised from 125 to 140 years, many of these hardwood stands – would not be rated as OG and so not protected. Yet they are all part of the same age cluster.

Is that what we want? I don't think so.

The simplest way to solve that issue is to **lower the minimum age to 100 years**. It makes sense in order to protect more habitat supportive of old forest species; and it makes sense technically, given the history of massive blowdowns in our forests.

Pit and Mound formation is an integral aspect of forest dynamics.

→ If an Old Growth forest blows down -- is it still "Old Growth"?*

"In the eastern boreal forest of Quebec (Canada) windthrow is a major natural disturbance, given the long fire cycle interval…

"From an ecosystem management perspective, retention patches with dead wood and standing living trees should be kept in salvaged cut-blocks.

"To minimize salvage operation effects on microtopography, machinery trails should be reduced to a minimum. Also, a certain proportion of windthrow should be exempted from logging operations."

from: Forest structural attributes after windthrow and consequences of salvage logging
by Kaysandra Waldron et al., 2013 in *Forest Ecology and Management*

→ *A: yes, if we don't remove the blowdown

Pits & Mounds: Some of their Natural Values

-Vernal Ponds (in pits, transient)

-Animal shelter, hibernacula (transient)

--Stumps & Mounds are preferred habitat for many trees, other plants

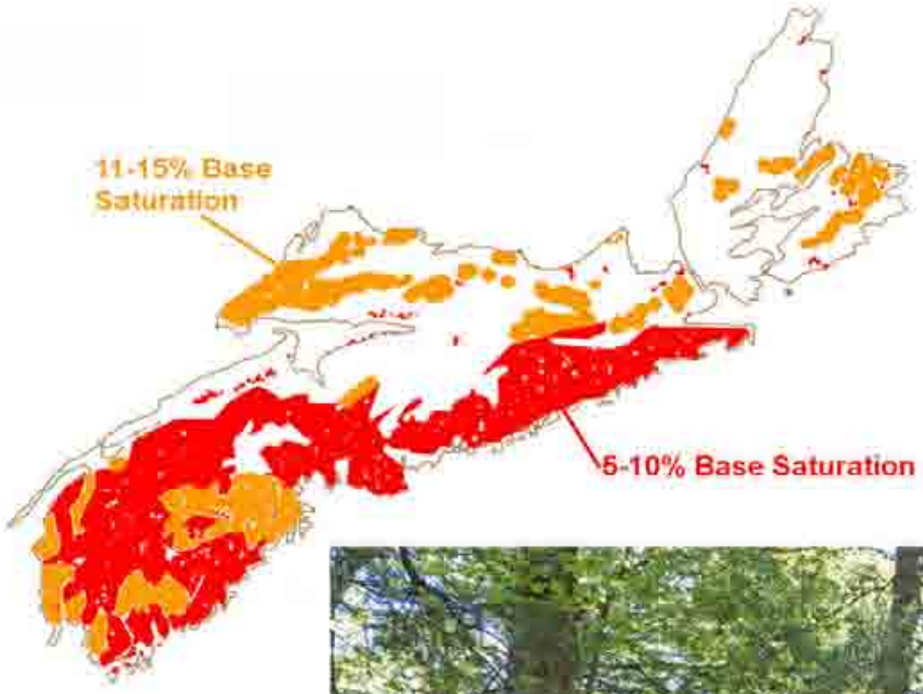
- Repeated formation mixes soil, moves rocks upwards and across landscape

Vernal Pool

-Hypothesis: Mounds provide continuity of *Mother-Tree* fungi and other microflora & fauna

--Spiritual: We live amongst the elders

Yellow Birch & E. Hemlock on a mound
"A Wabanaki Forest Love Affair"



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Pit and Mound topography in **Old Growth** hemlock/yellow birch forest by Sandy Lake (Bedford, NS).

Wil Brunner explains “Forest Bathing”