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Conservation Assessment
for
Sullivant's coneflower (*Rudbeckia fulgida* var. *sullivantii* [C. L. Boynt. and Beadle] Cronq.)

USDA Forest Service, Eastern Region

October 1, 2004

Shawnee National Forest
Hoosier National Forest

Brenda Molano-Flores
Illinois Natural History Survey
Center for Wildlife and Plant Ecology
607 E. Peabody Dr.
Champaign, IL 61820

Technical Report 2005(2)

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This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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EXECUTIVE SUMMARY

The National Forest Management Act and U. S. Forest Service policy require that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range within a given planning area (FSM 2670.5.22).

In addition to the above mandate the Forest Service has to protect species listed as endangered or threatened under the Endangered Species Act (ESA), species of Concern by U.S. Fish and Wildlife Service, and species designated as Regional Forester's Sensitive Species (RFSS) based on Global/National ranks and/or risk evaluation. The Eastern Region of the Forest Service (R9) updated its Sensitive Species list on February 29, 2000 (list maintained as of October 20, 2003). Part of that process included identification of priority species for further study by the development of Conservation Assessments and Strategies.

Rudbeckia fulgida var. *sullivantii*, one of these RFSS, occurs within the proclamation boundaries of the Eastern Region (R9) National Forests, which includes 20 states and 15 National Forests. The states included are Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin. The National Forests included are the Allegheny, Chequamegon/Nicolet, Chippewa, Green Mountain/Finger Lakes, Hiawatha, Hoosier, Huron-Manistee, Mark Twain, Midewin (National Tallgrass Prairie), Monongahela, Ottawa, Shawnee, Superior, Wayne, and White Mountain. This conservation assessment will concentrate on these states and National Forests, but particular emphasis will be given to Illinois and Indiana where the Shawnee and Hoosier National Forests are found.

The main objective of this conservation assessment is to present information on the taxonomy, life history, habitat, distribution, global and national status, population viability, and potential threats for *Rudbeckia fulgida* var. *sullivantii*. All the information presented here is the result of literature searches and reviews, examination of herbarium specimens, and personal and written communication with botanists from universities, herbaria, and state/federal agencies. The ultimate goal of this conservation assessment is to provide the available background information needed to prepare a subsequent conservation strategy for *Rudbeckia fulgida* var. *sullivantii*.

ACKNOWLEDGEMENTS

I would like to thank Steve Hill for his advise in the preparation of this document and for providing contact information. John Taft for gathering data from the Shawnee National Forest Herbarium and Mary Ann Feist, Lynne Elrick-Scott, and John Taft for editorial comments. Lynne Elrick-Scott provided photos and data on the species. Also, I want to thank the State Natural Heritage and Forest Service biologists for species information.

I would like to give special thanks to all the herbarium curators (see list of contact people) for the information that they provided about the species. Without their contributions, this report would be lacking a lot of habitat and state distribution information. Their contributions to this report should be a reminder of why herbaria should be supported.

Finally, many photos and maps have been used in this report to describe the species and to provide species distribution information, among other things. Web pages have been cited at the end of the report to acknowledge their use and the name of the photographers.

NOMENCLATURE AND TAXONOMY

Family: Asteraceae

Scientific Name: *Rudbeckia fulgida* var. *sullivantii* (C. L. Boynt. and Beadle) Cronq.

Common Names: Sullivant's coneflower, Sullivant's orange coneflower, showy black-eyed Susan, showy coneflower, orange coneflower.

Synonomy: *Rudbeckia fulgida* Aiton, *Rudbeckia speciosa* Wender., *Rudbeckia sullivantii* C. L. Boynt. and Beadle, *Rudbeckia deamii* Blake, *Rudbeckia fulgida* var. *speciosa* (Wender.) Perdue[1], *Rudbeckia speciosa* var. *sullivantii* (C. L. Boynt. and Beadle) B. L. Rob.

USDA Plants Code: RUFUS

The genus *Rudbeckia* was named after Olof Rudbeck the Elder (1630-1702) and Olof Rudbeck the Younger (1660-1740), by Swedish botanist Carolus Linnaeus (1707-1778). Both were professors of medicine at Uppsala University and had a great interest in botany. The elder Olof founded the Linnaean Garden in Uppsala. The species name *fulgida* means "resplendent or gleaming". The variety, *sullivantii*, was named after the botanist William Starling Sullivant (1803-1873), who was born in Ohio and was first to describe many native plants of central Ohio (W1).

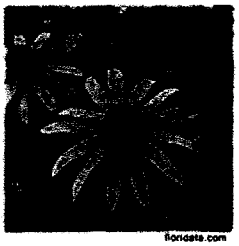
[1] It should be mentioned that the nomenclature and taxonomy of this variety are to some extent an unresolved issue since some states and Natural Heritage Programs call the variety *Rudbeckia fulgida* var. *speciosa* and some states such as Michigan do not recognize any of the varieties of *Rudbeckia fulgida*. It should be noted that the Integrated Taxonomic Information System (online database) and International Plant Name Index (2004) consider *Rudbeckia fulgida* var. *sullivantii* a valid taxonomical name. Only information that has been confirmed to be a true synonym has been considered.

DESCRIPTION OF SPECIES

Rudbeckia fulgida var. *sullivantii* is a stoloniferous perennial plant approximately 3-10 dm tall. This species has alternate leaves that are lanceolate to

ovate with sharply dentate margins (although sometimes shallowly serrate to crenate-serrate or almost entire), and a rounded to subcordate base. The leaf venation is pinnate although it can also be parallel. All leaves of *Rudbeckia fulgida* var. *sullivantii* have a crisp leathery texture and can easily rip or crack.

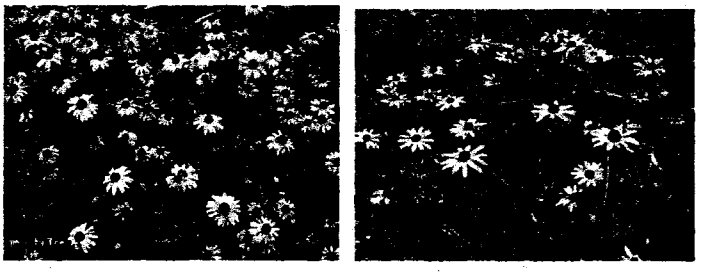
Rudbeckia fulgida var. *sullivantii* blooms from mid-July to the end of September. Each plant has several terminal inflorescences with long peduncles. The receptacle is conic with receptacular bracts that are obtuse or acute, smooth or more or less ciliolate margined, and rarely with a few appressed hairs on the back. There are between 8-21 sterile ray flowers with yellow ligules from 2.5-4.0 cm long. The tips of the ray flowers turn a paler yellow as they get older. Disk flowers are perfect. The base of the corolla is whitish with a dark brown to purple apex. Each flower has five dark brown to purple stamens with yellow to orange pollen and white filaments. The style is white at the base with a dark brown to purple stigma. In addition, the style is exserted, bifurcate, and glabrous. The achenes are more or less quadrangular and glabrous. The pappus consists of a minute short crown usually toothed on the angles. The chaff bracts partially enfold the achenes, which are not spinescent but sometimes awn-pointed. This species has a chromosome number of 38 (2n) (W2, Gleason and Cronquist 1991).



Rudbeckia fulgida var. *sullivantii* has a cultivated form known as "Goldsturm". This cultivar is an upright, rhizomatous, clump-forming perennial that can reach 8-9 dm in height when in bloom. The large inflorescences can be 7.5-10 cm across with deep yellow ray flowers and dark brownish-black center disk flowers. The flower rays of the cultivar can be slightly longer than the wild type ranging from 2.5-5 cm long. Inflorescences appear singly on stiff, branching stems in a prolific, long-lasting bloom from mid July to October. The leaves are lanceolate to ovate and dark green. "Goldsturm" is said to grow best in well-drained, consistently moist soils, but will tolerate clay soils and mild droughts (W3).

This cultivar has a European origin. Initially, the Botanical Garden of the University of Graz in Austria received seed from the United States, and provided some to the Gebrueder Schuetz's nursery in the Czech Republic (W4). Heinrich Hagemann (headgardener of the Karl Foerster's nursery at the time) noticed the plant and brought them to Karl Foerster's nursery in Potsdam, Germany in 1937 where it was propagated (W5). It was not until 1949 that this cultivar was first introduced worldwide. It was originally selected for uniform bloom height and bloom time (Roy Diblik pers. comm.), although it is believed that Karl Foerster never made a single selection (W4). "Goldsturm" was brought back to the United States between the 60's and the 80's where perennial grower Kurt Bluemel in Baldwin, Maryland and landscape architect Wolfgang

Oehme in Washington D.C. aided in the popularization of this cultivar (W6). Finally this cultivar was selected as the perennial plant of the year in 1999 (W3).



Growth form of cultivar "Goldsturm" and wild type

Rudbeckia fulgida var. *sullivantii* can be confused with other *Rudbeckia* species such as *R. hirta* and *R. triloba* (Fisher 1988, Nicholson and Hawke 1995) and with two other varieties of *Rudbeckia fulgida*: *umbrosa* and *fulgida*. Morphological and geographical differences can be used to differentiate between these varieties. Ray flowers in var. *sullivantii* are longer (2.5-4 cm) than *fulgida* and *umbrosa* (1-2.5 cm). Leaves of *sullivantii* are between *fulgida* and *umbrosa* in size. In addition to some morphological differences, *Rudbeckia fulgida* var. *sullivantii* is mainly found from Michigan to Illinois, to West Virginia and southern Missouri (Gleason and Cronquist 1991). Based on Mohlenbrock (2002) and Gleason and Cronquist (1991), var. *umbrosa* is not found in Illinois. This variety occurs in southern Ontario (Canada) to Georgia and Alabama. Variety *fulgida* can be found from Florida to Louisiana in the south and at low elevations to southern New York, Pennsylvania and Illinois in the north.

LIFE HISTORY

Rudbeckia fulgida var. *sullivantii* blooms from August to September (Swink and Wilhelm, 1994) in Illinois and from July to September in Indiana (Yatskievych 2000). No data at this point is available regarding the breeding system of this species, however the great majority of Asteraceae are self-incompatible (Mani and Saravanan 1999, Richards 1997).

Lynne Elrick-Scott, Master's student at the University of Illinois, is conducting research on the reproductive biology and population genetics of this species at the Midewin National Tallgrass Prairie and two adjacent sites in Illinois. Preliminary data from (2002-2003) is showing that for most studied populations seed set is over 50% (Lynne Elrick-Scott UI-NRES, pers. comm.). Inflorescences of *Rudbeckia fulgida* var. *sullivantii* are visited by a wide variety of insects mainly within four main orders: Diptera (e.g., Syrphidae and Bombillidae), Coleoptera (e.g., Cantharidae and Curculionidae), Lepidoptera (e.g., Pieridae [orange sulfur], Lycaenidae [orange skipper], Hesperiidae [skipper], and Arctiidae [tiger moth]), and Hymenoptera (e.g., Apidae, Andrenidae, and Megachilidae) (Lynne Elrick-Scott UI-NRES, pers. comm.). In addition to sexual reproduction, asexual reproduction occurs in *Rudbeckia fulgida* var. *sullivantii* via stolons forming discrete colonies (Eric Ulaszek USDA Forest Service Midewin, pers. comm.).

Although no studies have been conducted on seed dispersal, it is believed to be limited. *Rudbeckia fulgida* var. *sullivantii* produces small achenes that most likely will fall and stay under the maternal plant. Also, because of the habitat where it can be found (see next section-Habitat), it is possible that water could disperse the species. Preliminary seed germination studies have shown very low germination (out of 1400 only 12 seeds germinated; Cassandra Allsup pers. comm.) even when following the cultivar requirements (see below). Other *Rudbeckia* spp. (e.g., *hirta, subtomentosa*) do not require any treatments to break dormancy for germination (Shirley 1994).

The cultivar form of this species "Goldsturm" can be propagated by seed, division, or stem cuttings (W3). Seeds can either undergo moist chilling for 3-4 weeks at 32-35°F followed by a 72°F germination temperature, or cold stratification for 8-12 weeks at 41°F followed by a 68-72°F germination temperature at high humidity (90-95%) (Yuan et al. 1996). Without any treatment seeds can germinate at 82°F to 88°F. Seedlings can be transplanted 28-38 days after sowing. If clump division is used for propagation, it should be done in early spring or fall with spring preferred. Stem cuttings should be taken as the stem tissue begins to harden (W3).

HABITAT

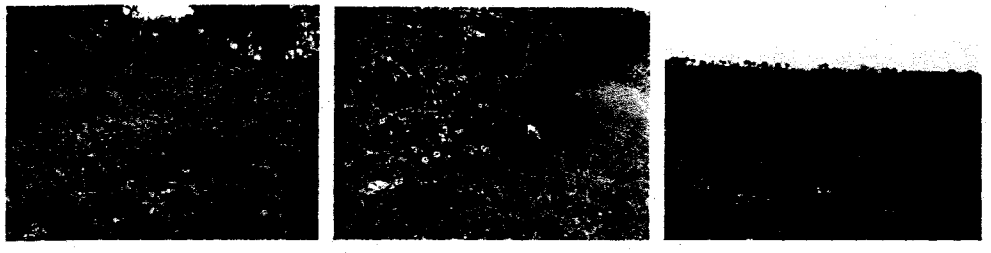
Across its range *Rudbeckia fulgida* var. *sullivantii* can be found in old pastures, prairies, moist open areas (e.g., fens, sedge meadows), and glades. In southern and east-central Missouri this species can be found in moist open places, thickets, moist ledges, glades, low, rich and rocky open woods (Steyermark 1963). In Ohio *Rudbeckia fulgida* var. *sullivantii* (= var. *speciosa*) occurs in prairies, fens and barrens (Greg Schneider, Manager, Ohio Natural Heritage Program, pers. comm.). In Michigan the species can be found in fens, sedge meadows, calcareous springy banks, riverside swamps, meadows and other wet (sometimes rocky) ground (Voss 1996). From a specimen collected in Berrien County (by K. Dritz, September 14, 1980; specimen at Morton Arboretum) at a mucky fen, *Rudbeckia fulgida* var. *sullivantii* was found associated with *Panicum clandestinum, Amphicarpa bracteata, Lindera benzoin, Aster umbellatus, Solidago patula, Apios americana, Cryptotaenia canadensis, Senecio aureus, Symplocarpus foetida, Agrimonia pubescens,* and *Prenanthes altissima.*

In Illinois, this species can be found in calcareous wet habitats, sometimes in dry prairies and rarely in calcareous sand prairies (Swink and Wilhelm 1994). Also, it can be found in mesic to wet-mesic prairies and woodland edges (Eric Ulaszek, Horticulturalist-Midewin National Tallgrass Prairie, pers. comm., Illinois Natural History Survey Herbarium specimens). The Illinois Plant Information Network (Iverson et al. 1999) has listed this species from the following Illinois natural communities: mesic uplands forest; mesic floodplain forest; thickets; glade and bluff, in particular cliff (i.e., rocky bluff). Plants associated with *Rudbeckia fulgida* var. *sullivantii* in northern Illinois are: *Andropogon gerardii, Aster lateriflorus, Cicuta maculata, Desmanthus illinoensis, Lysimachia quadriflora, Panicum virgatum, Ratibida pinnata, Rudbeckia subtomentosa, Solidago riddellii, Silphium terebinthinaceum, Solidago rigida, Valeriana ciliata,*

Veranicastrum virginicum, *Vernonia altissima*, and *Zizia aurea* (Swink and Wilhelm 1994).

In Indiana, *Rudbeckia fulgida* var. *sullivantii* can be found in seepage wetlands, especially fens in the northern half of the state (Michael A. Homoya Botanist/Ecologist, Division of Nature Preserves, Indiana Department of Natural Resources, pers. comm.). Also the species has been found in creek banks, roadside ditches, and dry open woods (Yatskievych 2000). From a specimen collected in a calcareous fen (collected by K. A. Board, August 22, 1990; specimen at Morton Arboretum) in St. Joseph County, *Rudbeckia fulgida* var. *sullivantii* was found growing with: *Cirsium muticum, Cornus racemosa, Dryopteris thelypteris* var. *pubescens, Lobelia kalmii, L. siphilitica,* and *Parnassia glauca.*

At the Midewin National Tallgrass Prairie (Midewin; former Joliet Army Ammunition Plant) in Illinois, *Rudbeckia fulgida* var. *sullivantii* can be found in woodland edge, old pasture, mesic prairie, and roadside (see photos below). Eric Ulaszek (Horticulturalist-Midewin, pers. comm.) pointed out that at the Midewin National Tallgrass Prairie, nearly all populations occur on the outwash plain, mostly west of Illinois Route 53. The largest populations occur in pastures, grasslands, and remnant prairies, including on and adjacent to Grant Creek Prairie Nature Preserve (which is part of Des Plaines State Fish and Wildlife Area, west of I-55). Some smaller populations have colonized sites disturbed by the Army in the construction of bunker fields. In other areas within Midewin (i.e., around Drummond Dolomite Prairie) small populations occur along drainages, in the shade of trees, in floodplains (i.e., along Jackson Creek), or on slopes above floodplains (usually associated with groundwater seepages, but not in the seeps). A few plants occur on the outwash plain in the pasture and roadsides north and south of the Midewin administrative site. Other populations east of Illinois Route 53 (but on the outwash plain) occur in a future Industrial Park, on Army land 0.75 miles west of the pasture around the Midewin administrative site. These plants occur in a prairie remnant with *Carex crawei, Hypoxis hirsuta, Zizia aurea, Sisyrinchium albidum, Antennaria plantaginifolia, Carex suberecta, Eleocharis compressa, Spartina pectinata, and Ratibida pinnata.* Near Midewin, *Rudbeckia fulgida* var. *sullivantii* is also present at Goose Lake Prairie State Park and it occurs southeastward along the Kankakee River to the Indiana state line.



Rudbeckia fulgida var. *sullivantii* along woodland edge and old pasture at Midewin.

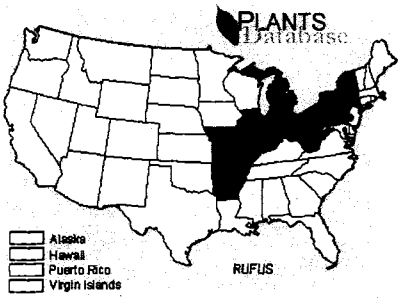
Limited habitat information is available for the Shawnee National Forest and Huron-Manistee National Forests, the other two National Forests where *Rudbeckia fulgida* var. *sullivantii* has been listed to occur. John E. Schwegman (retired Illinois state botanist,

pers. comm.) reports finding one population of *Rudbeckia fulgida* var. *sullivantii* during the 1990's in southern Pope County while conducting a vegetation study of the acid seep springs at the Shawnee Forest Service management unit, Poco Barrens. The Poco Barrens is in a remote location within the Cretaceous Hills. Schwegman pointed out that the species was near but not in one of the seep springs in a mostly unshaded area. It should be noted that the Cretaceous Hills is mostly a forested region of dissected hills with forested slopes, dry ridge forest, and ravine forest communities (McFall and Karnes 1995). In addition this area has several seep springs creating wet, acidic, "boggy" areas. The upland areas support white oak and hickories, while tulip tree and red oak occur in the ravines. Similar habitat can be found within the boundaries of the Shawnee National Forest.

Based on the records from the Shawnee National Forest identified just as *Rudbeckia fulgida* (Elizabeth Shimp-botanist Shawnee National Forest, pers. comm.), the species can also be found in abandoned fields, limestone glades, and wooded slopes. In the wooded slopes, this species can be found associated with *Spigelia marilandica*, *Amsonia tabernaemontana*, *Goodyera pubescens*, and *Mitchella repens*. In addition, Olson (2002) reported that at the Shawnee National Forest, *Rudbeckia fulgida* var. *sullivantii* could be found in barrens. Barrens are characterized by species of canopy trees tolerant of xeric conditions that have a stunted open-growth appearance, and the dominance of native warm-season grasses and prairie forbs (Olson 2002).

Finally, from one record at the Huron-Manistee National Forests, *Rudbeckia fulgida* var. *sullivantii* was found in 1993 along the edge of a fen in the transition zone to a jack pine upland forest (Alix Cleveland, Forest Plant Ecologist, Huron-Manistee National Forests, pers. comm.). However, in the 2001 Fuel Reduction Project study area, no habitat (i.e., sedge meadow) or the species was found (Thompson and Cole 2003).

DISTRIBUTION AND ABUNDANCE



Rudbeckia fulgida var. *sullivantii* can be found in nine states, most of which are midwest to eastern states (Arkansas, Illinois, Indiana, Michigan, Missouri, New York, Ohio, Pennsylvania, and West Virginia (USDA-NRCS 2004). It should be noted that at the United States National Herbarium in Washington DC (as of January 2004) one specimen of *Rudbeckia fulgida* var. *sullivantii* was collected in Alabama (1878). Appendix 1 shows the county distributions for Michigan, Missouri, and Ohio.

In Ohio *Rudbeckia fulgida* var. *sullivantii* is found mostly in the central western portion of the state (Fisher 1988). From the Friesner Herbarium (Butler University-Indiana Rebecca Dolan Director pers. comm.) one specimen was collected in Adam County (1952). The United States National Herbarium in Washington DC (as of January 2004) has three specimens collected in Ohio: one from Adam County (1945), one from Clark County (1931) and the last one was collected in unknown County (1924).

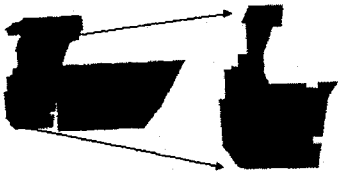
In New York, because this species is not rare, the New York Natural Heritage Program does not have data on the species distribution (Steve Young, New York Natural Heritage Program Botanist, pers. comm.). In addition, no herbarium records are found at the New York State Museum (Charles J. Sheviak, Curator of Botany New York State Museum, pers. comm.).

In Missouri this species is found mostly in the southwest corner of the state. John E. Schwegman (retired Illinois state botanist, pers. comm.) pointed out that the biggest population of *Rudbeckia fulgida* var. *sullivantii* is found at Grasshopper Hollow Fen in the Ozarks of southeast Missouri (Reynolds County). The Ozarks Regional Herbarium in Missouri has one specimen from this site (Laura Michelle Bowe pers. comm., Curator Ozarks Regional Herbarium; Southwest Missouri State University). Finally, at the University of Missouri herbarium, there is one specimen collected in Lawrence County (1953) (Robin C. Kennedy, Curator, University of Missouri Dunn-Palmer Herbarium, pers. comm.).

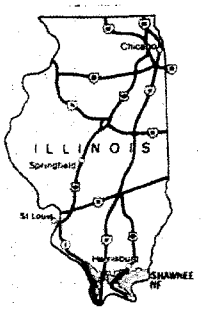
In Illinois this species has been reported in twelve counties, mostly in the eastern portion of the state: Coles, Hardin, Kane, Kankakee, Lawrence, Menard, Pope, Pulaski, Richland, Vermillion, Wabash, and Will (Iverson et al. 1999, Mohlenbrock 2002, Shimp 2001). However, limited information is available about the abundance of this species across Illinois. At the Illinois Natural History Survey Herbarium (as of June 2003) 15 specimens are available, 14 specimens from Illinois and one from Tennessee identified as *Rudbeckia fulgida*; but only six are var. *sullivantii*. These specimens were collected in Lawrence (2 specimens 1965-1969), Pulaski (2 specimens 1957), Wabash (1 specimen 1956), and Will (1 specimen 1980). No records are available from the Southern Illinois University herbarium (Michael Mibb, Assistant Curator, pers. comm.).

It should be noted that because var. *fulgida* is also found in Illinois (Christian, Coles, Jackson, Lawrence, Massac, Pope, St. Clair, and Union) and it could be confused with var. *sullivantii*, the reports associated with var. *sullivantii* in Pope and Hardin counties should be confirmed with voucher material before including them among the Illinois county distributions.

Within the Midewin National Tallgrass Prairie (red spot on the map), reliable information can be found about species abundance. At Midewin multiple populations can be found ranging in size from a few individuals to thousands.



Most of these populations are found on the west side of Midewin (green sections on the map, left side blowup; Eric Ulaszek, Horticulturalist-Midewin, pers. comm.). In addition, the species can be found at the Des Plaines State and Wildlife Area (including areas west of I-55). *Rudbeckia fulgida* var. *sullivantii* also occurs at Goose Lake Prairie State Park and southeastward along the Kankakee River to the Indiana state line.



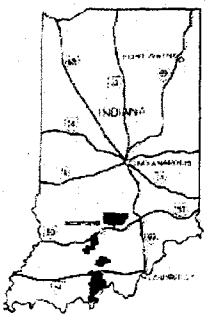
Identifications for *Rudbeckia fulgida* specimens collected within the Shawnee National Forest have mostly been to the rank of species but not to variety. (Elizabeth Shimp, Botanist-Shawnee National Forest, pers. comm.). Material identified as *Rudbeckia fulgida* at the Shawnee National Forest has been found in Hardin County (Victory Mine and Whoopie Cat Mountain), Jackson County (in proximity to Landreth School), Randolph County (Prairie du Rocher, nearby Fish Cave), and Pope County (Bell Smith Springs and Millstone Bluff). Most of these records are from 1976-1977.

Documents from the Shawnee National Forest have reported that *Rudbeckia fulgida* var. *sullivantii* can be found in Pope and Hardin counties (Shimp 2001). This species is known from Kickasola Barrens Forest Service Natural Area (15 ha [36 ac] area within District 4, [i.e., Kickasola Cemetery Ecological Areas]) in Pope County. Both John Schwegman (retired Illinois state botanist) and Jody Shimp (ILDNR-Natural Heritage biologist) have been to the site and have seen the species. Finally, Schwegman (pers. comm.) has found the species near an acid seep in the Cretaceous Hills (i.e., Poco Barrens) but has pointed out that *Rudbeckia fulgida* var. *sullivantii* is extremely rare within the Shawnee National Forest.

In Indiana, the species has been recorded in 18 counties mostly in the northern half of the state (Carroll, Cass; Decatur, Daviess, Elkhart, Greene, Henry, Huntington, Knox, Kosciusko, Lagrange, Marion, Montgomery, Morgan, Parke, Steuben, Vermillion, and White; Ronald P. Hellmich-Indiana Natural Heritage Database Center; Michael A. Homoya, pers. comm.; Kay Yatskievych, pers. comm.).

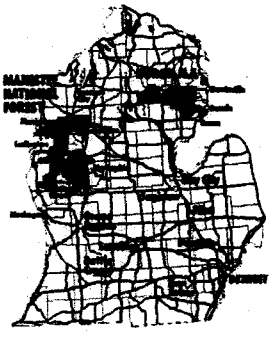
The Indiana University Herbarium has county records from 18 counties dating from 1897-1953 (Carroll: 1930, Cass: 1925, Daviess: 1932, Decatur: 1911, Elkhart: 1918, Henry: 1919, Huntington: 1916, Jefferson: 1934, Kosciusko: 1897, 1916, 1940-1942, Lagrange: 1923, Marion: two from 1913, Parke: 1911, 1953, St. Joseph: 1941, Steuben: 1931, Vermillion: 1910, Wayne: 1908, Wells: 1942-1943, and White: 1920). The Friesner Herbarium (Butler University-Indiana, Rebecca Dolan Director pers. comm.), has one specimen collected in Parke County 1929. The United States National Herbarium in Washington DC (as of January 2004) has Indiana specimens collected from Carroll (near Rt. 25, 1.6 miles NE of junction of Rt. 55 and 422- September 4 1955), Delaware (3 miles southeast of Daleville-August 6, 1918), Kosciusko (Shore on the east side of Little Chapman Lake-September 16, 1916), and LaGrange (1 mile south of Mongo- August 31, 1941) counties. Finally, the Field Museum of Natural History in Chicago (IL) has two specimens identified as *Rudbeckia fulgida* var. *sullivantii* collected

in Indiana during 1932 and 1941 (Christine Niezgoda, Collections Manager-Field Museum of Natural History, pers. comm.).



Although *Rudbeckia fulgida* var. *sullivantii* can be found in Indiana, due to its northern distribution the likelihood of finding this species in the nine southern counties (Brown, Crawford, Dubois, Jackson, Lawrence, Martin, Monroe, Orange, and Perry) that make the Hoosier National Forest is minimal.

In Michigan, the species has been reported from mostly southern portions of the state (Voss 1996). The northernmost record of *Rudbeckia fulgida* var. *sullivantii*, found at the University of Michigan Herbarium, is from Alma (Gratiot County) (Richard K. Rabeler pers. comm., Collections Manager University of Michigan Herbarium). Twenty other specimens from the following counties were also found at this herbarium and were all labeled *Rudbeckia fulgida*: Berrien, Calhoun, Cass, Gratiot, Hillsdale, Ionia, Jackson, Kalamazoo, Kent, Lenawee, Macomb, Oakland, St. Joseph, Washtenaw, and Wayne). The Michigan State University herbarium has three specimens of *Rudbeckia fulgida* var. *sullivantii* all from Berrien County (Debra Trock Assistant Curator pers. comm.). The United States National Herbarium in Washington DC (as of January 2004) has two specimens collected in Michigan; one dating from 1911. Also, the Field Museum of Natural History in Chicago (IL) has one specimen collected in 1941 (Christine Niezgoda, Collections Manager-Field Museum of Natural History, pers. comm.). Finally, the Michigan Natural Features Inventory, does not track this species (Michael Fashoway, Michigan Natural Features Inventory, pers. comm.).



Although *Rudbeckia fulgida* var. *sullivantii* has been reported from mostly southern portions of Michigan (Voss 1996; Appendix 1), the Huron-Manistee National Forests has one occurrence for this species, observed in Iosco County 1993 (Alix Cleveland, Forest Plant Ecologist, Huron-Manistee National Forests, pers. comm.). However, a recent survey conducted for a fuel reduction project (Thompson and Cole 2003) did not find *Rudbeckia fulgida* var. *sullivantii* within the study area.

RANGE WIDE STATUS

Global Heritage Status: The Nature Conservancy (TNC) and Association for Biodiversity Information (ABI) have ranked this species as G5Q (Eastern Region of the Forest Service [R9] Sensitive Species list, February 29, 2000 [list maintained as of October 20, 2003]). This ranking (i.e., G5) means that globally the species is widespread, abundant, and secure. However the taxonomic distinctiveness of *Rudbeckia fulgida* var. *sullivantii* at the current level is questionable (i.e., Q).

National Heritage Status: The Nature Conservancy (TNC) and Association for Biodiversity Information (ABI) have ranked this species as N3, meaning that nationally *Rudbeckia fulgida* var. *sullivantii* can be rare to uncommon in some places or widespread, abundant, and apparently secure, but with cause for long-term concern (Eastern Region of the Forest Service [R9] Sensitive Species list, February 29, 2000 [list maintained as of October 20, 2003]).

National Forest Status: The Eastern Region of the Forest Service (R9) updated its Sensitive Species list on February 29, 2000 (list maintained as of October 20, 2003). According to this list *Rudbeckia fulgida* var. *sullivantii* has been designated as a Regional Forester's Sensitive species at the Midewin National Tallgrass Prairie, Huron-Manistee National Forests, and Shawnee National Forest.

However, Alix Cleveland (Forest Plant Ecologist- Huron-Manistee National Forests, pers. comm.) from the Huron-Manistee National Forests reported that this species is going to be removed from their RFSS list. During the early 1990's Michigan Natural Features Inventory and Michigan's Heritage program decided to de-list *Rudbeckia fulgida* var. *sullivantii* because they had information that this taxon was no longer going to be recognized as a separate taxon and was being lumped with the more common *Rudbeckia fulgida.*

According to Region 9 Regional Forester's Sensitive Species Framework, National Forests are responsible for reviewing the status of taxa on their respective lists and to recommend changes accordingly. The HMNF has not gone through the official process of updating their RFSS list, which does contain *Rudbeckia fulgida* var. *sullivantii.* However, HMNF has chosen to rely on the expertise of a technical committee that reviews sensitive plant taxon in the state of Michigan for Michigan Natural Features Inventory. In 1997, the technical committee recommended that this taxon be referred to as *Rudbeckia fulgida*, and that it be de-listed due to its more common presence in Michigan. The next time the Region 9 RFSS list is updated, HMNF is planning to remove *Rudbeckia fulgida* var. *sullivantii* from sensitive status due to the its taxonomic change, making it no longer rare in Michigan (Alix Cleveland, Forest Plant Ecologist- Huron-Manistee National Forests, pers. comm.).

State Status: Arkansas, Illinois, Indiana, Michigan, Missouri, New York, Ohio, Pennsylvania, and West Virginia, have ranked *Rudbeckia fulgida* var. *sullivantii* as SNR-

Unranked: State conservation status not yet assessed. In Ohio and New York, the Natural Heritage Programs do not have data on the species since it is not considered rare (Greg Schneider, Manager, Ohio Natural Heritage Program; Steve Young New York Natural Heritage Program Botanist, pers. comms.). However, in 2003 *Rudbeckia fulgida* var. *sullivantii* was going to be listed as either threatened or endangered in Illinois by the Illinois Endangered Species Protection Board (ILESPB). The ILESPB decided against listing the species due to concerns associated with hybridization with its cultivar (J. Ebinger-ILESPB, pers. comm.). John E. Schwegman (retired Illinois state botanist, pers. comm.) pointed out that in Illinois *Rudbeckia fulgida* var. *sullivantii* is extremely rare.

POPULATION BIOLOGY AND VIABILITY

Populations of *Rudbeckia fulgida* var. *sullivantii* can range from a few dispersed individuals to thousands in discrete colonies (Eric Ulaszek, Horticulturalist- Midewin, pers. comm.). Based on work being conducted at the Midewin National Tallgrass Prairie (Midewin) by Lynne Elrick-Scott (UI-NRES, pers. comm.) populations of this species can have very high fruit set to low fruit set (2002: 26.1-62.4%; 2003: 45.6 - 57.0%). At Midewin most of the populations are stable and viable. In the Huron-Manistee National Forests only eight plants were found in 1993 along the edge of a fen in the transition zone to a jack pine upland forest (Alix Cleveland, Forest Plant Ecologist- Huron-Manistee National Forests, pers. comm.). Finally, no information is available regarding the viability of this species at the Shawnee National Forest.

The potential threats listed under the next section can have a negative impact on the structure and viability of *Rudbeckia fulgida* var. *sullivantii* populations, since most of them can lead to reduction in population size or plant recruitment.

POTENTIAL THREATS

Across the range of *Rudbeckia fulgida* var. *sullivantii* the main threat to this species is habitat loss as a consequence of development, agriculture, grazing, and changes in the hydrology of the area as a consequence of these activities. Even though *Rudbeckia fulgida* var. *sullivantii* can also be found in forests and can persist in shaded conditions, encroachment of successional vegetation can affect the species.

Actives going on within National Forest lands can impose some threats to this species, such as trampling by hikers, trail construction (i.e., expansion, replacement, etc.) or recreational activities. Unauthorized ATV activity is a concern within the Shawnee National Forest. *Rudbeckia fulgida* var. *sullivantii* is known from Kickasola Barrens Forest Service Natural Area (i.e., Kickasola Cemetery Ecological). During the late 1990's some ATV use was noted coming in from the east boundary (Shimp 1998-1999). Motorized vehicles are also a concern at the Huron-Manistee National Forests and motorized vehicle barriers have been placed to prevent traffic in locations containing rare plants (e.g., Newaygo Prairies Research Natural Area; Schuler 2002). In the particular case of the population that was found in 1993, it was potentially threatened by unmanaged off-road vehicle use on an adjacent lakeshore (Alix Cleveland, Forest Plant Ecologist - Huron-Manistee National Forests, pers. comm.).

Minor insect damage (i.e., chewing) has been observed in both the wild type and cultivar of *Rudbeckia fulgida* var. *sullivantii* (Nicholson and Hawke 1995). At Midewin National Tallgrass Prairie insect damage has been observed on the petals (i.e., chewing) and receptacle (i.e., larva) (Lynne Elrick-Scott UI-NRES, pers. comm.).

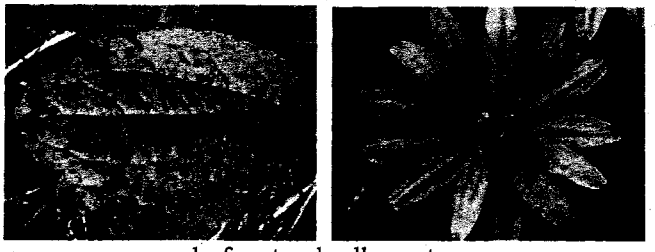
Another threat associated with *Rudbeckia fulgida* var. *sullivantii* is the potential gene flow between the cultivar and wild type. Crosses between the cultivar ("Goldsturm") and wild type suggest that gene flow is a possibility (Lynne Elrick-Scott UI-NRES, pers. comm.). Further research (i.e., additional crosses) is needed to determine the extent of this gene flow and the potential consequences of it (e.g. loss of unique wild type alleles, genetic swamping by cultivar).

Finally, ornamental (and most likely wild type) *Rudbeckia* spp. can be attacked by different pathogens (W7). The fungi *Septoria rudbeckiae*, *Ramularia rudbeckiae*, and *Cylindrocladium* spp. are among the most common foliar pathogens. Brown leaf spots are the sign of infection. This leaf infection occurs due to frequent watering (too wet). Removing infected leaves at the end of the growing reason, avoiding overhead watering, and using fungicides can control this disease.

The fungus *Septoria rudbeckiae* can turn most leaves brown (left leaf photo [W7]). Brown spots (=leaf spot, right photo [W7]) on *Rudbeckia* sp. leaves may be the fungus *Septoria*. Microscopic analysis is necessary for positive diagnosis.

Powdery mildew, angular leaf spot, and aster yellows are other common diseases of *Rubdeckia* spp. (W7, Nicholson and Hawke 1995). Powdery mildew is a leaf disease where a white powder is found on the leaves. Usually, this happens during the summer when cool evenings are followed by warm humid days. The main agents are *Erysiphe cichoracearum* and *Sphaerotheca fusa*; improving air circulation and using fungicies can control this disease. Angular leaf spot disease is the result of a bacterial infection. The symptoms are angular brown spots on leaves. Removal of infected leaves and the use of a bactericide can minimize the infection. Finally, the aster yellow disease is the result of a phytoplasma infection spread by leafhoppers. This is a very common disease among members of the Asteraceae. General symptoms are leaves sprouting from flowers and witches brooms. Control of this disease is limited to searching and destroying infected specimens.

It should be noted that leaf spot and yellow aster diseases (photos below) have been observed on *Rudbeckia fulgida* var. *sullivantti* at the Midewin National Tallgrass Prairie.



leaf spot and yellow aster

RESEARCH AND MONITORING

Botanists at the Midewin National Tallgrass Prairie, Huron-Manistee National Forests and Shawnee National Forest are actively looking for new populations of *Rudbeckia fulgida* var. *sullivantii*, since Forest Service policy dictates that forest areas proposed for any type of management activity are first inventoried (ground or map surveys of known occurrences) to determine if and how the habitat for this species may be affected (Shimp 2001). These surveys are needed at the Shawnee National Forest since documentation of this species is not reliable. A lot of the locations that previously were thought to be *Rudbeckia fulgida* var. *sullivantii* at the forest turned out to be other *Rudbeckia* spp. These surveys should be conducted during the late summer when basal leaves and blooms are visible.

In the case of the Huron-Manistee National Forests as of 2002 about 17,500 acres have been surveyed for rare plants (Schuler 2002). Although *Rudbeckia fulgida* var. *sullivantii* has been reported within the National Forest from one location, searches for populations should be conducted in case populations have been overlooked due to similarity with other *Rudbeckia* spp. It should be mentioned that the Huron-Manistee National Forests take multiple steps to insure that no harm is done to *Rudbeckia fulgida* var. *sullivantii* (if found in other areas of the National Forest) or any other sensitive species. Among these steps are the determination of suitable habitat and the potential occurrence of Regional Forester's Sensitive Species (RFSS) in project areas by: Searching the Ranger Station's Endangered, Threatened, and Sensitive (ETS), Species Data Base (USDA), the Michigan Natural Features Inventory Data Base (MNFI), on-site surveys, and professional evaluations of habitats (e.g., Amendment to the Biological Assessment and Evaluation For 2001 Fuel Reduction Project, Thompson and Cole 2003).

At the Midewin National Tallgrass Prairie (Midewin), populations and suitable habitats have been mapped (Appendix 2). As part of the Prairie Plan (USDA-Forest Service 2002), monitoring and survey protocols have been suggested. In addition, the species has been recommended as a desired plant species for the following plant communities to be restored at Midewin: dolomite prairie, upland typic prairie, wet typic prairie, seep, savanna, forest and woodland, and perennial stream/riparian.

As part of these surveys within National Forest lands, attention should be placed on determining the distance of nearby cultivar plantings. This is important since there is some evidence suggesting that gene flow can occur between wild type and cultivar (Lynne Elrick-Scott UI-NRES, pers. comm.).

Most of the research associated with *Rudbeckia fulgida* var. *sullivantii* is going on at the Midewin National Tallgrass Prairie. Several aspects of the biology of the species such as breeding system, reproductive output, pollinators, and population genetics are being studied. This information is going to allow for the development of a better conservation plan at Midewin, but also at other National Forests, such as the Shawnee National Forest.

Other areas that will need research are: impact of diseases, medicinal properties, and host capability. As previously mention, this species at Midewin has the leaf spot disease. However the nature of the leaf spot pathogens (fungi or bacteria) and the impact that it may have on the reproduction and survivorship of plants at the site is unknown. Also, *Rudbeckia fulgida* var. *sullivantii* has compounds with immunomodulating activity (Bukovsky et al. 1998, Kardosova and Matulavo 1997). Additional research should be conducted to determine other potential medicinal properties. Finally, *Rudbeckia fulgida* var. *sullivantii* could be a host plant for *Agalinis auriculata* a rare species in many states. Cunningham and Parr (1990) determined that var. *fulgida* was a host for this parasitic plant. However Molano-Flores et al. (2003) conducted greenhouse germination and host studies using var. *sullivantii*, and although *Agalinis auriculata*'s seeds germinated in the presence of var. *sullivantii*, none developed haustoria connections with this variety. Field studies should be conducted at Midewin National Tallgrass Prairie since *Agalinis auriculata*, an Illinois state threatened species, and *Rudbeckia fulgida* var. *sullivantii* are found at the site.

Extensive research has been conducted with the cultivar variety (*Rudbeckia fulgida* var. *sullivantii* ["Goldsturm"]) including seed germination (Fay et al. 1993, Fay et al. 1994, Yuan et al. 1996), photoperiod (Keever et al. 2001, Runkle et al. 1998, Runkle et al. 1999), genetic similarly (Gettys and Werner 2001), and growth (Chapman and Auge 1994, Groves et al. 1998a, Groves et al. 1998b, Kraus et al. 2002, Yuan et al. 1998). Most of this research is for commercial purposes. Although some of this information can be applied to the wild type, it should not be used to replace much needed research associated with the wild type. For example, a seed germination study using the cultivar stratification requirements resulted in the germination of 12 seeds out of 1400 (Cassandra Allsup, pers. comm.).

Finally, research is currently being conducted to determine genetic diversity of wild type and cultivar populations using random amplified polymorphic DNA procedures. This will determine how similar the wild type and cultivar populations are to each other. The implications of this research are significant because it can determine the future conservation status of *Rudbeckia fulgida* var. *sullivantii*.

SUMMARY

Rudbeckia fulgida var. *sullivantii* is a perennial species that occurs in Arkansas, Illinois, Indiana, Michigan, Missouri, New York, Ohio, Pennsylvania, and West Virginia. This species can be found mostly in old pastures, prairies, moist open areas (e.g., fens, sedge meadows), and glades. The national status of *Rudbeckia fulgida* var. *sullivantii* is rare to uncommon in some places, or widespread, abundant, or apparently secure, but with cause for long-term concern. Although limited to no information is available for some states. This species has been designated as a Regional Forester's Sensitive species (Region 9) at the Midewin National Tallgrass Prairie and Shawnee National Forest. Although this species was included as a RFSS in Huron-Manistee National Forests, forest staff members have reported that it is going to be removed due to changes in the taxonomy of the species.

Data are available on several aspects of the life history, habitat requirements, and threats to viability for *Rudbeckia fulgida* var. *sullivantii*. Nonetheless there is additional room for research and monitoring. It should be noted that extensive research has been conducted with the cultivar form of this species *Rudbeckia fulgida* var. *sullivantii* "Goldsturm".

Although some data are available to assess the effects that anthropogenic activity, environmental, demographic, and genetic stochasticity may have upon this species, further research is needed to establish the current conditions of additional populations. This should be done both within the National Forest lands (i.e., Midewin National Tallgrass Prairie, Huron-Manistee National Forests, and Shawnee National Forest), as well as across the range of the species. In the case of National Forest lands this information is needed to analyze potential impacts from proposed forest management actions. Finally, determining the genetic similarities between wild type and cultivar populations of *Rudbeckia fulgida* var. *sullivantii* will help determine the future conservation status of this species (i.e., listed as threatened or endangered species).

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W2- Missouriplants.com: http://www.missouriplants.com/

W3- 1999 the perennial plant of the year, *Rudbeckia fulgida* var. *sullivantii* 'Goldsturm': http://www.perennialplant.org/ppy/99ppy.html

W4- *Rudbeckia fulgida* var. *sullivantii* 'Goldsturm': https://www.jelitto.com/english/RA164.htm

W5- *Rudbeckia fulgida* 'Goldsturm': http://www.northcreeknurseries.com/Plants/Rudbeckia%20fulgida%20'Goldsturm'.htm

W6- Plant Picks *Rudbeckia*: http://www.greenbeam.com/features/plant111698.stm

W7- Yard and Garden Brief Line: Diseases of *Rudbeckia* by Janna Beckerman, Extension Plant Pathologist: http://www.extension.umn.edu/projects/yardandgarden/ygbriefs/p154rudbeckiadisease.html

Online Databases Consulted

Integrated Taxonomic Information System: http://www.itis.usda.gov.

Morton Arboretum - *vPlants web page*: http://www.vplants.org/.
4100 Illinois Route 53
Lisle, IL 60532-1293
Tel: 630-968-0074
Email: trees@mortonarb.org

Herbaria visited

Illinois Natural History Survey Herbarium
Illinois Natural History Survey
Room 396
607 E Peabody Dr.
Champaign, IL 61820

United States National Herbarium
Department of Botany
Smithsonian Institution
P.O. Box 37012
Washington, DC 20013-7012

Photos

Cover page photo taken by Lynne Elrick-Scott at Midewin National Tallgrass Prairie.

Page 6 taken from vPlants (http://www.vplants.org/).

Page 7 taken from Floridata: http://www.floridata.com/

Page 8 taken from The Daily Muse: A Garden Journal - July 2004 (http://www.soulofthegarden.com/dailymuse0704.html) by Tom Spencer and Lynne Elrick-Scott at Midewin National Tallgrass Prairie.

Page 10 taken by Lynne Elrick-Scott at Midewin National Tallgrass Prairie.

Page 18 taken by Janna Beckerman (W7).

Page 19 taken by Lynne Elrick-Scott at Midewin National Tallgrass Prairie.

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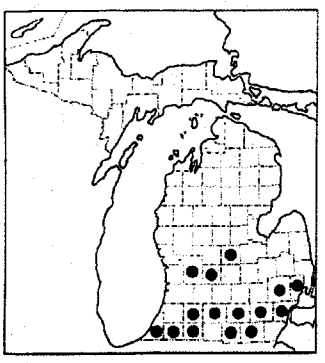
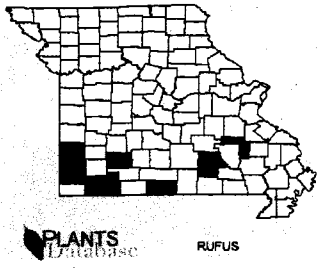
APPENDIX 1 - State county distribution map. These maps may not show all the possible county records within a state. Maps were taken from the following online resource: the PLANTS Database (http://plants.usda.gov/) and from Fisher 1988 and Voss 1996.

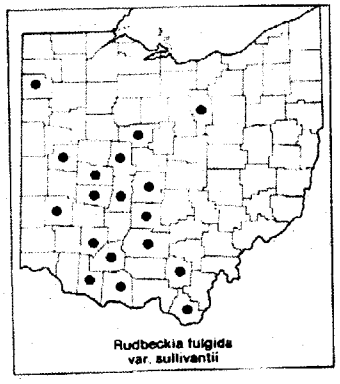


624. Rudbeckia fulgida

Michigan



Missouri



Ohio

APPENDIX 2 – Suitable habitat for *Rudbeckia fulgida* var. *sullivantii* at Midewin National Tallgrass Prairie.