

WINTER TWIG KEYS TO COMMON, NATIVE,
FULLY DECIDUOUS TREES AND PHANEROPHYTE SHRUBS
OF THE NORTH CAROLINA EASTERN PIEDMONT

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ABSTRACT

Illustrated, bracketed, dichotomous keys to winter twigs of the most common, native, fully deciduous trees and shrubs of the North Carolina eastern piedmont are presented. Sixty-seven species and three genera (blackberries, hickories, and oaks) can be identified with these keys. Species of gymnosperms, evergreen and semi-evergreen angiosperms, woody vines, and uncommon and introduced species not included in the keys are listed (Tables 1 and 2).

Trees and phanerophytic shrubs (perenniating buds ≥ 1 m above ground during dormant season) are prominent in most natural plant community types of the eastern piedmont in North Carolina. Although many acres of forest have been removed from this region by urban development and impoundment construction, much wooded landscape remains in privately-owned woodlots, buffer zones bordering reservoirs and streams, and properties owned by conservation organizations. During the growing season, most students of the flora identify trees and shrubs by observing leaf characteristics. With experience, individuals can identify deciduous trees and shrubs during the dormant season by observing features of woody twigs. Typical winter twig features of eastern piedmont species can be observed during most years from mid – late November to mid - March. One should observe features of relatively straight, healthy twigs from the previous growing season with a magnifying hand-lens. One should use a sharp blade to slice twigs longitudinally to see pith tissue. Slices made with dull blades are usually ragged and obscure pith structure.

METHODS

Taxa included in the keys presented here are those which the author has encountered commonly during fieldtrips in the eastern piedmont throughout the last 30 years. Keys are based on the author's observations of living material and herbarium specimens in NCSC. The keys benefited from an unpublished key written by Dr. James Hardin and from keys presented by Brown and Brown (1972) and Preston and Wright (1988). Images (Appendix A) were captured with a digital camera attached to a dissecting microscope. Many images included a section of a metric ruler showing millimeter divisions. Plant nomenclature followed Radford et al. (1968).

RESULTS

Figures are grouped alphabetically according to taxon name and follow the lists of excluded species. Keys are presented in the bracketed format because students in the author's university classes consistently have had fewer problems with this format than with the indented format.

Key to structural groups

1. Leaf scars opposite.....Group 1
- 1.' Leaf scars alternate2.
2. Pith of internode diaphragmed or chambered.....
-Group 2, Figs. 1 and 2
- 2.' Pith of internode homogeneousGroup 3

Group 1: Leaf scars opposite

1. Twigs angled, surfaces nearly flat; twigs and stems green to ground level or nearly to ground level.....
-*Euonymus americanus*, Fig. 19
- 1.' Twigs round, surfaces not flat; twigs and stems often brown, gray, or maroon to ground level (*Acer negundo* saplings usually

- have green stems nearly to ground level but their stems are round)2.
2. Stipular scars prominent*Staphylea trifolia*, Fig. 42
- 2.' Stipular scars inconspicuous or lacking (transverse lines joining adjacent leaf scars may resemble stipular scars)3.
3. Vascular bundle scars ≥ 6 4.
- 3.' Vascular bundle scars 1-5 or not discernable6.
4. Buds with about 6 pairs of scales *Aesculus sylvatica*, Fig. 6
- 4.' Buds with 2-3 pairs of scales5.
5. Upper edge of largest leaf scars deeply notched; plant of dry soils *Fraxinus americana*, Fig. 21
- 5.' Upper edge of all leaf scars straight or only slightly notched; plant of wet or inundated soil
..... *Fraxinus pennsylvanica* or *F. caroliniana*
- [NOTE: Leaf scar shape of ashes is frustratingly variable. Perhaps, the best character distinguishing *F. americana* from *F. pennsylvanica* and *F. caroliniana* in natural habitats during the winter is wet vs. dry soils. The author knows of no winter twig or habitat character that distinguishes *F. pennsylvanica* from *F. caroliniana*.]
6. Terminal bud scales keeled, distinctly sharply pointed
.....*Chionanthus virginicus*
- 6.' Terminal bud scales not keeled, if pointed not distinctly so7.
7. Axillary bud scales woody / leathery; pith spongy and white
.....*Sambucus canadensis*, Fig. 40
- 7.' Axillary bud scales not woody / leathery; pith spongy and white or otherwise8.
8. Axillary buds sunken into stem tissue *Cephalanthus occidentalis*

- 8.' Axillary buds not sunken (may be obscured by petiole bases or leaf scars)9.
9. Axillary buds usually partly or totally obscured by petiole bases or leaf scars*Cornus florida*, Fig. 17
- 9.' Axillary buds not obscured10.
10. Axillary buds valvate (only 2 scales enclose valvate bud)11.
- 10.' Axillary buds imbricate (a bud composed of 2 valvate scales and two small basal scales is imbricate)15.
11. Line connecting opposite leaf scars projected upward into ridge
.....*Acer negundo*, Fig. 4
- 11.' Line between opposite leaf scars not evident or, if evident, then not projected upward into ridge12.
12. Pith of year-old stem brown..... *Cornus amomum*, Fig. 16
- 12.' Pith white13.
13. Bud scales covered with dense, velvety, reddish hairs
.....*Viburnum rufidulum*
- 13.' Bud scales smooth or hairs not velvety or reddish.....14.
14. Buds dark brown, gray or black; twigs rigid.....
.....*Viburnum prunifolium*, Fig. 50
- 14.' Buds rusty – colored; twigs often flexuous
.....*Viburnum nudum*, Fig. 49
15. Twigs green – red/pink16.
- 15.' Twigs brown – gray.....17.
16. Line connecting opposite leaf scars projected upward into ridge
.....*Acer negundo*, Fig. 4
- 16.' Line connecting opposite leaf scars straight or nearly so
.....*Acer rubrum*, Fig. 5

- 17. Twigs hairy 18.
- 17.' Twigs smooth 19.

- 18. Twig hairs radially branched *Viburnum dentatum*
- 18.' Twig hairs unbranched *Viburnum acerifolium*, Fig. 48

- 19. Axillary buds appressed against twig *Viburnum rafinesquianum*
- 19.' Axillary buds divergent 20.

- 20. Buds with > 2 or 3 pairs of visible scales
 *Acer barbatum*, Fig. 20
- 20.' Buds with 2 or 3 pairs of visible scales 21.

- 21. Upper edge of largest leaf scars deeply notched; plant of
 dry soils *Fraxinus americana*, Fig. 21
- 21.' Upper edge of all leaf scars straight or only slightly notched;
 plant of wet or inundated soil
 *Fraxinus pennsylvanica* or *F. caroliniana*

[NOTE: Leaf scar shape of ashes is frustratingly variable. Perhaps, the best character distinguishing *F. americana* from *F. pennsylvanica* and *F. caroliniana* in natural habitats during the winter is wet vs. dry soils. The author knows of no winter twig or habitat character that distinguishes *F. pennsylvanica* from *F. caroliniana*.]

Group 2: Leaf scars alternate, pith chambered or diaphragmed

- 1. Stipular scars encircling twig 2.
- 1.' Stipular scars absent or, if present, not encircling twig 3.

- 2. Buds valvate *Liriodendron tulipifera*, Figs. 1 and 27
- 2.' Buds capitate *Magnolia tripetala*, Fig. 29

- 3. Pith chambered 4.

- 3.' Pith diaphragmed 7.

- 4. Bud naked *Asimina triloba*, Fig. 10
- 4.' Bud scaly 5.

- 5. Bundle scars numerous, in groups *Juglans nigra*
- 5.' Bundle scars 1 or 3 6.

- 6. Bundle scar 1 *Symplocos tinctoria*, Fig. 44
- 6.' Bundle scar 3 *Itea virginica*, Fig. 2

- 7. Buds naked *Asimina triloba*, Fig. 10
- 7.' Buds scaly 8.

- 8. Bundle scars 3 *Nyssa sylvatica*, Fig. 31
- 8.' Bundle scar 1 *Diospyros virginiana*, Fig. 18

Group 3: Leaf scars alternate, pith homogenous

- 1. Prickles or thorns present 2.
- 1.' Prickles and thorns lacking 6.

- 2. Stems arching or trailing, longitudinally grooved; bundle scars
 not evident *Rubus* spp.
- 2.' Stems erect, not grooved; bundle scars evident 3.

- 3. Bundle scars > 8; leaf scar deeply U-shaped and large
 *Aralia spinosa*, Fig. 9
- 3.' Bundle scars 3; leaf scar crescent-shaped, narrow 4.

- 4. Prickles lacking; at least some branch stems modified as thorns;
 stems often forming dense thickets *Prunus angustifolia*
- 4.' Prickles present; branch stems not modified as thorns; stems
 not forming dense thickets 5.

- 5. Plant of wet or inundated soil; prickles curved
.....*Rosa palustris*, Fig. 38
- 5.' Plant of dry soil; prickles straight – slightly curved.....
.....*Rosa carolina*
- 6. Stipular scar completely encircling stem.....7.
- 6.' Stipular scar lacking or present but not encircling stem9.
- 7. Buds valvate.....*Liriodendron tulipifera*, Figs. 1 and 27
- 7.' Buds capitate8.
- 8. Buds brown; leaf scar encircles axillary bud
.....*Platanus occidentalis*, Fig. 35
- 8.' Buds gray – black; leaf scar does not encircle axillary bud
..... *Magnolia tripetala*, Fig. 29
- 9. Buds associated with different leaf scars clustered at twig ends
(superposed buds of a single leaf scar near twig end do not consti-
tute clustered buds) 10.
- 9.' Buds associated with different leaf scars not clustered at twig
ends 11.
- 10. Bud scales tan, beige, pink, pink-tipped
.....*Rhododendron periclymenoides*
- 10.' Bud scales brown or grayish – brown*Quercus* spp., Fig. 36
- [NOTE: Refer to Preston and Wright (1988) for a key to winter twigs of oak spe-
cies.]
- 11. Buds stalked 12.
- 11.' Buds sessile 13.
- 12. Plants of dry soil; buds densely covered with short, tan, matted
hairs*Hamamelis virginiana*
- 12.' Plants of wet or inundated soil; buds smooth or with dark
brown hairs.....*Alnus serrulata*, Fig. 7
- 13. Buds naked or so densely hairy that scales cannot be seen ...14.
- 13.' Buds obviously scaly (this lead includes buds with a single
scale)19.
- 14. Leaf scar deeply horseshoe-shaped.....15.
- 14.' Leaf scar round, half-round, shield-shaped, or crescent-shaped
.....16.
- 15. Twigs 3-sided; leaf scars >2-ranked, nearly surrounding buds
.....*Rhus glabra*
- 15.' Twigs round; leaf scars 2-ranked, not nearly surrounding buds
.....*Asimina triloba*, Fig. 10
- 16. Leaf scar round or nearly so..... *Rhus aromatica*
- 16.' Leaf scar half-round, shield-shaped, or crescent-shaped.....17.
- 17. Axillary buds often superposed, thumb-shaped; vascular bundle
one, often elevated above surrounding leaf scar.....
..... *Styrax grandifolia*, Fig. 43
- 17.' Axillary buds solitary, not thumb-shaped; vascular bundles >1,
not elevated above surrounding leaf scar18.
- 18. True terminal bud present *Toxicodendron radicans*, Fig. 45
- 18.' True terminal bud absent; false terminal present or absent
..... *Rhus copallina*, Fig. 37
- 19. Bud scale 1, capitate.....*Salix nigra*, Fig. 39
- 19.' Bud scales >1, imbricate or valvate20.
- 20. Crushed twigs or scratched twig bark with distinct smell21.
- 20.' Crushed twigs or scratched twig bark lacking distinct smell
.....22.

21. Smell bitter; bark and bud scales dark brown - maroon.....
 *Prunus serotina*, Fig. 34
- 21.' Smell spicy, lemony; bark and bud scales tan, brown or green
 *Lindera benzoin*, Fig. 26
22. Bundle scar 1 per leaf scar23.
 22.' Bundle scars >1 per leaf scar.....32.
23. Short, spur shoots with closely spaced leaf scars present; stipular scars present (may be difficult to see without handlens).....
 *Ilex decidua*, Fig. 29
- 23.' Spur shoots lacking; stipular scars not evident24.
24. Axillary buds often superposed *Ilex verticillata*, Fig. 24
 24.' Axillary buds solitary25.
25. Buds partly sunken in stem tissue; twig bark maroon.....
 *Oxydendrum arboreum*, Fig. 33
- 25.' Buds not sunken; twig bark brown, black, gray, green or pink..
26.
26. Bud scales acute, acuminate or apiculate; twig bark green or pink27.
 26.' Bud scales acute or obtuse; twig bark brown, gray, maroon, pink, or green.....29.
27. Leaf bud scales acute or apiculate but not acuminate; young twigs not warty dotted *Vaccinium stamineum*
 27.' Leaf bud scales acuminate; young twigs warty dotted28.
28. Low shrub, 30-50 cm tall *Vaccinium pallidum*
 28.' Shrub to 3 m tall *Vaccinium corymbosum*, Fig. 47
29. Bundle scar a straight, horizontal, elongated band

- *Sassafras albidum*, Fig. 41
- 29.' Bundle scar curved or oval (not straight and elongated)30.
30. Bud scales green, brown, or pink, with golden glands
 *Gaylussacia frondosa*, Fig. 22
- 30.' Bud scales brown-black, lacking glands.....31.
31. Bud scales 2, overlapping with a wavy line, dark brown-black
 *Diospyros virginiana*, Fig. 18
- 31.' Bud scales several, imbricate, reddish-brown
 *Leucothoe racemosa*, Fig. 25
32. Wood (internal to bark) conspicuously yellow.....
 *Xanthorhiza simplicissima*, Fig. 51
- 32.' Wood (internal to bark) brown, gray, tan, pinkish, or white .33.
33. Leaf scar edge slightly elevated as a rim, interior sunken-dished; vascular bundle scars slightly elevated *Morus rubra*, Fig. 29
 33.' Leaf scar edge not elevated, interior not sunken; bundle scars not elevated34.
34. Axillary bud recurved toward twig
 *Amelanchier arboreum*, Fig. 8
- 34.' Axillary bud straight, not recurved35.
35. Axillary bud length $\geq 5X$ width..... *Fagus grandifolia*, Fig. 20
 35.' Axillary bud length $< 5X$ width.....36.
36. Each bundle scar a white ring with a dark center
 *Liquidambar styraciflua*, Fig. 28
- 36.' Bundle scars not as above37.
37. Bundle scars ≥ 5 , scattered or in 3 groups... *Carya* spp., Fig. 13
 37.' Bundle scars < 5 38.

[NOTE: Refer to Preston and Wright (1988) for a key to winter twigs of hickory species.]

- 38. Bundle scars slightly depressed into leaf scar tissue39.
- 38.' Bundle scars not depressed.....41.

- 39. Some twigs have corky wings *Ulmus alata*
- 39.' Twigs lack corky wings.....40.

- 40. Buds densely hairy; twigs rough hairy *Ulmus rubra*, Fig. 46
- 40.' Buds smooth-slightly hairy; twigs smooth-slightly hairy
..... *Ulmus americana*

- 41. Vegetative bud scales ≤ 4 42.
- 41.' Vegetative bud scales > 444.

- 42. Scales of axillary leaf buds 2-3, buds often superposed
.....*Cercis canadensis*, Fig. 15
- 42.' Scales of axillary leaf buds 3-4, buds solitary.....43.

- 43. Bud oblong or narrowly lanceolate, ratio of bud length / greatest width ≥ 2 ; twigs reddish-brown*Betula nigra*, Fig. 11
- 43.' Bud deltate, ratio of bud length / greatest width < 2 ; twigs greenish-brown or gray.....*Celtis laevigata*, Fig. 14

- 44. Bud apex obtuse; twig ends with short, protruding, stiffish, reddish-brown hairs *Corylus americana*
- 44.' Bud apex acute; twig ends smooth or with hairs not as above ...
.....45.

- 45. Bud scales distinctly longitudinally striate
..... *Ostrya virginiana*, Fig. 32
- 45.' Bud scales not striate or, if striate, then not distinctly
..... *Carpinus caroliniana*, Fig. 12

TABLE 1. Deciduous species not included in keys

A. Uncommon or of questionable occurrence in eastern Piedmont

<i>Amelanchier canadensis</i>	<i>Halesia carolina</i>
<i>Amelanchier obovalis</i>	<i>Hydrangea arborescens</i>
<i>Amelanchier spicata</i>	<i>Lindera subcoriacea</i>
<i>Aronia arbutifolia</i> **	<i>Lyonia ligustrina</i> **
<i>Asimina parviflora</i>	<i>Lyonia mariana</i> **
<i>Callicarpa americana</i> **	<i>Nestronia umbellula</i>
<i>Calycanthus floridus</i>	<i>Populus deltoides</i> **
<i>Castanea pumila</i>	<i>Ptelea trifoliata</i>
<i>Clethra alnifolia</i> **	<i>Robinia pseudoacacia</i>
<i>Cornus alternifolia</i>	<i>Symphoricarpos orbiculatus</i>
<i>Crataegus</i> spp.	<i>Taxodium distichum</i> **
<i>Dirca palustris</i>	<i>Tilia americana</i>
<i>Gleditsia triacanthos</i>	<i>Toxicodendron quercifolium</i>

B. Introduced and naturalizing

<i>Albizia julibrissin</i>	<i>Melia azedarach</i>
<i>Ailanthus altissima</i>	<i>Morus alba</i>
<i>Baccharis halimifolia</i> ** : widely naturalizing	<i>Paulownia tomentosa</i> : widely invasive
<i>Broussonetia papyrifera</i>	<i>Pyrus calleryana</i>
<i>Elaeagnus umbellata</i> : widely invasive	<i>Rosa multiflora</i>
<i>Maclura pomifera</i> : only occasionally naturalizes	

TABLE 2. Evergreen and semi-evergreen species not included in keys (arranged alphabetically by species).

*Arundinaria gigantea*** : grass with “woody” stems; in upper edges of wetlands
*Cyrilla racemiflora*** : semi-evergreen; occasional in wetlands of easternmost parts of region
Elaeagnus pungens: widely invasive exotic; disturbed woodlands
Ilex glabra: seen in swamp north of Raleigh in 1997 but this population was destroyed by road construction; possibly occurs in region
*Ilex opaca*** : common in mesic woods
Juniperus virginiana: not uncommon in uplands
Kalmia latifolia: on mesic bluffs throughout region
*Leucothoe axillaris*** : in wetlands in easternmost region
Ligustrum lucidum: exotic; occasionally escapes from cultivation and naturalizes
*Ligustrum sinense*** : widely invasive exotic; common in riparian zones and somewhat less common in disturbed uplands throughout region, often forms dense populations in riparian zones that displace native woody and herbaceous species
Magnolia grandiflora: occasionally escapes from cultivation and naturalizes
*Magnolia virginiana*** : semi-evergreen; occasional in wetlands of easternmost part of region
Mahonia bealei: escapes from cultivation and naturalizes
*Myrica cerifera*** : native but much used in cultivation, its natural abundance is probably being augmented by escapes from cultivation
Nandina domestica: exotic; escapes from cultivation and naturalizes
Photinia serrulata: occasionally escapes from cultivation and naturalizes
Pinus echinata: dry uplands throughout region
Pinus palustris: infrequent in region, usually widely separated individuals
*Pinus serotina*** : two trees seen in swamp north of Raleigh in 1997 but these destroyed by road construction; current occurrence in region is possible
*Pinus taeda*** : common in dry and mesic habitats throughout region
Pinus virginiana: infrequent
Rhododendron catawbiense: occasional in mesic habitats
Tsuga canadensis: natural population known only from Hemlock Bluffs in Wake Co.; used in cultivation
Vaccinium arboreum: semi-evergreen; common in upland areas
Yucca filamentosa: occasional in dry areas

** Described and illustrated in *Common, Woody, Piedmont and Coastal Plain Wetland Plants of the Carolinas*:
<http://ceres.cals.ncsu.edu/wetland/library/PrefaceNEW.cfm>

ACKNOWLEDGMENTS

I thank John Nelson (University of South Carolina) and Mike Baranski (Catawba College) for their thoughtful review of the manuscript.

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APPENDIX A: Figures



FIG. 1. Diaphragmed pith of *Liriodendron tulipifera*



FIG. 2. Chambered pith of *Itea virginica*

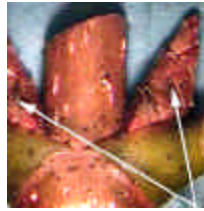


FIG. 3. *Acer barbatum*

numerous bud scales



FIG. 10. *Asimina triloba*



FIG. 11. *Betula nigra*



FIG. 12. *Carpinus caroliniana*



FIG. 4. *Acer negundo*



FIG. 5. *Acer rubrum*



FIG. 6. *Aesculus sylvatica*

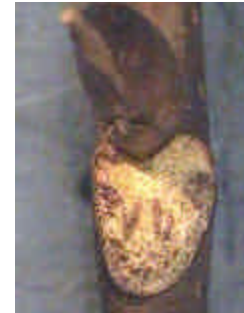


FIG. 13. *Carya*



FIG. 14. *Celtis laevigata*



FIG. 15. *Cercis canadensis*



FIG. 7. *Alnus serrulata*



FIG. 8. *Amelanchier arborea*



FIG. 9. *Aralia spinosa*

leaf scar

prickles

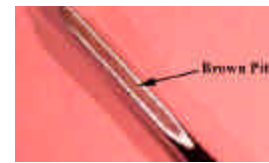


FIG. 16. *Cornus amomum*



FIG. 17. *Cornus florida*



FIG. 18. *Diospyros virginiana*

Brown Pith



FIG. 19. *Euonymus americanus*



FIG. 20. *Fagus grandifolia*



FIG. 21. *Fraxinus americana*



FIG. 28. *Liquidambar styraciflua*



FIG. 29. *Magnolia tripetala*



FIG. 30. *Morus rubra*



FIG. 22. *Gaylussacia frondosa*



FIG. 23. *Ilex decidua*



FIG. 24. *Ilex verticillata*



FIG. 31. *Nyssa sylvatica*



FIG. 32. *Ostrya virginiana*



FIG. 33. *Oxydendrum arboreum*

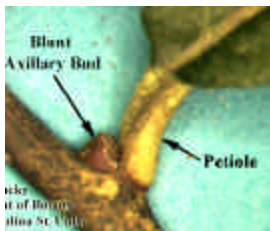


FIG. 25. *Leucothoe racemosa*



FIG. 26. *Lindera benzoin*

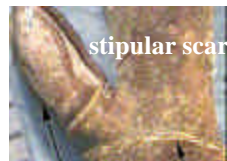


FIG. 27. *Liriodendron tulipifera*



FIG. 34. *Prunus serotina*



FIG. 35. *Platanus occidentalis*

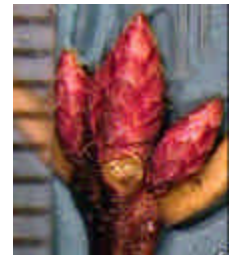


FIG. 36. *Quercus nigra*



false terminal bud missing

FIG. 37. *Rhus copallina*

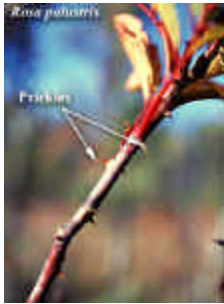


FIG. 38. *Rosa palustris*



FIG. 39. *Salix nigra*

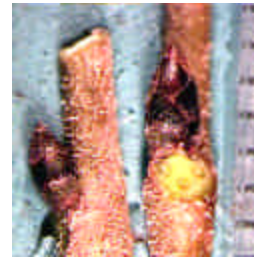


FIG. 46. *Ulmus rubra*



FIG. 47. *Vaccinium corymbosum*



FIG. 48. *Viburnum acerifolium*



FIG. 40. *Sambucus canadensis*



FIG. 41. *Sassafras al-*



FIG. 42. *Staphylea trifolia*



FIG. 49. *Viburnum nudum*



FIG. 50. *Viburnum prunifolium*



FIG. 51. *Xanthorhiza simplicissima*



superposed, thumb-shaped buds

FIG. 43. *Styrax grandifolia*

single bundle scar



FIG. 44. *Symplocos tinctoria*



FIG. 45. *Toxicodendron radicans*