

A Guide to the Seedlings of New England

Jo Robertson



A Seedling Guide to New England

Forest Health Monitoring

By Jo Robertson



FEMC

Forest Ecosystem Monitoring Cooperative

Who We Are

Established in 1990 and ratified in 1996 via a memorandum of understanding between the Vermont Agency of Natural Resources, the University of Vermont, and U.S. Department of Agriculture (USDA) Forest Service, the Forest Ecosystem Monitoring Cooperative (FEMC, formerly the Vermont Monitoring Cooperative) has been conducting and coordinating forest ecosystem monitoring efforts for twenty-nine years.

Originally designed to better coordinate and conduct long-term natural resource monitoring and research within two intensive research sites in Vermont (Mount Mansfield State Forest, the Lye Brook Wilderness Area of the Green Mountain National Forest), FEMC efforts have since expanded to capture relevant forest ecosystem health work across the northeastern region with an expanding list of partners from Maine, Massachusetts, New Hampshire, New York, and beyond.

Today, the FEMC funding stems primarily from a partnership between the USDA Eastern Region State & Private Forestry as part of the Cooperative Lands Forest Health Management Program, the Vermont Department of Forests, Parks and Recreation, the Massachusetts Department of Conservation and Recreation, and the Rubenstein School of Environment and Natural Resources at the University of Vermont. Staff affiliated with the University of Vermont handle the majority of FEMC operations. While FEMC funding primarily supports ongoing monitoring, outreach and data management, the bulk of FEMC activities are accomplished by “in kind” contributions provided by the larger collaborative network.

The current mission of the FEMC is to serve as a hub of forest ecosystem research and monitoring efforts across the region through improved understanding of long-term trends, annual conditions and interdisciplinary relationships of the physical, chemical and biological components of forested ecosystems. These proceedings highlight the breadth of activities undertaken by cooperative contributors and demonstrate the potential of large collaborative networks to coordinate and disseminate the information needed to understand, protect and manage the health of forested ecosystems within a changing global environment.

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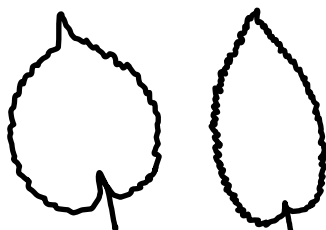
Helpful Tips for Seedling ID

- **Leaf Characters**

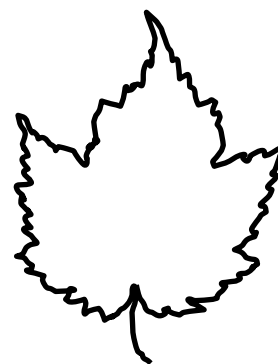
Leaf characters can be used to identify seedlings. However, these character can be somewhat variable, especially with younger seedlings. Here are a few of the characters that are referenced in this book:



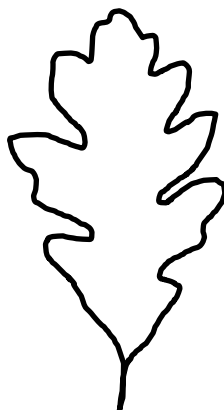
A tapering leaf apex (“drip tip”)



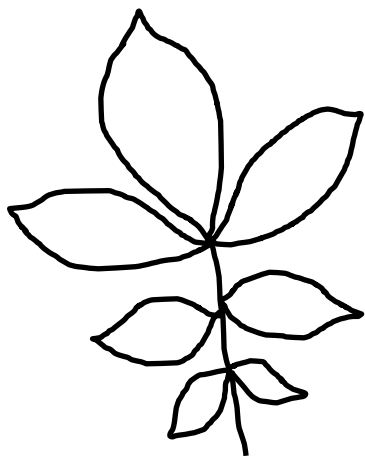
Cordate leaf base s



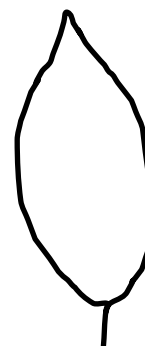
Palmately lobed



Pinnately lobed



Pinnately compound



Elliptical Leaf Shape

Helpful Tips for Seedling ID

- **Alternate Vs. Opposite**

When a seedling consists of nothing but a two-inch-tall stem and a pair of leaves, the space between nodes is can be extremely compressed, sometimes causing alternate leaves look opposite. One way to identify alternate seedlings in these scenarios is to look at the relative size of the seedling's true leaves. Since alternate leaves emerge one after another, leaves that differ significantly in size could indicate that a seedling is alternate. That being said, this is not always a reliable character and should only be used in addition to other identification characters.

The leaves on this mountain-paper birch are very clearly different sizes



- **Twig Appearance**

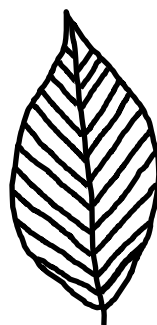
Leaf morphology can be incredibly variable, especially on young seedlings. While it can be tempting to rely solely on the leaf characters, it is always helpful to notice the patterning of species' twigs. Helpful characters to note include the coloration of the twig at mature points along the stem, the coloration of the new growth, and the shape of leaf scars.

- **Venation**

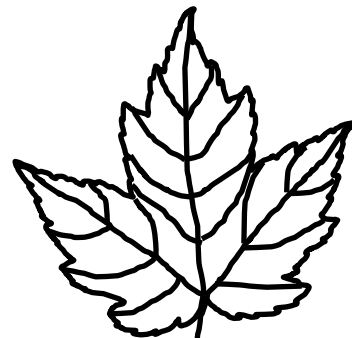
Leaf veins can be some of the most reliable characteristics when identifying a young seedling.



Arcuate



Pinnate



Palmate

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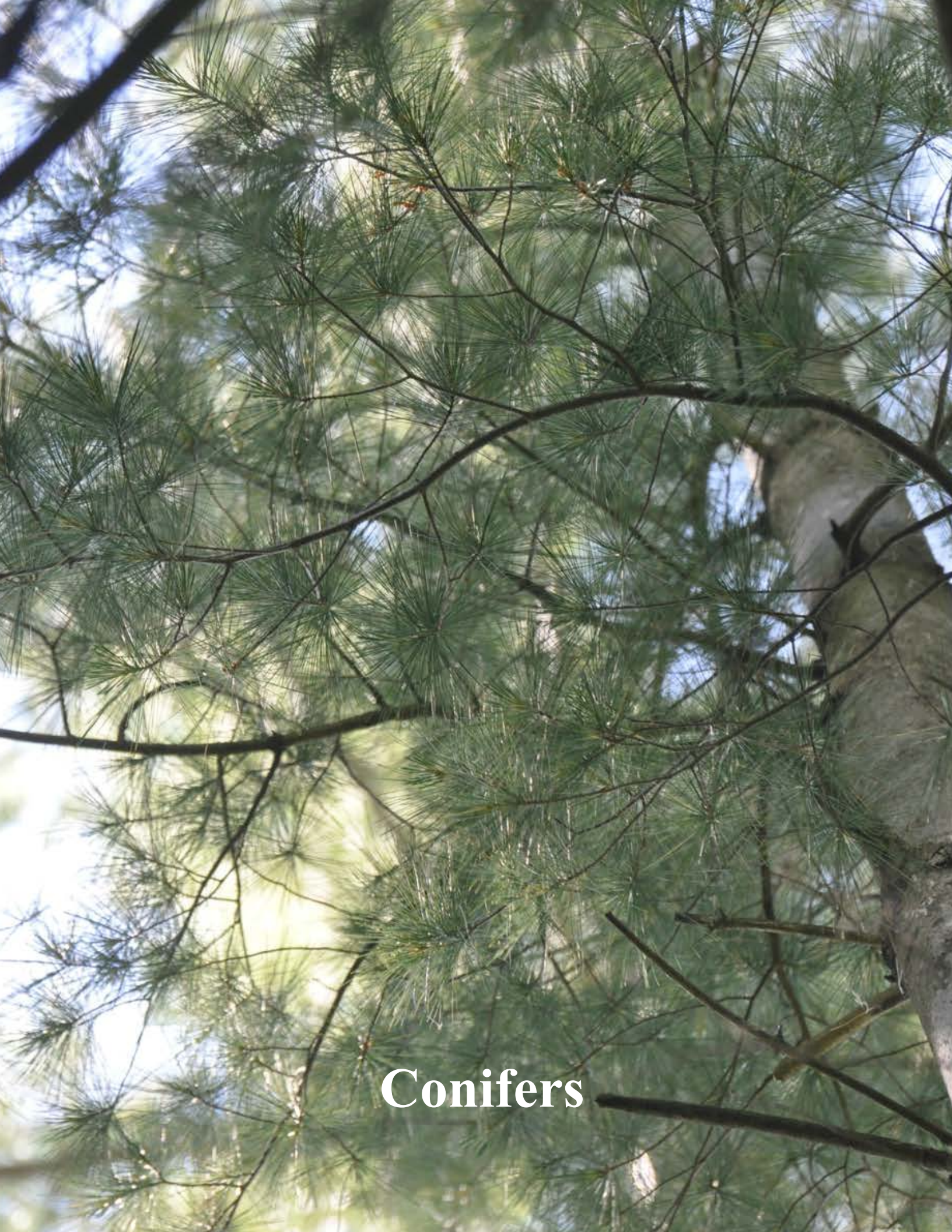
= **young seedling leaf morphology**, typically found on the smallest class one seedlings



= **maturing leaf morphology**, typically found on larger individuals (only included if leaf morphology changes dramatically as a seedling develops.



= **information** on lookalikes, the diversity of species within a section, and tips for telling species apart



Conifers

Conifers

Lycophytes

Lycophytes are spore-producing plants. In New England, they grow terrestrially and could potentially be mistaken for young conifer seedlings. There are several different genera of lycophytes, each of which looks quite unique.



The lycophytes above are in the genus *Huperzia*. Some helpful characters to differentiate species of *Huperzia* from conifer seedlings are:

- **Dichotomous branching** — *Huperzia* branch dichotomously so stems appear Y shaped with two equally-sized branches. Conifers do not branch dichotomously.
- **Rhizomes** — If you gently peel back the leaf litter from a *Huperzia* you will encounter a subterranean rhizome linking individuals that may have initially appeared to be separate organisms.
- **Stems** — By the time that conifer seedlings have grown to be as tall as a mature *Huperzia*, their stems are woody.

Conifers



Lycophytes



Strobilus

Look-alikes

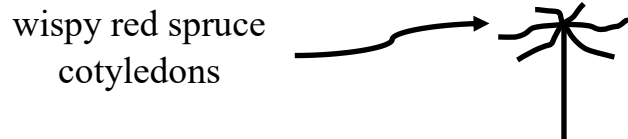
The lycophytes on this page are in the genus *Dendrolycopodium*. Some characteristics that can help to differentiate *Dendrolycopodium* from conifer seedlings:

- **Leaf Length** — Conifer needles and the small leaves of lycophytes (microphylls) differ considerably in length. The smallest conifer needles will be at least 1 cm long, while *Dendrolycopodium* microphylls are always well under 1 cm in length.
- **Strobilus Presence** — A yellow strobilus (spore-producing structure pictured top right) is a clear indication that a specimen is a spore-bearing lycophyte and not a conifer. Not all *Dendrolycopodium* individuals will have strobili, so this should not be the only character to rely on when identifying these plants.

Red Spruce, *Picea rubens*

Class One Characters

- **Cotyledons:** Whorl of several wispy needles.
- **Stem:** Green initially, turning woody after a few whorls have been established.



Class Two Characters

- **Needles:** Wispy and pointed. Grabbing needles will often reveal their tips are sharp.
- **Needle Orientation:** Needles all oriented towards the twig apex.



Similar Species:

- Balsam fir, *Abies balsamea*
- Eastern Hemlock, *Tsuga canadensis*
- Eastern White Pine, *Pinus strobus*

Notes:

Look for red spruce seedlings nestled into moss, on moist logs or on rocks. They can also be found growing straight out of the duff.



At first glance, this moss can look like a miniature grove of spruce seedlings. The moss will form a mat, which spruce seedlings won't do.

Red Spruce, *Picea rubens*



Class One Seedlings



A very young red spruce seedling with a whorl of wispy cotyledons (left).

An older class one red spruce seedlings with multiple whorls of needles (far left).

Class Two Seedlings



Eastern White Pine, *Pinus strobus*

Class One Characters

- **Cotyledons:** Seedlings emerge with a whorl of several wispy cotyledons.
- **Needles:** Mature seedlings have needles in bundles of 5.

Class Two Characters

- **Needles:** In bundles of 5, typically 3-5 inches in length at full maturity. The needles of younger seedlings are often shorter than adult needles.



Notes:

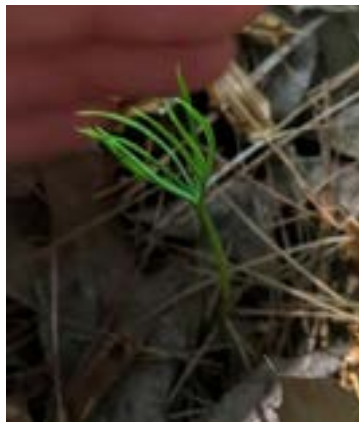
When eastern white pine and red spruce seedlings just have a set of cotyledons, these seedlings have very similar morphologies. The best way to tell these species apart at this stage is **size** — red spruce seedlings start out as minute (typically less than an inch tall) and are very dainty, while eastern white pine seedlings often start out much taller (often well over an inch) and seem far more robust.

Similar Species:

- Balsam fir, *Abies balsamea*
- Eastern Hemlock, *Tsuga canadensis*
- Eastern White Pine, *Pinus strobus*

Eastern White Pine, *Pinus strobus*

Class One Seedlings



A recently emerged seedling has a green stem and a single whorl of wispy needles (above). The green-stemmed form is less common than more mature seedlings with woody stems and needles in bundles of five (left).

Class Two Seedlings



Balsam Fir, *Abies balsamea*

Class One Characters

- **Cotyledons:** Typically a whorl of 3-5 needles, most commonly 4 or 5.

General Characters

- **Needle Length:** Generally 2 cm or longer.
- **Stomata:** Arranged in two white lines on underside of needles.



Notes:

Balsam fir seedlings are most commonly encountered at high elevation plots, but can also be found at lower elevations.



Look out for lycophytes which can be mistaken for young conifer seedlings. See p. 8-9 for more details.

Similar Species:

- Balsam fir, *Abies balsamea*
- Eastern Hemlock, *Tsuga canadensis*
- Eastern White Pine, *Pinus strobus*

Balsam Fir, *Abies balsamea*



Class One Seedlings



Balsam fir often have variable needle lengths on the same individual, but long needles are typically present somewhere along the stem (left and top left).

A young balsam fir with a whorl of five cotyledons (top right).

Class Two Seedlings



Class two balsam fir have long needles with two distinct lines of white stomata on their underside (bottom right).



Eastern Hemlock, *Tsuga canadensis*

Class One Characters

- **Cotyledons:** Typically a whorl of 3 needles.
- **First True Leaves:** Short needles. True leaves often emerge in whorls that resemble loose groups of three (see first photo to the right).

General Characters

- **Needle Length:** Generally 1.75 cm or shorter.
- **Stomata:** Arranged in two white lines on underside of needles.



Notes:

When they first emerge, hemlock seedlings are extremely small and their presence is often masked by leaf litter.



Similar Species:

- Balsam fir, *Abies balsamea*
- Eastern Hemlock, *Tsuga canadensis*
- Eastern White Pine, *Pinus strobus*

Look out for lycophytes which can be mistaken for young conifer seedlings. See p. 8-9 for more details.

Eastern Hemlock, *Tsuga canadensis*



Class One Seedlings



Hemlock seedlings tend to emerge with needles in whorls of three (left). As hemlock seedlings grow, their needles typically don't exceed a length of 1.75cm.

Class Two Seedlings



Class two hemlock seedlings have white lines of stomata on the underside of the needles and the same short needles found on class ones seedlings.





Broadleaves

Compound Leaves

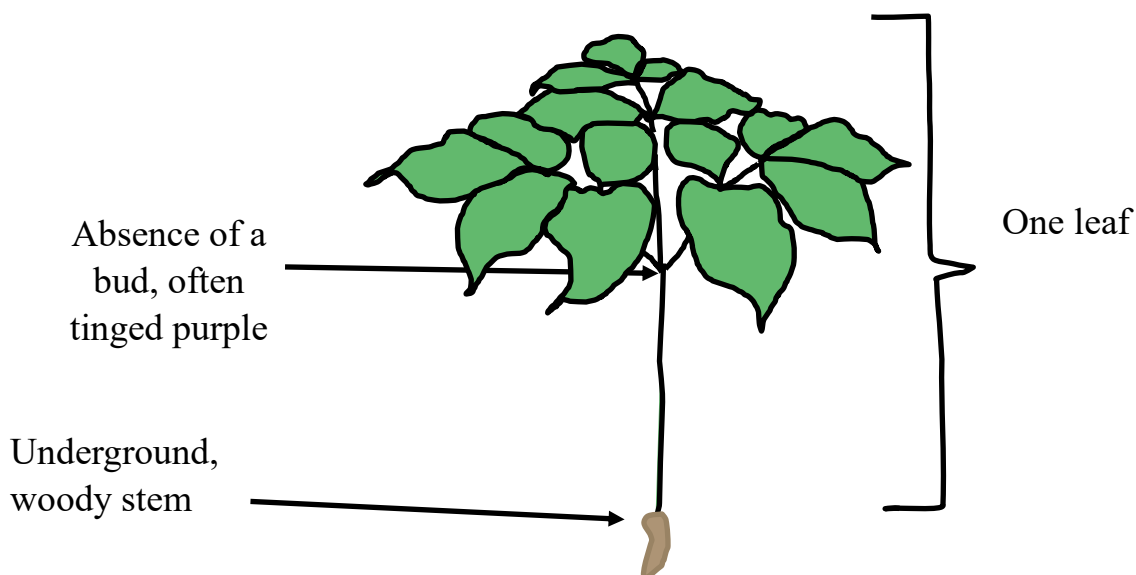
Sarsaparilla



This herbaceous plant has a woody underground stem from which it produces a single, doubly compound leaf. This compound leaf is split first into three leaflets originating from a single node which are each subdivided into three to five secondary leaflets.

Characters that distinguish this sarsaparilla from woody species:

- Absence of a bud (look at the node from which the three primary leaflets emerge)
- Presence of a subterranean woody stem
- Purple tinge often present at node from which the three primary leaflets emerge





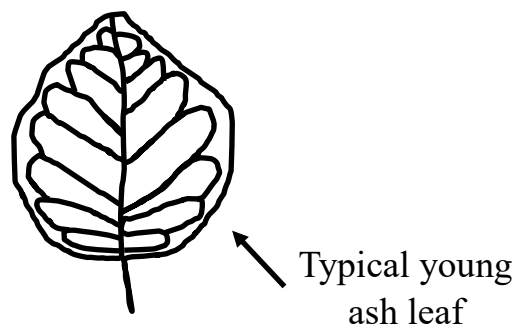
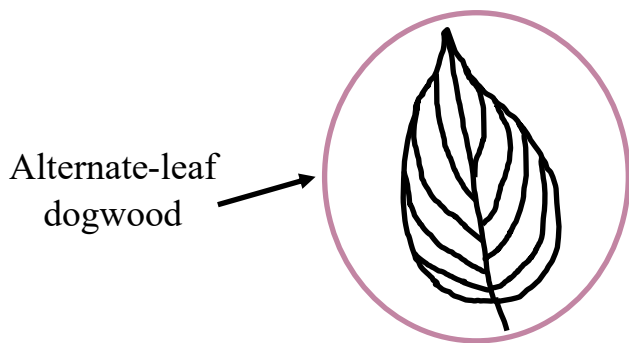
Alternate-Leaf Dogwood



This woody plant does not have compound leaves, but can easily be mistaken for a young ash due to the similarities in venation pattern and leaf shape.

Characters that distinguish alternate-leaf dogwood from ashes:

- **Leaf Arrangement** — Leaves are arranged alternately on the stem of alternate-leaf dogwood, ashes are always opposite.
- **Leaf Shape** — The leaves of alternate-leaf dogwood typically end in a drip-tip (long-tapering leaf apex). Ash leaves typically do not have a tapering leaf apex.
- **Leaf Venation** — Alternate-leaf dogwood venation is far more obviously arcuate (left) than that of ashes.



Compound Leaves

Elderberry



Elderberry looks almost identical to young ash and American mountain-ash seedlings. While on the surface American mountain-ash and elderberry look very similar, **American mountain-ash has alternate leaves and elderberry has opposite leaves.**






The differences between true ashes and elderberry are far more subtle...

- **Leaf position** — Elderberry and ash both have opposite leaves and a handful of serrated leaflets.
- **Node Coloration** — Elderberry often have a tinge of purple between leaflets and in the node between the leaf petiole and the bud.
- **Buds** — Elderberry will produce large, purple egg-shaped buds while ash produce black/brown, pointed buds.
- **Serrations** — Elderberry tends to be more heavily, jaggedly serrated than ashes, especially young ash seedlings.



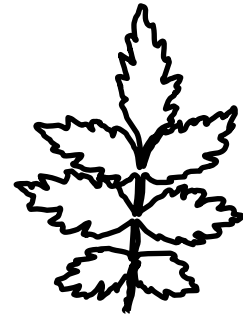
More Information on Distinguishing Class One Seedlings: Species with Compound Leaves

	American Mountain-Ash <i>Sorbus americana</i>	Ash spp. <i>Fraxinus</i>	Hickory spp. <i>Carya</i>
Class One Seedling Leaf Form			
Morphology of First True Leaves	Compound	Often simple	Compound
Elevation	High elevation forests. In northern states like New Hampshire, the elevational range of this species is 2300—4290 feet.	Lower elevation forests	Lower elevation forests

American Mountain-Ash, *Sorbus americana*

Class One Characters

- **Cotyledons:** Round and similar to birch cotyledons.
- **First True Leaves:** Compound with a few serrated leaflets.



Class Two Characters

- **Leaf Margins:** Serrated.
- **Leaflet Number:** 13-17 leaflets at maturity, younger individuals will have less.



Notes:

American mountain-ash is a high-elevation species that is found from an elevation of 2300-4200 ft in the white mountains. This elevation range changes with latitude, but this species is generally restricted to higher elevation areas throughout New England.

Similar Species:

- Elderberry
- Ashes, *Fraxinus* spp.

American Mountain-Ash, *Sorbus americana*



Class One Seedlings



Class one American Mountain-Ash seedlings produce compound leaves as their first set of true leaves (top left). Seedlings begin by developing 3-5 leaflets per leaf and ultimately end up with 13-17 at maturity.

Class Two Seedlings



Mature American mountain-ash. On the left is a small individual with 7-9 leaflets. Above is a fully mature mountain ash with leaves composed of 13-17 leaflets.

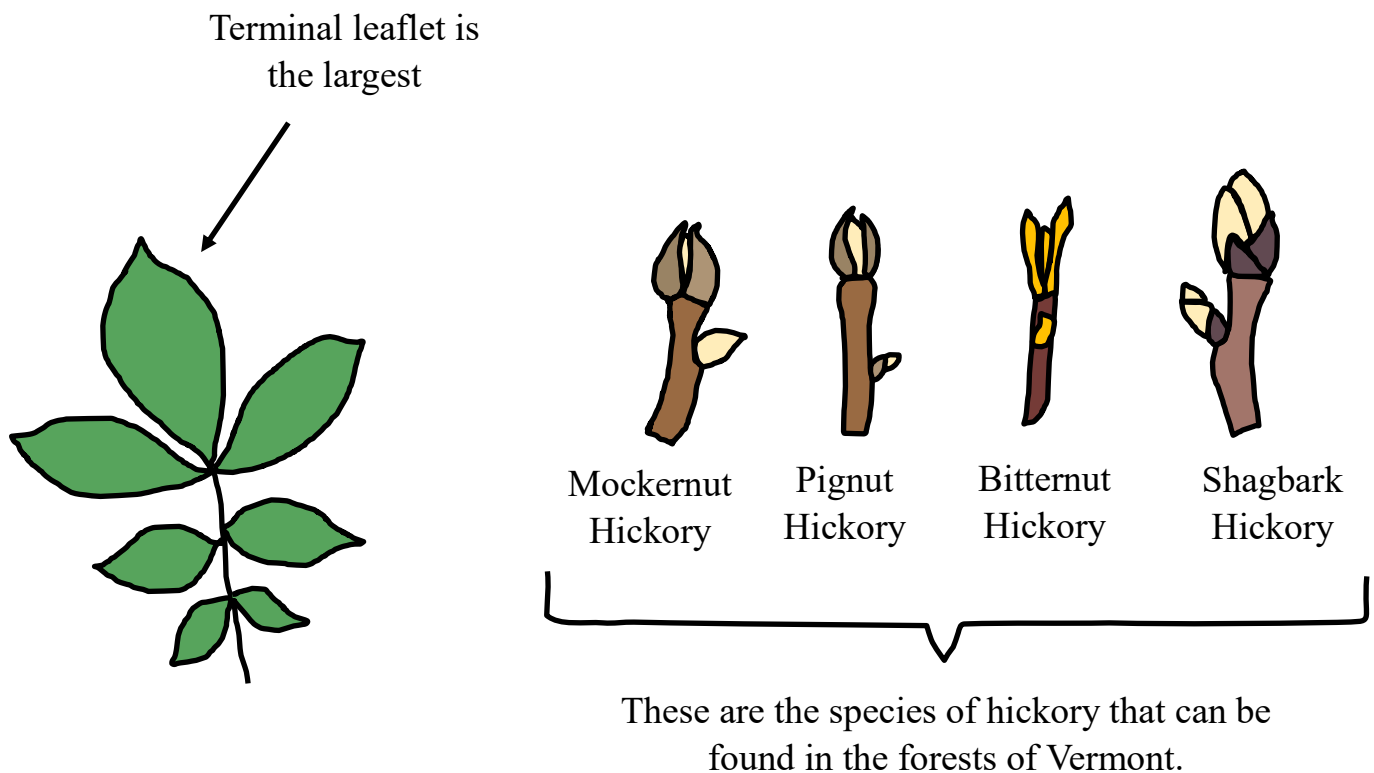
Hickory, *Carya spp.*

Class One Characters

- **Leaf Position:** Alternate.
- **Leaf Dissection of Young Seedlings:** Unlike young ash, young hickories are often have well developed compound leaves.

Class Two Characters

- **Leaf Structure:** The terminal leaflet on a hickory leaf is often the largest, with each subsequent leaflet getting smaller towards the base of the leaf. Some class two seedlings exhibit this trait nicely, others do not.



Hickory seedlings can be incredibly hard to tell apart — especially when there are no buds to reference!

Hickory, *Carya* spp.



Class One Seedlings



Class Two Seedlings



Bitternut Hickory, *Carya cordiformis*

Class One Characters

There are no reliable characters that can be used to definitively differentiate a bitternut hickory from the other hickories without buds. Some suggestions for narrowing down possible candidates include:

- **Associated Species** — Which hickories are found growing nearby?
- **Buds** — When present, the buds of bitternut hickory are incredibly distinct. Look for a naked bud, tinged golden orange in the late summer.



Hickory, *Carya* spp.



Seedling Characters



Pignut, Mockernut and **Shagbark** hickories are all very similar in appearance, even when young seedlings have buds present. The seedlings of these species can be almost impossible to tell apart, so exercise extreme caution when identifying these young hickories. When in doubt, take diligent notes about the species growing nearby, document the seedling with photos from several angles and record the seedling as a member of the hickory genus *Carya*.



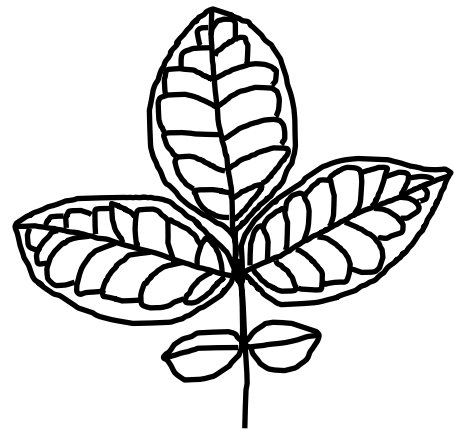
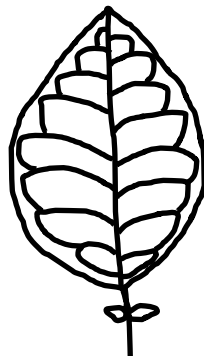
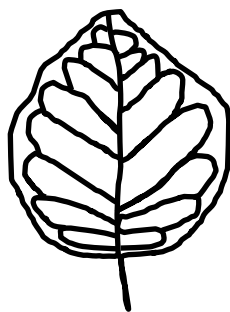
Ashes, *Fraxinus spp.*

Class One Characters

- **Leaf Dissection:** Leaves of class one seedlings can be either simple or compound. The smallest class one ashes typically have simple leaves. Older class ones may have compound leaves, but the terminal leaflet is often far larger than the other leaflets (see below).
- **Venation:** The venation of young ash is typically somewhat arcuate (see below). The venation pattern on young ash is quite consistent and is a reliable identification character.
- **Buds:** Look for the beginning of a small, stout, brown or black bud throughout the summer. This is a great character to use to ID even the smallest ash.

Class Two Characters

- **Leaf Dissection:** Almost always compound. Leaflet number ranges from 3 to 9. Mature ash trees typically have 7-9 leaflets per leaf, while younger ash often have less.
- **Leaf Scars:** Differ based on species (see p. 34-35) and can be a helpful identification character.
- **Buds:** Larger than on class one seedlings, but still characteristically black or brown and pointed at the tip.



Ashes, *Fraxinus* spp.



Class One Seedlings



A young ash seedling with simple leaves. This seedling, like many ash seedlings, is nearly impossible to identify to species, even with leaf scars visible.

Class Two Seedlings



Ashes, *Fraxinus spp.*

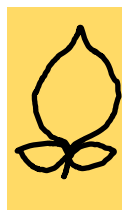


The ashes are another group of species that are incredibly difficult to tell apart as young seedlings. The most common means of distinguishing between different ash species are:

- Habitat
- Leaf Scar Shape

That being said, it can be really tricky to apply these characters to young seedlings. Leaf scar shape is a variable character that might not be readily apparent in young ash seedlings. As with other groups of species that are hard to tell apart, it is helpful to note the species of any mature individuals that are growing nearby and take photos of specimens that are harder to identify. **When in doubt, identify an unknown ash seedling to the ash genus and include notes/photos as a reference.**

There are three species of ash in Vermont: **black ash** (*Fraxinus nigra*), **white ash** (*Fraxinus americana*) and **green ash** (*Fraxinus pennsylvanica*).



Characters that may be useful for identifying different ash species:

	Black Ash <i>Fraxinus nigra</i>	White Ash <i>Fraxinus americana</i>	Green Ash <i>Fraxinus pennsylvanica</i>
Habitat	Black ash typically occupies poorly drained sites such as swamps, bogs and gullies.	White ash tends to prefer well-drained sites with rich soil. At FEMC plots, this is the most commonly encountered forest interior ash species.	Green ash tends to prefer floodplains, riparian areas and swamps but can occasionally be found on drier sites.
Leaf Scar Shape	Leaf scars are often only slightly indented at the top.	Leaf scars on mature individuals are U shaped.	Leaf scars are often only slightly indented at the top.

There are plots which have two or three ash species present — these are the circumstances in which it becomes almost impossible to identify an ash seedling to species.

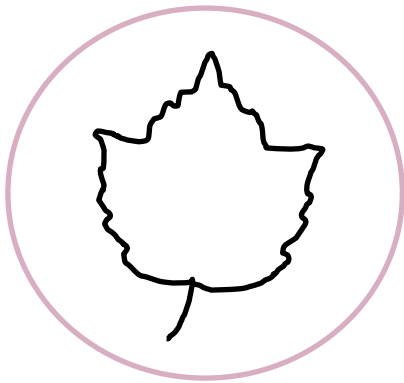
Maples

Maple-Leaf Viburnum

Look-alikes



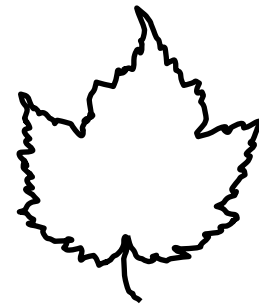
Maple-leaf viburnum (*Viburnum acerifolium*) looks extremely similar to red maple and mountain maple. One of the best characters to use to distinguish between this viburnum and red/mountain maple is the fact that **maple-leaf viburnum has rounded serrations**. Both mountain maple and red maple will have jagged, sharp-pointed serrations.



Maple-Leaf Viburnum



Red Maple







Mountain Maple

Note on Red Maple and Mountain Maple:

It can be extremely hard to tell mountain maple apart from red maple, especially when they are really young. Both can have red petioles, serrate leaf margins, and cordate leaf bases—and they can be found growing together. One of the best characters used to differentiate these species are the sunken veins that are often found on mountain maples. When in doubt, record a seedling as a member of the maple genus and take notes and photos that can be referenced later to try to get a more accurate identification.



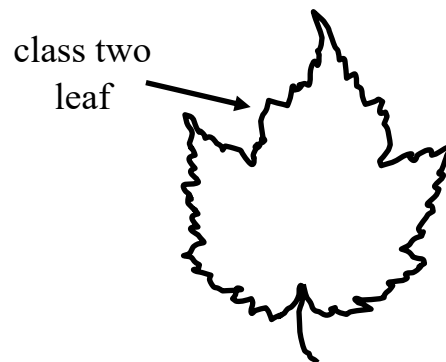
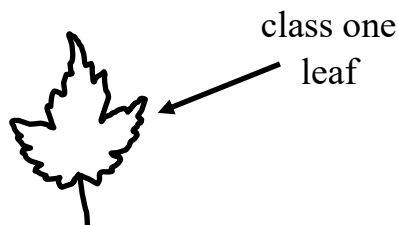
More Information on Distinguishing Class One Seedlings: Maples

	Red Maple <i>Acer rubrum</i>	Mountain Maple <i>Acer spicatum</i>	Striped Maple <i>Acer pensylvanicum</i>	Sugar Maple <i>Acer saccharum</i>
Leaf Form				
Leaf Edges	Sparse, coarse serrations.	Sparse, coarse serrations.	Frequent, minute serrations. These serrations are distinct among the other maples, which all have coarser serrations.	Scattered, irregular serrations that are less frequent than those of striped maple and less jagged than red/mountain maple's.
Notable Characters	Serrations are consistent, even as leaf shape varies	Veins appear to be sunken into the leaf tissue.	Leaf apex ends in a taper, which can be very long in some individuals.	Extremely variable leaf morphology.

Mountain Maple, *Acer spicatum*

Class One and Two Characters

- **Veins:** Appear to be sunken into leaf tissue.
- **Lobes:** Three lobes common, even on younger seedlings.
- **Petiole:** Red petiole found on some individuals (also on red maple).
- **Twig:** Red, green or red/brown.
- **Buds:** Valvate, appearing in the late summer. Green until they mature, at which point they turn red.



Notes:

Pay special attention to definitively rule out red maple when identifying this species; this can be done by looking at twig morphology and looking for mountain maple's characteristically sunken veins. That being said, these two species are still quite tricky to tell apart.

Similar Species:

- Striped Maple, *Acer pensylvanicum*
- Sugar Maple, *Acer saccharum*
- Red Maple, *Acer rubrum*

Mountain Maple, *Acer spicatum*



Class One Seedlings



Sunken veins is the best character to use to distinguish mountain maple from other similar species like red maple. The side-view of the maple seedling **above** shows how pronounced this character can be.

Class Two Seedlings

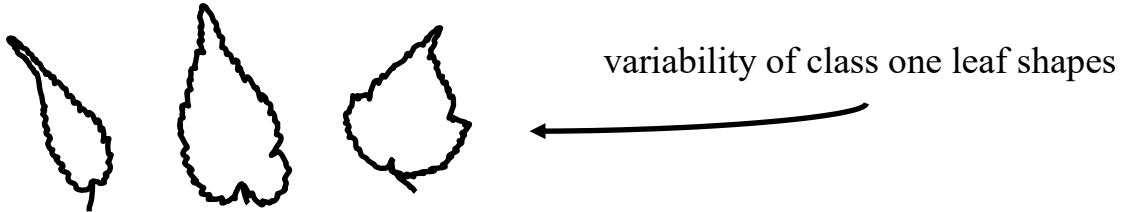


The red/green twig of more mature mountain maple seedlings can be a helpful character to identify older seedlings (**top right**). Another helpful character to use later in the season is the presence of a valvate bud, as similar species like red maple will have imbricate buds.

Striped Maple, *Acer pensylvanicum*

Class One Characters

- **Leaf Apex:** Often tapering, forming a drip tip.
- **Leaf Shape:** Variable. Some seedlings have three distinct lobes and others have no lobes.
- **Serrations:** Minute, frequent and sharp.



Class Two Characters

- **Leaf Shape:** Leaves have three distinct lobes, forming a shape like a goose's foot.
- **Lobe Apex:** Each lobe apex ends in a tapering tip.
- **Twig:** Smooth and tinged with red or green.



Notes:

Striped maple seedling's have variable leaf morphology, but the long, tapering tip and frequent, minute serrations are usually reliable identification characters.

Similar Species:

- Mountain Maple, *Acer spicatum*
- Sugar Maple, *Acer saccharum*
- Red Maple, *Acer rubrum*

Striped Maple, *Acer pensylvanicum*



Class One Seedlings



Variable leaf shapes are often encountered in class one seedlings. The most consistent characters are small, frequent serrations and a tapering leaf apex.

Class Two Seedlings

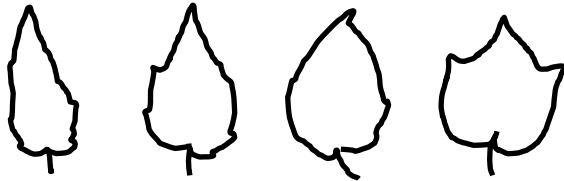


Twigs of striped maple are fairly distinctive (left). As class two seedlings, their leaves are also typically always shaped like a goose foot with three broad, shallow lobes (above).

Sugar Maple, *Acer saccharum*

Class One Characters

- **Leaf shape:** Incredibly variable, often lacking prominent lobes.
- **Serrations:** Infrequent, broad.
- **Growth Pattern:** Tend to grow in large clusters, but can also grow singly.



variability of class one leaf shapes



Class Two Characters

- **Leaves:** Three to five prominent lobes.
- **Serrations:** Coarse, large serrations.



Notes:

Sugar maple seedlings often grow in dense patches which take a great deal of patience to count, and which can mask the presence of seedlings of other species.

Similar Species:

- Mountain Maple, *Acer spicatum*
- Striped Maple, *Acer pensylvanicum*
- Red Maple, *Acer rubrum*

Sugar Maple, *Acer saccharum*



Class One Seedlings



The above seedlings represent just a small sample of the morphological variation in sugar maple seedlings.

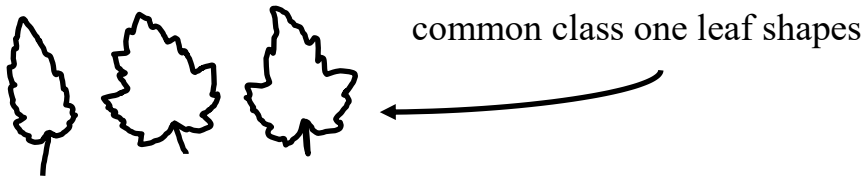
Class Two Seedlings



Red Maple, *Acer rubrum*

Class One Characters

- **Lobes:** Leaves can appear almost entire or can have three lobes.
- **Serrations:** Jagged, doubly-serrate.
- **Petiole:** Red petiole common, but not a consistent character. Mountain maple leaves can also have a red petiole.



Class Two Characters

- **Lobes:** Leaves consistently have three lobes.
- **Serrations:** Jagged, doubly serrate.
- **Petiole:** Petiole can be red.



Notes:

Red maple can thrive in a variety of soil types, moisture levels, and at a wide range of elevations.

Similar Species:

- Mountain Maple, *Acer spicatum*
- Striped Maple, *Acer pensylvanicum*
- Sugar Maple, *Acer saccharum*

Red Maple, *Acer rubrum*



Class One Seedlings



Seedlings can vary significantly in how serrated their leaves are. The **top-middle** seedling has some of the most jagged serrations, and the **top-right** has much blunter serrations. Most individuals will be somewhere between these two extremes.

Class Two Seedlings



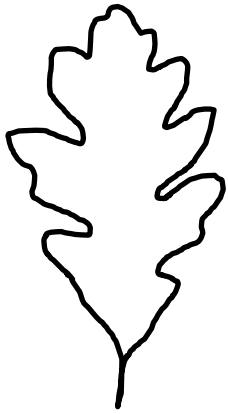
Class two seedlings look very similar to class ones. Their leaves are more consistently three-lobed and their serrations are more consistently jagged in appearance. Note the red petiole on the seedling **above**.

Oaks





Red Oaks and White Oaks



In temperate regions, oaks are defined by their distinctive pinnately lobed leaves.

Oaks in Vermont fall into two broad categories

Red Oaks



Red oak seedlings have pointed lobe tips, even as young seedlings.

White Oaks



White oak seedlings have rounded lobe tips, even as young seedlings.

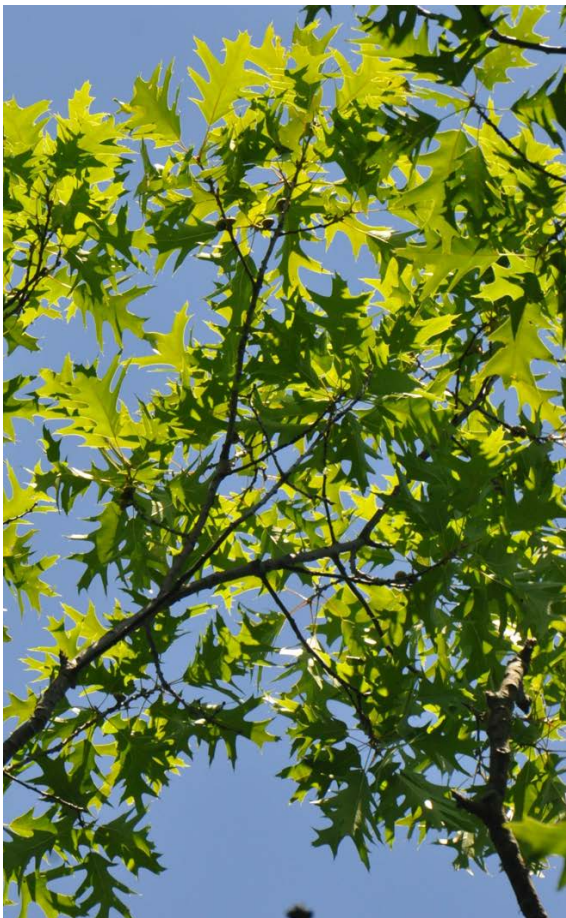
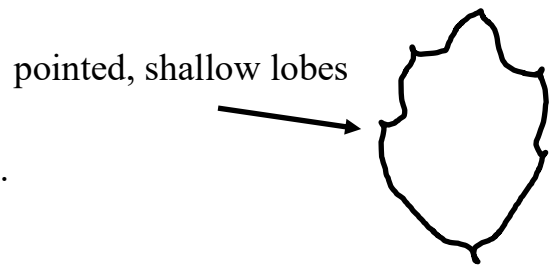
Red Oaks, *Quercus* spp.

Class One Characters

- **Leaf Shape:** Minute, shallow lobes with pointed tips. These pointed tips are what differentiates red oaks from white oaks.
- **Leaf Arrangement:** Alternate, sometimes appearing almost whorled.
- **Buds:** A whorl of several buds at sits at the twig apex. This is one of the best features to distinguish between red oak species (see below)

Class Two Characters

- **Leaf Shape:** Prominent lobes with pointed tips.



Red Oaks in Vermont Forests:

- Northern Red Oak, *Quercus rubra*
- Black Oak, *Quercus velutina*

angular, fuzzy,
buff colored buds



Black Oak

conical, red-brown,
mostly hairless buds



Northern Red Oak

Black oak and northern red oak hybridize. It can be nearly impossible to tell these two species apart, especially at a young age.

Red Oaks, *Quercus* spp.



Class One Seedlings



The pointed lobes on these young seedlings indicate that this is a young red oak seedling. The bud (right) looks somewhat like a northern red oak (*Quercus rubra*) bud, but on a seedling so young it can be hard to be certain.

Class Two Seedlings

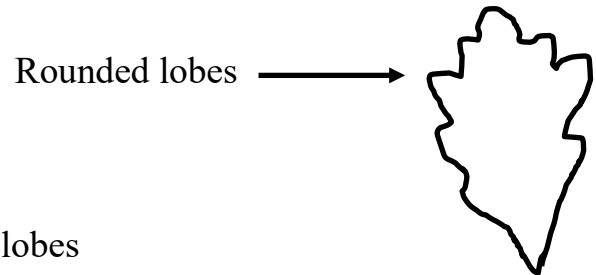


This class two seedling again has lobes with minute pointed tips and a spirally arranged set of buds. This is another one that, based on the conical and hairless buds, could be a northern red oak (*Quercus rubra*). Watch out for hybrids!

White Oaks, *Quercus* spp.

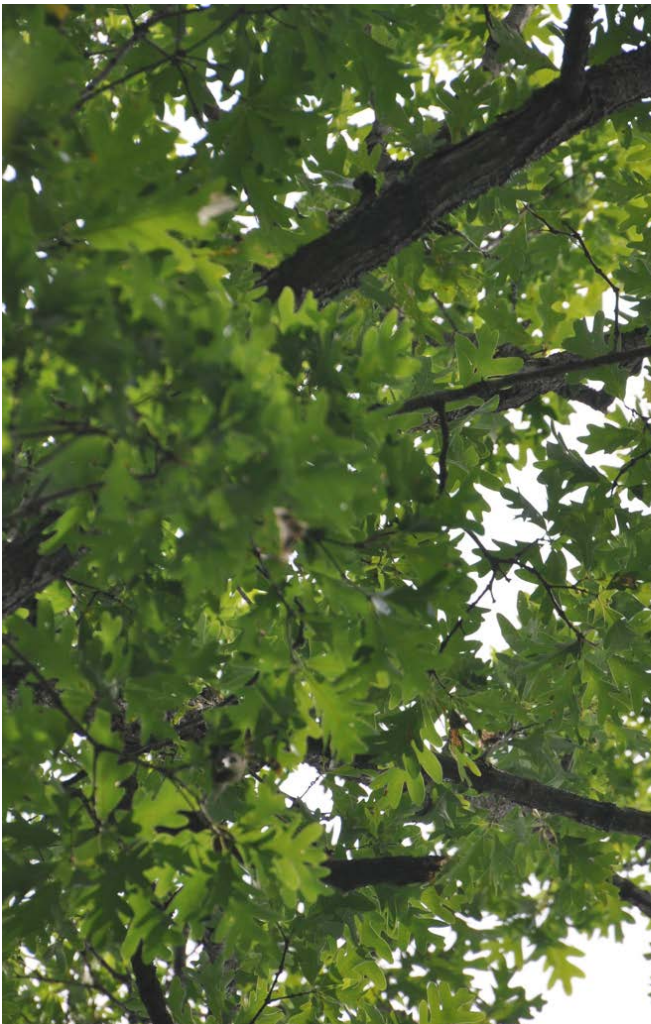
Class One Characters

- **Leaf Shape:** Minute, shallow lobes with rounded tips.
- **Leaf Arrangement:** Alternate, sometimes appearing almost whorled.
- **Buds:** When buds are present, they form a whorl of several buds at the twig apex.



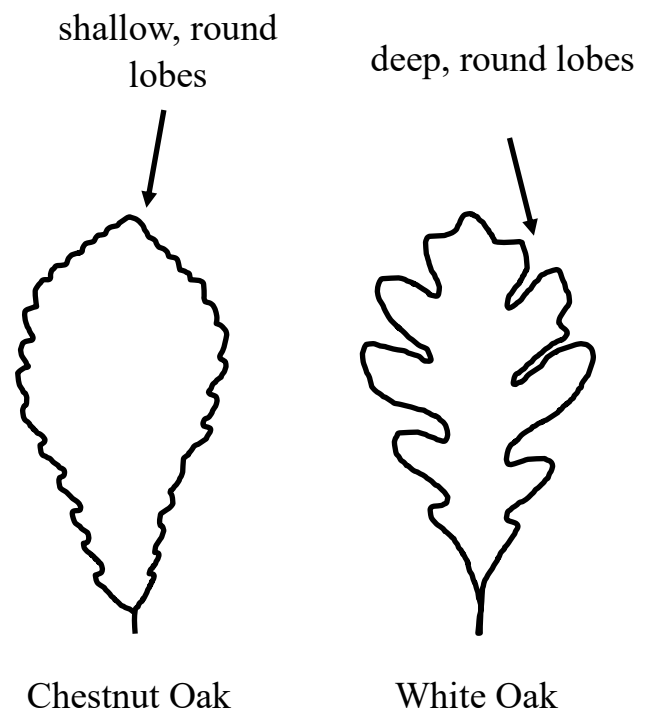
Class Two Characters

- **Leaf Shape:** Deep, prominent and rounded lobes
- **Buds:** In late summer, a whorl of rounded buds will become evident at the twig apex.



White Oaks in Vermont Forests:

- White Oak, *Quercus alba*
- Chestnut Oak, *Quercus montana*



White Oaks, *Quercus* spp.



Class One Seedlings



The photos depicted to the top left and top middle are of a class one white oak seedling (*Quercus alba*). Note how the lobes, while shallow, are still rather deeply indented. The lobes of a young chestnut oak are already much shallower than those of *Q. alba* (top right).

Class Two Seedlings



This photo is of the leaves of a mature white oak (*Quercus alba*), which look very similar to the leaves that can be found on class two seedlings of this species. The leaves of chestnut oak class two seedlings will also look quite similar to the adult leaf (drawing on left page).

Simple Leaves

Hobblebush

Look-alikes



Hobblebush has wide, broadly circular leaves with shallow serrations and a cordate leaf base. A mature hobblebush is hard to mistake for anything else due to its unique growth pattern (branches emerging oppositely at a 90 degree angles to form a T). However, young hobblebush can be more tricky (**top right**).

Some helpful tips to identify a young hobblebush include:

- **Opposite leaves** — One of the only species that looks quite similar to hobblebush is basswood. However, basswood has alternately arranged leaves. At this young age, check the stem to see if the leaves are alternate. If this is inconclusive, look to see if one of the true leaves is larger than the other (this is a great way to determine whether a seedling is alternate).



Witch Hazel



Witch hazel is a common woody forest shrub, often with arching branches and multiple stems. While witch hazel isn't a tricky lookalike for any other species in particular, a witch hazel seedling could easily be a confusing thing to encounter in microplot. This species is not tallied as a part of FHM microplot seedling counts.

Some helpful tips for identifying witch hazel include:

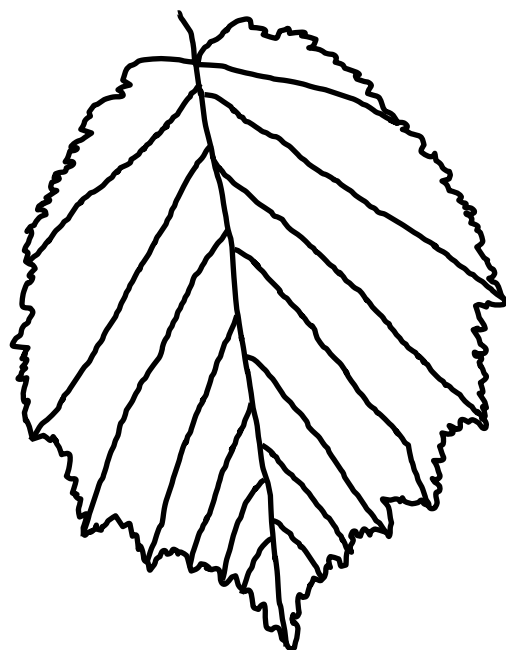
- **Alternate, nearly round leaves** — Witch hazel has leaves that can be almost round in appearance.
- **Undulate margins** — This species is one of only a few that exhibits truly undulating margins. This leaf morphology is characterized by a wavy margin with irregular, frequent lobes and no serrations.

Simple Leaves

Beaked Hazelnut



Photo courtesy of Coastal River Conservation Trust. Found at <https://www.coastalrivers.org/beaked-hazelnut/>



Beaked hazelnut (*Corylus cornuta*) is woody shrub in the birch family. This species is one of several woody forest-dwelling species that are not included in microplot seedling counts. This species is potentially a lookalike for just about any member of the birch family, but there are a number of characters that can help to identify this species. These characters include:

- **Serrations and Leaf Shape** — The serrations of most birches are doubly serrated, but the double serrations of beaked hazelnut seem more pronounced than in many other birches. This, combined with beaked hazelnut's cordate or rounded leaf base, can be helpful characters to use to identify this species.
- **Buds** — If an individual has buds, they can be incredibly helpful in telling this species apart from other birches. Beaked hazelnut buds are small and hairless, often with two flanking scales that look like a small, open bird's beak.
- **Fruit** — Beaked hazelnut is the only species of birch that has fruit with this morphology.



Found at <http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=144>



Found at <https://landscapeplants.oregonstate.edu/plants/corylus-cornuta-var-californica>



Overview of Leaf Morphology of Seedlings with Simple Leaves

Serviceberry

Amelanchier arborea



Black Cherry

Prunus serotina



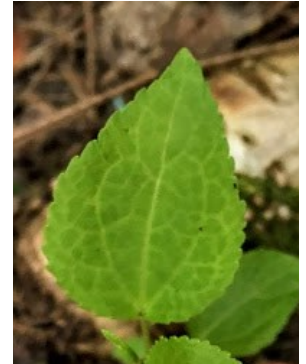
American Beech

Fagus grandifolia



Quaking Aspen

Populus tremuloides



Bigtooth Aspen

Populus grandidentata



American Basswood

Tilia americana



Elms

Ulmus spp.



Mountain Paper Birch

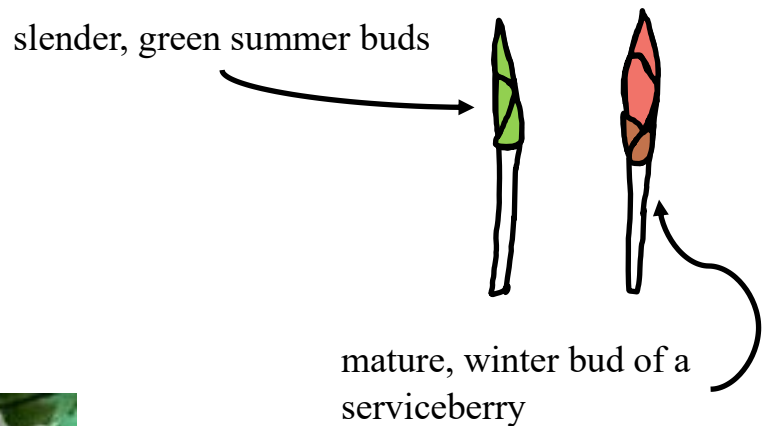
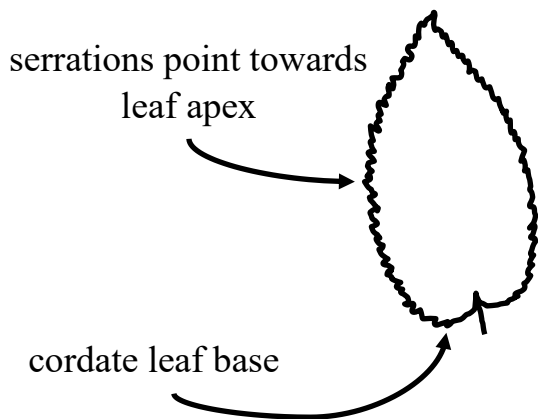
Betula cordifolia



Serviceberry, *Amelanchier arborea*

General Characters

- **Serrations:** Consistent, jagged and pointed towards leaf apex.
- **Leaf Bases:** Cordate leaf bases common, but not always present.
- **Buds:** In mid summer, seedlings will start developing long, green, pointed buds. By late summer, buds will often pick up a tinge of red.



Notes:

Pay special attention when identifying serviceberries — they can often look like birches at a glance. Serviceberry's serrations and their slender buds are the most reliable identification characters.

Similar Species:

- Birches, *Betula* spp.
- Ironwood, *Ostrya virginiana*
- Black Cherry, *Prunus serotina*
- Musclewood, *Carpinus caroliniana*

Serviceberry, *Amelanchier arborea*



Class One Seedlings



Class one serviceberry leaves are typically somewhat cordate and have regular, jagged serrations. Also note the green, pointed bud on the individual to the left.

Class Two Seedlings

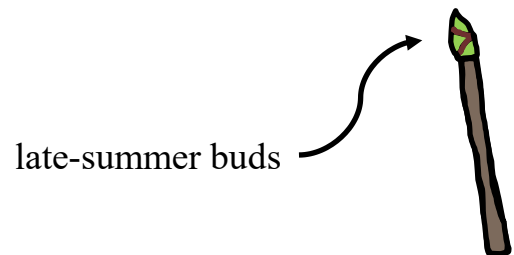


Class two seedlings with more mature buds which will only appear pretty late in the field season. Leaf shape and serrations are the best characters to rely on, but looking for that developing bud can be a good character to fall back on.

Black Cherry, *Prunus serotina*

Class One Characters

- **Leaf Shape:** Elliptical.
- **Buds:** Stout, brown buds developing green bud scale margins later in the season.
- **Serrations:** Fine, shallow serrations that point towards the leaf apex.
- **Lenticels:** Typically present on twigs.



Class Two Characters

- **Leaf Pubescence:** Orange fuzz at the base of the midrib is sometimes present (and is a great ID character).
- **Lenticels:** Typically present on twigs.
- **Scent:** Scratch a small portion of the bark and smell the wound. Black cherry bark has a rich aroma that some describe as smelling like almonds.



Notes:

Black cherries can seem quite nondescript. The best characters to rely on are minute serrations and a generally elliptical leaf shape. If a seedling does not have orange fuzz along the midrib, it could still be a black cherry. Orange fuzz is a great ID character when it is present, but it is an inconsistent character among black cherries.

Similar Species:

- Serviceberry, *Amelanchier arborea*
- American Beech, *Fagus grandifolia*

Black Cherry, *Prunus serotina*



Class One Seedlings



Young black cherry with distinctly alternate leaves (note that one leaf is much larger than the other). The developing bud is another useful character as, unlike other similar species, black cherry buds remain small and stout (above)

Class Two Seedlings



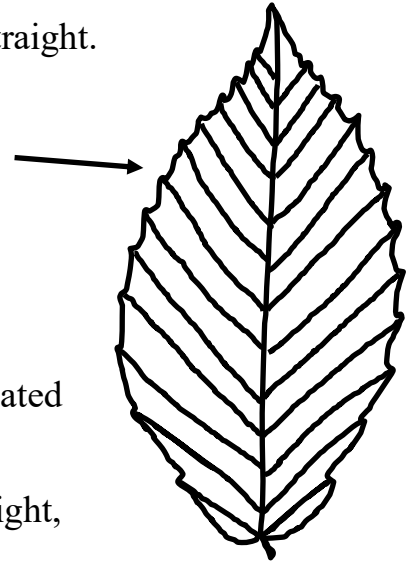
Mature black cherry seedlings have elliptical leaves and prominent lenticels on their twigs. Some leaves may have orange fuzz along the midrib (above).

American Beech, *Fagus grandifolia*

Class One Characters

- **Leaf Margin:** Undulate, often lacking defined serrations. If serrations are present, they will be located at sites along the leaf where veins reach the leaf margin.
- **Veins:** Typically pinnate, parallel to one another and straight.

parallel, straight veins ending in
a serration



Class Two Characters

- **Leaf Margins:** Serrate. Serrations large and toothy, located where veins intersect the leaf margin.
- **Veins:** Always pinnate and parallel to one another, straight, and without branching.



Notes:

Keep a keen eye out for beech seedlings interspersed with sugar maple, as they can often get lost in sugar maple thickets. Beech seedlings have variable leaf morphologies, but their straight, parallel venation is a consistent ID character.

Similar Species (to class one beech):

- Black Cherry, *Prunus serotina*
- Sugar Maple, *Acer saccharum*

American Beech, *Fagus grandifolia*



Class One Seedlings



Class one beech at multiple points throughout the summer. Note that **above** there is no hint of a bud, but **left** there is a prominent, characteristic beech bud. This is a helpful character to note as the summer progresses.

Class Two Seedlings



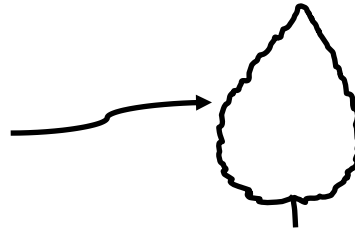
When stems are browsed, the leaves that subsequently emerge can often look a little strange (above). That being said, the characteristic veins/serrations will usually still be present in some capacity.

Quaking Aspen, *Populus tremuloides*

Class One Characters

- **Leaf Shape:** Leaf bases are typically cordate.
- **Serrations:** Minute, shallow, and rounded.

shallow, rounded serrations



Class Two Characters

- **Petiole:** Mature leaves have a flattened petiole.
- **Dieback:** Dying leaves have black patches or become entirely blackened.
- **Leaf Size:** Adult quaking aspen typically produce leaves that are less than 3 inches long. Some class two seedlings develop massive leaves, far larger than any seen on an adult individual.



Notes:

Quaking aspens can appear in all sorts of seemingly unlikely places — from forests dominated by balsam fir and red spruce to northern hardwood forests. Watch out for the highly variable leaf size and shape of these seedlings.

Similar Species:

- Bigtooth Aspen, *Populus grandidentata*

Quaking Aspen, *Populus tremuloides*



Class One Seedlings



Young quaking aspen seedling with cordate leaves and shallow, rounded serrations.

Class Two Seedlings

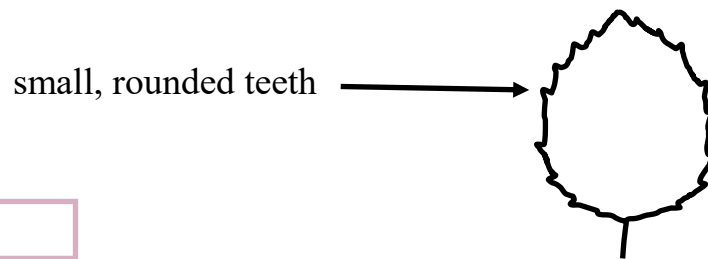


A class two aspen seedling with black dieback on some leaves.

Bigtooth Aspen, *Populus grandidentata*

Class One Characters

- **Leaf Shape:** Close to completely round.
- **Serrations:** Minute, rounded teeth at regular intervals along the margin.



Class Two Characters

- **Leaves:** Circular base with a gradually tapering apex, almost egg-like.
- **Serrations:** Large, blunt teeth regularly spaced along the margin.
- **Petiole:** Older individuals will have leaves with flattened petioles.



Photo by Homer Edward Price accessed at <https://www.flickr.com/photos/28340342@N08/6241149270>

Notes:

Bigtooth aspen can be quite challenging to tell apart from quaking aspen as a class two seedling, since the leaves of both of these species can be large and distorted on younger individuals.

Similar Species:

- Bigtooth Aspen, *Populus grandidentata*

Bigtooth Aspen, *Populus grandidentata*



Class One Seedlings



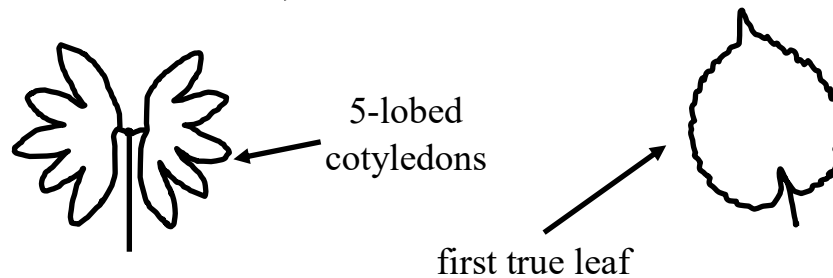
Class Two Seedlings



American Basswood, *Tilia americana*

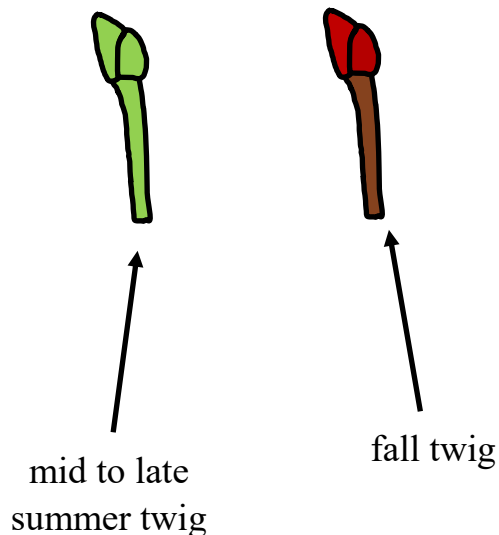
Class One Characters

- **Cotyledons:** Typically 5-lobed and almost hand-like in appearance,. Very different from American basswood's true leaves.
- **First True Leaves:** Cordate, serrated.



Class Two Characters

- **Leaves:** 5-6 inches long with uneven, cordate leaf bases.
- **Buds:** Won't be present for much of the summer, but can be another helpful character to use for ID in the late summer. Look for rotund, green buds with two bud scales. Buds turn red as the fall approaches.



Notes:

American basswood is one of the less frequently encountered seedlings in microplot. Look out for the unique cotyledons of this species and its characteristic cordate leaves with asymmetric leaf bases.

Similar Species:

- Hobblebush

American Basswood, *Tilia americana*



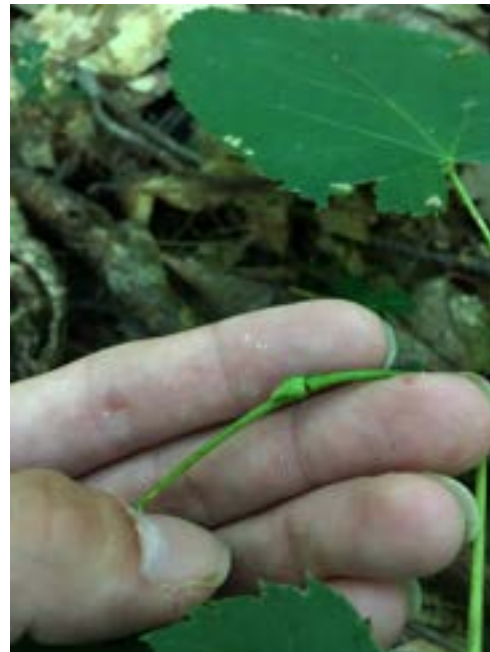
Class One Seedlings



The first true leaves look very similar to the leaves produced by a mature basswood (far left). The cotyledons of a basswood look nothing like the species' true leaves (left).



Class Two Seedlings



Mature basswood leaves are toothed and have cordate, uneven leaf bases. While buds don't emerge until late in the field season, they can be helpful ID characters once they do.

Elm, *Ulmus spp.*

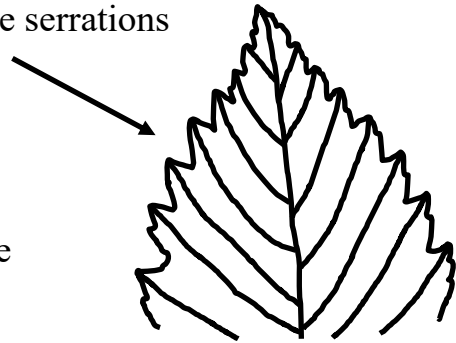
Class One Characters

- **Serrations:** Jagged, double serrations that typically point towards the leaf apex.
- **Leaf Texture:** At a young age some seedlings already have the rough, sandpapery texture that is characteristic of mature elm.

Class Two Characters

- **Serrations:** Large, jagged, double serrations.
- **Leaf Texture:** Rough leaf texture that feels like sandpaper.

jagged, double serrations



Species of Elm in Vermont:

- American Elm, *Ulmus americana*
- Slippery Elm, *Ulmus rubra*



Identifying American Elm and Slippery Elm can be challenging. Some characters that can help separate these species include:

- **Upper leaf surface texture** — American elms typically have less coarse hairs on the upper leaf surface, while slippery elms often have very dense coarse hairs on the upper leaf surface.
- **Buds** — American elms typically have reddish brown buds while slippery elms often have buds that are almost black.

These characters are often not fully developed in seedlings, so elm seedling identification can be a real challenge.

Elm, *Ulmus spp.*



Class One Seedlings



This leaves of this class one elm already had a rough, sandpappy texture.

Class Two Seedlings



This elm leaf demonstrates the coarse, jagged and doubly serrate leaf margins that are characteristic of elms.

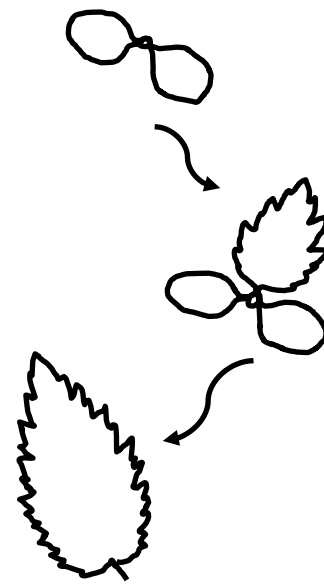
Birches: *Betula*, *Ostrya* and *Carpinus*

Class One Characters

- **Cotyledons:** Small and round.
- **True Leaves:** Simple leaves with jagged serrations.
- **Leaf Arrangement:** Alternate.



These characters are a good way to identify young seedling as a member of the birch family. However, it can be extremely challenging to identify birch seedlings to species.



Birches: *Betula*, *Ostrya* and *Carpinus*



Forest Trees in the Birch Family:

- Yellow birch
- Paper birch
- Mountain paper birch
- Gray birch
- Black birch
- Ironwood
- Musclewood

Mountain Paper Birch, *Betula cordifolia*

Mountain paper birch can be identified most reliably by two characters:

- **Leaf Shape:** Cordate leaf bases.
- **Elevation:** Mountain paper birch are typically found in high elevation forests. This species is often one of the few broadleaved trees growing among the spruce-fir dominated forests at high elevations.

Class One Seedlings



Even young mountain paper birch seedlings often have cordate leaf bases (**left**).

Class Two Seedlings



Birches: *Betula*, *Ostrya* and *Carpinus*



Tips for Identifying Birch Seedlings

Birches can be extremely hard to tell apart, especially as young seedlings and sometimes even as saplings. With young seedlings there are almost no foolproof ways to identify an individual to species, but there are some characters that can help:

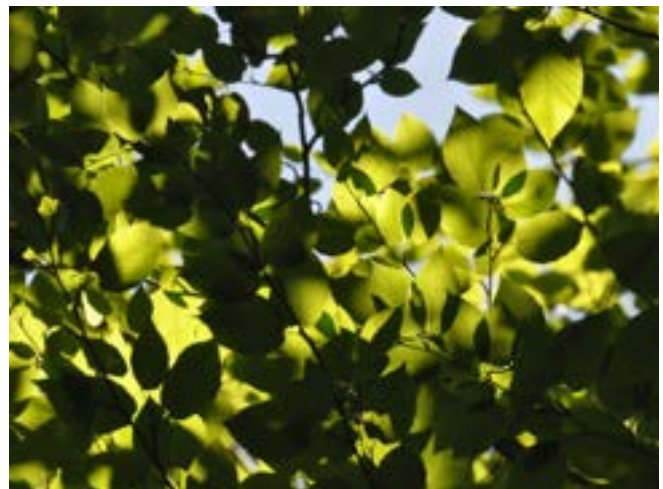
Black Birch and Yellow Birch

Scratch the bark off of a small patch of birch twig. Does the twig smell like **wintergreen**? If so, the seedling is either a black birch or a yellow birch.



General Tips

- Look to see which birch seedlings are growing nearby. This can be one of the best ways to narrow down a list of potential candidates, but this should not be the sole factor upon which an identification is based.
- Make sure to rule out serviceberry. This species is not in the birch family but can easily be mistaken for a birch.
- When in doubt, take notes and photos, and record the seedling as a generic member of the birch family.



Seedlings of Montane Spruce-Fir Forests



Common Species:

- Balsam Fir
- Red Spruce
- American Mountain-Ash
- Mountain Paper Birch



Elevation:

This natural community can begin as low as 2500 ft of elevation in the more northern parts of Vermont, and typically begins at 2800 ft in southern portions of the state. Since this boundary fluctuates based on latitude, habitat characteristics can also be used to identify this natural community.



Habitat:

- Moss dominates the forest floor
- Abundant lichens
- Balsam fir and red spruce dominant in the forest canopy



Source: Wetland, Woodland, Wildland (2019)

Seedlings of Northern Hardwood Forests



Common Species:

- Sugar Maple
- Yellow Birch
- American Beech
- Eastern White Pine
- Eastern Hemlock
- Red Spruce
- White Ash
- Black Birch
- American Basswood
- Black Cherry
- Red Maple



Elevation:

In Vermont, these forests are found at elevations below 2,700 feet.

Habitat:

This is the most common natural community type to encounter in Vermont's forests. Habitat traits to look out for include the presence of beech and yellow birch, species which are almost always found in these natural community types. Sugar maple and red maple are also often encountered. Look for herbaceous plants like jack-in-the-pulpit, intermediate wood fern, ghost pipes and wood sorrel, among many others. Keep an eye out for wandering red efts.



Identifying Unknown Seedlings



The seedling to the left is a tricky one to identify. When approaching a seedling like this, there are a few questions to ask yourself:

1. What family might this seedling belong to?

Characters that help narrow this down include:

- Jagged, doubly-serrate leaf margins
- Small, round cotyledons (visible below leaves)

Based on these characters, the seedling is likely in the **birch family**

Take photos of seedlings from multiple angles—with this photo as the only documentation, we can't tell whether this seedling is alternate or opposite. It is also hard to see the round cotyledon clearly.

2. What genus might this seedling belong to?

Characters that help narrow this down include:

- Birch species growing nearby were yellow birch and ironwood.

These are important facts to note — definitely record this somewhere in your notes — but **this is not enough information to definitively identify this seedling to genus.**

Even if only one species of birch was growing near to this specimen, that would still be too little information to base an accurate identification on. Never use associated species as the only thing to base your identification on. That being said, always include these details in your notes.

Identifying Unknown Seedlings

Steps for documenting the presence of unknown seedlings in microplot:

1. Assign the specimen a number

Assign a specimen number based on the plot name, subplot number and the number of other unknowns at that plot. For example, the first unknown encountered at subplot 3 LEMP15 could be called “LEMP15-Sub3-1.” Record the presence of this unknown on the datasheet using this specimen number.

2. Document the specimen with photos

Write down the specimen number on a piece of paper (even the corner of a datasheet) and situate this label near the specimen so that it will be visible in photos. Take several photos of the specimen from multiple angles.

3. Take detailed habitat notes

This is the time to record which closely related species are growing nearby. Other habitat features that are helpful to note include elevation and the moisture level at the site.

4. Send photos to others for identification

At the end of the field day, send these photos to the team member(s) who have been designated to help with identification questions.

5. Add updated ID to datasheets

Once the seedling has been identified, remember to add the updated identification to the datasheets.