

**ANOTHER REVIEW OF THE *SYMPHYOTRICHUM PATENS* COMPLEX
(ASTERACEAE), INCLUDING A NEW VARIETY OF *S. PATENS* FROM THE
SOUTHERN BLACKLANDS, NEW RECORDS OF *S. GEORGIANUM* AND NOTES
ON *GEORGIANUM*-LIKE PLANTS OUTSIDE ITS KNOWN RANGE**

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APPENDIX: Typical Habitats of *Symphyotrichum* sect. *Patentes* Taxa in Relation to Major Ecological Gradients across Southeastern U.S.A.

A. Hydrological gradients in terms of modal positions for tree species.

A1. Simplified summary of gradients in warm- to mid-temperate woods (broadly defined). Mesic conditions (= M) are at center-left; more open, stressed or disturbed conditions increase to upper right (xeric extreme = X), to lower right (hydric extreme = H), or to lower left (riparian or rheophytic with active scouring = R).

Six-letter codes indicate approximate modal positions of species, using first three letters of genus and species; if more than one mode, the average is usually shown.

Red letters = codes for species associated with strongly acid soils (low pH ca. 4-5); green = medium acid (pH ca. 5-6); blue = circumneutral (high pH ca. 6-7); used for index below.

Dark grey fill = generally continuous forest; medium grey = more open woods, often mixed with shrubland or grassland; pale grey = zones usually dominated by shrubs or graminoids.

Parentheses indicate species with relatively northern ranges, which are replaced by other species to the south within this region.

** Ring-porous wood; * semi-ring-porous.

A2 to A7. Distribution of taxa along these gradients, based on general review of common woody associates; see text for references. Underlining indicates most abundant associates; parentheses () indicate minor or peripheral associates; brackets [] indicate shrubs, added in some cases to the species listed in A1. Shadings indicate concentrations. "Index of basiphily" is a 10-point scale calculated as mean from associates: low pH = 1; medium = 5; high = 10.

A1. Hydrological gradients among trees of southeastern states.

		CLIFFS	CLIFFS	CLIFFS	PINVIR JUNVIR ULMSER**	PINRIG QUEPRI** ULMALA**	QUELAE** QUEILI** CELTEN**	XERIC EXTREME
MESIC SLOPES (below)	CLIFFS	QUEMON** CARGLA** FRAQUA**	QUECOC** QUEVEL** QUESCH**	VACARB QUEFAL** (ULMTHO)**	PINECH (POPGRA) FRABIL**	QUEMAR** MALCOR* GLETRI**	QUEMRG** MALANG* RHUGLA**	GRASS- LAND
TSUCAR HALTET CLAKEN	MAGMAC QUERUB** TILAME	CASDEN** CAROVA** ULMRUB**	OXYARB QUEALB** QUEMUE**	CARPAL** CARTOM** CARCAR**	PINTAE SASALB* PRUSER*	PINPAL QUESTE** GYMDIO**	QUEINC** (QUEIMB)** (QUEMAC)**	GRASS- LAND
TSUCAN FAGGRA ACESAC	BETLEN LIRTUL AESFLA	MAGACU ACERUB CARCOR*	ILEOPA NYSSYL FRAAME**	(PINSTR) (JUGCIN)* JUGNIG*	QUENIG** ROBPSE** MORRUB*	QUEHEM** DIOVIR* MACPOM**	PINSER QUEPHE** QUESIN**	GRASS- LAND
PLAOCC	HALCAR BETNIG ACENEG	MAGTRI LIQSTY ULMAME**	MAGGRA QUESHU** CARLAC**	PERBOR QUEPAG** CELSPP**	QUELAU** ILEDEC FRAPEN**	(QUEPAL)** CHATHY CARMYR*	PINELL TAXASC QUELYR**	BOG or MARSH or FEN
POPDEL	ACESNM CATSPE**	ACETRI CARILL*	QUEMIC** FRASUB**	NYSBIF FRAPRO**	MAGVIR FRACAR** POPHET	PERPAL TAXDIS CARAQU*	CYRRAC NYSQU GLEAQU**	STAGNANT WATER
RHEIC EXTREME	SALSER SALCAR SALINT	ALNSER SALNIG	CORSTR PLAAQU	CEPOCC FORACU	DECVER HIBSPP	STAGNANT WATER	STAGNANT WATER	HYDRIC EXTREME

A2. *Aster patens* var. *terranigrum*: index of basiphily = 8.5 (1 low/4 medium/15 high).

					<u>JUNVIR</u> CERCAN	ULMALA	<u>CELTEN</u>	X
					FRABIL	(QUEMAR) <u>SIDLYC</u>	<u>PRUANG</u> (RHUGLA)	
M			(QUEMUE)	(CARMYR)	(PRUSER)	(QUESTE) (GLETRI)	<u>CRACRU</u>	
				(JUGNIG)	(MORRUB)	(DIOVIR) MACPOM		
				(CELLAE)				
R								H

A3. *Aster patens* var. *gracile*: index of basiphily = 1.1 (11 low/3 medium/0 high)

					PINVIR		QUELAE	X
		QUEMON		<u>VACARB</u> QUEFAL	PINECH	<u>QUEMAR</u>	<u>QUEMRG</u>	
M			OXYARB			<u>PINPAL</u>	QUEINC	
			NYSSYL	ILEVOM		<u>DIOVIR</u>		
R								H

A4. *Aster patens* var. *patens*: index of basiphily = 2.5 (12 low/12 medium/0 high)

					PINVIR			X
		QUEMON CARGLA	QUECOC QUEVEL	VACARB QUEFAL	<u>PINECH</u>	<u>QUEMAR</u>	RHUCOP?	
M		(CASDEN) CAROVA	(OXYARB) QUEALB	(CARPAL) CARTOM	(PINTAE) SASALB*	(PINPAL) <u>QUESTE</u>		
		(ACERUB)	NYSSYL	[CORFLO]		(DIOVIR)		
R								H

A5. *Aster patens* var. *patentissimum*: index of basiphily = 4.6 (4 low/7 medium/3 high)

					JUNVIR	ULMALA	CELTEN	X
				VACARB QUEFAL?	PINECH FRABIL	QUEMAR? PRUAME	RHUCOP	
M				CARTEX	SASALB?	<u>QUESTE</u>		
						DIOVIR?		
R								H

A6. *Aster georgianum*: index of basiphily = 4.4 (5 low/8 medium/3 high)

					JUNVIR [CERCAN]			X
		(CORFLO)	QUEVEL	VACARB QUEFAL? [VIBRAF]	PINECH [HYPPRO]	<u>QUEMAR</u>	[RHUCOP]	
M					PINTAE [ILELON] [SYMORB]	<u>PINPAL</u> <u>QUESTE</u>		
R								H

A7. *Aster phlogifolium*: index of basiphily = 6.4 (2 low/11 medium/8 high)

					JUNVIR			X
		CARGLA FRAQUA	QUECOC QUEVEL QUESCH		FRABIL			
M	QUERUB	CAROVA ULMRUB	QUEALB QUEMUE		SASALB PRUSER			
TSUCAN ACESAC	LIRTUL	ACERUB	FRAAME	PINSTR		DIOVIR		
PLAOCC								
R								H

B. Soil pH-related (left-right) and mesic-xeric/disturbance (lower-upper) gradients.

B1. This soil pH-related gradient is a more detailed expansion of the color-coded gradient illustrated above in A1. The mesic-xeric/disturbance gradient combines the somewhat parallel mesic-subxeric-xeric and mesic-submesic-grassland sequences of A (where they are left-to-right). It excludes species of largely rheic (scoured riparian) and hydric habitats. Several smaller species are added, but some related pairs are combined in the same box if they are segregated mostly along the hydric-xeric gradient (lower-to-upper in A).

Colors indicate the following taxonomic concentrations.

Pink (lower left): mostly *Tsuga*, *Magnolia*, *Betula*, *Rhododendron*.

Orange (center left): mostly *Quercus*, *Carya*, *Ilex*, *Nyssa*, *Acer rubrum*.

Yellow (upper left): mostly *Pinus*, *Quercus*, Ericaceae.

Brown (lower right): *Fagus*, *Acer saccharum* (s.l.), *Tilia*, *Halesia*, *Liriodendron*, *Liquidambar*.

Green (center right): mostly *Aesculus*, *Juglans*, *Fraxinus*, Ulmaceae, some *Quercus* and *Carya*.

Blue (upper right): mostly Rosaceae, Fabaceae, *Rhus*, *Juniperus*, some Ulmaceae, *Quercus*; includes all thorny trees (and note several other ecomorphological trends among species groups).

B2 to B7. Distribution of taxa along these gradients, based on general review of common woody associates; see notes above on each taxon for references. Underlining indicates most abundant associates; parentheses () indicate minor or peripheral associates; brackets [] indicate shrubs, added in some cases to the species listed in A1. Shadings indicate concentrations. “Index of basiphily” is more refined than in A, and is calculated as mean of associate positions along the five gradient classes: 0 (low pH), 0.25, 0.5, 0.75, 1 (high pH).

B1. Soil pH-related and mesic-xeric/disturbed upland gradients.

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND	<i>Quercus myrtifolia</i> <i>Quercus laevis</i> <i>Kalmia</i> spp.	<i>Pinus palustris</i> <i>Pinus virgin./clausa</i> <i>Vaccinium</i> spp. <i>Quercus prinoides</i>	<i>Rhus copallina</i> <i>Malus</i> spp. <i>Corylus americana</i> <i>Chionanthus virgin.</i>	<i>Juniperus virginiana</i> <i>Crataegus</i> spp. <i>Prunus</i> spp. (plums) <i>Cercis canadensis</i>	<i>Sideroxylon</i> spp. <i>Crataegus</i> spp. <i>Celtis tenuifolia</i> <i>Frangula caroliniana</i>
TRANSITIONAL OPEN WOODS OR THICKETS	<i>Quercus ilicifolia</i> <i>Quercus georgiana</i> <i>Pinus rigida/serotina</i>	<i>Quercus incana</i> <i>Quercus margaretta</i> <i>Quercus marilandica</i> <i>Pinus echinata/elliottii</i>	<i>Diospyros virginiana</i> <i>Quercus stellata</i> <i>Carya tomentosa</i> <i>Sassafras albidum</i>	<i>Rhus glabra</i> <i>Robinia pseudoacacia</i> <i>Ulmus alata/crassifolia</i> <i>Q. imbricaria/phellos</i>	<i>Cornus drummondii</i> <i>Gleditsia triacanthos</i> <i>Maclura pomifera</i> <i>Q. macrocarpa/sinuata</i>
MORE OPEN SUBMESIC OR SUBXERIC	<i>Quercus arkansana</i> <i>Quercus coccinea</i> <i>Quercus montana</i> <i>Oxydendrum arboreum</i>	<i>Pinus taeda/strobus</i> <i>Ilex vomitoria</i> <i>Q. hemispae./aurifolia</i> <i>Carya pallida</i>	<i>Q. falcata/pagoda</i> <i>Quercus alba</i> <i>Quercus velutina</i> <i>Carya glabra/texana</i> <i>Cornus florida</i>	<i>Prunus serotina</i> <i>Fraxinus bilt./profun.</i> <i>Carya carolin./myrist.</i> <i>Ostrya virginiana</i> < <i>Cladrastis kentukea</i>	<i>Gymnocladus dioica</i> <i>Juglans nigra</i> <i>Quercus shumardii</i> <i>Q. muehlenbergii</i> < <i>Ulmus serotina/thom.</i>
SUBMESIC OR TRANSITION TO SUBXERIC	<i>Magnolia macro./ashei</i> <i>Rhododendron maxim.</i> <i>Tsuga caroliniana</i>	<i>Castanea dentata</i> <i>Nyssa sylvatica</i> <i>Ilex opaca</i> <i>Quercus nigra</i>	<i>Acer rubrum</i> <i>Quercus rubra</i> <i>Hamamelis virginiana</i> <i>Ilex decidua/longipes</i>	<i>Carya ovata/laciniosa</i> <i>Juglans cinerea</i> <i>Morus rubra</i> <i>Asimina triloba</i>	<i>Celtis occident./laevig.</i> <i>Aesculus glabra</i> <i>Fraxinus quadrangul.</i>
MESIC TO SUBMESIC WOODS	<i>Betula lenta/alleghen.</i> <i>Magnolia fras./pyram.</i>	<i>Magnolia acuminata</i> <i>Magnolia grandiflora</i> <i>Persea borbonia</i>	<i>Liriodendron tulipifera</i> <i>Liquidambar styracifl.</i> <i>Halesia diptera</i>	<i>Fraxinus amer./penns.</i> <i>Aesculus flava/sylvat.</i> <i>Carpinus caroliniana</i>	<i>Carya cordiformus</i> <i>Ulmus rubra</i>
MESIC WOODS	<i>Tsuga canadensis</i>	<i>Magnolia tripetala</i> <i>Halesia carolina</i>	<i>Fagus grandifolia</i> < <i>Halesia tetraptera</i>	<i>Acer saccharum/florid.</i> <i>Tilia heterophylla/car.</i>	<i>Acer nigrum/leucod.</i> <i>Tilia americana</i>

***Aster patens* var. *terranigrae*: index of basiphily = 7.8 (0/1/2/6/6)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND				<i>Juniperus virginiana</i> <i>Crataegus engelmannii</i> <i>Prunus angustifolia</i> <i>Cercis canadensis</i>	<i>Sideroxylon lycioides</i> <i>Crataegus crus-galli</i> <i>Celtis tenuifolia</i>
TRANSITIONAL OPEN WOODS OR THICKETS		<i>(Quercus marilandica)</i>	<i>(Diospyros virginiana)</i> <i>(Quercus stellata)</i>	<i>Rhus glabra</i> <i>(Ulmus alata)</i>	<i>Cornus drummondii</i> <i>Maclura pomifera</i>
MORE OPEN SUBMESIC OR SUBXERIC				<i>Fraxinus biltmoreana</i>	
SUBMESIC OR TRANSITION TO SUBXERIC					
MESIC TO SUBMESIC WOODS					
MESIC WOODS					

***Aster patens* var. *gracile*: index of basiphily = 2.7 (1/9/2/0/0)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND		<i>Pinus palustris</i> <i>Pinus virginata</i> <i>Vaccinium</i> spp. <i>Quercus elliotii</i>			
TRANSITIONAL OPEN WOODS OR THICKETS		<i>Quercus incana</i> <i>Quercus margaretta</i> <i>Quercus marilandica</i> <i>Pinus echinata</i>	<i>Diospyros virginiana</i>		
MORE OPEN SUBMESIC OR SUBXERIC	<i>Quercus montana</i>	<i>Ilex vomitoria</i>	<i>Quercus falcata</i>		
SUBMESIC OR TRANSITION TO SUBXERIC					
MESIC TO SUBMESIC WOODS					
MESIC WOODS					

***Aster patens* var. *patens*: index of basiphily = 3.5 (3/9/11/1/0)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND		<i>Pinus palustris?</i> <i>Pinus virginiana</i> <i>Vaccinium arboreum</i>	<i>Rhus copallina</i>		
TRANSITIONAL OPEN WOODS OR THICKETS		<i>Quercus marilandica</i> <u><i>Pinus echinata</i></u>	<i>Diospyros virginiana?</i> <u><i>Quercus stellata</i></u> <i>Carya tomentosa</i> <i>Sassafras albidum</i>		
MORE OPEN SUBMESIC OR SUBXERIC	<i>Quercus coccinea</i> <i>Quercus montana</i> <i>Oxydendron arbor.?</i>	<i>Pinus taeda</i> <i>Carya pallida?</i>	<i>Quercus falcata</i> <i>Quercus alba</i> <i>Quercus velutina</i> <i>Carya glabra</i> <i>Cornus florida</i>		
SUBMESIC OR TRANSITION TO SUBXERIC		<i>Castanea dentata?</i> <i>Nyssa sylvatica</i>	<i>Acer rubrum?</i>	<i>Carya ovata</i>	
MESIC TO SUBMESIC WOODS					
MESIC WOODS					

***Aster patens* var. *patentissimum*: index of basiphily = 5.4 (0/4/5/4/1)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND		<i>Vaccinium arboreum</i>	<i>Rhus copallina</i>	<i>Juniperus virginiana</i> <i>Prunus americana</i>	<i>Celtis tenuifolia</i>
TRANSITIONAL OPEN WOODS OR THICKETS		<i>Quercus marilandica?</i> <i>Pinus echinata</i>	<i>Diospyros virginiana?</i> <u><i>Quercus stellata</i></u> <i>Sassafras albidum?</i>	<i>Ulmus alata</i>	
MORE OPEN SUBMESIC OR SUBXERIC		<i>Carya texana</i>	<i>Quercus falcata?</i>	<i>Fraxinus biltmoreana</i>	
SUBMESIC OR TRANSITION TO SUBXERIC					
MESIC TO SUBMESIC WOODS					
MESIC WOODS					

***Aster georgianum*: index of basiphily = 5.0 (0/5/6/5/0)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND		<i>Pinus palustris</i> <i>Vaccinium arboreum</i>	<i>(Rhus copallina)</i>	<i>Juniperus virginiana</i> <i>Cercis canadensis</i> [<i>Hyperocum prolific.</i>]	
TRANSITIONAL OPEN WOODS OR THICKETS		<i>Quercus marilandica</i> <i>Pinus echinata</i>	<i>Quercus stellata</i>	[<i>Viburnum rafinesqu.</i>]	
MORE OPEN SUBMESIC OR SUBXERIC		<i>Pinus taeda</i>	<i>Quercus falcata?</i> <i>Quercus velutina</i> <i>Cornus florida</i>	[<i>Symphoricarpos orb.</i>]	
SUBMESIC OR TRANSITION TO SUBXERIC			[<i>Ilex longipes</i>]		
MESIC TO SUBMESIC WOODS					
MESIC WOODS					

***Aster phlogifolium*: index of basiphily = 6.1 (2/1/8/6/4)**

BROAD CLASSES OF VEGETATION	POOR ACID SOILS (pH ca 4-5) ultisols or dystrochrepts	INTERMEDIATE POOR ACID TO AVERAGE SOILS	AVERAGE SOILS (pH ca. 5-6) mixtures/transitions among soil classes	INTERMEDIATE AVERAGE TO BASE-RICH SOILS	BASE-RICH SOILS (pH ca. 6-7) alfisols, eutrochrepts or mollisols
DISTURBED OR XERIC SCRUB OR GRASSLAND				<i>Juniperus virginiana</i>	
TRANSITIONAL OPEN WOODS OR THICKETS			<i>Diospyros virginiana</i> <i>Sassafras albida</i>		
MORE OPEN SUBMESIC OR SUBXERIC	<i>Quercus coccinea</i>	<i>Pinus strobus</i>	<i>Quercus alba</i> <i>Quercus velutina</i> <i>Carya glabra</i>	<i>Prunus serotina</i> <i>Fraxinus biltmoreana</i>	<i>Q. shumardii</i> <i>Q. muehlenbergii</i>
SUBMESIC OR TRANSITION TO SUBXERIC			<i>Acer rubrum</i> <i>Quercus rubra</i>	<i>Carya ovata</i>	<i>Fraxinus quadrangul.</i>
MESIC TO SUBMESIC WOODS			<i>Liriodendron tulipifera</i>	<i>Fraxinus americana</i>	<i>Ulmus rubra</i>
MESIC WOODS	<i>Tsuga canadensis</i>			<i>Acer saccharum</i>	