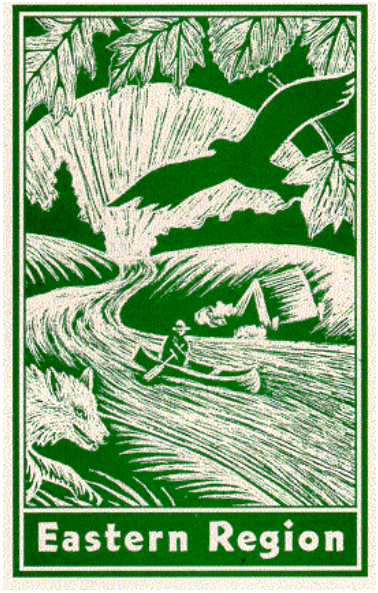
Conservation Assessment
For
Butler's Quillwort (Isoëtes butleri) Engelm.



USDA Forest Service, Eastern Region
2003

Prepared by:

This Conservation Assessment was prepared to compile the published and unpublished information and serves as a Conservation Assessment for the Eastern Region of the Forest Service.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.

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NOMENCLATURE AND TAXONOMY

Scientific Name: Isoëtes butleri Engelm.

Common Name: Butler's quillwort, glade quillwort, limestone quillwort

Family: Isoëtaceae

Synonyms: None

USFS Region 9 Status: Sensitive Species

USFW Status: None

Illinois Status: Endangered Species

Global And State Rank: G4

RANGE:

This species can be found in Alabama, Arkansas, Georgia, Illinois, Kansas, Kentucky, Missouri, Tennessee, and Texas (Taylor et al., 1993) (figure 1). In Illinois, this species can be found in one county: Will (figure 2).

PHYSIOGRAPHIC DISTRIBUTION:

Isoëtes butleri can be found in the Central Till Plains Section of the Prairie Parkland Temperate Province (Key et al., 1995). Based upon the Natural Divisions of Illinois (Schwegman et al., 1973), Isoëtes butleri can be found in the Grand Prairie Division (Eric Ulaszek per. comm.).

HABITAT:

This species can be found in seasonally wet calcareous soils of cedar glades (limestone glades) or barrens in Alabama, Arkansas, Georgia, Kentucky, Missouri and Tennessee and in the Midwest on sandstone outcrops (Boom, 1982). In Illinois, this species is found in and around shallow depressions in dolomite prairie (i.e. pavements) (Swink and Wilhelm, 1994). These depressions are seasonally moist and with minimum vegetation (i.e. low competition). Taylor and Schwegman (1992) suggest that open, calcareous soils, saturated with water in spring and dry in summer, provide the conditions that are required for the species to complete its life cycle. Plants associated with Isoëtes butleri in dolomite prairie are: Allium cernuum, Apocynum sibiricum, Arenaria patula, Aster ericoides, Desmanthus illinoensis, Dalea purpurea, Eleocharis compressa, Helianthus rigidus, Onosmodium hispidissimum, and Verbena simplex (Swink and Wilhelm, 1994).

SPECIES DESCRIPTION:

Heterosporus turfed grass-like perennial herb with a nearly globose (2-lobed) rootstock. Leaves 6-20 cm long, 0.3-0.7 mm wide, erect, twisted, dull green to gray green or yellow green, and whitish or pale reddish near the base (Gleason and Cronquist, 1991; Taylor et al., 1993). Leaves have numerous stomata. Sporangia 5-15 mm long, megaspores 480-650 µm diameter and microspores 27-37 µm long (Brooks, 1986). This species can be confused with other Isoëtes species such as Isoëtes melanopoda or Isoëtes engelmannii.

LIFE HISTORY:

Isoëtes butleri is a very seasonal species that is visible (i.e. leaves) from May to June. This species is heterosporus producing both megaspores of a light cream color and microspores of a brown color (Boom, 1982). Based upon other Isoëtes species, Isoëtes butleri can produce 200-900 megaspores and 300,000-1,000,000 microspores (Gifford and Foster, 1987). As suggested by Taylor and Schwegman (1992), Isoëtes butleri requires open, calcareous soils, saturated with water in spring and dry in the summer to complete its life cycle. Spores mature from late spring-early summer, then the leaves shrivel and turn yellow and by late July are gone (Swink and Wilhelm, 1994; Taylor et al., 1993). Spores will produce an endosporic gametophyte. After fertilization the young sporophyte becomes attached to the substratum but stays attached to the gametophyte for some time (Gifford and Foster, 1987). It has been suggested that growth of this species will depend upon the amount of precipitation that the site will receive (Steven R. Hill per. comm.).

Because this species produces spores (i.e. heterosporous), water is required for the species to complete its life cycle. Spores can germinate almost immediately after being shed from the sporangium, but in this cold climate species, the spores will germinate from late spring to middle July (Gifford and Foster, 1987; Swink and Wilhelm, 1994; Taylor et al., 1993). For Isoëtes butleri, dispersal of spores is by surface water flow (Steven R. Hill per. comm.), however wind dispersal is possible.

Currently, Illinois has five populations of Isoëtes butleri in Will County (Illinois Natural Heritage Database, 1999). Limited information is available regarding population dynamics or size. However, from the Illinois Natural Heritage Database (1999) population sizes can range from 10-20, 30-50 or greater than 100 individuals.

NATURAL AND HUMAN LAND USE THREATS:

Because Isoëtes butleri is considered a conservative species (Swink and Wilhelm, 1994) highly associated with limestone and dolomite prairies, concern regarding the decline of this species in the region is evident. The main threat to this species is the loss of habitat as a consequence of development, agriculture, and grazing. These activities can increase nutrient levels (e.g. fertilizers or cow/horse manure) in the soil increasing the potential for invasive species to out compete Isoëtes butleri or create a siltation problem. Also, changes in the

hydrology of its habitat and vegetation encroachment may affect this species, potentially impairing its reproduction (e.g. movement of spores).

VIABILITY:

To maintain minimum viable populations of Isoëtes butleri throughout its habitat range, protection, management, and restoration of habitat should be provided as much as possible. A minimum viable population is defined as a population size likely to give a population a 95% probability of surviving over a 100 year period (Menges, 1992). To insure viability:

1. It is vital that the size of the existing populations of Isoëtes butleri be maintained or increased to insure the persistence of this species in the region. Also, it is necessary that local spore sources are available for future reintroductions of the species to other areas. The only way to accomplish such a task is by protecting the already existing spore sources (i.e. populations) available in the region.

2. The creation and maintenance of a metapopulation for Isoëtes butleri is crucial for the persistence of the species in the region. A metapopulation is as an assemblage of populations existing in a balance between extinction and colonization, the boundaries of which can be a site or a geographical region (Husband and Barrett, 1996; Levins 1969, 1970). The populations that will form this metapopulation should be large because they can have a better opportunity of persistence than small populations (Hanski et al., 1996). Hanski et al. (1996) have suggested, based upon models, that a metapopulation should consist of a minimum of 15-20 well connected populations. However, Hanski et al. (1996) point out that if this cannot be achieved, the few remaining populations and habitats should be protected and other management techniques should be used to allow the persistence of these populations. Also, based upon models, populations should be >200 individuals to avoid demographical and environmental stochasticity (Menges, 1992). This number can be higher or lower depending upon the species.

The existing populations of Isoëtes butleri in the region potentially can go extinct as a consequence of severe drought years that may kill individuals or impair reproduction. By developing several populations (i.e. metapopulation) this situation may be prevented. Also, by having a metapopulation, other interactions that will impact the overall viability of Isoëtes butleri in the region, such as genetic structure, gene flow within and between populations, and spore dispersal, can be maintained

3. Protection of existing and newly discovered populations in the region should be attempted. Protection of these populations also implies protection of their habitat.

MANAGEMENT:

To maintain minimum viable populations of Isoëtes butleri throughout its habitat range, specific management practices will be needed to insure the persistence of the species.

1. To maintain and increase the existing populations of Isoëtes butleri, specific practices should be followed:

a. Management practices such as prescribed burns, minimum grazing, mowing, and removal of vegetation (e.g. woody, noxious weeds, etc.) should be used to avoid encroachment in existing habitat. These management practices should be conducted during the early spring or fall to avoid any impact on the reproduction of the species. The use of an Integrated Pest Management Plan such as the one developed by Carroll and White (1997) can be used to control exotic species in these areas.

b. Tiles should not be broken to prevent changes in the hydrology of the site (existing habitat) that may impair reproduction, recruitment, and establishment of individuals.
c. Activities that increase the likelihood of noxious weed introduction or cause trampling (e.g. humans or animals) of the plants should be avoided or minimized.
d. Development of trails in areas where Isoëtes butleri is found should be avoided or minimized to prevent negative impacts to the populations.

e. Collection of Isoëtes butleri should only be allowed for scientific reasons and only by permit.

2. To develop and maintain a metapopulation of Isoëtes butleri, attempts should be made to restore or reintroduce this species in areas that were historically dolomite. This includes the improvement of areas that have dolomite prairie and the reconstruction of areas that have lost the dolomite prairie plant matrix. Part of this restoration and reconstruction will include the reintroduction of Isoëtes butleri in the appropriate habitat. Potential habitat that can be used are sites that have soils found in dolomite prairies. The following is a list of soils found in dolomite prairies (Laatsch and Loebach, 1997; Eric Ulaszek per. comm.; William Glass per. comm.). For this particular species, priority should be given to areas with Romeo silt loam (soil depth ~2-10" over bedrock) and Channohon silt loam (soil depth 10-25" over bedrock). Swink and Wilhelm (1994) point out that the species can be found in shallow depressions in dolomite prairie (i.e. pavements). Also, at Grant Creek Prairie, this species is found in these soils (William Glass per. comm.). Other soils that should be considered for this species are Joliet silty clay loam (soil depth 10-25" over bedrock) and Millsdale silty clay (soil depth 25-42" over bedrock) (Laatsch and Loebach, 1997). However, Steven R. Hill (per. comm.) points out that the soil type is not as important as soil depth.

To maintain and increase these populations of Isoëtes butleri, the following practices should

be considered in addition to those measures outlined under 1 of this section:

a. To enhance the genetic diversity of the populations, spores (i.e. megaspores and microspores) should be collected from nearby populations (e.g. 50-100 miles) to develop gametophytes.

b. Spore sowing and gametophytes should be used to develop populations in the proper areas.

c. To create habitat for new populations, depressions resembling pavements should be created by removing soil to expose dolomite bedrock. The depression should be of approximately 2-3 meters in diameter and have very shallow soil (i.e. soil depth ~2). These depressions should be created in such a way that they will not fill with silt from scraped-off soil. In addition, depressions should be kept free of competition (e.g. noxious weeds, vegetation encroachment) (Steven R. Hill per. comm.).

d. Monitoring and evaluation should be conducted for any restored or reintroduced populations. In the event that a restored or reintroduced population is unsuccessful, a site's potential for a second reintroduction or restoration attempt should be reevaluated. This may require additional research.

3. In the case that additional populations of Isoëtes butleri are found in the region, they should be marked and protected from any potential damage and the above practices for maintenance and enhancement of these populations should be followed. Their habitat should also be protected.

MONITORING:

In natural populations, regular counts of individuals should be done during the late spring when leaves are yellow to determine population status. Transects and quadrats should be used to determine the size of a population in a large area. Hand counts can be done if a population is small (less than 100 individuals). In restorations, sampling should be done as above to detect increases or decreases in the population. If no significant changes are detected, reevaluation of propagation techniques and management practices should be done to enhance the population.

RESEARCH NEEDS:

Immediate research needs that will help in the establishment and management of Isoëtes butleri are:

1. Collect information on several aspects of the natural history such as specific habitat requirements (e.g. soils) of the species. This will allow a better understanding of how and where the species can be reintroduced.

2. Land inventories to determine the presence of the species. One of the reasons that this

species is considered endangered or threatened is because of the lack of available records. It is possible that an extended survey of sites with suitable habitat may change the status of the species.

3. Determine the requirements and techniques for vegetative propagation. This will help in the reintroduction of the species to suitable habitat.

4. Collect demographic and population size information. This information is needed to determine the population structure and population changes (i.e. increases or decreases) of the species. With this information, specific recommendations can be made if the population is declining or only megasporophyte or microsporophyte are found.

5. Develop a Population Viability Analysis (PVA). A PVA identifies the threats faced by a species and can evaluate the likelihood that the species will persist for a given time into the future. To develop a PVA, field studies, data analysis, modeling, assessment of extinction risks, sensitivity analysis, and monitoring, among other things, are needed.

6. Determine the impact of different management (e.g. grazing, fire) and recreational activities. It is important to determine the best management practice(s) to improve the habitat for the species. Also, it is important to determine which recreational activities are compatible with the species. This will prevent any risks to the species and its habitat.

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