Hardwood, Shrubs, and Nature's Dynamics
of the Maritimes and Northern New England

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FURTHER BARK KEYS:

Bark colors: WHITE: gray birch **A**; white birch **B**; WHITE POWDERY trembling aspen **E**; SILVER: old pin cherry **C**; LIGHT GRAY: Indian pear **F**; red maple **F**; GRAY: muscled: beech **A**; warty lenticel mountain ash **C**; cracks > strips red maple **G**; rough sugar maple **G**; GREENISH GRAY: large-toothed aspen **E**; GREEN: striped maple **F** mountain ash **C** GREENISH BROWN: balsam poplar **E**; northern red oak **I3**; REDDISH BROWN pin cherry **C**; black cherry **D**;

Horizontal Fine Cracks: balsam poplar **E**; sugar maple **G**; basswood / linden **I2**; black locust **I3**; CREATING BLOCKS London plane **D**;

Horizontal wrinkles: beech **A**; trembling aspen **E**;

Vert. cracks show inner bark: ORANGE or RED: black cherry **D**; large-toothed aspen **E**; sugar maple **G**; Norway maple **I1**; northern red oak **I3;** American elm **I3**

Spongy Ridges: white ash **I1**; basswood / linden **I2**; American elm **I3**;

Smells / tastes: WINTERGREEN: yellow birch **B**; BALSAM SMELL (and sticky): balsam poplar **E**; SALICIN: trembling aspen **E**; large-toothed aspen **E**; balsam poplar **E**; willow **I2**; ALMOND: black cherry **D**;



A – Smooth Bark **B** – Bark with Peels **C** - Warty Hort. Lenticel



D – Warty Lent. > Scales **E** – Diamond Lenticel > **F** – Stripes > Vert. Crack



G – Vert. Crack > Vert. Strips **H** Ridges Broken **I** –Vert. Ridges: fine, wide, weave
J – Cankers, Galls, Burls, Sapsucker Holes, Scars, Frost Cracks

Compare your plant's bark, leaf, fall color, seed, or flower with the pictorial table of contents to select the group it belongs. Under "Leaves" you'll find uses for animals and people. In "Nature Dynamics" you will find the mutualism of nature.



K – Compound Leaves **L** – Lobed Leaves **M** – Round & Egg-Shaped



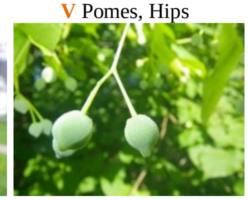
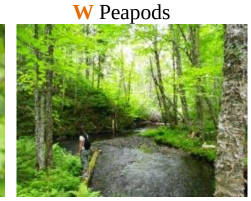
N Asym; Heart; **O** Oval, Elliptical, & Lance [**P** – Fall Pigments] **Q** Flower Cluster



R Lobed, Bell, or Urn **S** Tiny, Scrawny, or No Petals **T** Catkins



U – Berry clusters **V** Pomes, Hips **W** Peapods

X Samaras **Y** Husks, Capsules, Acorn, Cones **Z**– Nature's Dynamics

A Smooth Bark

Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

B Smooth Bark with Peels

See mountain ash & pin cherry at C

Beech A J1 Oel Pyb Y1

Fagus grandifolia

beech: elliptical, coarse-teeth pleats

American beech Rec. Park, Bible Hill

American beech Earltown Mt.

American beech Rec. Park, Bible Hill

American beech Rec. Park, Bible Hill

American Beech

CONTAINS: Sabinene

BARK: Smooth light gray > with a few horiz. wrinkles in branch arm pits. Some beech get bark disease or circular beech canker. See J1.

HABITAT: Moist, well-drain, hardwood

A, B **[Smooth; With Peels]**

Gray Birch A J4 L1 Py Y4

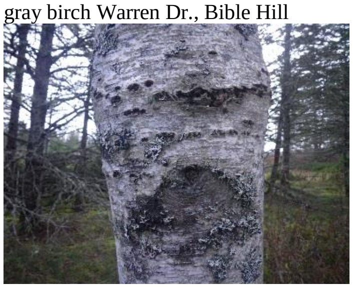
Betula populifolia

gray birch triangle, coarse-teeth, tail

gray birch Earltown Mountain

gray birch Nelson's Park, Tata.

gray birch Warren Dr., Bible Hill



gray birch Earltown Mountain

Gray Birch

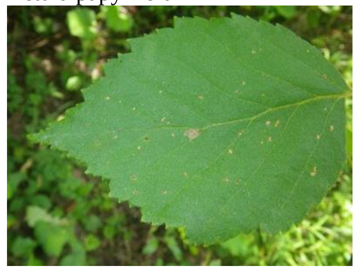
CONTAINS: Betulin

BARK: White or gray, dark lenticels, no peels, **black chevrons** at branch base to protect from fungus > same. Some may get woodpecker holes. See J4.

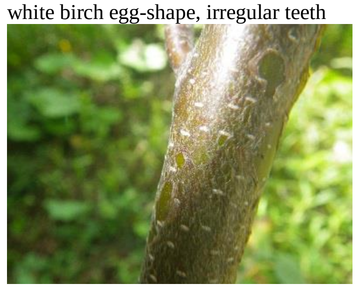
HABITAT: **follows clear cuts**, burns, or **old farmed land**. Dry, sandy. Intolerant.

White Birch B J3 Meg Py Y4

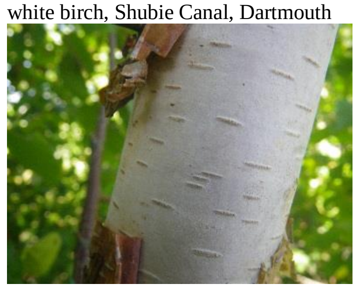
Betula papyrifera



white birch egg-shape, irregular teeth



white birch, Shubie Canal, Dartmouth



white birch Rec. Park, Bible Hill

white birch Shortt's Lake, Colchester C.

white birch Shortt's Lake

White Birch

CONTAINS: Betulin

BARK: White with orange or pink tint, Betulin, light lenticels, thin curly peels > white to creamy, thicker and wider peels > gray, rough. Some may get burls. See J3.

HABITAT: **follows clear cuts**. Forest slope, shore. Intolerant.

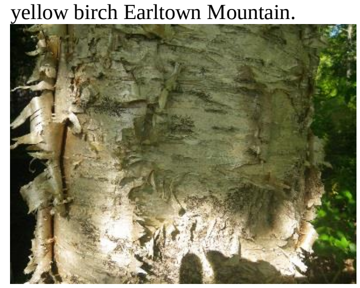
Yellow Birch B J6 Nh Py T2 Y4

Betula alleghaniensis

yellow birch heart-shape, irregular teeth

yellow birch Earltown Lake 1

yellow birch Earltown Mountain.



yellow birch Biorachan Rd., Earltown

yellow birch Earltown Biorachan Rd.

Yellow Birch

CONTAINS: Betulin, methyl salicylate

BARK: GRAY YELLOWISH, thin long lenticels, frilly peels, inner bark wintergreen > bronze – silver gray, thin lenticels, frillier. > irregular frilled plates. Some have frost ribs. See J6.

HABITAT: Moist, rich, hillsides.

C Warty Hort. Lenticels>

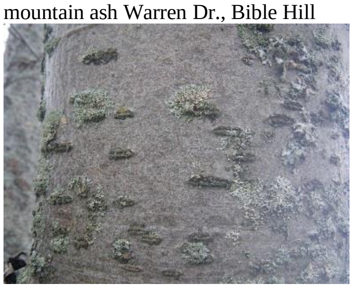
+I1 Man. Maple **H**

Northern Mountain Ash

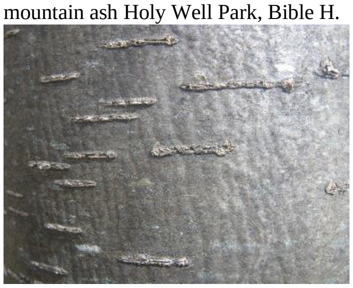
Sorbus Americana **C K7 Pyb V1**

mountain ash: pinnate, fine-toothed

mountain ash Warren Dr., Bible Hill



mountain ash Holy Well Park, Bible H.



mountain ash Tatamagouche Village

mountain ash Farmers Market, Truro

Northern Mountain Ash

showy mountain ash, b
CONTAINS: hydrogen cyanide, parascorbic acid
BARK: Gray, smooth, warty buff to orange lenticels > longer warty lenticels, little rolls of peeling bark cracked patches.
HABITAT: moist, cool, high elevation

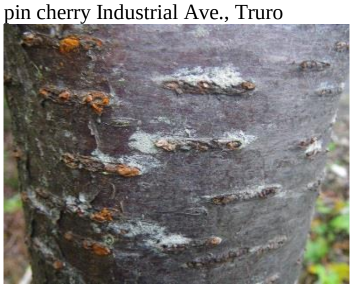
Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

Pin Cherry **C J1 Oln Pp Q3 U3**

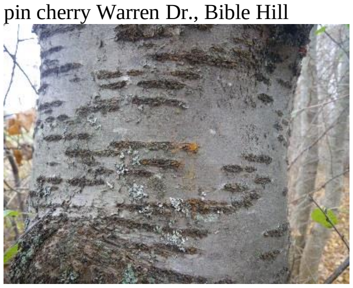
Prunus pensylvanica

pin cherry: lance, toothed, tipped

pin cherry Industrial Ave., Truro



pin cherry Warren Dr., Bible Hill



pin cherry

pin cherry Industrial Ave., Truro

Pin cherry

CONTAINS: hydrogen cyanide
BARK: Reddish brown smooth, warty orange lenticels > silver bark warty lenticels, little rolls of peeling bark. Some get black knot canker. See J1.
HABITAT: clearings, hills, roads, burns.

D Warty Lent.> Scales

Wild Apple **D Oel Q5 V1**

Malus pumila (M. domestica)

wild apple round - elliptical, wavy tooth

wild apple Shortt's Lake, Colchester C.

wild apple Earltown Mountain 3

crab apple Duke St., Truro

wild apple Earltown Mountain 3

Wild apple

CONTAINS: hydrogen cyanide, methyl acetate
BARK: Brownish green, warty lenticels > gray with some brownish green, vertical squarish scales > loose squarish scales
HABITAT: roadsides, old farmlands

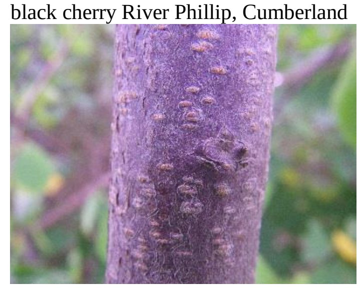
Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

Black Cherry

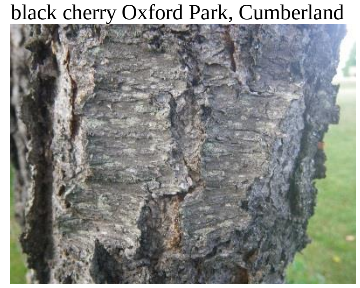
Prunus serotina **D Oln Po Q2 U2**

black cherry lance, fine-toothed

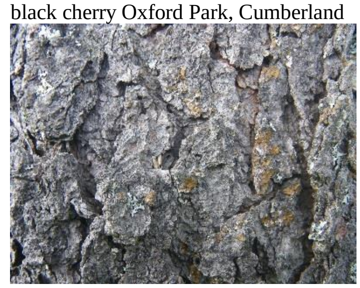
black cherry River Phillip, Cumberland



black cherry Oxford Park, Cumberland



black cherry Oxford Park, Cumberland



black cherry Oxford Park, Cumberland

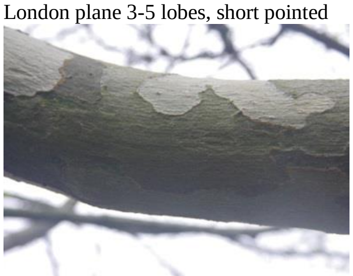
Black Cherry

CONTAINS: hydrogen cyanide
BARK: Reddish brown to grayish brown smooth, gray linear lenticels > irregular curl-outward scales with lenticels; bark and twigs have bitter almond smell
HABITAT: moist-dry, woods, thickets

[Warty; Warty > Scales] C, D

(Alien but Fun)
London Plane
Platanus x acerifolia **D L5 Py**


London plane 3-5 lobes, short pointed


London plane Alumni Gardens, Bible H


London plane HFX Public Gardens


London plane Alumni Gardens, Bible H


London plane Alumni Gardens, Bible H

London Plane / Buttonwd
BARK: green, white, tan scales puzzle-like, flake off > small scales with barkless spots > narrow flat vert. ridges horiz blocks, steep furrows
HABITAT: poorly drain, rich lowlands

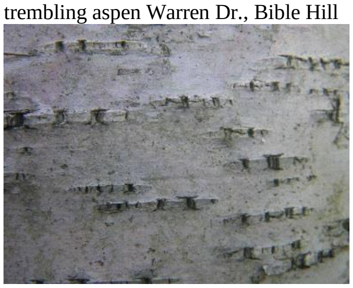
D, E **[Scales; Diamond Lenticels]**

E Diamond Lenticels >
Also striped maple F.

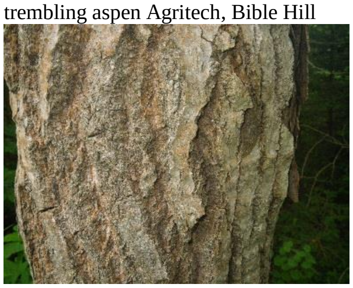
Trembling Aspen
Populus tremuloides **E Meg Po Py Y**


trembling aspen egg-shape, fine, tip


trembling aspen Warren Dr., Bible Hill


trembling aspen Shubie Canal, Dart.


trembling aspen Agritech, Bible Hill


trembling aspen Warren Dr., Bible Hill

Trembling Aspen
CONTAINS: salicin, chrysin, tetrochrysin, populin, resin, and a volatile oil
BARK: white powdery, ylw green, smooth, horizontal wrinkles > line of small diamond lenticels, > hort. lines abrupt change to rough bark > dark vert. cracks flat gray white ridge.
HABITAT: **follows clear cuts**, or burns. Moist, well drained.

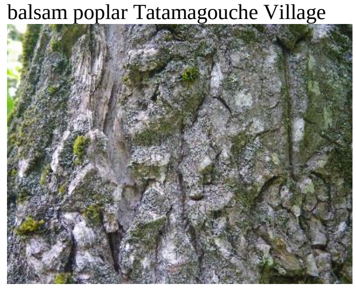
Balsam Poplar
Populus balsamifera **E Meg Py**


balsam p. egg-shaped, fine, sticky buds


balsam poplar Rt 6 Pugwash Basin


balsam poplar Rt 6 Pugwash Basin

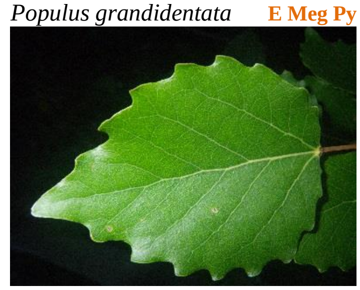

balsam poplar Tatamagouche Village

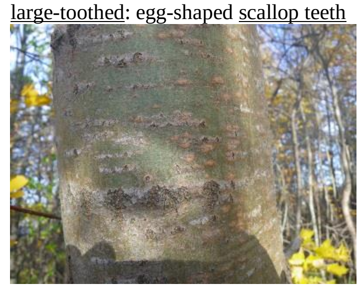

balsam poplar Alumni Gardens, B. H.

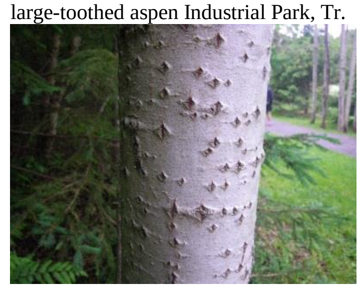
Balsam Poplar
CONTAINS: salicin (aroma), chrysin, tetrochrysin, populin, resin, and a volatile oil
BARK: **greenish red or brown**, diamond lent. > diamond lent. line up hort. > gray-reddish vert. cracks, flat scaly vert ridges, hor. cracks > rough ridges some maintaining pyramid shape.
HABITAT: moist, rich, edges of waters.

Bark Top: youngest or highest.
Bottom: oldest.

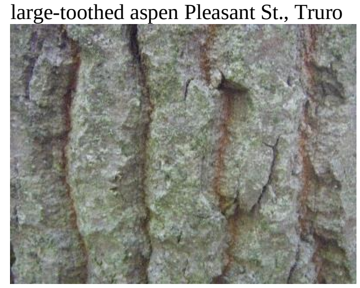
Large-Toothed Aspen
Populus grandidentata **E Meg Py**


large-toothed: egg-shaped scallop teeth


large-toothed aspen Industrial Park, Tr.


large-toothed aspen Victoria Park Truro


large-toothed aspen Pleasant St., Truro


large-toothed aspen Warren Dr. B. H.
Sim. **White Poplar** (*Populus alba*) bark

Large-toothed Aspen
CONTAINS: salicin (aroma), chrysin, tetrochrysin, populin, resin, and a volatile oil
BARK: gray greenish, ylw gray, large diamond lenticels, > diamonds connect vertically, orange inner bark > rough rounded ridges with feet,
HABITAT: **follows clear cuts**, or burns. Dry sandy.

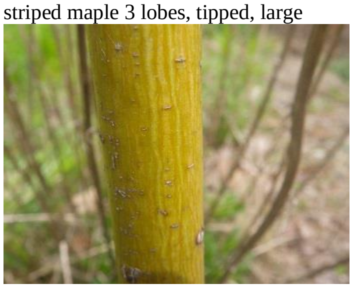
F Stripes > Vert. Cracks

[See Norway Maple I1 –orange stripes.]

Striped Maple

Acer pensylvanicum F L3, Py R

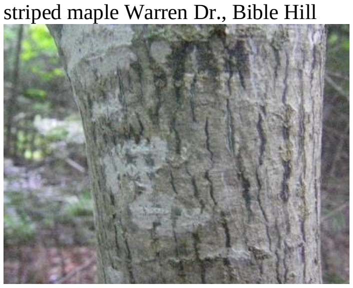
striped maple 3 lobes, tipped, large



Stiped maple [Chain Lakes Trail]

striped maple Rogart Mt. 1, Earltown

striped maple Warren Dr., Bible Hill



striped maple Rogart Mt. 2, Earltown

Striped Maple

BARK: orange green > white or green stripes on dark bk. > blackish stripes on reddish brown bk, light diamond lenticels > rough (cantaloupe-like)

HABITAT: moist, cool, well drain

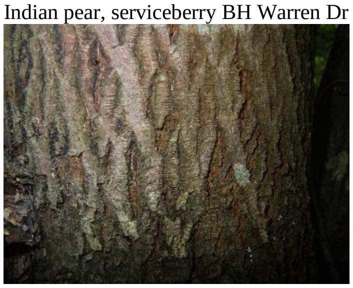
Indian Pear / Serviceberry

Amel. arborea F Oel Py Q5 V1

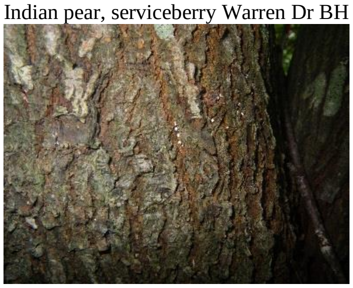
Indian pear oval, fine saw-toothed

Indian pear, serviceberry Warren Dr,BH

Indian pear, serviceberry BH Warren Dr



Indian pear, serviceberry Warren Dr BH



Indian pear, serviceberry Warren Dr BH

Indian pear / Serviceberry

BARK: dark green stripes on light gray bark > stretch marks > long dark flat vert. strips > some darken flat ridges, some twisting

HABITAT: disturbed, barrens, shores

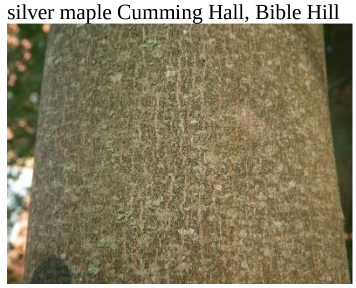
G Vert. Crack >Vert. Strip

Silver Maple

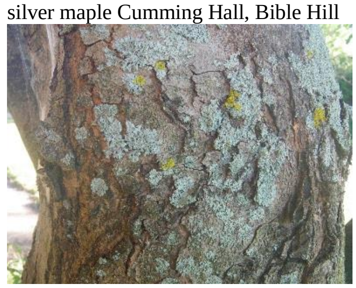
Acer saccharinum G L5

silver maple 5 lobe, deep sinuses

silver maple Cumming Hall, Bible Hill



silver maple Cumming Hall, Bible Hill



silver maple Cumming Hall, Bible Hill

silver maple Victoria St., Truro

Silver maple

BARK: Gray silvery > gray, smooth, random vertical cracks > vert. plate-like strips curl flaky & less curling, brown stripes

HABITAT: flood plain, water edges

{Woj098} {Bol070} {Aud264}

Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

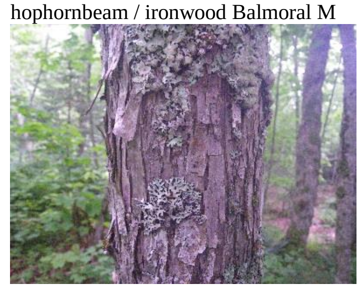
Hophornbeam / Ironwood

Ostrya virginiana G J4 Oel Py X4

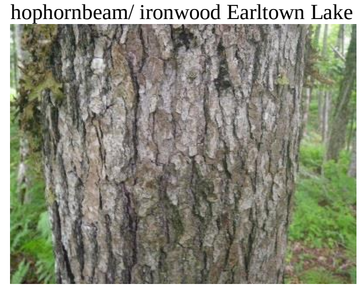
hophornbeam double-teeth, veins split

hophornbeam / ironwood Balmoral M.

hophornbeam / ironwood Balmoral M



hophornbeam/ ironwood Earltown Lake



hophornbeam/ ironwood Earltown Lake

Hophornbeam / ironwood

BARK: gray stripes on brown to grayish brown > narrow vert. strips with loose ends (shingle-like) > vert. strips thicken, loose ends. Some get sap suckers holes. See J4.

HABITAT: dry rich, slopes, ridges

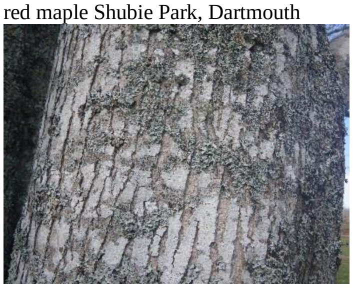
G Vert. Crack>Vert. Strip
continued

Red Maple
Acer rubrum **G J1 5 6; L3 Pr S1 X2**


red maple – 3 lobe, sharp sinuses


red maple Shortt's Lake, Colchester Co.


red maple Shubie Park, Dartmouth

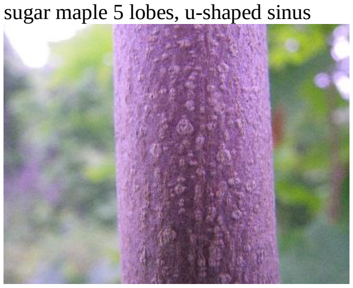

red maple Tennis Courts, Shortt's Lake


red maple Shortt's Lake

Red Maple
CONTAINS: digallates
BARK: Gray light, or white, smooth, random dark fine vertical cracks over smooth bark > consistent vert. plate-like strips > may curl. Some have target canker or frost crack. See J1, J6
HABITAT: moist, swamps, watersides

Sugar Maple
Acer saccharum **G K5 Po S1 X2**


sugar maple 5 lobes, u-shaped sinus


sugar maple Earltown Mountain 2


sugar maple Earltown Mountain 2


sugar maple Earltown Mountain 2


sugar maple Earltown Mountain 2

Sugar Maple
BARK: Gray brownish [Whitish here], meandering vert. cracks fine horiz cracks > vert. strips with horiz cracks, curl shingle like > detach, red inner bark no hor.
HABITAT: moist, rich

H Ridges or Scales > Broken
(See also white ash I1 & basswood I2.)

Manitoba Maple/Box Elder
Acer negundo **H K7 Py S2 X2**


Manitoba maple pinnate, lobed


Manitoba maple Cobequid Trail, Truro


Manitoba maple Laconia NH


Manitoba maple Holy Well Park, BH


Manitoba maple Laconia, NH

Manitoba maple / Box Elder
BARK: Brown gray > light brown to gray, fine squarish scales / buff warty ORANGE lent.> furrows intersect ridges, hort. Blocks

HABITAT: floodplain, near water, disturbed area, invasive

Black Ash
Fraxinus nigra **H K7 Pgb X1**


black ash pinnate, lance, no stem


black ash Point Pleasant Park, Halifax


black ash Point Pleasant Park, Halifax


black ash Point Pleasant Park, Halifax


black ash Dal. U., South Street, Halifax

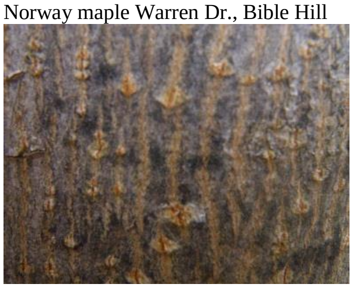
Black Ash / Swamp Ash
BARK: Brown light to gray > darker gray to gray brown, deep cracks, soft & corky > thicker and knobby scaly (almost ridges)
HABITAT: wet, very rich

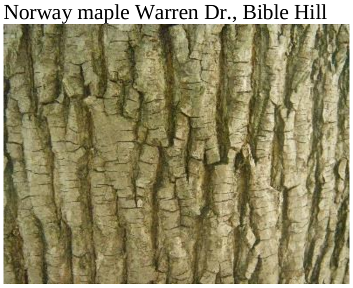
I1 Fine Vertical Ridges

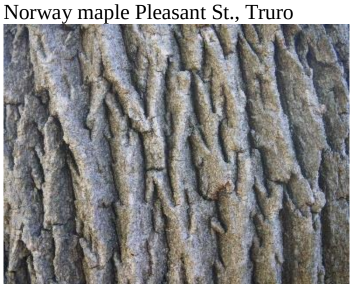
Norway Maple
Acer platanoides **I1 L5 Py S2 X2**


Norway maple 5 lobes, u-shaped sinus


Norway maple Warren Dr., Bible Hill


Norway maple Warren Dr., Bible Hill


Norway maple Pleasant St., Truro


Norway maple WOW Trail Laconia NH

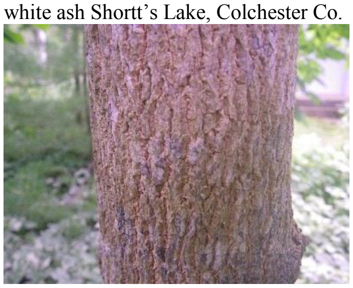
Norway maple
BARK: Brown to gray, smooth striped > dev. vert. cracks orange tint > narrow intersecting ridges & diamond furrows > wide flat ridges with feet
HABITAT: urban, roadside, invasive

Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

White Ash **I1 K7 Pp Pyb S1 X1**
Fraxinus americana


white ash pinnate, oval, stemmed


white ash Shortt's Lake, Colchester Co.


white ash Shortt's Lake, Colchester Co.


white ash Cox Field, Bible Hill

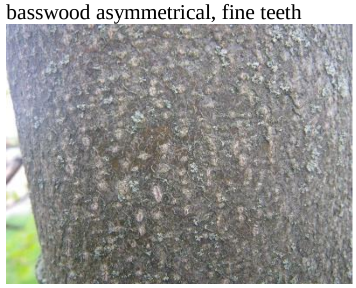

white ash Balmoral Grist Mill, Col. Co.

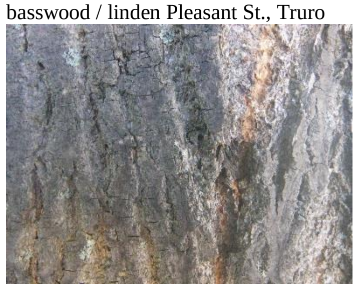
White ash
CONTAINS: betulin
BARK: Brownish gray to gray, squarish scales - shallow spongy ridges > vert cracks with horiz cracks breaking to blocks > thin soft intersect ridges, > flat jagged ridges with feet
HABITAT: moist, well drain, rich

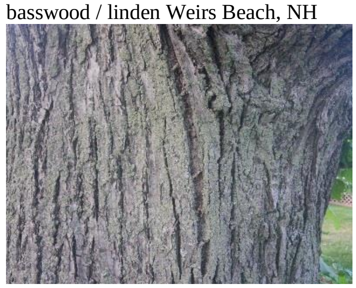
I2 Wider Ridges > Loose Intersect

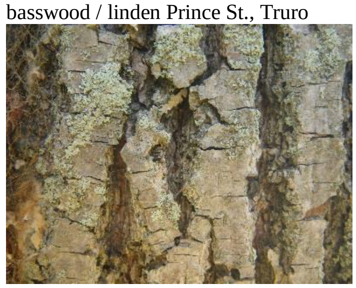
Basswood / Linden
Tilia Americana **I2 Nas Py S2 Y2**


basswood asymmetrical, fine teeth


basswood / linden Pleasant St., Truro


basswood / linden Weirs Beach, NH


basswood / linden Prince St., Truro


basswood/ linden Main S. Kingston MA

Basswood / Linden
Contains mucilage, flavonoids and tannins.
BARK: Brown light to light gray, orange vert. cracks with HORIZ CRACKS and jigs and jags > flat vertical ridges spongy > loosely intersect ridge, curves around branch.
HABITAT: moist, rich, often slopes.

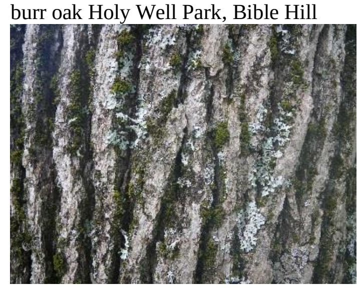
Burr Oak
Quercus macrocarpa **I2 L7 Pyb Y3**


burr oak 7 lobes, round tips, wide sinus


burr oak Holy Well Park, Bible Hill


burr oak Victoria Park, Truro


burr oak Holy Well Park, Bible Hill


burr oak Alumni Gardens, Bible Hill

Burr Oak
CONTAINS: Quercitrin, tannic acid, terpene, and resin.
BARK: branches & trunk with wings > cracks > gray light thin vertical strips > flat rough ridges loosely intersecting, rope-like. Thick bark is fire resistant.
HABITAT: moist, rich

Bark Top: youngest or highest. Bottom: oldest. Further inf. at orange ref.

I3 Thick Ridges > Weaving

(See also large-toothed aspen **E** & Norway maple **I1**.)

Willow

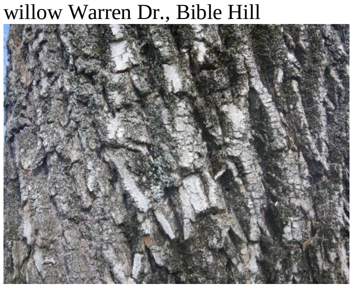
Salix spp. **I2 J2, Oln Y**

willow lance, + various others

willow Rt 6 Pugwash Basin

willow Rt. 6 Pugwash Basin

willow Warren Dr., Bible Hill



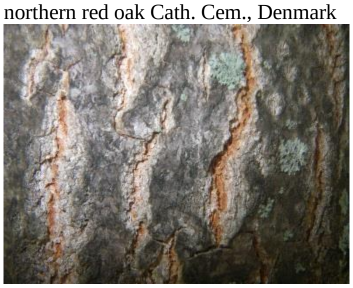
willow Tennis Court, Short's Lake

Northern Red Oak

Quercus rubra **I3 J2 L7 Pr T1 Y3**

northern red oak 7 lobes, pointed tips

northern red oak Cath. Cem., Denmark



northern red oak WOW Trail, Laconia

northern red oak Lake Ainslie C. Breton

northern red oak WOW Trail , Laconia

American Elm

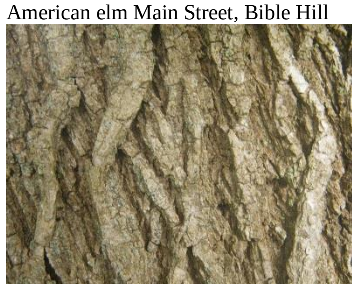
Ulmus americana **I3 Nas Py X3**

elm asymmetrical, double teeth

American elm Point Pleasant, Halifax

American elm Main Street Bible Hill

American elm Main Street, Bible Hill

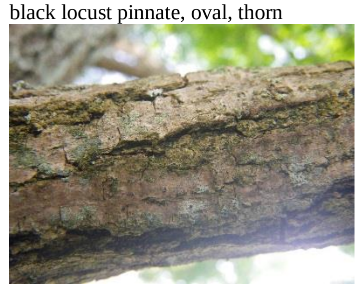


American elm Main Street, Bible Hill

Black Locust **I3 K7 Pgb Q6 W**

Robinia pseudoacacia

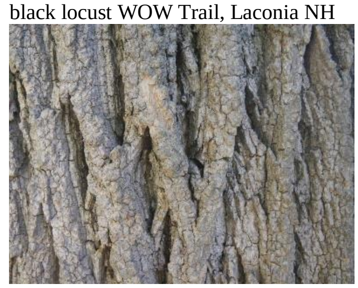
black locust pinnate, oval, thorn



black locust Park Street, Truro

black locust WOW Trail, Laconia NH

black locust WOW Trail, Laconia NH



black locust WOW Trail, Laconia NH

Willow

CONTAINS: tannin, salicin.
BARK: dark brown to black, scaly, brittle, hard flat vert. strips > loose flaky flat strips / ridges, may intersect > broken looking. . See J2 willow pine cone gall.
HABITAT: moist, wetlands, water

I2 I3 [Wider Ridges; Thick > Weaving]

Northern Red Oak

CONTAINS: the tannic acid - Quercitrin, terpene, & resin.
BARK: greenish brown grn-gray smth round buff lent > widens with orange inner bark > deep cracks, (red inbk) flat concentric loosely intersecting ridges > rough. Some have oak apple or bullet gall. [J2].
HABITAT: well drain, mixed, deciduous

American Elm

BARK: Brown to grayish brown, scales or vert. strips SPONGY, dark light layers, soft > long diamond furrows weaving intersect ridges > very old bark has small layers upon larger layers, upon larger layers, etc.
HABITAT: moist, rich

Black locust

CONTAINS: methyl acetate & acetic acid
BARK: brown, rough, broad gray-brown flat weaving, intersecting ridges, > fine horizontal cracks deep furrows, lumpy ridges with inter-connecting feet
HABITAT: disturbed, roadsides

J Cankers, Galls, & Other Deformations

J1 Cankers (from fungi)


beech canker on beech **A** {Woj82}


circular canker on beech **A** {Woj77}


circular canker on beech **A** {Woj77}


target canker, red maple **G J1 J5 J6 L3 Pr S1 X2** S254


perennial canker on red maple **G J1 J5 J6 L3 Pr S1 X2** {Stokes253} {Woj77}


black knot canker on pin cherry **C J1 Oln Pp Q3 U3** {Stokes254}


witch's broom / mistletoe on spruce
Earltown Lakes


witch's broom on spruce

J2 Galls (from insects)

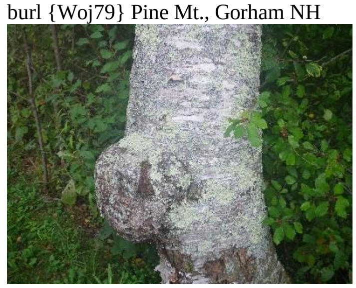

oak apple gall on northern red oak **I3 J2 L7 Pr T1 Y3** {Stokes163}


willow pine cone gall on willow **I2 Oln Y** {Stokes169}

J3 Burls


burl on spruce {Woj79}
Earltown Mountain


burl {Woj79} Pine Mt., Gorham NH


burl on white birch **B** [BH Rec. Park]

J4 Sapsucker holes


sapsucker holes on hophornbeam **G J4 Oel Py X4** {Woj71}


woodpecker holes on gray birch **A J4 L1 Py Y4** {Woj71}

J5 Scars Healing

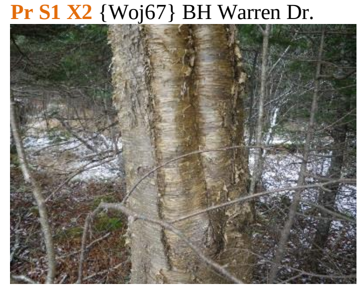

scar unknown origin, with growth rings
BH Warren Dr. {Woj64}


scar on red maple **G J1 J5 J6 L3 Pr S1 X2** {Woj64}


scar Norway maple **I1 L5 Py S2 X2**

J6 Frost Cracks & & Fr. Ribs


frost crack on red maple **G J1 J5 J6 L3 Pr S1 X2** {Woj67} BH Warren Dr.

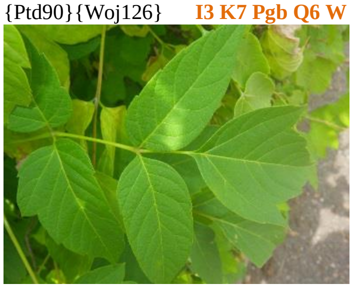

frost rib on yellow birch **B J6 Nh Py T2 Y4** {Woj67}

Leaves (Trees and Shrubs)

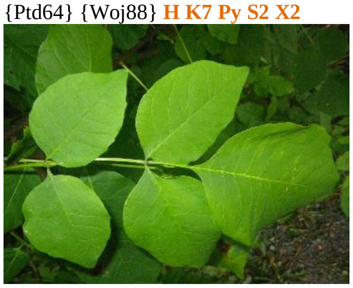
K7 Pinnate Compound

Also false spiraea, shrubby cinquefoil

black locust Leaflets are oval and smooth {Bol202} {Lit526} {PetL184} {Ptd90}{Woj126} **I3 K7 Pgb Q6 W**



Manitoba maple [TOWNS] Leaflets are oval and lobed {Bol172} {Lit572} {Ptd64} {Woj88} **H K7 Py S2 X2**



white ash Leaflets oval, stemmed, finely teeth or smth {Bol173} {Dow2} {Fos298} {Lit647} {MKi65} {Ptd62} {Woj174} **I1 K7 Pp Pyb S1 X**

black ash Leaflets dark green, oval to lance, no stems finely toothed, tipped. {Bol175} {Dow2} {Lit650} {Ptd062} {Woj176} **H K7 Pgb X1**

northern mountain ash lftets lance-shaped, finely tthed. {Blo20} {Bol197} {Dwt120} {Lac75} {Lit510} {MKi83} {Ptd96{Woj218} **C K7 Pyb V1 See Q4**

K7 K5 Compound

Black Locust
Robinia pseudoacacia
Contains methyl acetate & acetic acid
Native to central Appalachians**.**
FLOWER CLUSTER: "Make outstanding fritters." SEEDS: Bobwhite, pheasant, mourning dove, rabbit, deer. SEEDS, LEAVES, BARK, SHOOTS, ROOTS: POISONOUS. WOOD: Strong, hard, durable. Virginia Indians used for bows. PLANTED: For fence posts.

Manitoba Maple / Box Elder
Acer negundo
Manitoba Maple / Box Elder Sprouts often come from lower trunk. SEEDS: Squirrels and songbirds. Provides winter foods for evening grosbeaks and pine grosbeaks. SAP: Plains Indian made sap into sugar. WOOD: White soft used in boxes. PLANTED: Originally as ornamental, now invasive.

White Ash
Fraxinus americana
LEAVES & ROOTS: Contains betulin which resists bacteria, fungus, and insects. SAP: Amerindians sometimes made dark bitter sugar. INNER BARK: Mi'kmaq, Maliseet, Abenaki, Iroquois used it for women's ailments, wounds. Amerindians wash for sores, itching ... Inner bark made yellow dye. WOOD: Durable for oars, tool handles, snowshoes, tennis rackets, baseball bats, and hockey sticks.

Black Ash
Fraxinus nigra
RARE!! WOOD: Amerindians split short logs along growth rings into thin sheets. Woven for baskets. Made into chair seats & barrel hoops. Rare caused by its overuse in basket making and for furniture veneers.

Northern Mountain Ash
Showy Mountain ash / Dogberry
Sorbus decora
Contains cyanide compounds and parascorbic acid POMES: bitter, after ripening mellows, iron and vit. C, for scurvy: mountain ash jelly. Cedar waxwing, grosbeaks, robins, other songbirds, ruffed grouse, ptarmigan, fisher, marten, black bear; LEAVES: cyanide POISONOUS, Mi'kmaq: induce vomiting. TWIGS: hares, deer, moose. INNER BARK: astringent used medically.
BARK: beaver, heavily browsed by moose. Mi'kmaq teas for stomach pains, child birth, vaginal infections.

American mountain ash long-pointed lance tth, fruit smaller than northern ma {Blo020} {Bol195} {Dwt118} {Fos311} {Lacey75} {Lit510} {MKi083} {PetL188} {Ptd096} {Ryn093} {Scott45} {Woj218} **K7**

red elderberry Leaflets lance sharp tth undulating edge {Blo056} {Bol178} {MKi125}{Ptd060}**K7 Q1 U1**

common elderberry Leaflets elliptical-lance, finely toothed. {Blo50} {Bol177} {Lacey84} {Lit669} {MKi125} {Ptd60} **K7 Q4 U4**

staghorn sumac Leaflets lance, toothed, limp, hairy stem. {Blo024} {Bol199} {Den304} {Dow120} {Lacey58} {Lit551} {MKi090} {Ptd104} **K7, Pp, Q1 U1**

K5 Palmately Compound

5 centered leaflets also dewberry

Virginia creeper [TOWNS] Leaflets coarse-toothed. {Bol183} {Den307} {Dwt184} {MKi154} **K5 Pr**

American Mountain Ash
Sorbus americana
Contains cyanide compounds and parascorbic acid See Northern mountain ash for human uses and for animals and birds uses

Red Elderberry
Sambucus racemose
Contains hydrogen cyanide.
FRUIT: POISONOUS to humans. Fed on by 43 species of birds including pheasants, mourning doves; BUDS: Ruffed grouse. LEAVES: TOXIC. TWIGS: Deer, moose. [] Twigs hollowed out pith for pipe stems, maple syrup spiles, & toy blow guns.

Common Elderberry
Sambucus canadensis
Contains hydrogen cyanide.
FLOWERS: Mi'kmaq & Malecite teas for sweating, inducing sleep, urine flow. Yellow dye. FRUIT: Vit. A, Vit. C, & protein, but CAREFUL, has hydrocyanic acid, Cooked for jams, jellies, wine. Purple dye. 43 bird species, robins, catbirds, mourning dove, pheasant, wild turkey; LEAVES: Insect repellent TOXIC. Green dye. TWIGS: Algonquians removed pith for flutes, whistles and maple syrup spiles; PITH balls: electrical experiments. BARK: Maritime Indians as emetic. COVER: alder flycatchers, goldfinches, yellow warblers.

Staghorn Sumac
Rhus typhina
Contains tannic and gallic acid. ALL PARTS POISONOUS to humans, can cause severe dermatitis. FRUIT: 93 species of birds. Winter food of ruffed grouse and deer. High in vitamin A. Berries soaked, strained to remove hairs, boiled to remove tannin and bitter taste. BERRIES, LEAVES, ROOTS: Made yellow, red, black dyes. BERRIES & BARK: Made ink. LEAVES: Sold to tanneries for light-colored leather. STEMS: Amerindians made flutes. PLANTED: Ornamental for thick summer green foliage, fall's reds, and winter's red fruit. Checks erosion.

Virginia Creeper / Woodbine
Parthenocissus quinquefolia
Contains oxalic acid.
Alien. Introduced from eastern North America. BERRIES Mildly TOXIC to humans. Eaten by winter birds. LEAVES: Considered poisonous. Deer and livestock browse. COVER: For birds and mammals. PLANTED: As garden climber, for soil stabilization, and for its bright red autumn foliage.

blackberry Leaflets coarsely toothed stem thorns {Bol184} {Fos264} {MKi093} {PetL30} {PetL184} {Scott37} **K5 Pp Q5**

Blackberry
Rubus canadensis Rose Family
Leaves and root contain tannin.
FRUIT: Edible plain, pies, jelly, jam, juice. LEAVES: Dried and use for tea. Salad. In Germany, tea used for diarrhea. Leaf tea also a wash for sores. SPRING SHOOTS: Salad. ROOTS: Astringent tea.

K3 Trifoliate Compound

Also Virgins' bower, Scotch broom,

dewberry / dwarf raspberry some palmate comp. double tth {Bol179} {Bolwf144}{MKi095}{Scott35}**K3 Q5**

Dewberry, Dwarf Raspberry, Hairy Plumboy
Rubus pubescens
Rose Family. Contains fragarine.
FRUIT: Sweet and tart. Made into pies, jam, and jelly. Use in cold drink or salad. LEAVES: Wilted leaves TOXIC. Only fresh leaves to be dried for tea and only drunk in moderation.

poison ivy shiny, tipped, lobed, toothless or uneven {Bart Bresnik photo} {Bol181} {Dwt165} {Dow102} {MKi395} {Ptd015} **K3 Pp Po**

Poison Ivy
Toxicodendron radicans Cashew family.
Contains urushiol, an oily resin. ALL PARTS: TOXIC can cause severe dermatitis. The oil does not carry through the air but can be transmitted by contact elsewhere or through burning carried by smoke. Wash affected areas with a strong soap. [See speckled alder and sweet fern.]

virgins bower / Virginia clematis lobed deep veins {Bol171} {Croc98} {Dwt96} {Fos25} {MKi412} {Pet076}

Virgins Bower / Virginia Clematis
Clematis virginiana Contains glyscoside ranunculin PLANT: TOXIC With contact, can cause severe skin irritation and swelling. With ingestion may cause diarrhea, bloody vomiting, depression or even death.

L7 7 or More Lobes

northern red oak Shallow wide sinuses, pointed tips. {Bol153} {Den304} {Dow92} {Lacey57} {Lit407} {MKi059} {Ptd141} {Woj150} **I3 J2 L7 Pr T1 Y3**

Northern Red Oak
Quercus rubra
Contains Quercitrin, tannic acid, terpene, and resin, Oak was more common in NS in the past. SEED (acorn): Herbivorous birds, mourning dove, ruffed grouse, bobwhite, wood duck, turkey, pheasant, squirrel, fox, raccoon, opossum, deer, & bear. Eastern Amerindians removed acorn shells, leached in water to rinse out tannin. Used to make mush, bread, pancakes. TWIGS: Cottontail, hare, deer. BARK: Porcupine. Rich in tannin for tanning leather. Mi'kmaq used bark to treat piles.

burr oak [TOWNS] Rounded tips, wide deep sinuses. {Bol154} {Den307} {Lit395} {Mai120} {Ptd146} {Woj138} **I2 L7 Pyb Y3**

Burr Oak, Mossy Cup Oak
Quercus macrocarpa
Contains Quercitrin, tannic acid …
In west, it is a pioneer species. Chippewa used some part of it for wounds. [Not sure which part.] FRUIT (Acorns) BARK: Thick bark resistant to fire. WOOD: Durable, hard, heavy, strong. Used for cabinets, flooring, barrels, and fence posts. PLANTED: For ornament, shade, and to surround homes.

swamp white oak rounded lobes, shallow sinuses {Lit384} {Ptd149} {Woj136} RARE Based on the above references [Shubie Canal] **L7**

Swamp Oak
Quercus bicolor
Beech Family. Found on Shubie Trail across from Dartmouth Crossing. Probably planted. Leaves are green on top and white on back. Look at Northern red oak for possibly uses and properties. Lumber about the same as white oak, whose leaf is more deeply lobed.

White Oak *Quercus alba*
Similar to swamp oak, but deeper sinuses. Seen at Truro, Point Pleasant Park, and southern New England.

English oak smaller deeper lobes, [SETTLEMENTS] {Bol155} {Lit406} {Ptd147} **L7 Y3**

English oak
Quercus robur
Contains tannin and others.
Alien, introduced from Europe. Leaves are tinier than other oaks. Old trees can be very tall in England. SEED (acorn): See other oaks for uses. BARK: Had been source of tannin. WOOD: Had been used for British Navy's wooden ships and paneling in famous buildings. PLANTED: As ornamental.

hawthorn 6–8 lobes, large sharp irregular teeth. {Blo070} {Bol132} {Dens} {Dow62} {Dwt128} {Lit466} {MKi080} {Ptd114} {Ryn050} **L7 Q5 V1**

Hawthorn, May-Apple
Crataegus Haw (means hedge).
Pilgrim ship, Mayflower, named for the hawthorn flower. .FLOWERS & LEAVES: Amerindians: cough medicine; honey plant. FRUIT: High in sugar, low in fat, contain pectin, dried for winter. Certain species lower blood pressure. Cedar waxwings, robins, pine grosbeaks, bobwhite, pheasant, ruffed grouse, rabbit, gray fox, deer. TWIGS: Mi'kmaq: tea for rheumatism. Tool handles and firewood. White-tailed deer. THORNS: Amerindians: awls for leather. COVER: Grey catbirds, American woodcock, ruffed grouse.

L5 5 Lobes

sugar maple U-shaped sinuses, 3-5 points / lobe. {Bol71} {Dow80} {Lit579} {MKi66} {Ptd70} {Woj100} **G K5 Po S1 X2**

Sugar Maple, Rock Maple
Acer saccharum
Sugar Maple, Rock Maple Acer saccharum SAP: High sugar content; Red squirrels bite through bark to get sap leaving black-green streaks. Amerindians boiled for sugar and syrup, and taught colonists. Fermented to wine, beer, or vinegar. LEAVES: Wilted leaves may REDUCE BLOOD COUNT. INNER BARK: Cough syrup or expectorant. PLANT: Highly affected by acid rain. Requires rich soil strong amounts of Calcium. Doesn't come back for centuries as forest after tilling.

Trifoliate Compound, 7 Lobed, 5 Lobed **K3 L7 L5**

Norway maple [TOWNS] U-shaped sinus, 5-7 hooked points {Bol067} {Lit575} {Lit577} {Lit#259} {Lit#388} {Woj092} **I1 L5 Py S2 X2**

white poplar fuzzy looking {Bol158} {Lit320} {MKi49} {Ptd135} **E**

silver maple [Agriculture College] Deep long rounded sinuses, thin foliage, {Bol70} {Lit578} {Mai76} {MKi67} {Ptd70} {Woj98} **G L5**

L3 3 Lobes

red maple sharp sinuses, almost a right angle. {Bol69} {Den} {Dwt176} {Lacey74} {Lit577} {MKi067} {Ptd069c} {Woj94} **G J1 J5 J6 L3 Pr S1 X2**

mountain maple soft, rounded teeth, rugose, deep veins. {Blo046} {Bol064} {Dwt172} {Lit580}{Ptd69b} **E L3 Po S1 X2**

[Lobed, Egg-Shaped]

L5, L3, L1 Mrn

Norway Maple
Acer platanoides
Alien. Leaves subject to lots of spots. Native to Europe and southwest Asia. PLANTED As shade tree and ornamental. It is fast growing and capable of growing in cities' pollution. Spreads easily from seed, so now considered invasive.
The leaf of the crimson king maple is darker but the bark is nearly the same.

White Poplar, Silver Poplar
Populus alba
Alien - Eurasia. SEED, BUDS, TWIGS: Ruffed grouse, rabbit, beaver, porcupine, deer, moose, bear. BARK: Like large-toothed aspen with large diamonds connecting into chunky furrows. PLANTED: Ornamental. Invasive. Introduced in colonial times.

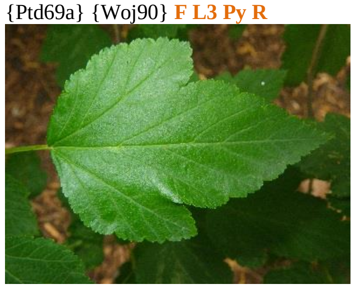
Silver Maple
Acer saccharinum L.
Alien to province. SAP: Made into sugar but has a low yield. PLANTED: As shade tree and ornamental. It tolerates shade and dry better than red maple. It grows rapidly, but branches are brittle. [See other maples for more.] Similar:

Freeman's Maple (not shown)
Acer x freemanii
Hybrid between silver maple and red maple as is its deep sinus. Bark is like red maple. {uoguelph.ca/arboretum.}

Red Maple / Swamp Maple
Acer rubrum
Contains possibly TOXIC digallates
SEEDS (samaras): Eaten by many birds and squirrels. LEAVES: CAUTION: Wilted leaves may reduce red blood count ... SAP: Can produce a syrup, but less than sugar maple. TWIGS: Rabbit, white-tailed deer and moose. INNER BARK: Porcupines. BARK: From extract, pioneers made brown and black dyes and they made black ink. WOOD: Sometimes used in furniture.
PLANTED: As shade and ornamental tree. Has brilliant reds in autumn.

Mountain Maple
Acer spicatum
TWIGS: 80% gnawed off over winter by white-tailed deer with no apparent effect of the plant. It is also called moose maple. BRANCHES' BARK: Malecite scrape inside off, steeped, and used to rinse eyes. Made poultice for very sore eyes. Drug companies substituted for cramp bark (highbush cranberry). PLANTED: As ornamental. Needs moisture and neutral soil. Though it has lots of seeds, usually comes up from sprouts.

striped maple Large, toothed. Pointed tips {Blo42}{Bol63}{Lit574}{MKi67} {Ptd69a} {Woj90} **F L3 Py R**



eastern ninebark {Bol157} {Dwt113} {MKi138} **L3 Q3 Y2**

highbush cranberry deep sinuses, lower two lobes may have deeper sinuses {Blo102} {Bol066} {Dow38} {Dwt259} {Lacey25} {MKi127} {Ptd074} {Ryn024} {Scott 19} **L3 Q4**

L1 Triangular

gray birch coarse- toothed, tailed. Like 1 lobe. {Bol125} {Lit370} {MKi053} {PetLR200} {Ptd163} {Woj114} **A J4 L1 Py Y4**

Meg Egg Shaped - Ovate

chokecherry Fine sharp teeth, oval, ovate, elliptical, pointed tip. {Bol116} {Den304} {Fos329} {Lit326} {MKi86} {Ptd131} {Woj230} **Meg Q2 U2**

Striped Maple, Moose Maple
Acer pensylvanicum
INEDIBLE. LEAVES: For inflamed breasts. TWIGS: high protein. Eaten by deer and moose. Called "moosewood" "mousou", Algonquian, for branch eater. BARK: Steeped for poultices for swelling limbs. Ojibwa: an emetic (to cause vomiting). Malecite believed it to be unlucky to have near home. Mi'kmaq called it the "starving tree" and did not cut it for firewood.

Eastern Ninebark
Physocarpus opulifolius Naturalized in NS out of Quebec and Ontario. It is noted for its bark peeling in nine layers. FLOWERS: Lots of nectar and used by lots of birds. ROOTS: Pacific version steamed and food of Okanagan, BC Amerindians. Also boiled and made into a poultice for sores and burns, etc. PLANTED: As ornamental for foliage, clustered flowers, and unique star-shaped seeds.

Highbush Cranberry
Viburnum opulus
Contains viburnic acid.
DRUPES: Tart, Vit. C. Sweeter after frost. Used for cooking as substitute for cranberry, jelly. Mi'kmaq and Malecite steeped for swollen glands and mumps, winter for scurvy. Makes red dye. Cedar wax wings, grosbeaks, ruffed grouse, too tart for most other birds except emergency. The hold over berries are among bears' first food of spring. BARK: Medieval Europe & North America "squawbush" "cramp bark": cramps, menstrual, and uterine sedative. COVER: Nesting and roosting. PLANTED: As ornamental and to attract birds.

Gray Birch, Fire Birch, Old-Field Birch *Betula populifolia*
Contains betulin
SAP: Drunk straight from tree or boiled to syrup, or fermented with honey or sugar to make birch beer, wine, or vinegar. SEEDS & BUDS: Several song birds & ruffed grouse. TWIGS & BARK: Eaten by deer. BARK: Waterproof, pliable after heating, outer skin of canoes, roofing. [Remember bark removal can harm or kill tree.] WOOD: Extremely hard, used in sleds, snowshoes, paddles, canoe ribs, arrows, tool handles.

Chokecherry
Prunus virginiana
Contains hydrocyanic acid.
Leaves, bark, wood, and seeds: POISONOUS. FRUIT: Edible but astringent (contracts body tissues). To humans tart raw. Cooked strained for syrup, sauce, jelly and wine. Dried mixed with meat for winter pemmican. Bobwhite, grouse, pheasant, squirrel, rabbit, raccoon, fox, deer, bear. INNER BARK: Malecite: for diarrhea. BARK: Tea to treat colds, coughs, sore throats, and diarrhea. Post childbirth for strengthening. Folk medicine used to expel worms.

balsam poplar fine teeth, reddish brown sticky buds almost cordate {Bol114} {Dens304} {Dwt49} {Lit321} {MKi050} {Ptd134} {Woj222} **E Meg Py**

trembling aspen finely toothed, almost round, tipped. {Bol116} {Den304} {Fos329} {Lit326} {MKi049} {Ptd131} {Woj230} **E Meg Po Py, Y**

large-toothed aspen scalloped edges {Bol115} {Dwt045} {Lit323} {MKi049} {Ptd132} {Woj226} **E Meg Py**

white birch (almost cordate) irregularly toothed, tapering pointed tip {Bol123} {Dens} {Dow16} {Lit368} {MKi053} {Ptd163} {Scott51} {Woj112} **B J3 Meg Py Y4**

Balsam Poplar
Populus balsamifera
Contains salicin, chrysin, tetrochrysin, populin, resin and a volatile oil. INNER BARK: Contains Salicin which deters bacteria, fungi, and insects and is a pain reliever. Mi'kmaq steeped for colds and influenza. SEED, BUDS, TWIGS: Ruffed grouse, rabbit, beaver, porcupine, deer, moose, bear. PLANTED As shade tree.

Trembling Aspen
Populus tremuloides
Contains salicin, chrysin, tetrochrysin, populin, resin and a volatile oil. SEED, BUDS, TWIGS: Many birds, ruffed grouse, hare, rabbit, beaver, porcupine, deer, moose, bear. INNER BARK: The bark's Salicin deters bacteria, fungi, and insects and used as a pain reliever. Used as substitute for quinine. Favorite food of beavers and eaten by snowshoe hare. POWDERY BARK RESIDUE: Regulates temperature. Amerindians used as a sunscreen. Contains yeast used to make dough. WOOD: Construction and boxes. Occasionally as teepee poles. PLANTED For wind breaks.

Large-Toothed Aspen
Populus grandidentata
Contains salicin, chrysin, tetrochrysin, populin, resin and a volatile oil. ORIGINALLY ONLY SMALL PART OF NS FOREST. Also established after fires. SEED, BUDS, TWIGS: Many birds, ruffed grouse, hare, rabbit, beaver, porcupine, deer, moose, bear. INNER BARK: Used as substitute for quinine. Contains Salicin which deters bacteria, fungi, and insects and used as a pain reliever. Favorite food of beavers and eaten by snowshoe hare. WOOD: Construction and boxes. PLANTED: For wind breaks.

White Birch, Paper Birch
Betula papyrifera
Contains betulin, whitens the bark & holds moisture in cold climates, so could be used in sunscreens, resists bacteria, fungi, insects. White birch was ORIGINALLY ONLY SMALL PART OF NS FOREST, as only scattered in original forest. Sometimes pure stands after a fire. SEEDS & BUDS: Ruffed grouse. SAP: Drink straight from tree or boiled to syrup, fermented with honey or sugar to make birch beer, wine, or vinegar. TWIGS & BARK: Hare, deer, moose. Betulin make it distasteful to gnawing animals. BARK: Red vireos used strips for nests. Bark waterproof, pliable after heating. Amerindians used outer skin of canoes, or as large rolls, carried it place to place, unroll it & cover waddles (frames of twigs). For cups, dishes & storage containers. Repeat folded & teeth cut into symmetrical designs which later added quills and beads. Thin strips excellent for tinder. Thin used as paper. [Bark removal can harm or kill tree.] WOOD: Extremely hard, Used in sleds, snowshoes, paddles, canoe ribs, arrows, tool handles.

beaked hazelnut sharp double-toothed, crab-like, rugose (wrinkled) {Baker} {Blo038} {Bol127} {Dens} {MKi145} {Scott53} **Meg Py S2 Y1**

speckled alder to round; doubled-teeth, deep straight veins (pleated), rugose {Blo014} {Bol118} {Den303} {Fos286} {Lacey22} {Lit362} {MKi151} {Ptd169} {Scott49} {Wohl144} **Meg T2 Y4**

alternate-leaved dogwood Ovate - elliptical, deep curved veins, convex, untoothed undulating. {Blo34} {Bol106} {Dens304} {Lacey08} {Lit613} {MKi110} {Ptd206} **Meg Pp Q4**

Nas Asymmetrical Base

witch-hazel round toothed, undulating [Bluff Trail] {Blo086} {Bol131} Lacey65} {Lit452} {MKi144} {Ptd157} **Nas Py S2 Y2**

Beaked Hazelnut
Corylus cornuta
Germans considered sacred, representing gods of thunder and skies. BUDS CATKINS: Protein for ruffed grouse, moose, snowshoe hare, American woodcock. FRUIT - NUT: Edible. Sold in NB, protein, low in carbohydrates, nuts in cookies, breads, etc. Chipmunks, red squirrels store them. SEED HUSKS: Amerindians boiled with butternut to make black dye. LEAVES: Calcium, magnesium. TWIGS: For rheumatism. Algonquian: Bundled together for brooms. STEMS: Drumsticks. BARK: Reduce fever. ROOTS: Pliable, made into baskets. WHOLE PLANT: White-tailed deer. PLANTED As screening hedges.

Specked Alder *Alnus incana*
SEEDS: Siskins, goldfinch, redpolls; BUDS: Ruffed grouse. Humans nibble young buds. LEAVES: Rich in nitrogen. Being so high, the leaves needn't pass nutrients to their roots for winter.STEMS: Beaver: dam construction. TWIGS: Rabbits, muskrats, deer, moose. INNER BARK: Malecite dried for tea for cramps and retching astringent. Mi'kmaq: Externally for diphtheria. Amerindians: External wash for hives, poison ivy etc. BARK: Beaver. Young bark nibble. PLANT: Quick hot fire. COVER: American woodcock. PLANTED: With its bacterial nitrogen fixers around tis roots, it helps fertilize plantations, check erosion, and for windbreaks. It is pioneer to poorly drained areas but shade intolerant.

Alternate-Leaved Dogwood
Cornus alternifolia
Contains betulinic acid, gallic acid, tannin, and verbanalin. FRUIT: Very bitter. Late summer snack. Many song birds, vireos, ruffed grouse, deer, bear. TWIGS: Rabbits, white-tailed deer, black bear. INNER BARK: Contains coronic acid so used as a pain killer. Scraped, dried, Mi'kmaq / Malecite mixed inner bark with tobacco for kinnikinnik. BARK AND ROOTS: Maritime natives: eye bath for sore eyes. ROOTS: Amerindians: red dye. WOOD: Small, but very hard. Used for bearings, pulleys, mallets, weaving wood shuttles. PLANTED: As ornamental for flowers, bright green leaves and autumn reds. From cuttings, in moist sites, with lots of phosphorus.

Witch-Hazel *Hamamelis virginiana*
Flowers in fall, seeds open following fall. Seeds eject up to 6 meters with large snap. SEEDS, BUDS, TWIGS: Bobwhite, pheasant, ruffed grouse, rabbit, beaver, deer. LEAVES: Aromic tea. TWIGS: Mi'kmaq: steeped and inhaled fumes for aphrodisiac and headache. Manufactured for bruises, sprains, skin. BRANCHES: Water divining and bows. INNER BARK: Iroquois used for skin trouble.

[Egg-Shaped Asymmetrical] Meg Nas

basswood / linden fine saw toothed {Bol141} {Dow8} {Lit597} {MKi68} {Ptd129} {Woj236} **I2 Nas Py S2 Y2**

American elm doubled-tooth, deep veins, rough surface some crab-like. {Bol128} {Dens} {Dwt090} {Lit419} {MKi064} Ptd158} {Woj240} **I3 Nas Py X3**

Nh Heart-Shaped (Cordate)

hobblebush Tan-green heart-shaped to egg-shaped, irregular teeth, heavy veined, tan buds {Blo98} {Bol56} {Dwt251} {MKi127} **Nh, Pp Q4 U4**

yellow birch irregularly toothed oval, usually heart-based bas, sometimes asymmetrical. Young stems smell of wintergreen. {Bol121} {Lacey51} {Lit364} {MKi53} {Neily104} {PetL200} {Ptd164} {Woj106} **B J6 Nh Py T2 Y4**

[Egg-Shaped, Asymmetrical, Hesrt Shaped, Elliptical] Meg, Nh, Oel Nas

Basswood / Linden *Tilia americana*
Contains mucilage (soothes or reduces inflamation), flavonoids (sweat inducing) and tannins (astringent). POLLEN: Its strong smell, preferred by bees. Produced a strong lavored honey Used as cough suppressant. FLOWERS: European basswood used to make a honey flavored tea. LEAVES: Used to promote sweating and reduce fevers. BUDS & TWIGS: Ojibwa ate raw or cooked. INNER BARK: Amerindians made laces to sew up shoes. Bark was ripped in stringy sheets, boiled for a long time, pounded till soft and fibrous, and twisted. Amerindians used for rope, cord, fishnets, mats, baskets. WOOD: Soft. does not crack or warp. Used in carving, models, furniture parts. Amerindians for troughs for maple syrup. Iroquois made it into false faces masks. ROOTS: Malecete steeped. PLANTED: For flowers and smell.

Elm *Ulmus americana*
Elm ruined by Dutch elm disease - a fungus introduced around 1930 and spread by elm bark beetles. FRUIT: Song birds, game birds, squirrels. TWIGS: Rabbits, muskrats, deer; BARK: Iroquois steeped to treat diarrhea, hernias and internal hemorrhage. Iroquois used bark for canoes, twisted fibers into rope. Settlers peeled strips of bark and braided it into whips. WOOD: Water resistant, flexible, odorless. Made into wharfs, boat frames, food containers, furniture, & paneling. ROOTS: Twisted into rope, fish line, snares. PLANTED: As a shade tree.

Hobblebush
Viburnum lantanoides
Inedible FRUIT: Ruffed grouse, squirrels, chipmunk, inedible. LEAVES: Ameridians: migraines. TWIGS / BUDS: Protein energy, winter: deer, moose "moosewood", hares. BARK: Sedative properties "cramp bark", but TOXIC. NESTING: Songbirds, warblers.

Yellow birch
Betula alleghaniensis
Yellow birch contains methyl salicylate - oil of wintergreen. & betulin. That is anti inflammatory and analgesic. Good for flavorings. Once more prevalent than sugar maple, yellow birch was severly affected by bronze birch bore in early 1900's. Provincial tree of Quebec. SEEDS & BUDS: Several song birds. TWIGS & BARK: Ruffed grouse, red squirrel, rabbit, deer, moose. SAP: Drunk straight from tree or boiled to syrup, fermented with honey or sugar to make birch beer, wine, or vinegar. BARK: Waterproof, pliable after heating, outer skin of canoes, roofing. Thin strips used for excellent tinder even when wet. [Remember bark removal can harm or kill tree.] Makes yellow tan dye. WOOD: Extremely hard. Used in sleds, snowshoes, paddles, canoe ribs, arrows, tool handles.

Oel Oval to Elliptical

wild apple oval, elliptical almost round, toothed {Bol95} {Dwt115} {Lit491} {MKi72} {Ptd115} **D Oel Q5 V1**

beech deep coarsely toothed, pleated {Bol89} {Downi14} {Lacey50} {Lit380} {MKi061} {Ptd155} {Woj128} **A J1 Oel Pyb Y1**

hophornbeam / ironwood double-toothed, veins split at ends {Bol088} {Dens} {Dwt062} {Lit374} {MKi055} {Ptd167} {Woj118} **G J4 Oel Py X4**

Indian pear / serviceberry fine saw-toothed (almost cordate) {Blo80} {Bol91} {Dow112} {Lit460} {MKi109} {Ptd192} {Scott25} {Woj212} **F Oel Py Q5 V1**

mountain holly / false holly untoothed, tipped, lt green - gray green, purple stalk {Bol105} {Dwt168} {Lit557} {Ryn072} **Oel**

Wild Apple, Crab Apple
Pyrus Malus
Contains hydrogen cyanide Alien from Eurasia. Cultivated and an escape. FRUIT: Vitamin C etc. Raw from tree or into preserves, vinegar. Eaten by grouse, deer and all kinds of wildlife. BARK: CAUTION Contains "cyanide producing-compounds". WOOD: Hard closed grain, durable. PLANTED: Crab apple as ornamental for flowers and fruit. Grafted for special types. Cultivated since ancient times.

Beech
Fagus grandifolia
NUTS: Edible, but bitter. Amerindians: stored dry till winter, ate. Bobwhite, pheasant, ruffed grouse, turkey, squirrels, rabbit, fox, raccoon, opossum, deer, bears. LEAVES: Antiseptic. Mi'kmaq used dry winter leaves steeped. Used to treat chest complaints. WOOD: For cheap furniture, tool handles, fuel, etc. As it does not rot, colonists used for oars, planking ships, and cart axles.

Hophornbeam, Ironwood
Ostrya virginiana INEDIBLE. CATKINS, FRUIT, & BUDS: Purple finch, rose-breasted grosbeak, downy wood pecker, bob white, grouse, pheasants, turkey, squirrel, rabbit. TWIGS: Rabbit, deer. BARK: Amerindians steeped to use as blood medicine, wash for toothache relief, and bathed sore muscles. WOOD: Hardest of any Canadian wood, but decays rapidly on ground. Runners on sleighs, posts, mallets, tool handles, fence posts. PLANTED: As slow grow ornamental.

Indian Pear, Serviceberry, Chuckley-Pear
Amelanchier spp.
Edible POLLEN: Bees and insects. FRUIT: Juicy, Used in pies and muffins. Ground into flour. Amerindians: raw, cooked, or dried and blended with meat for pemmican or plum puddings. Song birds, hermit thrush, robin, chickadee, blue jay, woodpecker, mourning dove, grouse, turkey, chipmunks, squirrel, martin, raccoon, skunk, fox, & bears. TWIGS: Almond taste, moose, deer, beaver, red fox, flying squirrels, rabbit. Amerindians: Tool handles, fishing rods. Cree: arrow shafts. PLANTED: As ornamental.

Mountain Holly, False Holly, Catberry
Ilex mucronatus formerly *Nemopanthus mucronatus*
Found in damp woods.
PLANT: Inedible.

northern bush honeysuckle opposite, fine teeth, elongated pointed tip, reddish > dark green {Bol044} {Pet128} {Ryn033} {Dens304} {Dens342} {Dwt241} {MKI156} **Oel R**

Northern Bush Honeysuckle
Diervilla lonicera
Contains alkaloid believed to be narceline and a glucoside. LEAVES: Some Amerindians used it for stomach pains.

wild raisin / witherod lance to elliptical: slightly-toothed, contrasting vein {Mki127} **Oln Pp Q4 U4**

Wild Raisin, Witherod, Viburnum, Appalachian Tea.
Viburnum nudum
Contains hydrogen cyanide.
Pioneer species after fires with gray birch, pin cherry, poplar, and jack pine. FRUIT: Edible. Prune taste. Has laxative effect. Robins, cedar wax wings, blackbirds, ruffed grouse, mice, chipmunk, squirrels, hares, skunks. LEAVES: Cyanide - POISONOUS. TWIGS: Deer (substantial part of diet). COVER: Birds, mammals.

glossy buckthorn smooth, undulating, turning veins. {Bol145} {Dwt182} {Lit595} {MKi71} **Oel Q5 U5**

Glossy Buckthorn
Frangula alnus
Contains anthraquinone. Alien from Europe. FRUIT (drupes): Mildly TOXIC. Overwintering fruit eating birds. PLANT: Some Amerindians used it to induce vomiting when poisons had been ingested. PLANTED: Once planted at a tall hedge. Spreads rapidly. Considered invasive.

willow various teeth types {Blo092} {Bol73-77} {Bol82,85} {Bol86} {Bol117} {Dens378} {Dwt022} {Dwt023} {Lacey19} {Lit327} {MKi152} {Ptd176} {Ptd#38} {Ptd#39} {Woj182} **I2 J2 Oln Y**

Willow *Salix*
Contains tannin, acetylsalicylic acid. Some are native and some alien. ARCHAEOLOGY: 70 million years ago eaten by dinosaurs. BUDS: Ruffed grouse (partridge), beaver, muskrat, red squirrel, deer, hare. BUDS, LEAVES, TWIGS: Rich in vitamin C and zinc. Ptarmigan, ruffed grouse, grosbeaks, hare, rabbit, beaver, muskrat, porcupine, deer, moose. Twigs sometimes has willow pine cone gall caused by midge. Amerindians hollowed into ceremonial pipes. BARK: Bark is rich in tannin, acetylsalicylic acid Porcupines strip outer bark and eat inner bark. Greeks (2400 ya) and Amerindians used tea as pain reliever - ASA - acetylsalicylic acid - aspirin. Mi'kmaq made poultices to heal bruises stop bleeding. Malecite: stimulate appetite. PLANTED: Controls wet area erosion.

fly honeysuckle {Bol049} {Pet128} {Dwt246} {Dens342} {MKi156}

Fly Honeysuckle
Lonicera canadensis
LEAVES: Chippewa used for stomach medicine.

[Oval, Lance] Oel Oln

Oln Lance

black cherry sharp fine-toothed, glossy, thick, elliptical to lance leaf {Bol97} {Lacey53} {Lit506} {MKi087} {Ptd171} {Woj216} **D Oln, Po Q2 U2**

Black Cherry
Prunus serotina
Contain hydrogen cyanide.
TOXIC (All except fruit pulp and skin.) FRUIT: Bobwhite, grouse, pheasant, squirrel, rabbit, raccoon, fox, deer, bear. BARK: Has bitter taste but pleasant bitter almond odor which wards off browsers. Bark extract, hydrocyanic acid (Prussic acid) used in cough medicines, for sore throats, and in expectorants. CAUTION Pregnant should not consume.

pin cherry toothed, pointed, shiny {Blo60} {Bol79} {Dow30} {Lit504} {MKi087} {Ptd172} {Scott29} {Woj214} **C J1 Oln Pp Q3 U3**

Pin Cherry
Prunus pensylvanica
Contain hydrogen cyanide. Plant requires a fire to open its seed. FRUIT: Sour, raw, jellies, cough syrup. Amerindians dried, bruised, and added to pemmican. FRUIT: Robins, thrushes, cedar waxwings, grosbeaks, starlings, and catbirds, chipmunks, skunks, red fox, deer. BUDS: Ruffed grouse. LEAVES: TOXIC. TWIGS: Chipmunk, rabbit, beaver, deer, moose. PITS & BARK: POISONOUS. ROOTS: Prevent erosion, stomach disorders.

P Fall Colors (Trees & Others) Colors vary & mix.

Pp Purples, Pinks, Red shades

white ash > brown pinnate oval, tipped, stemmed, fine teeth I1 K7 Pp Pyb S1 X

pasture rose pinnate, sometimes orange > red coarse tth Po V2

staghorn sumac pinnate lance, teeth, hairy stem K7, Pp, Q1 U1

bunchberry or evergreen 6 lfs whl Pp

blackberry palmate coarse t. K5 Pp Q5

poison ivy trifoliate irreg. tth K3 Pp Po

P [Red, Orange, Brown - Yellows]

hobblebush heart-shape irregular teeth, heavily vein, opp. leaves Nh, Pp Q4 U4

hobblebush heart shaped, irregular teeth heavily vein, opposite leaves

arrowwood egg-shaped to round, coarse teeth deep veins Pp

alternate-leaved dogwood egg-shpd, smth undulate, veins > par. Meg Pp Q4

wild raisin / witherod ellipt - lance curls slightly-toothed, contrasting vein, Oln Pp Q4 U4

pin cherry red, orange yellow lance, teeth, point tip C J1 Oln Pp Q3 U3

Pr Reds Also highbush cranberry

Virginia creeper palm. coarse tth K5 Pr

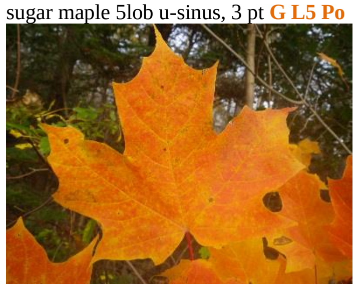
northern red oak red orange > brown 7 lobe sharp tips I3 J2 L7 Pr T1 Y3

red maple yellow, orange, burgundy 3 lobes, sharp sinus, irregular double teeth G J1 J5 J6 L3 Pr S1 X2

lowbush blueberry elliptical to lance fine-toothed Pr

Po Oranges

sugar maple 5lob u-sinus, 3 pt G L5 Po



Norway maple ylw org.5 lb u-sinus 5 pt hooked tips, + tar spts I1 L5 Py S2 X2

mountain maple 3 lobes, rounded teeth E L3 Po S1 X2

trembling aspen egg-sh. fine-tth E Meg Po Py Y4

black cherry elliptical-lance glossy, fine teeth, veins' ends connect, twigs almond smell D Oln Po Q2 U2

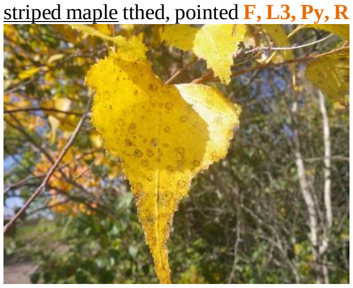
Py Yellows

Manitoba maple pin..lb H K7 Py S2 X2

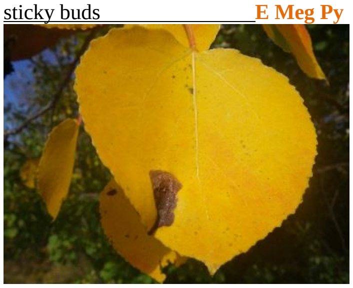
wild grape *Vitis riparia* 5 lobed, coarse-toothed [Thomas Ave.] Py

London plane short-pointed D L5 Py


striped maple tthed, pointed **F, L3, Py, R**


gray birch / old farm birch: triangular, long tail, coarse teeth **A J4 L1 Py Y4**

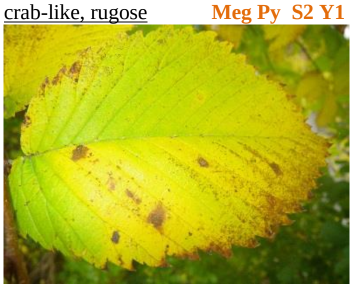

balsam poplar egg-shaped fine teeth, sticky buds **E Meg Py**


trembling aspen: egg-shape fine-teeth **E Meg Po Py Y4**


large-toothed aspen: egg-shape scallop teeth **E Meg Py**


white birch egg-shaped irregular toothed, tapering tip **B J3 Meg Py Y4**


beaked hazelnut: egg-shaped double tth, crab-like, rugose **Meg Py S2 Y1**


elm asymmetrical double-toothed (big/ small), crab-like, rough surface **I3 Nas Py X3**

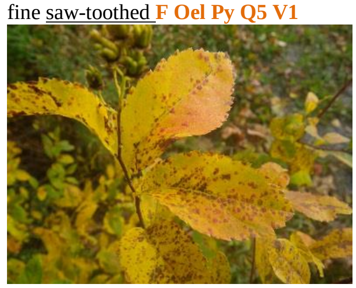

basswood / linden asymmetrical with tip, coarse saw teeth **I2 Nas Py S2 Y2**


witch-hazel asymmetrical round-toothed undulating edge, **Nas Py S2 Y2**


yellow birch oval and slightly heart-shaped, coarse teeth **B J6 Nh Py T2 Y4**

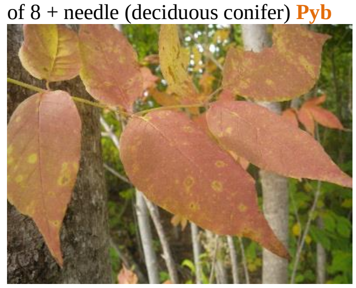

hophornbeam oval-elliptical double-toothed **G J4 Oel Py X4**


Indian pear / serviceberry oval – ellipt. fine saw-toothed **F Oel Py Q5 V1**


meadowsweet oval coarse tth yellow to pink **Pp Q1 Y2**

Pyb Yellows / Browns


tamarack / larch, hackmatack bundles of 8 + needle (deciduous conifer) **Pyb**


white ash pinnate stemmed, oval, fine teeth **I1 K7 Pp Pyb S1 X**


northern mountain ash pinnate lance fine teeth **C K7 Pyb V1 See Q4**


burr oak deep wide sinus **I2 L7 Pyb Y3**


northern red oak red orange > brown 7 lobe sharp tips **I3 J2 L7 Pr T1 Y3**


beech oval-ellipt coarse teeth, pleat **A J1 Oel Pyb Y1**

Pgb Green or Browning

Also apple, bog laurel, bunchberry


black locust green brown or yellow pinn. oval smooth **I3 K7 Pgb Q6 W**


black ash green-brown often yellow, pinn.fine tth, no stems **H K7 Pgb X1**

Flowers 25 June 2020 version

Q1 Vertical Clusters (4/5/6p)

red elderberry MAY **K7 Q1 U1**

staghorn sumac JUN-JL **K7, Pp, Q1 U1**

meadowsweet JULY-AUG **Pp Q1 Y2**

Q2 Hanging Clusters

chokecherry spikes MA-JU cyl. 6-12 cm. white 5 petals **Meg Q2 U2**

black cherry JUNE cyl.15 cm white 5 petals **D J Oln Q2 U2**

Q3 Round Clusters

pin cherry MAY 5p. **C Oln Pp Q3 U3**

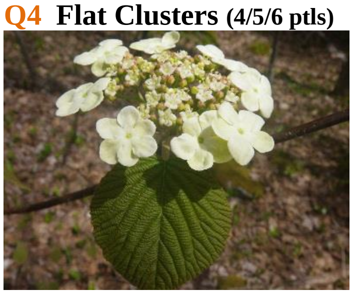
apple MAY – JUNE white to pink 5 ptls **D Oel Q5 V1**

American mountain ash JUNE 5 ptls pinnate leaf **Q4 see C K7 Pyb V1**

Eastern ninebark JUNE **L3 Q3 Y2**

Labrador tea JUNE 5 ptls Peggy's C.**Q3**

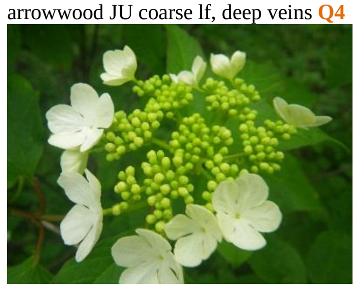
Q4 Flat Clusters (4/5/6 ptls)



hobblebush MAY-JUNE flat cluster, blm edge first, rugose lf **Nh, Pp Q4 U4**

red osier dogwood JUNE opposite lvs **Meg Q4 U4**

arrowwood JU coarse lf, deep veins **Q4**



highbush cranberry JUNE-JULY 5ptl out large fl., in sm. fertile fls **L3 Q4**

alternate leaved dogwood JUNE-JULY leaves in whorl or alt. lea. **Meg Pp Q4**

wild raisin / witherod JUNE-JULY flat-topped clusters white **Oln Pp Q4 U4**

common elderberry JULY-AUG 5ptl **K7 Q4 U4**

Q5 Small Clusters

Indian pear / serviceberry MAY white 5 ptls [Warren Dr. BH.] **F Oel Py Q5 V1**

hawthorn MAY-JUNE 5 ptl many lobed-lf **L7 Q5 V1**

buckthorn MAY-JUNE 5ptl **Oel Q5 U5**

dewberry/dwarf rasp. JUNE 5 angled petals. **K3 Q5**

black chokeberry JUNE 5 ptls spoon-shaped lf **Q5 V1**

blackberry JUNE-JULY 5 p. **K5 Pp Q5**

multiflora rose JULY 5 ptl. oft rounded cl. **Q5**

Q6 Fused / Pea-Like Cl.

rhodora MAY-JUNE 5 fused ptls **Q6**

black locust JUNE-JULY **I3 K7 Pgb Q6 W**

R Lobed / Funnel / Bell / Urn Flowers (4/5)

fly honeysuckle APRIL-MAY funnel-sh **R**

northern bush honeysuckle JN-JL **Oel R**

black huckleberry JUNE urn-shaped red to coral pink 5 lobes **R**

striped maple MAY yellow-green, bell-shaped **F, L3, Py, R**

Norway maple MAY **I1 L5 Py S2 X2**

S1 Tiny or No Petals

white ash MAY female**I1 K7 Pyb S1 X**

sugar maple APRIL-JUNE ylw-gr. long hairy stalks ptl-less **G K5 Po S1 X2**

red maple MAY male red stalk-less flowers **G J1 J5 J6 L3 Pr S1 X2**

red maple MAY female **G J1 J5 J6 L3 Pr S1 X2**

Manitoba maple MAY long stalk **H K7 Py S2 X2**

mountain maple JUNE **E L3 Po S1 X2**

S2 Scrawny Petals

beaked hazelnut APRIL-MAY pink [Dixon Court,BH] **Meg Py S2 Y1**

basswood / linden JULY greenish to yellowish white 5 ptls nodding sm. clts fragrant [Laconia] **I2 Nas Py S2 Y2**

witch-hazel SEPT-NOV yellow 4 ptls [Shubie Canal] **Nas Py S2 Y2**

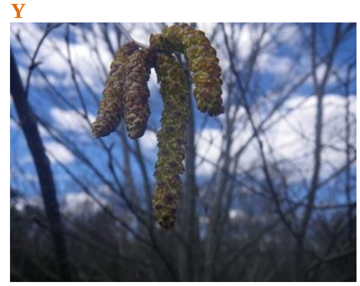
T1 Catkins Loose

northern red oak MAY-JUNE **I3 J2 L7 Pr T1 Y3**

T2 Catkins Bumpy Beady

speckled alder MARCH-MAY **Meg T2 Y4**

trembling aspen APR.-MAY **E Meg T2 Y**



yellow birch MAY-JUNE**B Nh T2 Y4**

bayberry JUNE **T2**

T3 Catkins soft

willow [Sobeys Mall] **I2 Oln T3 Y**

willow [Main-á-Dieu CB] **I2 Oln T3 Y**

Seeds

U1 Conical or Upright Drupes Clusters


red elderberry [Warren Dr.] K7 Q1 U1


staghorn sumac fuzzy red, poisonous [BH Cobequid Trail] K7, Pp, Q1 U1

U2 Hanging Drupe / Berry Chains


chokecherry red > purplish, chains [Tatamagouche Vil.] Meg Q2 U2


black cherry purple black drupes, hang clusters [N. Plym.] D J Oln Q2 U2


Barberry red elliptical, hanging chains [Bible Hill, Maple Bld.] Q2 U2

U, R, S [Flower Clusters, Pomes, Hips, Peapods & Samaras]

U3 Round Drupe Clusters


pin cherry > red edible but acidic [Lower Truro] C, J1, Oln, Pp, Q3 U3

U4 Flat Drupes Clusters


hobblebush drupes > red Nh, Pp Q4 U4


red-osier dogwood > white Meg Q4 U4


wild raisin / witherod > pink and blue black > raisin-like Oln Pp Q4 U4


common elderberry K7 Q4 U4

U5 Sm. Drupes Clusters


European buckthorn [Warren Drive] black, cluster at twig base; fine-tth U5


glossy buckthorn black in leaf axils; smooth shiny ellip. leaves Oel Q5 U5


alder-leaved buckthorn purple-black in leaf axils, often hidden by finely toothed oval leaves {Bol140} U5

V1 Pomes


northern mountain.ash C K7 Pyb V1


Indian pear / serviceberry elongated cl. > red > black F Oel Py Q5 V1


wild apple D Oel Q5 V1


hawthorn L7 Q5 V1


black chokeberry spoon-sh. lf Q5 V1

V2 Hips


pasture rose / Virginia rose Po V2


rugosa rose [MacRae Lib.] V2

W Peapods


black locust [Laconia]I3 K7 Pgb Q6 W

X1 Samaras, Single Wing


white ash samaras no twist, wing at end of seed I1 K7 Pp Pyb S1 X1


black ash [South St., Hlfx] samaras twist, wing surrounds seed H K7 Pgb X1

X2 Samaras, Paired

red maple [Pleasant St.] samaras partly tight pk grn > brn **G J1 J5 J6 L3 Pr S1 X2**

mountain maple [Earltown Mt.] samaras tight pink or red **E L3 Po S1 X2**

bloodgood Japanese maple [University Ave. Halifax] pink wings **L7 S2 X2**

Manitoba maple samaras tight, remain on tree in winter **H K7 Py S2 X2**

striped maple wide samaras, hanging chains [Chain Lakes Trl] **F L3 Py R X2**

sugar maple samaras spherical dark green seed **G K5 Po S1 X2**

Norway maple samaras very wide spreading **I1 L5 Py S2 X2**

crimson king maple samaras extremely wide spreading See Nor. Mp. **I1 L5 X2**

X3 Samaras, Round

elm **I3 Nas Py X3**

X4 Bract Clusters

hophornbeam / ironwood [Earltown Lake] clusters of seeds: **G Oel Sbcl X4**

Y1 Husks

beech > woody husk **A J1 Oel Pyb Y1**

beaked hazelnut [Taylor Lake] **Meg Py S2 Y1**

Y2 Capsules

meadowsweet star-like caps. **Pp Q1 Y2**

eastern ninebark capsules **L3 Q3 Y2**

basswood / linden **I2 Nas Py S2 Y2**

witch-hazel Bluff Trail **Nas Py S2 Y2**

Y3 Acorns

northern red oak [Dixon Court, Bible Hill] flat cap. **I3 J2 L7 Pr T1 Y3**

English oak Long acorn. **L7 Y3**

burr oak [Holy Well Park, Bible Hill] Cap with burrs. **I2 L7 Pyb Y3**

Y4 Cone-Like

speckled alder [Tatamagouche Village] **Meg T2 Y4**

gray birch **A J4 L1 Py Y4**

white birch **B J3 Meg Py Y4**

yellow birch **B J6 Nh Py T2 Y4**

yellow birch - older cones **B J6 Nh Py T2 Y4**

Z Nature's Dynamics

By Norris Whiston Canada © 2017
norrisw@ns.sympatico.ca 4945 Hwy 311 Tatamagouche NS B0K 1V0 902-657-3476. From *Hardwoods, Shrubs and Nature's Dynamics*. A full free hyperlinked bibliography is available upon request.   25 June 2020 version

This section may be hard to digest and should be read in pieces.

Those interested in the references will be able to get them from this author.

Z1 It Took So Long …

to get Earth's air, water, soil, and life right.

Z1.1 Early Earth 4,600 mya

(4,600 million years ago)

Precambrian Landscape
{Wikimedia Commons}

Forests weren't always here. The Earth's atmosphere, water, and soils didn't always have the many qualities they now have for evolving and nurturing Earth's plants and animals.

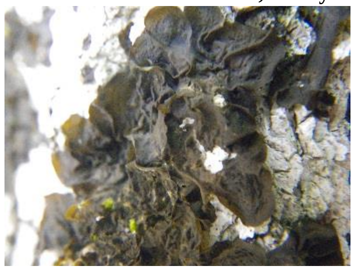
Though Earth's bombardment from icy comets had stopped by 3.6 billion years ago, and Earth had, by that time, water, minerals, and gases, it had no surface plants or animals. The most important thing that Earth did have, but living in the oceans, was bacteria and cyanobacteria. {Dodd2017} {Fensome2001p32}

Evolving to higher forms of life required our planet's life processing the rock and the atmosphere for nutrition and protecting itself from ultra violet waves. It has been long and complicated evolution. Most other water zone planets in ours (Mars and Venus) and, most likely other solar systems, have not gone through the long process Earth has gone through. {Chopra2016}

In spite of the work of microscopic creatures, and oxygen spikes from oceanic cyanobacteria, **after 2.2 more billion years, Earth's atmosphere contained way too much carbon dioxide, had no ozone layer, and 1/1000 the oxygen it has now.**

Though complex changes had occurred, the Earth was still not habitable enough to allow for modern evolution. {Planavsky2014}

Z1.2 Lichen's Role 1,300 mya



jelly skin / *Leptogium* (cyanobacteria lichen) Admiral Trail, Halifax Co.

After three quarters of Earth's existence, around 1,300 million years ago (mya), based on genetic analysis, it has been figured cyanobacteria lichens began as first life on land. {Heckman2001}

The exterior fungus of the lichen protected the cyanobacteria interior from wide ranges of temperatures, ultraviolet light, and droughts of many months.

Those pioneer cyanobacteria lichen would get nutrients and water from the air. Using the sun's energy, the cyanobacteria combined the CO_2 from the air (sequestering) and H_20 from the rain and created carbohydrates and oxygen. The bacteria then shared them with its fungal host. {Hinds2007p3}

many fruited pelt / *Peltigera polydactylon* (cyanobacteria lichen) Earltown Mountain

Lichens also participated in nitrogen fixation – taking out (sequestering) atmospheric nitrous oxide (N_2O), another major greenhouse gas, and produced ammonia and nitrates usable for its and eventually all plant growth. {Hinds17} {Walewski2007p2}

Lichens didn't have roots or a vascular system, but would evolve hyphae (fungal hairs) to hold its location on soil and rock.

The lichen's traits were useful in cooling the atmosphere and their hyphae would later be useful for the regular rebuilding of soils after glacier retreats. The last glacial retreat was 12,000 ya.

Lichens continued to develop, while Earth's volcanic islands and smaller land masses (centered near the South Pole) were crushed into the supercontinent Rodinia around 1,000 million years ago. Pieces of rock dating to Rodinia's time can be found on a stream at the base of Nuttby Mountain and a stream on Glen Road in Pictou Co. {Donahue1982}

Nitrogen-fixing finger-scale foam lichen - *Stereocaulon dactylophyllum* Earltown Mountain

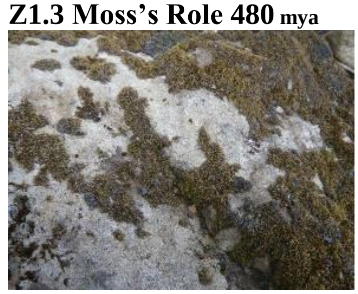
After many adaptations, the effect of lichens on rocks becomes noticeable in rock chemical components dating around 800 mya. {Hinds17} {Planavasky2014} {Hogenboom30Oct.2014}

Lichens chemical successes led to the first of tiny animals and to a series of global glaciations now known as "Snowball Earth". {Heckman2001} {Kennedy2001} {Hinds17}

[Incidentally, lichen's ability to turn atmospheric carbon dioxide into oxygen and carbohydrates led scientists into considering taking lichens on a Mars space trip. {Nowakowski2014}]

Around 750 million ya, the mega continent, Rodinia, broke apart and the continental pieces migrated.

Z1.3 Moss's Role 480 mya



Granite moss / *Andreaea rothii*
Earltown Mountain, NS

A LONG time afterwards, between 600 million to 480 million years ago, on the migrating continental pieces, mosses came into being. **At that time, Earth's atmospheric levels of CO_2 "are thought to have been 16 times higher than they are now, and average global temperatures are thought to have been 25C, around 10C higher than they are now.**" {Lenton2012} Way too warm!

Like lichens, mosses have no vascular system [lignin] and contain no roots. Instead of hyphae, mosses are held in place by thread-like rhizoids. As long as the air is moist, "mosses get their carbon dioxide, water, and minerals through the air over their whole surface [leaves]." {Munch2006p5} {Glime1993p7}

A rock moss
white-tipped moss / *Hedwigia ciliate*
Rogart Mt., Earltown NS

Mosses absorb water, are very slow to decay, and sequester carbon and nitrous oxide more efficiently than lichens. Due to those characteristics, mosses could keep sequestered carbon in the cooler and moist soil. Thanks to the mosses, "**by 460 million years ago, CO_2 levels had fallen by half and the planet began to cool, allowing the formation of the polar ice caps**" {Lenton2012}

Z1.4 Fungus 445 mya

(million years ago)

{Smith, Martin 2016}
Enlarged fossil of Tortotubus protuberans

Not until after 9/10 of Earth's existence, did soil exist. In 2016, Martin Smith published his findings on the oldest so far found, fossils discovered on land. Discoveries of the hyphae of *Tortotubus protuberans* were made in 1980s in New York, Scotland, and Gotland, Sweden. To be found now, they had been buried under a very old amount of mud indicating that the earth finally had soil.

The fossil had a cord-like structure, was incredibly small (Its length as thin as the width of a hair.), could not supply its own carbohydrates, and was between 443 and 445 million years old.

Though so small, *Tortotubus*, like our current mushrooms, served a mega purpose. It broke down decayed lichens and mosses, moved their nutrients to other areas, and stored the nutrients deeper in the Earth's first soils. {Smith2016} {Briggs2March2016} {ScienceNews2March2016}

It was very important role and was crucial for the next stages of evolution. Fungus will be examined in more detail for the needs of our current forest. All of this took a LONG time.

380 mya all the continental plates crashed again and formed, near the equator, the latest mega continent, Pangaea, and, with it, the Appalachian,

Cobequid, and numerous European Mountain Ranges. Rock in Earltown Village dates to 380 mya. {Donahue1982}

Z1.5 Club Moss, Fern, Horsetail, Conifers 370 mya

bristly club moss, *Lycopodium annotinum* Gully Lake Trail, Earltown

With earth's new found thicker soils, club moss, ferns, and horsetail, in that order, evolved between 370 and 350 mya.

Club moss, now between 15 & 30 cm, would reach up 50 meters high. Fossils of these large club moss are found along the Fundy and Northumberland shores.

Interrupted fern *Osmunda claytonianana* Earltown Lakes Trail

Ferns also became tree size. A fossil of the pictured fern dates to 200 mya. It would have been eaten by dinosaurs. One of the smallest ferns, would re-habilitate the Earth's atmosphere.

field horsetail *Equisetum arvense* Sobeys, Robie St., Truro {Cobb194-213}

"Land plants also can lower levels of carbon dioxide in the atmosphere. They have molecules called lignins, which contain carbon but do not readily decompose. After a plant dies, some of its carbon remains locked up in the lignins and can become buried in the Earth through geologic processes."

"Fossil fuels like coal and oil are made from plant material, containing carbon that was taken out of the atmosphere and buried in swamps millions of years ago." {Kennedy 2001} {Cobb218-233}

Z1.6 Conifers 330 mya

(Gymnosperms)

Norway spruce *Picea abies* Brown Pumping Station, Amherst

Conifers would come into existence about 330 mya, and the conifers and ferns would come to dominate the Earth. {Briggs14January2018} {Simonin2018}

Conifers don't store water. "If you're caught in a shower and stick close to the trunks, you'll hardly get wet at all, and neither will the tree's roots." "**Rainfall gets hung up in the needles and branches. When the clouds clear, this water evaporates and all this precious moisture is lost.**" "Spruce are comfortable in cold regions where, thanks to the low temperatures, the groundwater hardly ever evaporates." {Wohlleben102}

It would be a further 190 million years before flowering plants and trees came along. The conifers, ferns and others, with their large cells, continued to sequester carbon dioxide and nitrous oxide (two of the three major greenhouse gases), and, through photosynthesis, and bacterial conversions, they created carbo-hydrates, ammonia, nitrates, and nitrites. In between, there were many fluctuations in atmosphere carbon, nitrous oxide, oxygen, ozone content, and the temperatures of the earth.

140 mya, after 97% of the Earth's history, after nearly 200 million years, the conifers, ferns and the others could only stabilize the carbon in the atmosphere to 3 times what it is today. These groups made their efforts and it just wasn't enough. It was warm and the first mammals would could only come out at night. {Cobb218-233} {Bradshaw2016} {Fensome2001p51-53}

Z1.7 Flowering Trees & Plants (Angiosperms)

(140mya)

Gully Lake Wilderness Area Kemptown

By around 140 mya ago, flowering trees and plants evolved.

Flowering plants' evolved smaller genetic material / genome, and could build smaller cells. "In turn, this allows greater carbon dioxide uptake, and carbon gain from photosynthesis, the process by which plants use light energy to turn carbon dioxide and water into glucose and oxygen. **Angiosperms [Flowering plants] can pack more veins and pores into their leaves, maximizing their productivity"** {Briggs14January2018} {Simonin2018} and maximizing their carbon sequestering.

Grasses would join in much later. {Fensome2001p54} {Bradshaw2016xxv}

Z2 Flora Role in Sequestering N_2O & CO_2 and creating Carbon Hydrates, O_2 and O_3

Z2.1 Peat Moss's Role

green sphagnum - *Sphagnum girgensohuii* Portage Trail, Earltown

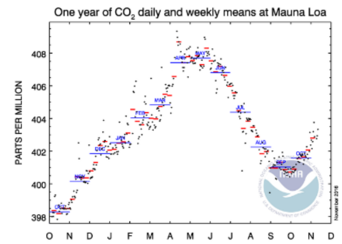
There is a larger need than ever to consider sequestering carbon by plants.

Peat / sphagnum mosses have weighed in heavily in carbon and nitrous sequestering. **Wet "peatlands store as much as 500 billion metric tons of carbon** – or twice as much as is incorporated into all the trees in all the world's forests – **roughly 1,450 metric tons of carbon per hectare." Canada's "current destruction [of peatlands including tar sands] adds 8.7 million metric tons [of Carbon] to the atmosphere every year**." {Biello8Dec2009}

ladies tresses sphagnum, *Sphagnum capillifolium* Sandy Cope Trail,

However, "**Degraded peatland emit nearly three billion tons per year of carbon dioxide that was previously locked up in the decaying matter, or roughly 6 percent of all such greenhouse gas emissions from human activity**." {Karhu et. al. 2014}

Z2.2 Trees and Flowers Role in Carbon Sequester



From National Oceanic and Atmospheric Administration (NOAA)

Looking at the graph, one can see how the forest and plants participate in the sequestering of Carbon. From May to October, while leaves are out, Mauna Loa Observatory's graph of atmospheric CO_2 shows nature's effect on the atmosphere. From January to March, there seems to be a slight slowdown of carbon being added to the atmosphere. {Mauna Loa Observatory and NOAA} "In the past few decades, the world's forests have absorbed as much as 30% (2 petagrams of carbon per year; Pg C year^{-1}) of annual global anthropogenic CO_2 emissions — about the same amount as the oceans."

After all that sequestering and storage, "**The world's soils hold about twice the amount of carbon as the atmosphere.**" {Karhu2014}

Z2.3 Oldest Trees Best

Gully Lake Trail, Earltown –Kemptown

A study, done by U.S Dept. of Interior of 673,046 trees throughout the world, found that older trees sequester carbon best. While older trees account for 6% of old growth forests, they account for 33% of its growth and consequently 33% of its carbon sequestering. It would be like the star player on a basketball team being a 90 year old. {Stephenson2014} {Quinn16Jan2014} {Walsh15Jan.2014}

Juniper Head Trail, Pictou Co.

Every year, as they older and bigger, they sequester more. Mature old growth eastern hemlock grow to 200+, eastern white pine 175+, red spruce

175+, sugar maple 150+. American beech 150+, and yellow birch to 150+. {Lynds & LeDuc1995}

Z2.4 Vs. Conifers

An old conifer tree *Picea*
Gully Lake Trail, Kemptown

If conifers don't store water and its cells are larger and more inefficient to photosynthesize atmospheric carbon, why would anyone believe that they can keep up with hardwoods in sequestering. The conifers, after 200 million years, could only bring the atmospheric carbon dioxide level to 3 times as it is now. {Wohlleben {Bradshaw2016xxv}

"Choosing conifers over broadleaved varieties also had significant impacts on the albedo - the amount of solar radiation reflected back into space." "**Even well managed [conifer] forests today store less carbon than their natural counterparts [hardwood and mixed forests] in 1750.**" {Naudts 2016}

The comparison to young saplings is more startling. "**Research has documented that for many years after a clearcut, a re-sprouting forest emits more CO2 than it absorbs.**" {Carter, Forest Ecology Network}

Z2.5 Vs Plantations

Colchester County

The "model assumes that the CO2 sequestered by immature woodlands and forest plantations full of saplings is instantaneously equal (that is to say, without a 35- to 50-year deficit) to the centuries of carbon captured by the old-growth trees of a mature forest." {Graber-Stiehl3March2016}

Once growing "In reality, biodiversity-challenged plantations are a far less reliable carbon sink than forests. **Plantations can sequester only a quarter of the CO2 that functioning woodlands can, and converting forests to plantations actually releases carbon trapped in soil.**" {Graber-Stiehl3March2016}

"**Removing trees in an organized fashion tends to release carbon that would otherwise remain stored in forest litter, dead wood and soil.**" {Naudts 2016}

Z2.6 Vs Forest in Drought

Currently there is an increase of world droughts, and, consequentially there is an increase of wildfires, loss of wild animals' populations, loss of wild and cultivated food resources, human poverty, political turmoil, and human migrations. {WorldBank14Nov2016} {King2015} {Fenichel2016} {Lelieveld 2016}

Droughts are hugely effecting Oceania, North Korea, Mongolia, eastern China, central Russia, Indonesia, Thailand, Australia, 330 million people in India, Arab nations, the eastern Mediterranean, Central Europe, western and southern Africa, Brazil, Andes, Venezuela, Central America, US Southwest and Central Plains, New England, and, of course, many parts of Canada. {NIDIS2016} From analysis of growth rings, the Eastern Mediterranean is found to be in the worst drought in at least the past 900 years. {Cook2016} {OldWorldDrought Atlas}

In drought conditions, plants sequester less. Everyone has seen tree's concentric growth rings. {Colchester Historium and other museums} {Woodpiles} Some are wide and some are thin. The thin layers occur when the year has been in drought. In those years, there wasn't as much water H_2O for the tree leaves to sequester CO_2 to make as much carbohydrates.

Maritimers need to expect more and longer droughts. "An Environment Canada climatologist [David Philips] is warning that **a dry spell in Nova Scotia that has left some people without water is just a "dress rehearsal" for the kind of weather conditions Canada can expect in the years to come.**" {The Canadian Press 16September2016} {Feldpausch2016}

Deforestation contributes heavily to climate change to droughts to climate change, and to the price of food. It is one case of many climate effects seen across the Earth. {Berwyn30June2016}

Z2.7 Does Nature Have Any Chance to Sequester Humans' Emissions of Green House Gases?

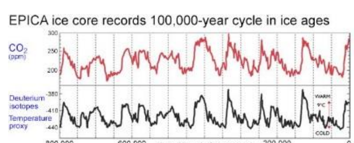
Thompson Station, Cumberland Co. NS

Though "The world's forests annually sequester as much as 30% of the equivalent of human-caused carbon emissions" {Lansky2016p4}, the earth is grossly losing things that sequester. "**Scientists estimate that the Earth contained approximately 1,000 billion tons of carbon in living biomass 2,000 years ago. Since that time, humans have reduced that amount by half.** It is estimated that just over 10 percent of that biomass was destroyed in just the last century." {Schramski2015}

Deforestation {Global Forest Watch}
Note the Maritimes and Northern NE.

Despite nature's efforts of removing the greenhouse gases of carbon dioxide and nitrous oxide during late spring and summer, throughout the whole year, as one can tell from the graph, Earth can't keep up with carbon emissions. {Earth System Research Laboratory - NOAA} Those emissions include those from deforestation {UN} and those released from repeatedly exposing soils.

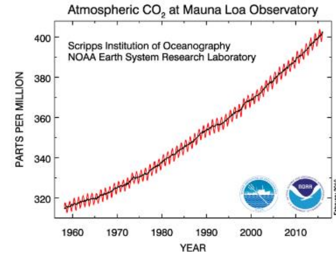
"**Climate change is happening, and as the Intergovernmental Panel on Climate Change, national scientific academies and scientific organizations across the world have all concluded human activities, particularly burning of fossil fuels and deforestation, are primarily responsible.**" [Ward2015}



{BAS/EPICA Antarctic Survey}

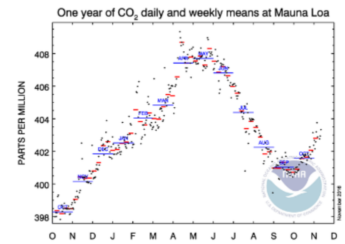
The top graph (red) shows, Antarctic ice core data samples, over the last 800 thousand years.

Evidence of human emission of carbon is found at the South Pole. Analyzing ice cores, which were dated to 800,000 ya in the Antarctic, "**for every single cold period carbon dioxide they [researchers] found CO_2 at about 190 molecules in every million molecules of air. In every warm period they found about 270 parts per million. Right now the level in the atmosphere is about 400 parts per million and that rise began at the beginning of the industrial revolution.**" {Mulvaney2016}



{National Oceanic and Atmospheric Administration (NOAA)}

The Earth reached **408 molecules per million last May 2016**.



From National Oceanic and Atmospheric Administration (NOAA)

A scientific analysis of seashell fossils off of New Jersey, determined that, last year [2015], humans added more carbon than in any single year in at least 66 million years. {Zeebe 2016} {Reuters22March2016} {Amos 21 March 2016} 2016 is expect to have broken that record.

Human emissions are heading far above the target of 1.5 C needed to save Pacific Island nations and the shorelines of all the continents. {European GeosciencesUnion21April2016} {Jeffrey et al. 2015}

In May 2016, it was announced: "At least 11 islands across the northern Solomon Islands have either totally disappeared over recent decades [5] or are currently experiencing severe erosion" {Albert2016}

"Malielegaoi [PM of Samoa] said Pacific Island nations, some of which are barely one metre (three foot) above sea level, were at the forefront of the climate change issue because it was a matter of survival for them."

"The reason for the very strong stance put forward by Pacific island countries is that we are the most vulnerable. Many of our states will disappear under the ocean if climate change is allowed to continue." {45th Pacific Islands Forum, held at Korar, Palau 29 July to 1 Aug. 2014}

Z3 After the Ice Age

Z3.1 The Progression

Glacial Extent Wisconsin Ice Age {Thenaturalhistorian.com 2013}

To examine Maritime and northern New England forests and their present regressions, it is useful to understand their original progression. Between 15,000 and 14,500 ya, ice began its retreat along the shores of the Pacific Ocean and the Bay of Fundy. It would immediately allow for animal, plant, and human migration. {Fensome2001-191} {Fensome2014

Tarmis, Nunavit {Spares, Aaron}

The glacial retreat left bare rock and glacial till, on the shores and gradually further inland.

Cladonia verticillata - ladder lichen
Earltown Mountain

As there was no soil there, the first plants to arrive to this barren world were tundra lichens, mosses, herbs, and shrubs. {Fensome2001-192} {Sperduto21}

The aforesaid cyanobacteria lichens and mosses, with a big assist from the soil building mycorrhizal fungi, began, only slowly, the buildup of useable nitrogen, carbohydrates, and many other nutrients. While the ground was bare, lichen's hyphae and mosses' rhizoids assisted with weathering, in breaking bare bedrock and mineral fragments' "complex mineral compounds into simple ionic forms that reside in soil water." {Sperduto17-22, 97} {Fensome193}

Trembling aspen *Populus tremuloides*

It took a long time for the soil's carbon stocks and nutrients to be prepared for the first trees – the aspen and conifers. With shallow roots, they didn't need much soil.

The plants made the land hospitable to mastodon and caribou. The melt would also allow America's earliest humans, their new found hunters, to arrive.

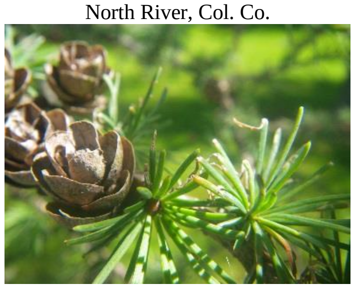
The warming lasted but 2000 years, when another cold period, called the **Younger Dryas, came on abruptly, (within 6 months). {Patterson2009} Named for dryas or mountain avens, it lasted from 12,900 to 11,600**. It was significant to Acadian forests and Wisconsin glacier's completed its withdrawal, between 11,500 ya and 10,500 ya. {Sperduto10} The now extinct animals hadn't evolved to deal with the two new situations.

For the following, the author uses the dates from Sperduto.

1500 years after the ice age, around 10,000 ya, alder, spruce, larch, and red pine arrived.

speckled alder *Alnus incana*
Wreck Cove, CB

white spruce – *Picea glauca*
4 sided needles upturned
North River, Col. Co.



larch, tamarack – *Larix laricini* needles in bundles of 8 or more Bible Hill

red pine *Pinus resinosa*
needles in bundles of 2
Tatamagouche Center

2500 years after the ice age, 9000 ya ago, were elm and white pine.

White pine *Pinus strobus* Park St. Truro
needles in bundles of 5

American Elm *Ulmus americana*
Halifax Public Gardens

3500 years after the ice age retreat, 8000 ya, hemlock arrived.

Eastern hemlock *Tsuga canadensis*
flat, blunt-tipped needles
Balmoral Grist Mill, NS

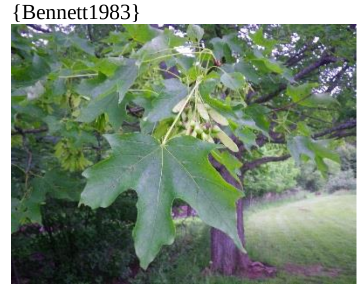
5000 years after the ice age ended, 6,500 ya, soils and nature's balance were in place enough for American beech arrival. {Sperduto21, 97-98} {Fensome189, 193} {McCarthy1995} {Ogden1987}

American beech *Fagus granifolia*
Rogart Mountain, Earltown

5500 years after the ice age ended, 6000 ya, ash appeared in Great Britain. Europe had the same glacial retreat as North America's, and a similar progression happened there.

Black ash *Fraxiмus nigra*
South Street Halifax

Eventually, in only special places, along with ash, came sugar maple and dogwood. All three required high-quality organic matter and calcium rich mafic bedrock or till. {Sperduto20} {Bennett1983}



Sugar maple *Acer saccharum*
Victoria Park Truro

Red osier dogwood *Cornus stolonifera*
Valley Road, Truro

When seeing the regression of Nova Scotia forests, noting the aforesaid progression of species. It is significant what is disappearing and what is left after humans began forests purely as resources and not considering nutrients.

Z3.2 The Regression after Farming and Forestry **400 ya to present**

Alex MacDonald Road, Earltown

The regression of Acadian forest, began mostly after 1600 AD, 400 ya. European immigrants' arrival. The regression of the forests is quite apparent in pollen counts at Penhorn Lake.

By 7000 ya in Europe, Asia, Africa and the Americas, humanities' desire to farm and to build, had already affected forests, with the weakening of soil, the growth of grasslands and deserts, and the changing of the climate cycle.

The Europeans, after harvesting their own forests and oblivious to incidentally ruining Europe's soils, Europeans couldn't believe their good luck in the Americas in finding tall trees and lands for farming. They found and set aside the tallest of trees for the "Kings Masts" and cut down others for ship building. They drained marshes and cleared woods for fields and firewood, unknowingly adding CO_2 and N_2O to the atmosphere.

Stands of sugar maple, beech, pine, and others had been turned into farms. The original stands, which were plowed, had their carbon and nitrates lost to the atmosphere and calcium, magnesium, phosphorus, potassium and other nutrients seeped away into water systems and washed down to the bays.

The historical pollen counts at Penhorn Lake NS and elsewhere show losses to balsam fir, pine and hemlock, and, agreeing with the scrub forests we see now along highways in the Maritimes,

white birch Highway 104
Between Amherst and Wentworth

… increases of birch, aspen (known as intolerant species), grasses, and alder. {Fensome189, 193} {McCarthy1995} {Ogden1987} {Lynds}

"**It takes many centuries without fire or severe windstorms for a self-replacing beech-maple forest to reclaim the land**." {Bonnicksen2000 p283}

Replacing the old farmed land are forests of: 1. white spruce and shaggy moss; 2. balsam fir and white spruce;

tamarack and alder Earltown

3. tamarack and speckled alder; 4. white pine and balsam fir; and

gray birch and trembling aspen Brule

5. trembling aspen and grey birch. {Neily 109-120}

Clearcut stands, which have lost the tree's nutrient replenishment of fallen trees, are also not replaced by similar trees. Instead they are replaced by the intolerant hardwoods of: 1. large-toothed aspen and lambkill; 2. red oak – red maple; 3. large-toothed aspen and Christmas fern; 4. trembling aspen – white ash; 5. white birch – red maple; and 6. red maple and hay scented fern. {Neily75-90} A look at the forests on our roadways shows that doesn't recover either.

It has taken thousands of years to get forests up to the state of our old growth forests. With forest's nutrients and protective features gone to poor management, it has been a quick process to destroy it.

Z4 Mutualism (Facets beyond Photosynthesis)

Ecosystems need a lot of things!

A. They need the rest of the nutrients from air – Nitrogen essential for chlorophyl and for proteins that warn the plant of various dangers [4.1].

B They need hard-to-win nutrients of potassium, which serves as an electrolyte moving information to the roots, magnesium, calcium, phosphorus, and others from rock. [4.2].

C. Ecosystems need recycling systems to re-get those tough nutrients from deadwood and dead life and move them around the ecosystem. [5]

E. Ecosystems need creators of water, a system for storing water for drought times, and ways to protect them from fire. [6.1 – 6.2]

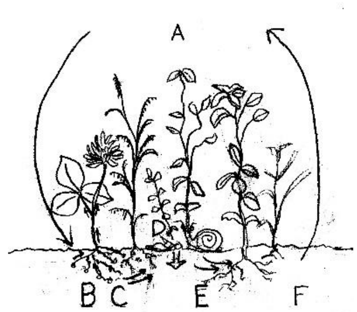
F. Ecosystems need modulators of temperatures, protector of moistures, and filters of pollution. [6.3-6.5]

G. Ecosystems need a physical and / or chemical defense from UV rays, [7.1]

H. Finally ecosystems need an alarm system and a chemical defense for micro-organisms, bacteria, cancer, other plants, insects, and herbivores. [7.2]

There is certainly a lot that needs to be in place.

Z4.1 Sources of Nitrogen



{Norris Whiston 2017}

"Most nitrogen used by plants originates from the atmosphere" {Sperduto17} either from the air directly or dissolved in rainfall.

Atmospheric nitrogen, greenhouse gas, NO, N_2O, N_2 [A], cannot be used directly by plants, but requires that nitrogen be converted (fixed) by particular bacteria to ammonium (NH_4^+) [B].

From ammonium other bacteria converts it to nitrites (NO_2^-) and then others to nitrates (NO_3^-) [C]. That then makes nitrogen accessible to neighboring plants.

Organic material such as dead plants, animal droppings and dead animals [D] also decompose and are processed in various ways. They then add to the nitrogen and other nutrients in the soil [E].

If soil, however, is exposed, it warms up and allows still other bacteria to process the nitrites and nitrates back to atmospheric NO, N_2O and N_2.[F] In the end that goes into the atmosphere and adds to the greenhouse gases. [A]

tree jelly lichen *Collema subflaccidum*
Earltown Mountain NS
Found on many hardwood trees

Nitrogen fixing cyanobacteria lichen is self-contained. The bacteria is within a fungal exterior. Cyanobacteria include Peltigera, Leptogium, Stereocaulon (all shown before), Collema, Lobaria, Nephroma, the rare Pseudocyphellaria, and the rarer Erioderma (boreal felt lichen).

Each lichen type aids its particular ecosystem with nitrogen fixing. "**This nitrogen can become available to plants in the immediate area when the lichen die and decay, or when nitrogen compounds leach from living lichens.**" {Brodo58} {Hines17-19}

Nitrogen-fixing boreal felt lichen
Erioderma mollissimum,
Ecum Secum, NS

The boreal felt lichen is getting in the Canadian news relative to its becoming extinct. It has a specific ecosystem that it helps out in. {Belliveau 26 Oct. 2013} {Chronicle Herald & CBC 2016}

Nitrogen-fixing Schreber's Moss / tree socks *Pleurozium schreberi*,
Sandy Cope Trail

The mosses, helping out forests significantly in obtaining fixed nitrogen, are Schreber's moss and stair-step moss.

Nitrogen-fixing stair-step moss
Hylocomium splendens

Those can be seen in lawns and on certain coniferous forest floors. Some moss grow up the bases of tree trunks like stocks. {Glime2006V1Ch8-1p3}

nitrogen fixing rabbit's foot clover (pink); yellow hop clover; white clover
Often seen in low mineral lawns.

On nutrient poor land and lawns, nitrogen-fixing plants have symbiotic bacteria, Rhizobium and Bradyrhizobium, living amongst its roots, aiding in converting atmospheric nitrogen to ammonia and nitrates.

In their symbiotic relationship, the plant gets the fixed nitrogen and the bacteria get carbohydrates. The excess nitrogen goes to the neighboring plants. {Wikipedia}

In fields and gardens, those nitrogen fixing plants include alfalfa, beans, black locust, clover, cowpeas, lupines, peanuts, soybean and vetches.

red clover, cow vetch (purple), & just above bayberry
Along low nutrient road graveled edges [Kemptown Road].

The bacteria around their roots each make more nitrates than the host plant needs.

Nitrogen-fixing black locust *Robinia pseudoacacia* Laconia NH

The production of black locust has allowed for its ecosystem to move to higher nutrient level and for consequential plants to thrive. {Von Holle2006}

nitrogen-fixing sweet fern *Comptonia peregrine* Old Barns Trail, NS
Often seen amongst white pine.

nitrogen-fixing bayberry *Morella pensylvanica* Debert Beach, NS

bayberry, whose leaf is used in seasoning, and whose berries are used in candle making, and alder. {Bol78} {Bol104}

nitrogen-fixing speckled alder
Alnus incana, Wreck Cove, CB

The alder is often seen in wet areas

The leaves of the alder are also high in Nitrogen. {Blouin16,} {Petrides198} {Boland78}

Even with all this help, after clear cutting, nitrogen takes a considerable time to get back to former levels. "**Research now underway in the Maritimes suggests that nitrogen levels in forest soils continue to decrease for up to 70 years following cutting. It takes up to 120 years for the nitrogen to recover to pre-harvest levels. This work suggests that any clear-cut rotation of less than 120 years is likely to be unsustainable.**" {Prest2014}

Z4.2 Sources of Calcium, Magnesium, Phosphorus, Potassium, Aluminium, Iron and other Ions

Tarmis, Nunavut {Spares, Aaron}

"It takes 500 to thousands of years to create an inch of topsoil. The reason is that soil is often derived from rock. The rock has to be broken into small pieces first. This happens by physical weathering: things like freezing and thawing in colder climates, and chemical weathering in warmer climates."{Soil Science Society of America29August2013}

Earth's rocks are expose at the edges of cliffs and the tops of mountains. They are exposed on the shorelines of water ways and oceans. They were particularly exposed after glacial retreats.

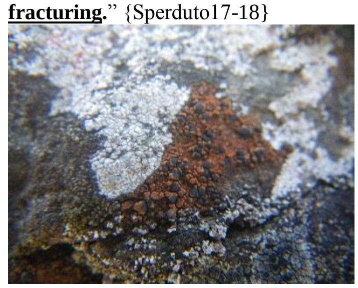
In the Maritimes, just like New Hampshire, "Most rocks have low concentration of calcium, magnesium, phosphorus, and potassium, and a high resistance to weathering. In addition, calcium not taken up by plants is readily lost to leaching." {Sperduto18}

The last major glacial retreat was 11,500 to 10,500 years ago, when the Younger Dryas ice age ended. Our friends, the lichens and mosses, thankfully, were the first to get there. "**Plant nutrients, such as calcium, magnesium, phosphorus, and potassium, originate from bedrock or mineral fragments**." {Sperduto17}

Nitrogen-fixing finger-scale foam lichen - *Stereocaulon dactylophyllum*

Chemical and physical weathering and breaks complex mineral compounds into simple ionic reside in soil water. These nutrients [ions] may attach to mineral or organic particles, leach out of the soil to streams or groundwater, or be taken up by plants."

"**Factors which affect weathering include the proportion of exposed surface area and the extent of fracturing.**" {Sperduto17-18}



Oeder's map lichen *Rhizocarpon oederi*
blueberry field, Earltown Mountain

Certain lichens hyphae, like the shown *Rhizocarpon* is doing, through biomechanical and biochemical weathering, released potassium and iron from granite rock. {Lee1999}

On calcareous rocks, different lichens free minerals including calcium. {Syers et al. 1973} The freed calcium, in turn, also takes carbon out of the air to form calcium carbonate limestone. {Heckman2001} {Hinds18} {Michalik2002}

a rock moss *Dicranum fulvum*,
Gully Lake Trails, Earltown, NS

Mosses also get the rock prepared. Besides holding them in place, mosses' rhizoids assisted lichens in biomechanical and biochemical weathering of rocks. Mosses would have helped release the rock's ions of calcium, magnesium, potassium, phosphorus and other minerals. The process **took a very long time** but also aided in balancing acidity of inland waters, oceans, and in cooling the atmosphere.

Former plant and animal life makes their contribution to keeping those precious nutrients by leaving their decay under moist and cool canopies.

On the other hand, clear cutting and acid rain diminish the abundance of these ions.

"**Calcium is in danger of being depleted from forest soils, due to the combined effects of acid rain and whole-tree clear-cutting on 40-year rotations. Magnesium and potassium are also in danger of depletion**". {Bandy1999} {Federer et al. 1989}

Among the cations attached to plants are aluminum and hydrogen. {Sperduto20} "**Aluminum ions in levels toxic to fish and other aquatic organisms were released into stream waters draining clearcut sites. These effects on water chemistry persisted for three to four years after the [Clear cutting] harvest.**" {Dahlgren1994}

Z5 Recycling Nutrients

Z5.1 It's Not Waste

Portage Trail, Earltown, Colchester

IT'S NOT WASTE! A tree and its floral neighbors have created a lot carbohydrates, and shared and stored a lot of nutrients. One can see many of these nutrients listed on fertilizer bags at hardware stores.

A fallen log and a broken branch is that bag and more. **It is the forest's next generation of calcium, potassium, phosphorus, magnesium, nitrogen, other nutrients and organic matter.** The fruit, vegetable scraps and egg shells, we so carefully save into our compost, or the bags of fertilizer and lime are all there in that decomposing log. Its bark has just as much. It's probably the most important reason to consider when "harvesting", that the left overs are food for the forest future.

yellow birch *Betula alleghaniensis* –
Victoria Park, Truro, N.S.

A yellow birch and beech are 8 times more likely to come up in a fallen tree than on the ground beside it.

"**Whole-tree harvests remove the entire above-ground portion of trees, including the tops, which contain**

more than half of the nutrients. Nutrients also leach from the soil after it is exposed by clear-cutting." {Bandy1999} {Federer, C. A., et al.1989} {Loads more}

trout-lily / dog's toothed violet, *Erythonium americanum* Besides the log, doing some temporary storage is the trout lily. During its growth spurt in the spring, the trout lily incorporates much potassium and nitrogen. This action prevents those two nutrients from leaching out of its forest when the snows leaves and the foliage above hasn't arrive yet. {Muller1976}

"**Many herbaceous forest understory plants, similar to the trout lily, recover very slowly or not at all from clearcutting**."… "The widespread use of intensive harvesting methods, short rotations and plantation forestry almost ensure a similar loss [to trout lily] of plant diversity here." {Bandy1999} {Duffy1992}

Z5.2 Recyclers and Processors – Insects, Mites and Salamanders

On the decaying log, one may have noted the lichen, mushrooms and mosses, which contribute to the breaking down of the log. **Harder to see are insects, mites, and the red-backed salamander**. They feed on soil microorganisms and the organic matter. They loosen the soil, and then add to the fertilizer. {Harmon1990} {Bergeron1997} {Fahrig1997} {Harvey 1989} {McGee1997}

Red backed salamander
Sandy Cope Trail, Earltown

"**One of the most disturbing findings of the study was that 50 to 70 years are required for salamander populations to return to pre-clearcut levels. The authors estimated that approximately 70 to 80 percent of salamanders inhabiting mature stands are lost following clearcutting, and most of those probably die due to physiological stress.** Other research has shown that clearcutting disrupts the habitat for salamanders by removing shade, reducing leaf litter, and causing dramatic changes in soil surface moisture and temperature." {Bandy1999} {Petranka et al. 1993}

Z5.3 Processors and Distributors – Mycorrhizal Fungi

Fungus
Sandy Cope Trail, Earltown NS

Fungus, like humans, don't make its own carbohydrates, nitrites, or other nutrients, but it does process nutrients. To get carbohydrates, fungus, like humans, goes to plants.

Fungi (mushrooms), over ground, might look like this. Underground from the substrate, mycorrhizal fungi, which can cover an area as large as a blue whale, extracts other things such as nitrogen, phosphorus, sulfur and other micronutrients.

Fungus among bunchberry
Rogart Mountain Trail, Earltown

The fungal roots engulf the roots of a tree helping the tree get more water and nutrients, while getting the carbo-hydrates for themselves. The fungi even share food between trees of the same species or sometimes different species. The exchange is another example of nature's mutualism. "**Around 90% of land plants are in mutually-beneficial relationships with fungi.**" {Fleming1Nov.2014}

Fungus colony Truro

"This research shows that in a natural forest ecosystem, trees such as paper birch, considered a "weed" species by foresters, may nourish other tree species such as the commercially valuable Douglas fir. These complex interactions may help stabilize the forest ecosystem in the long run and help protect against extremes of moisture, temperature, and against insect outbreaks and disease. **Unfortunately, intensive forest management techniques such as clearcutting and herbicide spraying disrupt these complex and beneficial associations between trees and fungi**." {Bandy1999} {Simard et al. 1997} {Zhou et al. 1997} {Simard TEDSummit2016}

Z6 Physical Defenses

Z6.1 Creators of Water

(This work is far from complete and those reading this copy need to understand this. One of the ways is in the detail of the following. NMW)

White pine *Pinus strobus* Earltown

Pine trees contribute moisture to areas above them as well. Because the pine's sweet-smelling vapours are sticky, they unite with particles above them to become aerosols. In that condition, they reflect sunlight and form clouds. Those clouds in turn reflect sunlight into space and rain on the forest below. {Ehn2014}

Z6.2 Storers of Water and Fire Protectors.

Sign at Dalhousie University Agricultural College, Bible Hill
Spring 2016

On a tree on the Agricultural College campus in Bible Hill, a sign said, **"Every year this tree sequesters 460 pounds of atmospheric carbon; intercepts 1917 gallons of storm water"** {Carol Goodwin's Dalhousie Class} {i-Tree}

The retention of water is extremely important.

When nature gets that taller version of plants life, the trout lily, other forest plants, the mycorrhizal fungi, insects, mites, salamanders, animals, amphibians, and birds all receive the needed dampness and coolness of a contained forest.

Hardwoods do favors back to pines While conifers contains oils that encourage fires, hardwoods hold water better in their roots and don't have the oils in their systems that the conifers do. One can note that the fast spreading fires out west are most likely in conifer areas and not mixed forests.

burr oak *Quercus macrocarpa*
Holy Well Park, Bible Hill, NS
The burr oak is considered fireproof.

Z6.3 Regulators of Temperature and Protectors of Moisture

mottled disk lichen *Trapeliopsis granulosa* Earltown Lakes Trail

All of earth's life is dependent on water – moisture. The most important mutualistic role, for parts of an ecosystem, is to protect that moisture and regulate the sun's heat.

There are many levels of moisture protection. Even in the earliest stages of surface Earth's life, that life, which took ¾ of Earth's history to get to, we saw how lichen and mosses sealed and reflected sunlight to keep the soils, forming below them, cool and moist. {Walewski27, 7}{Anderson135}

Currently, lichens continue to adjust to unique habitats, and secrete a variety of acids. The mottled disk lichen, shown here, colonizes thin bare soil, traps dust, and can be found in northern New England, the Maritimes and elsewhere on scraped off land. "**These lichens produce hyphae that bind soil particles and also make contributions to soil fertility**." {Walewski27}

"Additionally, by **changing the dominant color of the surrounding area from the soil's dark brown to a pale gray of the lichen, light and heat are reflected, allowing the soil to remain both cool and moist.**" {Ibid} In Quebec, mottled disk lichen has been spread over recently burned forest to prevent erosion. After a while, under its protective coat, the soil is built up enough for use by other vegetation. {Walewski27, 7} {Anderson135}

Forests, though taller, continue that process of sealing and reflecting for their soils and keeping the woods cool and moist.

"Water outputs include evapotranspiration, surface and near-surface runoff, and groundwater recharge."… "In addition, evapotranspiration is greater in deciduous plants than evergreens, and greater in communities with high total leaf surface area, such as forests, than in more sparsely vegetated communities." {Sperduto15}

The Burr oak is consider fire proof.

Z6.4 Protectors and Respirators - Bark and Lenticels

Layering bark on elm *Ulmus americana*, Willow St, Truro

The forest ecosystem has many ways of protecting itself from sun's rays, disease, predators, herbivores, and water shortages. They have oils, volatile organic compounds, warning systems, and carefully composed bark. Each property took a LONG time to evolve.

Lichens, though they have the ability to live at a wide range of temperatures, have little defense against pollution. They live until their particular tolerance of pollution gets topped. Trees have a higher tolerance to pollution for various reasons.

Bark is also among its parts that serve as protection, disease, and infestations, but, obviously still can exceed their limits. Bark has to deal with those problems as it grows new wood inside.

London plane tree *Platanus x acerifolia* Halifax Public Gardens

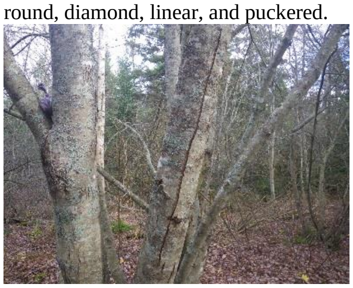
On the plane tree, when the lenticels get clogged by pollution, the outer most bark flakes off. Because of this anti-pollution system, plane trees are often planted in polluted cities. {Wojtech85} In the Maritimes, they may be seen at the Public Gardens in Halifax and the Alumni Gardens in Bible Hill.

Rec. Park, BH

Beech bark is very thin. It expands its periderm for its whole existence. Dead cells slough off without being noticed. If it gets past the consequences of forest fragmentations, diseases, and infestations, it will still be smooth for over 200 yrs. {Woj18} {Woh62}

Silver maple and others expand the outer bark for a time before it eventually cracks and becomes furrowed.

Lenticels allow the tree to exchange gases from the air to the living tissues of inner bark without permitting the tree to dry out or to let in fungal and bacterial infection. {Wojtech12, 22} Lenticels come in all sorts of shapes, round, diamond, linear, and puckered.



frost crack on red maple

Trees need protection from the swings in temperature from the dark time of early morning to the direct glare of sunlight in the afternoon. Those that can't bare that, will crack, like the red maple. Some trees have protection.

white birch *Betula papyrifera* left
grey birch *Betula populifolia* right
Laconia, New Hampshire
Old Barns, Colchester Co. NS

Birch has linear lenticels. Birch also have a whitish bark, which is from betulinic acid. Grey birch and white birch are pioneer species and so are more exposed to the sun than others. The white reflects sunlight, contains a sunscreen, and guards against the tree heating up. Betulin is antiretroviral, antimalarial, and anti-inflammatory and is reported to be an inhibitor of human melanoma. Betulinic acid is also found in yellow birch, white ash {Mki65}, and selfheal. {Woh182} {Wikip/Betulinic}

Puckered lenticels on pin cherry *Prunus pensylvanica* Warren Drive, BH

The bark and fruit stones of the pin cherry, mountain ash, black cherry, and apple contain hydrogen cyanide. Besides having pits in their fruit they have linear lenticels that often pucker and appear to be orange. The cyanide sickens or kills many of its herbivores.

Many trees, such as oaks and elms, create layered bark – the younger wider bark at the bark's base and the older bark stays attached and creates a ridge and a consequent furrow between.

Z6.5 Interceptors of Pollutants

Power plant

Forests intercept air pollutants such as particulate matter, ozone, nitrogen dioxide, sulfur dioxide, sequesters carbon, and storm water.

Plants suck in carbon from the atmosphere. "Carbon-14 is produced high in the atmosphere by incoming cosmic rays, and living plants and animals take the isotope in through the air." {Gustafsson2009}

"**Particulate matter (PM) is microscopic particles that become trapped in the lungs of people breathing polluted air. PM pollution could claim an estimated 6.2 million lives each year by 2050, the study suggests.**"

"The WHO Health Statistics 2016 says air pollution is "caused by inefficient energy production, distribution and use, especially in the industrial, transportation and building sectors, and by poor waste management." {Kinver BBC / 31 October 2016} {Rogers2015} {McDonald, Rob et al. 2016}

Sign at Dalhousie University Agricultural College, Bible Hill Spring 2016

That tree the Agricultural College campus also indicates the pollution intercepted "**Absorbs and intercepts air pollutants such as ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), Carbon Monoxide (CO) and particulates (PM_{10}) and provides habitat for birds and insects**." Its value was estimated at $20,000 for that year. {Carol Goodwin's Dalhousie Class} {i-Tree}

Besides being used in the Maritimes, the i-Tree –Tools for Assessing and Managing Forests & Community Trees, are being used throughout the world. A major study was conducted in Great Britain. Also, "**A study by US-based The Nature Conservancy (TNC) reported than the average reduction of particulate matter near a tree was between 7% and 24%.**" {Kinver BBC / 31 October 2016} {Rogers2015} {McDonald, Rob et al. 2016}

Z7 Chemical Defenses

Z7.1 UV Protectors (Note other defenses for each.)

Yellow birch *Betula alleghaniensis* Earltown

Yellow birch contains betulin and Methyl salicylate. The betulin protect it from sunlight and from splitting with a day's vast changes in temperature. The Methyl salicylate, which smells of wintergreen or root beer and is used that way, also deters insects who do not like that wonderful taste.

Z7.2 Defenses against Micro-Orgasms, Bacteria, Cancer, Other Plants, Insects, and Herbifores

Trees and plants emit powerful volatile organic compounds (VOCs). {Yirka, Phys.org, 9 Aug. 2013} These include phytoncides which defend plants and their neighbors from insects, fungi, and bacteria. Companion plants like garlic, onions, marigold, peppermint, and rosemary protect their garden neighbors from insects.

With insect repellent
red pine *Pinus resinosa*
Balmoral Road, Colchester County NS

Pine emits VOCs (terpenes) of alpha-pinene, careen, myrcene, and others. Alpha-pinene is a powerful repellent to insects. There is concern that losing the phytoncides of trees and their forest's companion plants is linked to the emergence of certain unhealthy bacteria and diseases. The leveling of mixed hardwoods for monoculture plantations is believed to have accelerated the spread of bark beetle in spruce trees. The one tree would have protected the other. {The Free Encyclopedia}

Insect repellent Feather flat moss / shelf moss - *Neckera pennata*
Rogart Mountain, Earltown NS

Trees often live close to moss buddies which have insect repellent properties. The mosses Brachythecium, Dicranum, Hypnum, Neckera, Papillaria, and Thuidium are among those. Found on sugar maple, Neckera pennata, requires a sweet bark. It was used as an insect repellent in Stone Age Germany and plugged seams in boats. {Glime2006v5c5p3} {Glime79}

Insect repellent - Oak fern
Gymnocarpium dryopteris
Earltown Lakes Trail, Earltown

Oak fern, a short and symmetrical fern, also has an active ingredient which repels insects. The Cree crushed the oak fern for a mosquito repellent and used it to sooth their bites. {Runesson}

Insect repellent
northern red oak *Quercus rubra*
North River, Colchester County NS

Oak's phytoncides keeps certain bugs away. Oak contain tannin which is toxic to many insects and animals, causing the victims to die or get very sick.

Z8 Protectors of Adjacent Areas and Animals

Z8.1 Storm Intercepts, and Waterways, Erosion Defence

Jane's Falls,
Rogart Mt. Trail, Earltown

The most significant ways to check erosion is the live deep roots of all tree species. Live large trees store lots of water. The sign on that tree at the Agriculture College in Bible Hill noted, "Intercepts 1917 gallons of storm water" each year. {Carol Goodwin's Dalhousie Class} {i-Tree} {Kinver BBC / 31 October 2016} {Rogers2015} {McDonald, Rob et al. 2016}

Intercepted and stored water is water that won't run quickly down the streams and out to sea. It is water stored for a drier time. It is water that can soften the effects of the drought periods and the severity floods and the losses of nutrients due to fast running water.

Erosion defence
pin cherry *Prunus pensylvanica*, Juniper Head Trail, Glen Road, Pictou County

Erosion defence
staghorn sumac Rhus typhina Laconia

Erosion protection is also needed to save the nutrients from leaving the soils. Among those shrubs checking erosion are alder, pin cherry, red-osier dogwood, black locust, staghorn sumac, crown vetch, and willow. {Petrides} {Little}

Z8.2 Neighboring Waterways and Waterlife

Salmon River, Portage Trail, Kemptown

Besides older trees roots and trunks storing water, they keep waterways slow running and prevent instant flooding and long term dryness.

Forests control adjacent waters and waterways in many other ways. They prevent silting, keep water cool for fish environment. They supply food for the food chain that reaches up to fish. Because of adjacent forests water storage and slow seepage of nutrients, forests can supply a steady amount of calcium and magnesium to the waters.

Slowing down the water, by protecting the sides of with those special plants, and the deep roots of adjacent trees, prevents erosion and silting. "Greater water force means more erosion and silts are deposited in what were spawning areas for speckled trout and the now endangered Atlantic salmon." {Hill14 April 2013}

Taylor Lake, Earltown Lakes Trail

Keeping the water shaded and cool is highly important to fish. "Cool water contains the extra oxygen which salmon and trout require. As water temperatures exceed 20° Celsius these fish weaken. At 25° C trout and salmon begin to die. Many rivers in New Brunswick and Nova Scotia now reach 30° C." Bancroft25 Nov. 2012}

Regarding the supplying of the food chain with leaf litter, "While plankton raised on algal carbon is more nutritious, organic carbon from trees washed into lakes is a hugely important food source for freshwater fish, bolstering their diet to ensure good size and strength,' he [Dr. Andrew Tanentzap] added."

Sandy Cope Lake,
Gully Lake Wilderness Area

"Dr. Tanentzap observed: 'Where you have more dissolved forest matter you have more bacteria, more bacteria equals more zooplankton. Areas with the most zooplankton had the largest, fattest fish,' he added, referring to the study's results."

"The data revealed that where there was more forest cover, the fish were fatter than fish found in areas with few or no trees." {Tanentzap2014}

Loss of forest neighbors means loss of that leaf litter, the leeching of Aluminum ions and phosphates, the lessening of calcium, and a consequential change in acidity.

Uncut or selectively cut forests control aluminum ion and phosphorus release levels in waterways. "Aluminum ions in levels toxic to fish and other aquatic organisms were released into stream waters draining clearcut sites. These effects on water chemistry persisted for three to four years after the harvest. Unfortunately, some of the large industrial landowners are making extensive use of this method of harvest." {Dahlgren, R. A. and Driscoll, C. T. 1994} {Mitchell, Phys.org, 24 Dec. 2014}

Having a nearby forest allows calcium and other nutrients to slowly seep into streams and keep the water's PH lower. "This [The calcium] makes the water less acidic, the fish less susceptible to contamination from heavy metals, and adds calcium and magnesium that fish need for the development of their bones and nervous systems." {Rutherford31 Oct. 2016}

Algae blooms, Mattatall Lake, Cumberland County, NS.

Sadly, researchers "have identified a biological shift in many temperate, soft-water lakes in response to declining calcium levels after prolonged periods of acid rain and timber harvesting. The reduced calcium availability is hindering the survival of aquatic organisms with high calcium requirements and promoting the growth of nutrient-poor, jelly-clad animals." {Jeziorski2014}

Here in the Maritimes and Ontario and across North America, there are many examples of waterways harmed by lack of calcium, jolts of aluminum ions, and herbicide use - Nova Scotia {Patriquin, Chronicle Herald 6 May 2016} Ontario and Nova Scotia {Smol CBC22 Nov. 2014} Mattatall Lake {Sullivan, Truro Daily30 Aug.2016}; Lake Torment, Kings County, NS {CBC News, 14Aug. 2015}; West River Sheet Harbour {Corfu, CBC 31 October 2016}; and southwest Nova Scotia {Minichiello2014}

Worldwide, "We do see particularly strong declines in the freshwater environment - for freshwater species alone, the decline stands at 81% since 1970. This is related to the way water is used and taken out of fresh water systems, and also the fragmentation of freshwater systems through dam building, for example." {Zoological Society of London (ZSL) and WWF. 2016}

Z8.3 Neighboring Lands beside Clearcuts

"Forest clearing produces a marked increase of mean annual maximum air surface temperatures, slight changes in minimum temperatures and an overall increase of mean temperatures." {Joint Research Centre of European Commission 5 February 2016}

"Such change in land cover could drive a rise or fall in local temperature by as much as a few degrees. This kind of fluctuation could substantially impact yields of crops that are highly susceptible to specific climate conditions, resulting in harvests that are less productive and less profitable." {Li, et al. 2015}

Even "selective logging, for example, can leave the forest fragmented or punch holes in the canopy, drying out the vegetation below. This, combined with the effects of climate change, is leaving the Amazon much more likely to catch fire." {Barlow et al. 2016}

Besides warming and drying the adjacent areas, the openings in the forest consequently take away stored nutrients in those adjacent areas, such as accumulated nitrogen, calcium, potassium, phosphorus, and magnesium. The loss of calcium in adjacent woods has affected sugar maple and other crop yields. {Juice2006}

Certain animals and birds have lost their cover from prey. "If you can imagine a landscape with 80% forest cover, I think most environmentalists would say that's a very good scenario and you've maintained most of your core habitat there," "But what we found was those landscapes only really have 50% of their potential value, because of disturbance in the remaining forest." {Barlow2016}

"Forest fragmentation on landscape scales further isolates populations that need wide genetic foundations for their survival. Fragmentation allows successful edge species, such as crows, jays and raccoons to prey upon birds, like the ovenbird, that normally would be isolated within large areas of continuous forest." {Bancroft2015}

"**If we're interested in conserving the life that lives with us on this planet today, then we need to conserve these systems.**"{Barlow2016}

Z8.4 Animals

As we have seen earlier in this book, plants have many roles for animals - from food, medicine, moisture, and also to cover from predators and seasonally places out of extreme heat or extreme cold. That cover and special places are very important. Certain species require wide genetic foundations and range to survive. {Bancroft2015} Others need certain kinds of older - taller forests to make it through NE and Maritime snow-filled winters, such as deer, fox, and rabbit. {Madden, NB Naturalist2014}

Cover and food contribute to the reason **"Global wildlife populations have fallen by 58% since 1970**" a report says." It is suggested "**that if the trend continues that decline could reach two-thirds among vertebrates by 2020**" {The Living Planet assessment, by the Zoological Society of London (ZSL) and WWF.}

"**Around 41% of all amphibians and 25% of mammals are threatened with extinction, it says.**" "The study - published in *Science Advances Journal* - **cites causes such as climate change, pollution and deforestation**." {Ceballos et al. 2015}

Z9 Burning Plants

Z9.1 Burning Forest Plants

We have learned about the long process required to extract and store calcium, potassium, phosphates, and magnesium, and other minerals in wood, peat, and soils. We've seen that trees, forests, peat, and soils produce carbohydrates, store it, and filter out particulates of carbon soot. We have learned that trees filter out of the air nitrous oxide and, with help from bacteria, process nitrates. We've seen that plants produce volatile organic compounds (VOCs) which protect them from various diseases and infestations; and we've learned that trees filter out ozone and carbon monoxide in cities. **All those characteristic took 100s of millions of years to evolve.**

Some say fires are natural, but forest fires weren't all that common before the Europeans arrived. "From these records [analysis of 4 million acres of Maine forest land] he [Lotimer] was able to determine that the average recurrence interval for fire for a given site would have been 800 years. Large-scale windthrows were even more infrequent, occurring on average every 1,150 years for a given site. Thus the forests of Maine prior to European settlement were not subject to frequent large scale disturbances, although that misconception continues to be spread by those who want to promote clearcutting as a form of harvesting that mimics natural disturbance." {Bandy1999} {Lotimer1977}

Z9.2 What happens when you burn biomass fibre or biofuels that have all these ingredients?

When the biomass is burned, Carbon is emitted into the air. By noting the Carbon 14 isotopes, in the air, which can only be from the youthful biomass burnt and not the very old coal, researchers "who have analyzed the cloud's [brown cloud over South Asia] composition, and **found that two-thirds of the haze is produced by burning biomass, primarily the wood and dung burned to heat houses and cook food throughout the region**. This research is the first step to doing something about the brown haze, **which is linked to hundreds of thousands of deaths — mainly from lung and heart disease — each year in the region**, they said." {Gustafsson2009}

Wood chips to be shipped to Europe to be burned as Biomass Energy,

88 air emissions permits for biomass energy plants in 25 states, submitted to US Environmental Protection Agency (EPA), were examined by Mary S. Booth PhD, of the Partnership for Policy Integrity. Her report is given in *Trees, Trash, and Toxics: How Biomass Energy Has Become the New Coal* {Booth2014 [See especially p 5, p 17 and page 38.]}

The report found biomass power plants emitted "nearly 50 percent more CO_2 per megawatt generated than the next biggest carbon polluter, coal."

Biomass Generating Plant, Point Tupper

Biomass burning released greater than 150% the nitrogen oxides of any carbon fuel. It found the particulate matter released from burning biomass is greater than 190% of any other carbon fuel including coal. It was found biomass burning releases greater than 600% the volatile organic compounds of any other carbon fuel including coal.

What does this mean for human health? "**We calculate that 5 to 10 percent of worldwide air pollution mortalities are due to biomass burning,**" Jacobson said. "**That means that it causes the premature deaths of about 250,000 people each year**." "**Exposure to biomass burning particles is strongly associated with cardiovascular disease, respiratory illness, lung cancer, asthma and low birth weights. As the rate of biomass burning increases, so do the impacts to human health.**" {Jacobson2014}

Some high credentialed bodies have come out against using biomass and biofuels.

65 PhD research scientists "who study energy, soils, forested and wetland ecosystems and climate change," summited a letter to Congress in Feb. 2016 and wrote "**Burning any carbon containing substance whether biomass or fossil fuels releases carbon dioxide into the atmosphere. Burning forest biomass to make electricity releases substantially more carbon dioxide per unit of electricity than does coal. Removing the carbon dioxide released from burning wood through new tree growth requires many decades to a century**, and not all trees reach maturity because of drought, fire, insects or land use conversion."

"The European Commission, which advises European Union lawmakers, last week [Late July 2016] **identified myriad environmental hazards from the transatlantic wood energy trade in a 361-page report**." {Olesen et al. July 2016}

Z10 Prologue

The balance of nutrients, soil, air and life is complex. It took too LONG to get right. Humans personally forget all the work going on even within in their own bodies that allow that entire body we find ourselves in to work right.

If you have thoughts about clear cutting, about using biomass for energy and about herbicides being on New England and Maritime forest for biomass energy, it would be best to write your representative (addresses online).

You can make other comments on clear cutting and biomass at https://www.change.org search for "clear cutting" and/or "biomass" and look for letters to Mr. McNeil. Also google search Avaaz clear cutting

Other information may be found at
http://nsforestnotes.ca
http://www.healthyforestcoalition.ca/
http://nswildflora.ca/
www.globalforestwatch.org
http://forestsinternational.org/

To quote John Muir, "When one tugs at a single thing in nature, he finds it attached to the rest of the world.

The full guide is presently available at Colchester Historium, Young Street, Truro and Food Muster Restaurant, Revere St., Truro. NMW

Northern Fibre, Sheet Harbor, NS

Hardwood logs awaiting to be chipped