Conservation Assessment

For

Strict Blue-eyed-grass (Sisyrinchium strictum)

USDA Forest Service, Eastern Region
2003

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This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information and serves as a Conservation Assessment for the Eastern Region of the Forest Service.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 community, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

Table of Contents

EXECUTIVE SUMMARY

The National Forest Management Act and U.S. Forest Service policy requires that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that 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) (Brzeskiewicz 2000).

This Conservation Assessment provides a review of the taxonomy, life history, habitat, distribution, population viability, and potential threats for strict blue-eyed grass (*Sisyrinchium strictum* Bicknell) within Region 9. The body of information within this report comes from literature review, personal and written communication with state, federal, academic, and consulting botanists, and examination of specimens at the University of Michigan herbarium.

Region 9 is comprised of 20 states and 15 National Forests. The states include 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 include 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.

Sisyrinchium strictum is known only from Michigan and Wisconsin. As of 2001, it was not listed as a species of conservation concern in Wisconsin. In Michigan, it has been assigned the status of Special Concern, indicating that it may be declining or is considered relict in the state. This status does not provide legal protection to the species under the State of Michigan Endangered Species Act. It has been given a Michigan state rank of S3, which indicates that is considered imperiled in the state because of rarity, making it very vulnerable to extirpation from the state. In Michigan, as of 2001, it was assigned a global rank of G2Q, indicating that it is imperiled globally and is of questionable taxonomy. The taxonomy has been determined since the assigned rank of Q was applied (see below). The species is ranked as a Regional Foresters Sensitive Species (R9) in the Huron-Manistee National Forest.

INTRODUCTION

E. P. Bicknell (1899) described *Sisyrinchium strictum* as a distinct species, with the type specimen collected by C.F. Wheeler in 1898 near Vestaburg, Michigan. It was not recognized as a species, however, by Fernald (1950), or was considered to be a synonym for *S. atlanticum* by Gleason and Cronquist (1991) or a synonym for *Sisyrinchium montanum* var. *montanum* in Katesz (1994). Cholewa and Henderson (2002) in their treatment of *Sisyrinchium* for the Flora of North America recognize *Sisyrinchium strictum* as a distinct species, based on distinct morphological characters.

S. strictum occurs in a variety of herbaceous dominated plant communities that occur on dry to moist soils that are generally sandy in consistency. The species has been collected at more

sites Wisconsin than Michigan. It is highly probable that this species is overlooked or initially misidentified in the field as another *Sisyrinchium* species and is simply not collected. Information provided on vouchers housed at the University of Wisconsin (Black, data request, 2002) and Michigan indicate that the populations are typically small, rarely in excess of 100 plants. Colonies may persist for long periods of time (Voss, 1967).

Currently, there is insufficient data to assess the effects that environmental, demographic, and genetic stochasticity, natural catastrophes, and anthropogenic activities may have upon the species. Further searches for additional populations and research on the biology of the species is recommended.

NOMENCLATURE AND TAXONOMY

Sisyrinchium strictum is a member of the genus *Sisyrinchium* Linnaeus in the family Iridaceae A. L de Jussieu (Cronquist, 1981). Goldblatt (2002) lists sixteen genera within the family Iridaceae in North America. *Sisyrinchium* and its immediate allies are divided into four sections, with *Sisyrinchium* sect. *Sisyrinchium* characterized by compressed stems and globose seeds usually with a large pit (Goldblatt and Rudall, 1990). Nearly all the species of the genus *Sisyrinchium* alliance lack styloid crystals, a basic and specialized feature within the family Iridaceae (Glodblatt et al., 1984; Goldblatt 1990, cf. Goldblatt, 1990). The following morphological characteristics of the genus *Sisyrinchium* has been excerpted and paraphrased in brief from Cholewa and Henderson (2002). The genus *Sisyrinchium* are annual or perennial herbs, often cespitose, rhizomatous or not, with thickened, fleshy roots. The stems are scapelike or branched, compressed, and two-winged. The leaves are basal and cauline, alternate, basally equitant and usually glabrous. The inflorescence is usually terminal; two equitant spathes that are usually connate basally. The actinomorphic flowers are not fragrant and have widely spreading tepals that are violet to light blue, white, lavender to pink, magenta, purple, or yellow. The stamens are symmetrically arranged, with distinct filaments that are connate basally into a tube. The anthers surround but are not appressed to the style. The capsule is globose, smooth to roughened by underlying seeds that are globose to obconic or hemispherical with a black seed coat that is granular to rugulose. The basic chromosome = 8.

The treatment of North American species within the genus *Sisyrinchium* began in earnest in last two decades of the nineteenth century by Bicknell (1896, 1899) and Greene (Henderson, 1976). Bicknell proposed a plethora of names, many of which have been reduced to conspecific status by Fernald (1950) and Gleason and Cronquist (1963) (Hill, 1984). Bicknell's work was based largely on the examination of herbarium material (Henderson, 1976). Henderson (1976) states that, "Even a superficial examination of local and regional floras available for North America will disclose the inconsistencies in taxonomic treatment of the genus *Sisyrinchium* (Iridaceae)". *Sisyrinchium* is a complex polyploid taxon in which the species are not always easily distinguished. When immature, plants of branched species appear to be simple-stemmed and those of simple stemmed species occasionally are branched. Vegetative characteristics, while distinctive in some species, may overlap greatly in wide ranging species (Cholewa and Henderson, 2002). Henderson (1976) considered much of the confusion regarding *Sisyrinchium* taxonomy to be two fold. "Unless great care are taken in preservation, the structural

characteristics are seldom evident, which not only makes identification of dried material difficult in the absence of detailed field notes, but also obscures natural floral variation. Secondly, intrapopulational variation of several external features is, in some cases, extreme, and unless a large sample is used as the basis for character evaluation, identification may be difficult, if not impossible. Even the most limited field observations will often disclose a gradation of character expression encompassing in a single population three or more of the taxa of Bicknell and Greene."

Voss recognized *S. strictum* as a distinct species in his treatment of the Michigan Flora (1972), indicating that S. *strictum* was accepted by Robinson and Fernald in Gray's Manual, ed. 7, but is completely ignored by Fernald in ed. 8. He points out that *S. strictum* differs from *S. montanum* in its narrower stems, slightly smaller capsule, and subequal spathe bracts. Cholewa (per comm. 2002) agrees with Voss that *S. strictum* is a separate entity from *S. montanum* var. *montanum* and *S. montanum* var. *crebum* in that they are wider stemmed with much longer bracts and dark fruits than is found in *S. strictum*.

The most recent taxanomic treatment of *Sisyrinchium* in North America (Cholewa and Henderson, 2002) recognizes 37 species including *S. strictum*.

DESCRIPTION OF SPECIES

Sisyrinchium strictum is a cespitose light green to glaucesecent perennial herb to the height of 4.8 dm. The compressed stems are 1.4-2.3 mm wide (Figure 1) with minutely denticulate margins. The branched stems are narrowly winged. The glabrous leaf blades are not persistent in fibrous tufts. The inflorescence is borne singly from spathes that usually have a purplish tinge to the margins. The spathe is 16-22.8 mm long (Figure 2), the bracts subequal. The margins of the spathe are basally connate for 4.2-6.9 mm. The tepals are pale to deep bluish violet with the bases yellow. The widely flaring tepals are 9-19.5 mm long with apex rounded or truncate. The pedicels (at least some of them) are wing margined basally more than half their length (Figure 3). The globose capsule is tan to nearly white, occasionally light brown, and sometimes with a purplish apex (Figure 4). The seeds are globose to obconic, lacking an obvious depression, rugulose or granular. It typically flowers from early to mid-summer.

The tan to nearly white versus dark brown or black capsule aids in differentiating *S. strictum* from *S. angustifolium* in the Great Lakes region flora. *S. strictum* usually dries light green to yellowish green while *S. angustifolium* usually dries dark olive green, bronze, or blackish. The spathe is 16-22 mm long in *S. strictum* while it 12-16.1 mm long in *S. atlanticum*, another species with which it could be confused.

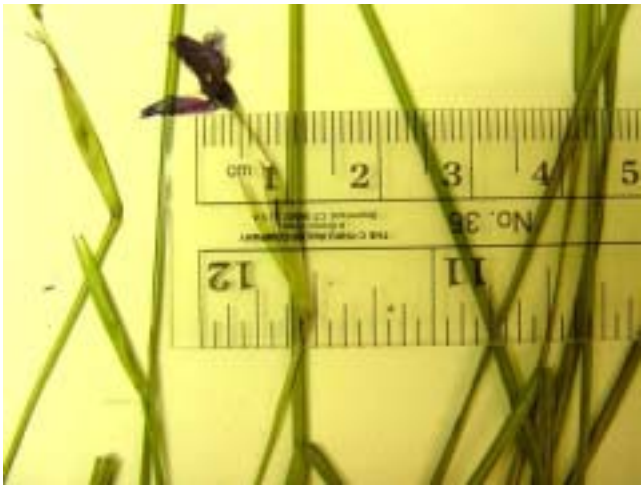

Figure 1: Example of stem <2mm wide.

Figure 2: Spathe; 18 mm long.

Figure 3: Winged margin on pedicel.

Figure 4: Pale whitish tan capsules.

LIFE HISTORY

Little is known about the life history of *S. strictum*, though inference can be drawn from work that has been done with other *Sisyrinchium* species by Henderson (1976) and Cholewa and Henderson (1984). *S. strictum* is a cespitose perennial that typically has branched stems. Cholewa and Henderson (1984) indicate that growth and development of perennating buds, located near the base of the plant, is the common method of vegetative propagation in the genus *Sisyrinchium*. The authors observed vivipary, fertile plants from the axil of the two spathe bracts, in six common garden and greenhouse-cultivated plants under 16-hr days. Allard and Garner

(1940, cf. Cholewa and Henderson, 1984) reported vivipary (in an eastern species) under short (10 hr) days.

Previous studies in the genus (Ingram, 1968; Henderson, 1976 cf. Cholewa 1984) have reported both outcrossing and selfing. Self-sterility, protandry, or the activity of insects apparently promotes outcrossing. A correlation between breeding systems and ploidal levels has also been demonstrated by these same studies; self pollination is reported to be frequent in some duodecaploids, whereas some tetraploid are self-incompatible. Henderson (1976) observed cross-pollination in natural populations in the northwestern species to be accomplished by solitary bees of the family *Megachilidae*. In the Rocky Mountains, some populations of *Sisyrinchium* are pollinated by solitary bees of the genus Lasioglossum Curt (Cholewa and Henderson, 1984. Observations of these populations indicate that bees visit *Sisyrinchium* flowers at an apparently random fashion, in some instances visiting neighboring plants, other times passing several flowering plants before making another visit. Although insect pollination is generally thought to promote outcrossing, observations of solitary bee behavior coupled with the self-incompatibility and self-pollination results indicate that insect pollinators may also effect self-pollination in *Sisyrinchium* (Cholewa and Henderson, 1984). This self-pollination could occur if the stigma maturation and anther dehiscence occur simultaneously and if the syle elongation has brought the stigmas to nearly the same height as the anthers. Self-incompatible plants often have the style well-exerted from the staminal tube versus styles equal in length to the filaments in self compatible plants (Cholewa and Henderson, 1984). Intraspecific crossability (the ability to produce seeds) was high in most Rocky Mountain species studied by Cholewa and Henderson (1984). Interspecific crossability was high in species of the same ploidy level but low in interploidal species.

HABITAT

The general habitat in which *S. strictum* has been collected includes moist meadows, dry or moist sandy soil openings that are either natural or the result of anthropogenic activities, low prairies, sandy-gravelly dry relict prairies, edges of mixed conifer/hardwood forest, stream banks, and shoreline cliffs. Associates species noted at the collection site along the edge of a conifer woods on Devils Island, Wisconsin (Cochrane 9208 Wisc) included *Abies balsamea*, *Betula papyrifera*, and *Alnus crispa* seedlings, and *Carex aurea*, *C. capillaris*, v. *major*, *C. crawfordii*, *Sisyrinchium farwelli*, *Dianthus barbatus*, *Fragaria virginiana*, *Potentilla tridentata*, *Arctostaphylos uva-ursi*, *Vaccinium myrtilloides*, *Diervilla lonicera*, and *Hieracium aurantiacum*. In a grassy meadow near Sobieski, Wisconsin (Judziewicz 2168 Wisc) the associates included *Scirpus atrovirens*, *Panicum boreale*, and *Scrophularia lanceolata*. A collection (Iltis 7944 Wisc) made near Chetek, Wisconsin, in a mesic, deep soil, sandy or gravelly prairie along a railroad indicated that associates included *Stipa spartea*, *Andropogon scoparius*, *A. gerardii*, *Danthonia spicata*, *Liatris spp*., and *Ambrosia psilotachya*. Another collection site near Pulcifer, Wisconsin was on sand and clayey soil of a SE-facing hillside or a road cut that supported *Geranium maculatum*, *Fragaria virginiana*, *Galium boreale*, *Daucus carota*, and *Rhus radicans* (Alverson 1514 Wisc). In Michigan, collections have been made at the edge of mixed woods along the Sturgeon River south of Alberta (Voss 12264 Mich), a gravelly hillside on the Flat River near Fallassburg (Bazuin 1629 Mich), along a utility right-of-way on dry soil (Ross 342 Mich), and along the margin of a small pond (Brunett 427 Mich).

DISTRIBUTION AND ABUNDANCE

Sisyrinchium strictum is considered a Great Lakes endemic, found only in Michigan and Wisconsin. The Michigan specimens are from six counties including Baraga, Jackson, Kent, Mecosta, Montcalm, and Newaygo (Figure 5). A location has been reported in Oceana County, although to date, no voucher has been deposited at major herbaria.

Information on the demographics of the existing populations is limited. Voss (Voss 7658 Mich) indicated that the species was "locally common" at a Baraga County site. Ross observed several clumps at the Mecosta County site in 2000, but did not consider it common. It was estimated that over 100 plants occurred at the Oceana County site (Ruta per comm. 2002).

Based on data from the collections at University of Wisconsin Herbarium (Black, 2002), *S. strictum* has been collected at 39 sites in 20 counties (Figure 6). It has been collected most often on the Apostle Islands in Ashland County, probably due to the intensive botanical surveys undertaken on the islands. The other Wisconsin collections are scattered throughout the state, with the exception of the Driftless Area. The data provides limited information on the size of the population from which the collections were made. The Shawano County collection (Alverson 1514 Wisc) indicated that the population supported "hundreds of healthy, flowering plants". In Florence County (Judziewicz 3977 Wisc) the habitat supported "large clumps with dozens of stems".

Figure 5: *Sisyrinchium* strictum; Michigan locations.

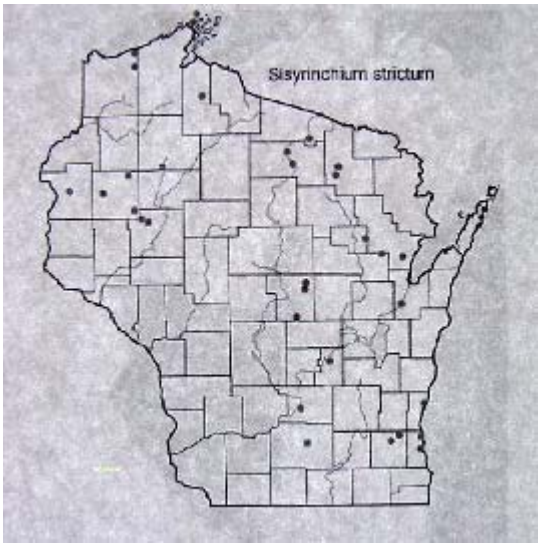

Figure 6: *Sisyrinchium* strictum; Wisconsin locations.

POPULATION BIOLOGY AND VIABILITY

The population biology of *S. strictum* has not been studied to date. Based on herbarium labels, it appears that *S. strictum* does not require a specialized habitat. It colonizes natural and artificial openings on both moist and dry sandy soils, and occurs along mixed conifer and hardwood forest edges. It appears to be intolerant of shade conditions and is likely stressed when woody plants encroach and become dominant in habitats supporting it. The size of populations appears to vary, ranging from a few individuals to hundreds of plants in large colonies. Once established a population may remain stable for long periods of time. Voss indicates that the population observed near the Upper Falls of the Sturgeon River in Baraga County in 1958 (Voss 7658, Mich) was "thriving and in good fruit when last visited…" in 1966 (Voss, 1967). Based on work with other *Sisyrinchium* species (Henderson, 1976; Cholewa and Henderson, 1984) it is doubtful that *S. strictum* has developed any unique pollinator/plant relationships. Some species are known to reproduce vegetatively, though information on *S. strictum* is lacking. The genus displays considerable intraspecific compatibility. It is not known whether herbivory plays a significant role in population dynamics. The prairie chicken, mountain quail, and wild turkey have been documented as utilizing blue-eyed grass, albeit in low quantities (Martin et al. 1951). The extensive flocks of wild turkey and herds of white tailed deer that reside in the Great Lakes may have an effect upon *Sisyrinchium* populations.

Our lack of knowledge about the biology of the species does not permit an assessment of the minimum viable population required to maintain the species in the long-term. Environmental, demographic, and genetic stochasticity, natural catastrophes and anthropogenic activities all apply pressure to natural populations. Lande (1993 and 1998 cf. Soule′ and Orians, 2001) has shown that demographic stochasticity is unlikely to be important for any population that has more than 100 individuals, but random environmental variation or catastrophes are important for populations of all sizes, and they become more significant as environmental variability becomes large in relation to the population growth rate. *Sisyrinchium* is a complex polyploid taxon that displays a great deal of phenotypic plasticity. Phenotypic plasticity may serve to buffer populations from environmental variation (Menges 1991 cf. Falk and Holsinger 1991).

Small populations may be genetically depauperate as a result of changes in gene frequencies, owing to founder effects or inbreeding. If a population suffers form-inbreeding depression, then it short-term viability may be compromised. (Menges1991 cf. Falk and Holsinger 1991). Cholewa (per comm. 2002) indicates that there is a lot of polyploidization in the genus *Sisyrinchium* and believes that this is the biggest factor attributed to the rarity of certain species. She cites *Sisyrinchium dichotomum* as a species that hardly produces viable seed in spite of available pollinators, suggesting genetic imbalances because of hybridization and polyploidization as a potential reason. If *S. strictum* is capable of reproducing by vegetative and/or apomictic means, similar to other species in the genus, it may be able to take advantage of environmental disturbance and expand current colonies regardless of limits on genetic diversity.

It is possible that *Sisyrinchium strictum* may have survived as isolated populations in patches of suitable habitat for a long time. It is not an ecological specialist and appears to be successful at colonizing disturbed sites. It may have developed a tolerance for low population densities and low viable seed production as well as inbreeding.

POTENTIAL THREATS AND MONITORING NEEDS

Anthropogenic activities and environmental stochasticity appear to be the current principal threats to S. *strictum.* Detailed studies of the breeding system and additional searches for historic and new populations need to be conducted prior to assessing the real threat of demographic or genetic stochasticity.

S. strictum has been occasionally observed along transportation and utility corridors. Maintenance of these corridors can have both negative and positive effects upon this species. Soil grading or herbiciding could result in the total destruction of the population or degradation of optimal habitat; however, the removal of encroaching woody vegetation or mowing of dense grass and herbs would reduce shade and potentially resource-competitive plants. The threat from invasive non-native species is or will likely become an issue at some sites harboring this species. Gilman (per comm. 2002) indicates that important management for *Sisyrinchium mucronatum*, a species with similar habitat requirements, is to maintain a thin turf and suppression of thick turf grasses. He believes that fires could be detrimental to the shallow root systems of *Sisyrinchium*.

Extant populations on public lands such as Huron-Manistee, Nicolet National Forests, the Apostle Islands, and potentially the Florence Barrons, could be considered for protection and may potentially serve as biological research sites. *Sisyrinchium strictum* is an R9 species on the Huron-Manistee National Forest and is subject to guidelines concerning monitoring and management of sensitive species. Consideration should be given to conducting additional searches for other populations within suitable habitat in adjoining compartments in the Huron-Manistee.

The prioritized strategy developed by Farnsworth and DiGregorio (2002) for purple milkweed (*Asclepias purpurascens*) in New England is potentially applicable to *Sisyrinchium strictum*. The authors suggest that the general actions, in descending order of importance, include;

1- land acquisition or protection of occurrences;
2- regular surveys of known occurrences;
3- de nova searches for new populations;
4- ex-situ activities including seed banking, germination research and propagation;
5- habitat and site management;
6- species biology research; and
7- augmentation, introduction, and reintroduction.

Future botanical surveys in suitable habitat should give particular attention to the presence of members of the genus *Sisyrinchium* and make attempts to accurately identify the plants to species. This attention may result in the discovery of additional populations of *Sisyrinchium strictum* in Wisconsin and Michigan.

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