USDA Natural Resources
Conservation Service

Ecological site F123XY003TN
Limestone Glades And Dry Woodlands

Last updated: 5/13/2025
Accessed: 05/21/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 123X–Nashville Basin

123—Nashville Basin
This area is entirely in Tennessee (fig. 123-1). It makes up about 5,625 square miles (14,580 square kilometers). The cities of Nashville, Franklin, Hendersonville, Columbia, Murfreesboro, and Shelbyville are in this area.

Physiography
Most of this area is in the Nashville Basin Section of the Interior Low Plateaus Province of the Interior Plains. A small part of the northeast corner and the western and southern fourth of the area are in the Highland Rim Section of the same province and division. Most of the outer part of the Nashville Basin is deeply dissected and consists of steep slopes between narrow, rolling ridgetops and narrow valleys. The inner part of the basin is dominantly undulating and rolling. In many areas the land surface is deeply pitted by limestone sinks, and outcrops of limestone are almost everywhere. Elevation generally is about 650 feet (200 meters), but it is 1,000 to 1,325 feet (305 to 405 meters) on isolated hills and is as low as 450 feet (135 meters) in some of the more deeply cut stream channels.

Geology
The bedrock geology in this area consists of Ordovician limestone exposed by geologic erosion of the top of the Nashville Dome (a high part of the Cincinnati Arch) throughout this area. Sinkholes are common in the limestone and are either open to the subsurface or are covered by soils and colluvium that have collected in the depressions formed on the land surface above the sinkhole. Younger rocks occur as a rim just outside this area. Surficial deposits include loess on the less eroded landforms and alluvium along the rivers

and streams.

Source: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the
Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Classification relationships

From NatureServe Explorer:

Scientific Name: Nashville Basin Limestone Glade and Woodland
Unique Identifier: CES202.334

Similar Ecological Systems
Unique Identifier Name: CES202.691 Central Interior Highlands Calcareous Glade and Barrens

Component Associations:
CEGL003712 *Quercus stellata* / *Viburnum rufidulum* - *Forestiera ligustrina* / *Andropogon gerardii* Woodland
CEGL003754 *Juniperus virginiana* var. virginiana - *Fraxinus quadrangulata* / *Polymnia canadensis* - (*Astranthium integrifolium*) Woodland
CEGL003938 *Juniperus virginiana* var. virginiana - *Forestiera ligustrina* - *Rhus aromatica* - *Hypericum frondosum* Shrubland
CEGL004169 Eleocharis (bifida, compressa) - Schoenolirion croceum - Carex crawei - Allium cernuum Seep Grassland
CEGL004292 Dalea foliosa - Mecardonia acuminata - Mitreola petiolata Seep Grassland
CEGL004340 Sporobolus (neglectus, vaginiflorus) - Aristida longespica - *Panicum flexile* - *Panicum capillare* Grassland
CEGL004346 *Sedum pulchellum* - Phemeranthus calcaricus - Leavenworthia spp. / Nostoc commune Limestone Glade Vegetation
CEGL005131 *Quercus muehlenbergii* - *Juniperus virginiana* / *Schizachyrium scoparium* - *Manfreda virginica* Wooded Grassland

Ecological site concept

The mapunits included in this group are shallow limestone soils and/or rock outcrop complex mapunits. Vegetation will be a mosaic of glades and dry woodlands. Future ESD development will likely result in multiple ecological sites being developed from soils in this initial PES group.

Scientific Name: Nashville Basin Limestone Glade and Woodland
Unique Identifier: CES202.334
Summary: This system encompasses a range of plant communities associated with thin

soils on flat areas of Ordovician limestone in the Nashville Basin of Tennessee (mostly inner basin, also outer basin), with a few disjunct occurrences in Kentucky. The vegetation of this system includes sparsely vegetated rock outcrops, annual Sporobolus spp.-dominated grasslands, *Schizachyrium scoparium*-dominated perennial grasslands, seasonally wet herbaceous washes and seeps, shrublands, as well as woodlands dominated by *Juniperus virginiana* and oaks. In addition, Echinacea tennesseensis and Astragalus bibullatus are completely endemic to this system. There are numerous other disjunct and near-endemic plants. (www.explorer.natureserve.org)

Associated sites

F123XY001TN	**Limestone Uplands** Limestone Uplands
F123XY002TN	**Limestone Flats** Limestone Flats

Table 1. Dominant plant species

Tree	(1) *Juniperus virginiana*
Shrub	(1) *Hypericum frondosum* (2) *Verbesina virginica*
Herbaceous	(1) *Andropogon* (2) *Sporobolus*

Physiographic features

This ecosite is found on hills, plateaus, and basins of MLRA 123. NASIS lists the unique landform positions as backslope and footslope. Unique landforms are hillside, hillslope and flats.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Flat
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	122–457 m
Slope	2–50%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Climate:
The average annual precipitation in this area is 48 to 57 inches (1,220 to 1,450 millimeters). The maximum precipitation occurs in midwinter and early in spring, and the minimum occurs in autumn. Rainfall primarily occurs during high-intensity, convective thunderstorms. Some snow occurs in winter, but it does not remain on the ground for long periods.
The average annual temperature is 56 to 60 degrees F (14 to 16 degrees C). The freeze-free period averages 210 days and ranges from 195 to 230 days. The longer freeze-free periods occur in the southern part of the area.

Source: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Table 3. Representative climatic features

Frost-free period (characteristic range)	165-173 days
Freeze-free period (characteristic range)	188-202 days
Precipitation total (characteristic range)	1,321-1,422 mm
Frost-free period (actual range)	162-174 days
Freeze-free period (actual range)	181-208 days
Precipitation total (actual range)	1,245-1,422 mm
Frost-free period (average)	169 days
Freeze-free period (average)	195 days
Precipitation total (average)	1,372 mm

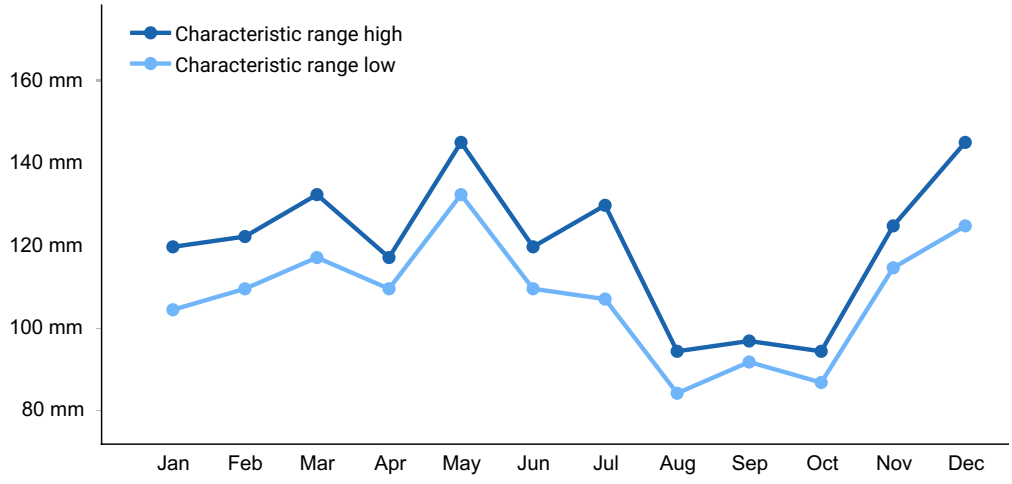

Figure 1. Monthly precipitation range

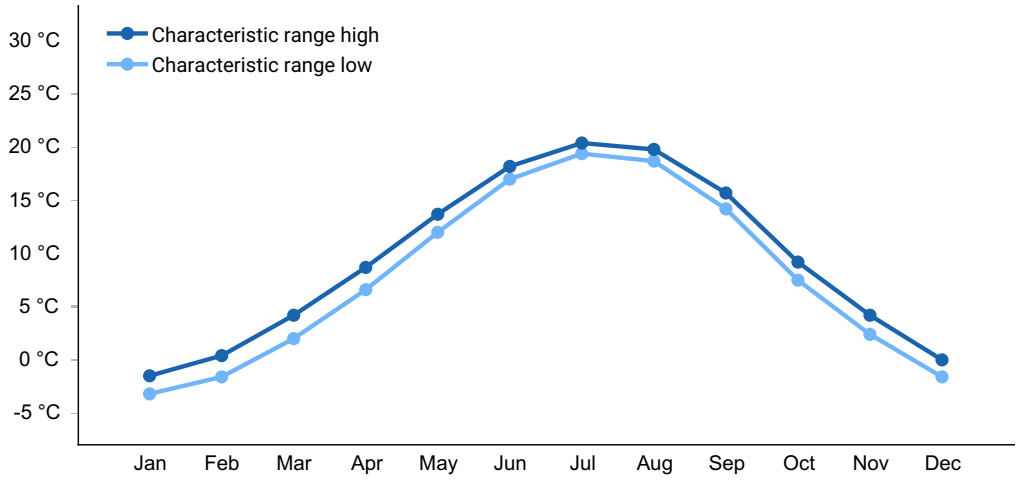

Figure 2. Monthly minimum temperature range

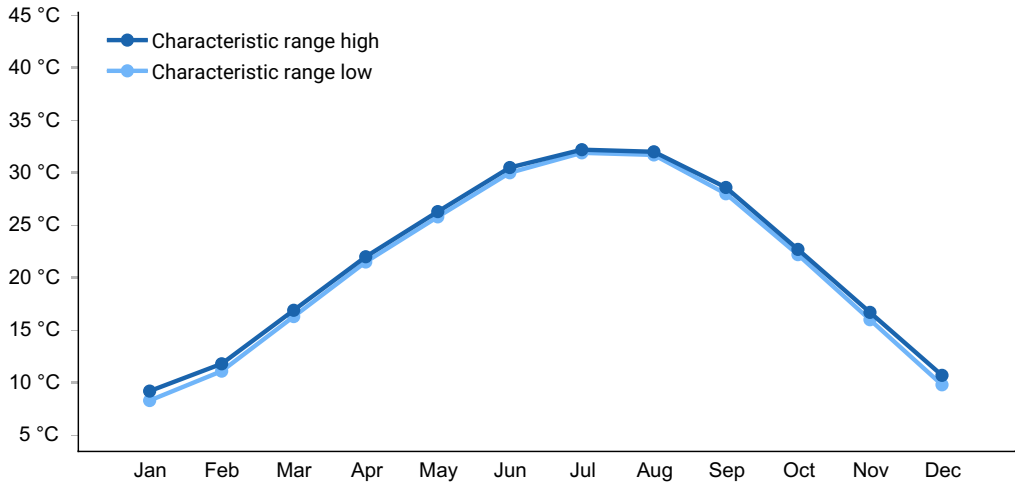

Figure 3. Monthly maximum temperature range

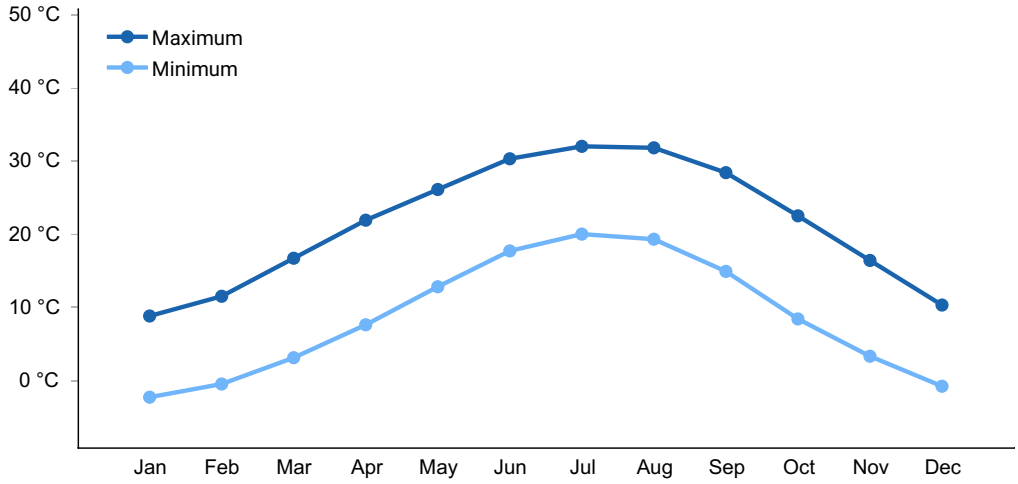

Figure 4. Monthly average minimum and maximum temperature

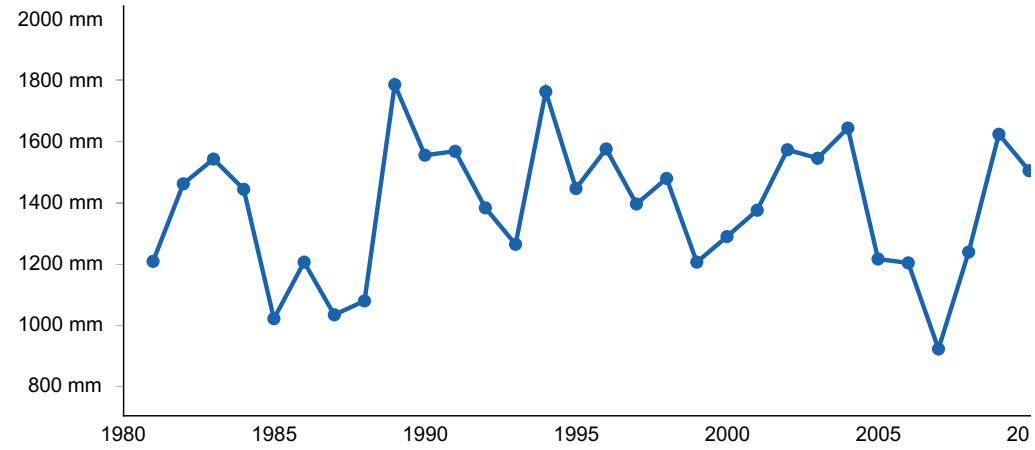

Figure 5. Annual precipitation pattern

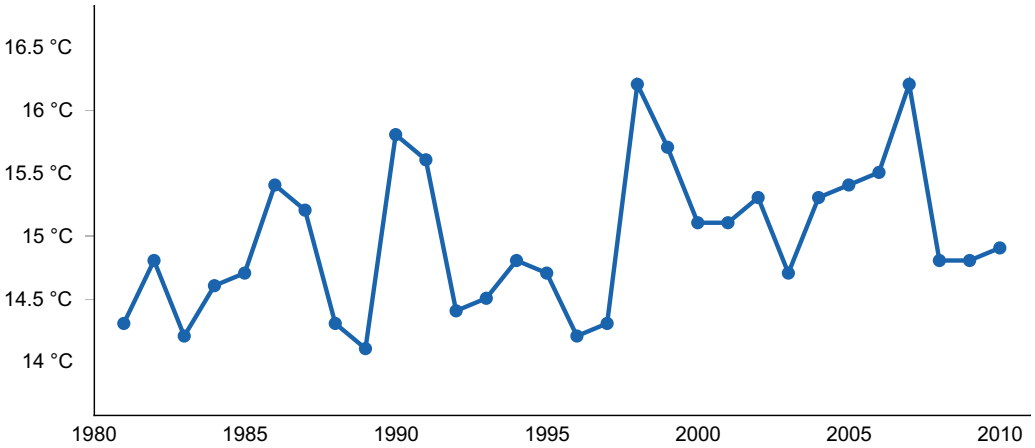

Figure 6. Annual average temperature pattern

Climate stations used

- (1) FAYETTEVILLE WTP [USC00403074], Fayetteville, TN
- (2) NASHVILLE INTL AP [USW00013897], Nashville, TN
- (3) COLUMBIA 3 WNW [USC00401957], Columbia, TN
- (4) GAINESBORO [USC00403370], Gainesboro, TN

Influencing water features

These sites have no influencing water features.

Soil features

Soils in this group are shallow to moderately deep, slow to moderate permeability and formed in residuum of limestone.

Table 4. Representative soil features

Parent material	(1) Residuum–phosphatic limestone

Surface texture	(1) Very flaggy silt loam (2) Stony silty clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderate
Soil depth	23–97 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	2–10%
Available water capacity (0-101.6cm)	2.54–10.16 cm
Calcium carbonate equivalent (0-101.6cm)	0%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.6–7
Subsurface fragment volume <=3" (Depth not specified)	0–24%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

Provisional Ecological Site (PES): F123XY003TN – Limestone Glades (and Dry Woodlands)

Major Land Resource Area (MLRA) 123

This PES describes ecological communities likely to be found on soil in the PES soil grouping. Future field work is required to develop detailed and accurate ecological site descriptions (ESDs) that can be used by conservation planners for restoration and planning activities. This PES describes hypotheses based on available data from many different sources and scales and has not been developed using site specific ecological field monitoring. Future ESD development will result in this initial PES group being split into more refined ecological communities.

Soil series currently included in this project are

Forest Vegetation as listed in Official Series Descriptions (OSDs):

Gladeville: Most areas are in forest consisting chiefly of redcedar and a few scattered hackberry, hickory, ash, sumac, and winged elm. Prickly pears and lichens are common on most areas with grasses in openings.

Barfield: original hardwood trees consisting chiefly of oak, hickory, red cedar, elm, maple, and redbud.

Dilton: About 50 percent has been cleared of original hardwood trees consisting chiefly of oak, hickory, red cedar, elm, maple, and redbud. Most of the cleared areas are used for pasture. (2003)

Talbott: Originally hardwoods, chiefly oak, hickory, elm, maple, and redcedar.
(Talbott mapunits in this PES group are Talbott- rock outcrop and Talbott very rocky mapunits)

Trees listed for PES map units in the USDA-NRCS Tennessee County Soil Surveys include eastern red cedar, southern red oak, loblolly pine, pignut hickory, and hackberry.

Ecological Dynamics
This PES describes shallow, rocky limestone woodlands and glade communities on mapunits in the Nashville Basin of Tennessee. There are multiple zonal components on these landscapes. Variations in plant composition on these sites ranging from grass glades to dry woodlands to dry and dry-mesic oak forests. True edaphic glades are small acreage areas and may transition into cedar woodlands and dry oak forest communities. These shallow and rocky sites form a mosaic of unique plant communities on the landscape and plant communities on these mapunits will vary depending on aspect, soil depth, seed sources, management, disturbance history, fire regime, micro-topography and rock content. Future field work is required to develop a full ecological site description (ESD) and accurate plant community phases to support future conservation planning. Multiple MLRA 123 dry woodland, forest and glade communities have been identified by NatureServe for the Nashville Basin and detailed information is available at http://explorer.natureserve.org/index.htm. A summary of pertinent NatureServe Associations possible for rocky/shallow limestone soils is described at the end of this document. Multiple ESDs may result from this initial PES grouping.

State 1, Phase 1.1:
Plant species dominants: eastern redcedar (*Juniperus virginiana*) / cedarglade St. Johnswort (*Hypericum frondosum*) - white crownbeard (*Verbesina virginica* L.) / Andropogon spp. (bluestem) – Sporobolus spp. (dropseed)

The shrub layer may be variable and include fragrant sumac (*Rhus aromatica*), smooth sumac (*Rhus glabra*), winged sumac (*Rhus copallinum*), winged elm (*Ulmus alata*), coral berry *Symphoricarpos orbiculatus*, blue ash (*Fraxinus quadrangulata*), and rusty blackhaw

(*Viburnum rufidulum*. The herbaceous layer may vary greatly depending on soil depth, rock content, aspect, and disturbances. Detailed descriptions of probable NatureServe associations for these sites are included at the end of this narrative.

State 2. Pastureland
Phase 2.1: Managed Pasture.
Plant species dominants: *Schedonorus arundinaceus* (tall fescue)

Some mapunits in this group may be appropriate for managed pasture. Some of the mapunits in this group are too rocky and shallow to support a productive pasture or crops. The pasture state is included in this initial PES until field work can be conducted to better delineate mapunits into different ESDs.

The following are association descriptions taken directly from http://explorer.natureserve.org/

Classification Approach: International Vegetation Classification (IVC)

Unique Identifier: CEGL003754
Juniperus virginiana var. virginiana - *Fraxinus quadrangulata* / *Polymnia canadensis* - (*Astranthium integrifolium*) Woodland
Translated Name: Eastern Red-cedar - Blue Ash / White-flower Leafcup - (Entireleaf Western-daisy) Woodland. Common Name: Red-cedar - Blue Ash Limestone Woodland

Summary: This woodland community is found on shallow soils of limestone slopes in the Central Basin and Cumberland Plateau escarpment of Tennessee and the Moulton Valley of Alabama; it may occur in association with limestone glades, on isolated eroded limestone knobs, on limestone ridges in the Highland Rim escarpment, or as a small patch within a matrix of dry to dry-mesic limestone oak forest (e.g., *Quercus alba* - *Quercus rubra* - *Quercus muehlenbergii* / *Cercis canadensis* Forest (CEGL002070) or *Quercus muehlenbergii* - *Quercus shumardii* - Carya (carolinae-septentrionalis, ovata) Forest (CEGL007808)). *Fraxinus quadrangulata* and *Juniperus virginiana* var. virginiana dominate the canopy and the subcanopy, but the composition of these strata may vary. Juniperus may share canopy dominance with the Fraxinus or other deciduous trees or it may be present as a distinct subcanopy. Quercus spp. do not dominate the relatively short canopy or the open subcanopy, either of which may include *Celtis laevigata*, *Celtis occidentalis*, *Cercis canadensis*, *Ulmus alata*, and *Ulmus serotina*. The shrub stratum may include *Quercus muehlenbergii*, *Forestiera ligustrina*, *Rhus aromatica*, *Symphoricarpos orbiculatus*, *Frangula caroliniana*, *Hypericum frondosum*, and *Viburnum rufidulum*. Vines may include *Bignonia capreolata* and *Smilax rotundifolia*. Herbs which may be present include *Polymnia canadensis* (= var. radiata), *Symphyotrichum shortii* (= Aster shortii), *Astranthium integrifolium*, *Sedum pulchellum*, *Minuartia patula* (= Arenaria patula), *Verbesina virginica*, *Opuntia humifusa*, *Commelina erecta* var. angustifolia, *Croton monanthogynus*, *Ruellia humilis*, and *Euphorbia dentata*. The 'herbaceous' stratum in

some examples may contain greater coverage of ferns (*Cheilanthes lanosa*, *Pellaea atropurpurea*), mosses (e.g., *Pleurochaete squarrosa*, *Thuidium delicatulum*, *Climacium americanum*), and foliose lichens (Cladonia spp.) than of flowering herbs. Scattered individuals of the near-endemic legume *Astragalus tennesseensis* may be found in some examples adjacent to glades. This woodland develops on rocky sites, which contain outcrops of Ordovician (or Mississippian) limestone. Soils primarily accumulate in fissures between the limestone. The exotics *Ailanthus altissima* and *Lonicera maackii* may invade examples of this vegetation in the vicinity of Nashville, Tennessee.

Global Status: G3 (13Dec1999) Rounded Global Status: G3 - Vulnerable
Reasons: This vegetation has a naturally restricted range of distribution, being limited to dry limestone rocky areas in central Tennessee, northern Alabama, and related areas of Kentucky. This association occurs on lands which are intermediate in soil depth and available moisture between hardwood forests and glade/barren environments. These areas are very slow to succeed to forest and maintain a Juniperus-dominated aspect. Most examples seen are limited in extent and restricted to a particular habitat type. The effect of fire on this association is not known; some examples are on isolated knobs or on slopes where fire might have been less frequent than in flatter areas.

Unique Identifier: CEGL003938
Juniperus virginiana var. virginiana - *Forestiera ligustrina* - *Rhus aromatica* - *Hypericum frondosum* Shrubland
Translated Name: Eastern Red-cedar - Upland Swamp-privet - Fragrant Sumac - Cedar Glade St. John's-wort Shrubland
Common Name: Southern Limestone Glade Margin Shrubland

Summary: This shrubland is a zonal component of Central Basin (Tennessee) limestone cedar glades. It is also found on limestone outcrops of the Alabama Cumberland Plateau and Moulton Valley glade systems, and as a component of cedar glade complexes at Chickamauga-Chattanooga National Military Park. It also occurs on the Pennyroyal Karst Plain of Kentucky. Alabama and Kentucky occurrences are rare and of restricted distribution and limited extent. The substrate consists of broken fragments of flat-bedded sedimentary limestone, with accumulations of shallow soil. Characteristic shrubs include *Juniperus virginiana* var. virginiana, *Rhus aromatica* var. aromatica, *Frangula caroliniana*, *Forestiera ligustrina*, *Berchemia scandens*, *Hypericum frondosum*, *Sideroxylon lycioides*, and stunted individuals of *Acer saccharum*, *Quercus muehlenbergii*, *Quercus shumardii*, *Fraxinus americana*, and *Ulmus alata*. Alabama occurrences may contain an occasional *Aesculus pavia*. A low 'herbaceous' stratum is dominated by *Cheilanthes lanosa*, *Pleurochaete squarrosa*, *Thuidium delicatulum*, *Climacium americanum*, Cladonia spp., and *Opuntia humifusa*. Typically grades into open, herbaceous-dominated glades, or into woodlands or forests commonly dominated by *Quercus muehlenbergii*, *Fraxinus americana*, and *Celtis laevigata*.

Global Status: G3G4 (31Jan2007). Rounded Global Status: G3 - Vulnerable

Reasons: This vegetation type is restricted to dry limestone substrates in the Nashville Basin of Tennessee and related areas of Alabama, Georgia and Kentucky. Although this shrubland type can be dominant at some extensive glade sites and is more stable than some other glade communities, its overall coverage of the landscape is limited, and it is threatened by development and land-use conversion in this area of rapidly increasing human population. Examples which are not conserved on national parks, nature preserves, state forests, or Army Corps of Engineers lands are highly vulnerable to development pressure. This shrub zone does not typically provide habitat for rare plant species, but it is an important component of this threatened landscape. Alabama, Georgia and Kentucky examples are rare and limited in extent.

Unique Identifier: CEGL003712
Quercus stellata / *Viburnum rufidulum* - *Forestiera ligustrina* / *Andropogon gerardii* Woodland
Translated Name: Post Oak / Rusty Blackhaw - Upland Swamp-privet / Big Bluestem Woodland
Common Name: Nashville Basin Post Oak Woodland
Classification Approach: International Vegetation Classification (IVC)

Summary: This woodland is restricted to the Inner Nashville Basin of Tennessee, where it occurs in association with Limestone Cedar Glades, in deeper soils than those of the annual grass zone. The prevalent tree is *Quercus stellata*. The open subcanopy may contain *Juniperus virginiana* var. virginiana. Shrubs include *Forestiera ligustrina*, *Hypericum frondosum*, *Rhus aromatica*, and *Viburnum rufidulum*. Fire suppression in these sites may lead to dense undergrowth of Juniperus.

Graminoids present may include *Andropogon gerardii* and/or *Schizachyrium scoparium*. Some other herbaceous species include *Baptisia australis* var. aberrans (= Baptisia minor var. aberrans), *Comandra umbellata*, *Eryngium yuccifolium*, *Hypoxis hirsuta*, *Lithospermum canescens*, *Parthenium integrifolium*, and *Viola pedata*.

The state-listed *Echinacea simulata*, *Liatris cylindracea*, and *Polygala boykinii* are also found here.

Global Status: G2? (31Dec1997) Rounded Global Status: G2 - Imperiled
Reasons: This oak woodland is restricted to the Inner Nashville Basin of Tennessee, where it occurs in association with Limestone Cedar Glades, in deeper soils than those of the annual grass zone. Few examples of this highly ranked association have been reported, and these are limited in extent. Many deeper soil areas of the Nashville Basin have been cleared of trees, pastured or cropped, and then allowed to succeed to shrub thicket or forest. Fire suppression in these sites may lead to dense undergrowth of Juniperus. Most of those occurrences which have not been destroyed are severely degraded.

Unique Identifier: CEGL004340
Sporobolus (neglectus, vaginiflorus) - Aristida longispica - *Panicum flexile* - *Panicum capillare* Grassland
Translated Name: (Barrens Dropseed, Poverty Dropseed) - Slimspike Three-awn - Wiry Panicgrass - Witchgrass Grassland
Common Name: Limestone Annual Grass Glade
Classification Approach: International Vegetation Classification (IVC)

Summary: This annual herbaceous community is a zonal component of Nashville Basin (Tennessee) and Moulton Valley (Alabama) Limestone Cedar Glades. Much of this vegetation is a mixture of annual grasses and perennial forbs, with enormous seasonal variation in dominance. Additional associations may be named. Relations with related vegetation in other ecoregions needs further investigation. Stands are dominated by *Sporobolus neglectus*, *Sporobolus vaginiflorus* var. vaginiflorus, and/or *Sporobolus vaginiflorus* var. ozarkanus (= Sporobolus ozarkanus). Some of the co-occurring forbs are the endemic or near-endemic *Dalea gattingeri* and *Pediomelum subacaule*, along with *Croton capitatus*, *Grindelia lanceolata*, Hedyotis nigricans var. nigricans, *Heliotropium tenellum*, Isanthus brachiatus, *Manfreda virginica*, and *Ruellia humilis*. *Dalea gattingeri* is present in most examples of this vegetation type. *Grindelia lanceolata* has become abundant in some examples; this may merit recognition as an association, or it may be a symptom of disturbance.

Global Status: G3 (20Dec2000) Rounded Global Status: G3 - Vulnerable
Reasons: This annual herbaceous community is restricted to the Nashville Basin (Tennessee) and Moulton Valley (Alabama) Limestone Cedar Glades. It may cover large parts of some glade sites. Succession is limited on the thin soils on which this type is found, so it is relatively stable. However, its overall coverage of the landscape is limited, and it is threatened by development and land-use conversion in areas of rapidly increasing human population (e.g., the Nashville Basin). Threats include destruction by recreational off-road vehicle traffic, gravel and mineral surface mining, and land-use change related to suburban development. It is restricted to the Inner Nashville Basin subsection of Tennessee and a few limited areas of Alabama and Kentucky. Examples which are not conserved on nature preserves, state forests, national forests, or U.S. Corps of Engineers lands are highly vulnerable to development pressure.

Unique Identifier: CEGL005131
Quercus muehlenbergii - *Juniperus virginiana* / *Schizachyrium scoparium* - *Manfreda virginica* Wooded Grassland
Translated Name: Chinquapin Oak - Eastern Red-cedar / Little Bluestem - False Aloe Wooded Grassland
Common Name: Central Limestone Glade
Classification Approach: International Vegetation Classification (IVC)

Summary: This limestone glade or barrens community is found in the central and eastern United States. Stands occur on gentle to steep slopes of hills, knobs, ridges, bluffs along streams, and broad terraces. Aspect is variable, but this vegetation is generally best developed on southern and western exposures. Parent material is limestone, cherty limestone, dolomite, or calcareous shale which is exposed at the surface, resulting in a very shallow, well-drained substrate. Soils are neutral to alkaline, shallow to moderately deep, and contain a homogenous mixture of rock fragments of various sizes. Herbaceous cover is very uneven, ranging from very dense in some areas to absent in others. Some dominant or characteristic grasses include *Schizachyrium scoparium*, *Sorghastrum nutans*, Aristida spp., and *Sporobolus compositus*. In deeper soil areas *Andropogon gerardii* may be present. At some sites *Bouteloua curtipendula* is present, but it may be rare or absent at others. Forbs vary in dominance by site. *Quercus muehlenbergii* and *Juniperus virginiana* var. virginiana can form a sparse canopy. *Quercus stellata* may be common in parts of the range. Other scattered trees which may be present include *Cercis canadensis*, *Fraxinus quadrangulata*, *Quercus velutina*, *Quercus alba*, *Quercus marilandica*, and *Liriodendron tulipifera*. The subcanopy is absent or very sparse. Commonly encountered shrubs include *Celtis tenuifolia*, *Cornus florida*, *Ulmus alata*, *Rhus aromatica*, *Rhus copallinum*, and *Symphoricarpos orbiculatus*. This vegetation may exist as more extensive areas, or in some southeastern cases, it may be limited to a more narrow zone between vegetation dominated by woody plants and that dominated by annual grasses.

Global Status: G2G3 (02Nov1999) Rounded Global Status: G2 - Imperiled
Reasons: There are probably over 100 occurrences range wide. Eighty-three have been documented: 32 in Illinois (S2), 48 in Indiana (S2S3), and 3 in Ohio (S2). Although no other occurrences are documented, the community is also reported in Alabama, Georgia, Kentucky, Tennessee, West Virginia, and Virginia (all S?). It is found in 15 ecoregional subsections. The present range of this community is probably very close to its pre-settlement range, but lack of fire permits increased dominance by woody species.

State and transition model

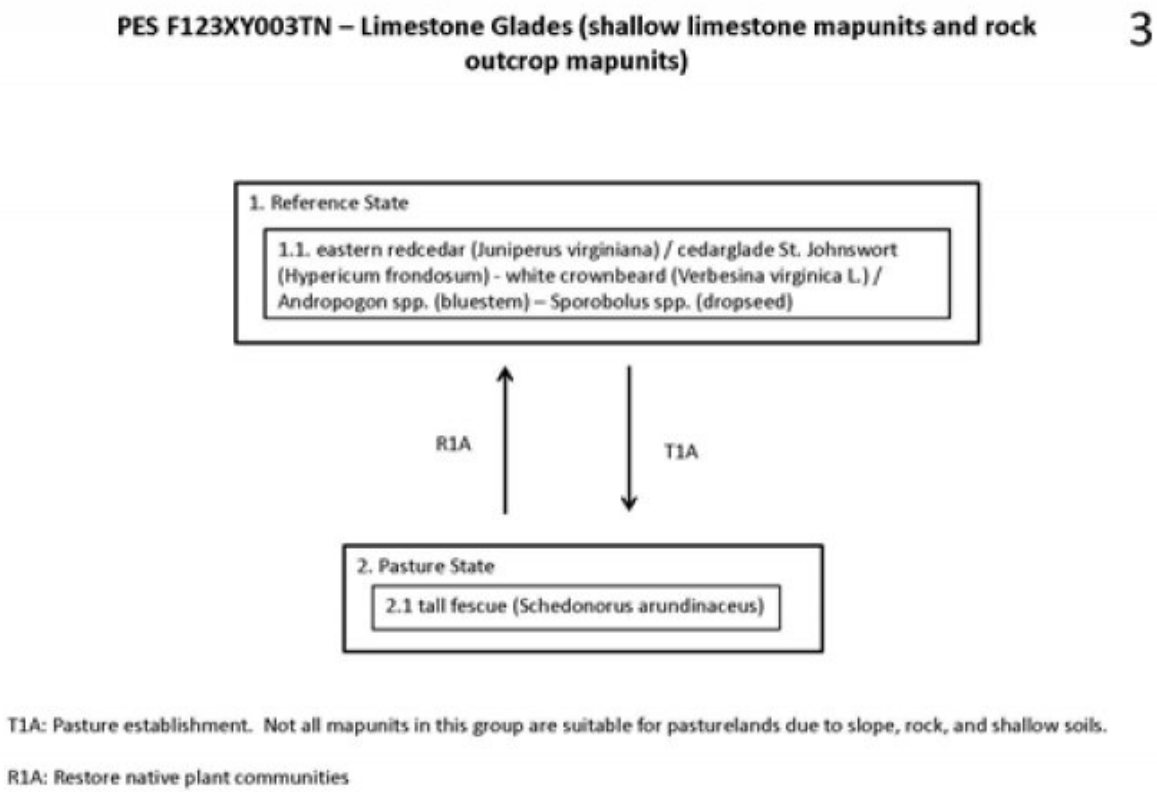

Figure 7. Limestone Glades (shallow and/or rock outcrop mapu

Inventory data references

Site Development and Testing Plan
Future work is needed, as described in a future project plan, to validate the information presented in this provisional ecological site description. Future work includes field sampling, data collection and analysis by qualified vegetation ecologists and soil scientists. As warranted, annual reviews of the project plan can be conducted by the Ecological Site Technical Team. A final field review, peer review, quality control, and quality assurance reviews of the ESD are necessary to approve a final document.

Other references

Abrams, M.D. 1992. Fire and the development of oak forests. BioScience, 42: 346–353.

Abrams, M.D. and G.J.Nowacki. 2008. Native Americans as active and passive promoters of mast and fruit trees in the eastern USA. The Holocene 18.7. pp. 1123-1137.

Alexander, H.D. and M.A. Arthur, D.L. Loftis, and S.R. Green. 2008. Survival and growth

of upland oak and co-occurring competitor seedlings following single and repeated prescribed fires. Forest Ecology and Management 256: 1021–1030.

Anderson, Michelle D. 2003. *Juniperus virginiana*. In: Fire Effects Information System, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, and Fire Sciences Laboratory.

Anderson, R.C. & Brown, L.E. 1983. Comparative effects of fire on trees in a Midwestern savannah and an adjacent forest. Bulletin of the Torrey Botanical Club, 110: 87–90.

Baskin, J.M., C.C. Baskin, and E.W. Chester. 1994. The Big Barrens of Kentucky and Tennessee: Further observations and considerations. Castanea 59:226-254.

Black, B.A., Abrams, M.D. 2001. Influence of Native Americans and surveyor biases on metes and bounds witness tree distribution. Ecology. 82:2574-2586.

Braun, E.L. 1950. Deciduous forests of Eastern North America. Blakinston Co., Pennsylvania. Reprinted in 2001 by Blackburn Press, Caldwell, New Jersey.

Carmean. W.H. 1970. Site quality for eastern hardwoods. The silviculture of oaks and associated species. USDA Forest Service Research paper, Northeast. Forest Exp. Sta., Upper Darby, PA, NE-144: 36-56.

Carmean, W.H. 1971. Soil-site relationships of the upland oaks. Oak Symp. Proc. USDA Forest Service Research Paper. Northeast. Forest Exp. Sta., Upper Darby, PA. p. 23-29.

Carmean, Willard H.; Hahn, Jerold T.; Jacobs, Rodney D. 1989. Site index curves for forest species in the eastern United States. Gen. Tech. Rep. NC-128. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne,
M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia.

Curtis, J. T., 1959. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Virginia. .

Denevan, W.M. 1992. The pristine myth: the landscape of the Americas in 1492. Annals of the Association of American Geographers, 82 (3), 369–385.

DeSelm, H. R. 1994. Tennessee barrens. Castanea 59(3):214-225.

Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA. 61 pp. + appendix (705 pp.).

Fenneman, N.M. 1917. Physiographic subdivisions of the United States. Proceedings of the National Academy of Sciences of the United States of America. Vol. 3(1). pp. 17 -22.

Gleason, H.A. and A. Cronquist. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd edition. The New York Botanical Garden, Bronx.

Griffith, G. E., J. M. Omernik, and S. H. Azevedo. 1998. Ecoregions of Tennessee. (Two-sided color poster with map, descriptive text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:940,000.

Kartesz, J.T., The Biota of North America Program (BONAP). 2011. North American Plant Atlas (http://www.bonap.org/MapSwitchboard.html). Chapel Hill, N.C. [maps generated from Kartesz,
J.T. 2010. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP). (in press)].

Keever, C. 1978. A study of the mixed mesophytic, western mesophytic, and oak chestnut regions of the eastern deciduous forest including a review of the vegetation and sites recommended as potential natural landmarks. Millersville State College, Pennsylvania.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. Spec. Publ. 36 New York, NY: American Geographical society.

Land Resource Regions and Major Land Resource Areas of the United States. United States Department of Agriculture Soil Conservation Service Handbook 296. Dec. 1981. 87-88.

Landfire [Landfire National Vegetation Dynamics Database]. 2007a. Landfire National Vegetation Dynamics Models. Landfire Project, USDA Forest Service, U.S. Department of Interior. (January - last update)

Lawless, P. J., Baskin, J. M. and C. C. Baskin. 2006. Xeric Limestone Prairies of Eastern United States: Review and Synthesis. The Botanical Review 73(4): 303–325. The New York Botanical Garden.

Lunt, I.D. & Spooner, P.G. 2005. Using historical ecology to understand patterns of biodiversity in fragmented agricultural landscapes. Journal of Biogeography, 32:1859–1873.

McNab, W.H. and P.E. Avers. 1994. Ecological subregions of the United States. U.S.

Forest Service. Prepared in cooperation with Regional Compilers and the ECOMAP Team of the Forest Service.

Miller, J.H., Chambliss, E.B. and Loewenstein, N.J. 2010. A field guide for the Identification of Invasive Plants in Southern Forests. US Forest Service Southern Research Station, General Technical Report SRS-119.

Parker, G.R. 1989. Old-growth forests of the Central Hardwood Region. Nat. Areas J. 9(1): 5-11.

Quarterman, E. and R.L. Powell. 1978. Potential ecological/geological natural landmarks on the Interior Low Plateaus. pp. 7-73. U.S. Department of the Interior, Washington, D.C. Quarterman,

Stritch, L.R. 1990. Landscape-scale restoration of barrens-woodland within the oak-hickory forest mosaic. Restoration & Management Notes 8: 73-77.

Somers, P., L. R. Smith, P. B. Hamel, and E. L. Bridges. 1986. Preliminary analyses of plant communities and seasonal changes in cedar glades of middle Tennessee. ASB Bulletin 33:178-192.

U.S. Department of Agriculture (USDA), Natural Resources Conservation Service. Soil surveys of Tennessee counties in MLRA 123.

U.S. Department of Agriculture-Forest Service, Agriculture Handbook 654, Silvics of North America.

Zollner, D., M.H. MacRoberts, B.R. MacRoberts, & D. Ladd. 2005. Endemic vascular plants of the Interior Highlands, U.S.A. Sida 21:1781-1791.

Websites:

Cleland, D. T., J. A. Freeouf, J. E. Keys, Jr., G. J. Nowacki, C. A. Carpenter, and W. H. McNab. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States.
GTR-WO-76C-1. http://fsgeodata.fs.fed.us/other_resources/ecosubregions.html

Ecosystem classification of the United States; Ecological Subregions of the United States.1994. Compiled by W. Henry McNab, Peter E. Avers, et al. Forest Service, U.S. Department of Agriculture [USDA], Washington, DC., USA: http://www.fs.fed.us/land/pubs/ecoregions

Environmental Mapping and Assessment Program (EMAP). 2004. Washington, DC., USA:

http://www.epa.gov/docs/emap/

Geospatial Data Gateways: https://gdg.sc.egov.usda.gov/

Landfire: http://www.landfire.gov

NatureServe. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. http://www.natureserve.org/explorer

Nashville Basin Limestone Glade and Woodland, Ecological System Comprehensive Report
http://http://explorer.natureserve.org/servlet/NatureServe?searchSystemUid=ELEMENT_GLOBAL.2.723170

Official Soil Series Descriptions, USDA-NRCS:
https://soilseries.sc.egov.usda.gov/osdname.asp

Silvics of North America, US Forest Service.
http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

USDA Plants: http://plants.usda.gov/java/

U.S. Geological Survey (USGS), Center for Biological Informatics (CBI) 2004. U.S. Department of the Interior: http://biology.usgs.gov/cbi

Vascular Plant Image Library: http://botany.csdl.tamu.edu/FLORA/imaxxara.htm

Vegetation Mapping Program, National Vegetation Classification Standard. 2004. Vegetation Classification Standard, Vegetation Subcommittee, U.S. Geological Survey [USGS; U.S. Department of the Interior], Reston, Virginia, USA.
http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation

Vegbank: www.vegbank.org

Web Soil Survey, USDA-NRCS: http://websoilsurvey.nrcs.usda.gov/app/

Woodland Wildflowers of Illinois:
http://www.illinoiswildflowers.info/woodland/woodland_index.htm

U.S. Department of Agriculture, Forest Service. 1994. Ecosystem classification of the United States; Ecological Subregions of the United States. Compiled by W. Henry McNab, Peter E. Avers, et al., Washington, DC. http://www.fs.fed.us/land/pubs/ecoregions

U.S. Department of the Interior. 2004. Vegetation Mapping Program, National Vegetation

Classification Standard. http://biology.usgs.gov/npsveg

U.S. Geological Survey (USGS), Center for Biological Informatics (CBI) 2004. U.S. Department of the Interior. http://biology.usgs.gov/cbi

Approval

Matthew Duvall, 5/13/2025

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/21/2025
Approved by	Matthew Duvall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

   _____

2. **Presence of water flow patterns:**

   _____

3. **Number and height of erosional pedestals or terracettes:**

   _____

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

---

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

---

17. **Perennial plant reproductive capability:**
