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Population Viability Assessment for Glade mallow (Napaea dioica L.)

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POPULATION VIABILITY ASSESSMENT FOR GLADE MALLOW (NAPAEA DIOICA L.)

SCIENTIFIC NAME: Napaea dioica L.

COMMON NAME: Glade mallow

FAMILY: Malvaceae

SYNONYMS: None

USFS REGION 9 STATUS: Sensitive Species

USFW STATUS: None

ILLINOIS STATUS: None

GLOBAL AND STATE RANK: G3N3

RANGE: This species can be found in Illinois, Wisconsin, Minnesota, Iowa, Indiana, Ohio, Virginia, and Pennsylvania (Gleason and Cronquist, 1991; Iltis, 1963; Robertson and Phillippe, 1992) (figure 1). However, the presence of Napaea dioica in Virginia and Pennsylvania may be based upon a misidentification with a similar species, Sida hermaphrodita (Iltis, 1963; Robertson and Phillippe, 1992). In Illinois, this species can be found in 31 counties: Bureau, Champaign, Clark, Cook, DeKalb, DuPage, Fulton, Grundy, Henry, Jo Daviess, Kendall, Knox, LaSalle, Logan, McHenry, McLean, Macon, Marshall, Menard, Ogle, Peoria, Piatt, Putnam, Rock Island, Sangamon, Stark, Stephenson, Vermilion, Whiteside, Will, and Winnebago (figure 2).

PHYSIOGRAPHIC DISTRIBUTION: Napaea dioica can be found in the Southwestern Great Lakes Moraines Section and Central Till Plains (Oak-Hickory) Section of the Eastern Broadleaf Forest Continental Province (Key et al., 1995). Based upon the Natural Divisions of Illinois (Schwegman et al., 1973), this species can be found in the Wisconsin Driftless Division, Rock River Hill County Division, Northeastern Morainal Division, Grand Prairie Division, Western Forest-Prairie Division, and Wabash Border Division (Vermilion River Section) (Eric Ulaszek per. comm.).

HABITAT: This species can be found in alluvial terraces above rivers and floodplains of permanent streams (Robertson and Phillippe, 1992). Although it has been suggested that Napaea dioica is a prairie species (Iltis, 1963; Utech, 1970), in Illinois the species has not been found in undisturbed prairies (Robertson and Phillippe, 1992). Plants associated with Napaea dioica in alluvial soil along streams and rivers are: Actinomeris alternifolia, Amorpha fruticosa, Campanula americana, Celtis occidentalis, Elymus virginicus,

Eupatorium rugosum, Rudbeckia laciniata, and Silphium perfoliatum (Swink and Wilhelm, 1994).

SPECIES DESCRIPTION: Dioecious perennial herb, 2-3 meters tall, with a stout taproot. Alternate leaves palmately lobed and coarsely toothed. Largest leaves (30-50 cm) found at the base of the plant. Numerous flowering stems (5-10) that will produce a large terminal panicle. Small white flowers (2 cm). Fruit a schizocarp with approximately eight to ten seeds (Robertson and Phillippe, 1992). This species can be confused with Sida hermaphrodita (L.) Rusby.

LIFE HISTORY: Napaea dioica is a dioecious (i.e. male and female individuals) species that blooms from June to July (August). Flowers open in the early morning and close at dusk (Robertson and Phillippe, 1992). Staminate flowers begin to flower before the pistillate flowers and overlap between both flower types occurs. After all the staminate flowers have bloomed, the pistillate flowers continue to bloom for a short time (Robertson and Phillippe, 1992). In general, the species is pollinated by numerous pollinators such as bumblebees, hover flies, and solitary bees (Itis, 1963). Vegetative propagation is possible via rhizomes and in cultivation it can become a weedy species (Kenneth Robertson per. comm.).

This species has long-lived seeds (John Taft per. comm.). Minimal information is available regarding the germination of Napaea dioica. Nonetheless, it has been suggested that scarified seed subjected to moist stratification will produce high seed germination (Robertson and Phillippe, 1992).

No information is presently available regarding seed dispersal. Kenneth Robertson (per. comm.) suggests that there are no apparent adaptations for dispersal on the seeds. Nonetheless, based upon the height of the inflorescence (i.e. at least 2 meters) and the fruit, a schizocarp that splits apart, it is likely the seeds will disperse several meters away from the maternal plant (Steven R Hill per. comm.). Also, because of the habitat (i.e. floodplains) that the species occupies, seeds can disperse by floating (Steven R Hill per. comm.).

In Illinois a total of 59 populations are known (Robertson and Phillippe, 1992). These populations for the most part are small with less than 100 individuals. However, several large populations of more than 300 and some of even greater than 1000 individuals have been found.

NATURAL AND HUMAN LAND USE THREATS: Because of land use practices and the association of this species with floodplains, concern regarding the decline of Napaea dioica in the region is evident. The main threat to this species is the loss of habitat as a consequence of development, agriculture, and grazing. Grazing, in particular, has been suggested to reduce the individuals to rosettes (William Handel per. comm.). Additional threats to this species are: herbicide application along railroad beds which has destroyed many populations, vegetation encroachment because the species does not tolerate shade (Kenneth Robertson per. comm.), and stream channelization (Robertson and Phillippe, 1992; TNC-BioSources, 1999).

VIABILITY: To maintain minimum viable populations of Napaea dioica 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 Napaea dioica be maintained or increased to insure the persistence of this species in the region. Also, it is necessary that local seed sources are available for future reintroductions of the species to additional sites. The only way to accomplish such a task is by protecting the already existing seed sources (i.e. populations) available in the region.

2. The creation and maintenance of a metapopulation for Napaea dioica 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 population of Napaea dioica in the region potentially can go extinct as a consequence of low recruitment, stochastic event, etc. 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 Napaea dioica in the region, such as pollinator interactions, genetic structure, gene flow within and between populations, and seed 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 Napaea dioica 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 Napaea dioica, 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 late fall to avoid any impact on the reproduction of the species. TNC-BioSources (1999) suggests that fire is a useful tool to prevent vegetation encroachment and can help in the establishment of seedlings. In addition to these management practices, an Integrated Pest Management Plan such as the one developed by Carroll and White (1997) can be used to control exotic species.

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 Napaea dioica is found should be avoided or minimized to prevent negative impacts to the populations.

e. Collection of Napaea dioica should only be allowed for scientific reasons and only by permit.

2. To develop and maintain a metapopulation of Napaea dioica, attempts should be made to restore or reintroduce this species in areas that were floodplains (i.e. alluvial terraces). This includes the improvement of areas that have floodplains, in particularly alluvial terraces, and the reconstruction of areas that have lost the floodplain plant matrix. Part of this restoration and reconstruction will include the reintroduction of Napaea dioica in the appropriate habitat (i.e. alluvial terraces). Potential habitat that can be used are sites that have soils found in floodplains, particularly in alluvial terraces. The following is a list of soils found in floodplains (i.e. alluvial terraces) (Laatsch and Loebach, 1997; Eric Ulaszek per. comm.): Brenton silt loam (soil depth 1.5-3.0 ft. over outwash), Camden silt loam (soil depth NA), Lawson silt loam (soil depth NA), Lorenzo silt loam (soil depth NA), Millbrook silt loam (soil depth 25-42' over bedrock), Proctor silt loam (soil depth 1.5-3.0 ft. over outwash), and Warsaw silt loam (soil depth 2.0-3.5 ft. over gravel drift).

To maintain and increase these populations of Napaea dioica, 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, seeds should be collected from nearby populations (e.g. 50-100 miles) to develop seedlings and rootstock.

b. Seed sowing should be used to develop populations in the proper areas.

c. For the successful establishment of Napaea dioica in floodplains, development of terraces may be needed for germination and seedling establishment.

d. For the successful establishment of Napaea dioica seedlings in floodplains, protection and maintenance of free-flowing streams to continue flooding and scouring of stream banks is needed (i.e. periodic disturbances) (TNC-Biosources, 1999).

e. 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 Napaea dioica 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 (i.e. flowering-male and female, non-flowering, juveniles and seedlings) should be done 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 restored areas, sampling should be done as above to detect increases or decreases in the population. If no significant changes are detected, reevaluation of restoration techniques and management practices should be done to enhance the population.

RESEARCH NEEDS: Immediate research needs for Napaea dioica that will help in the establishment and management of the species are:

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

2. Determine several aspects of the reproductive biology (e.g. breeding system, pollinators, asexual reproduction, etc.) of the species. For example, this information may help us understand if reproductive factors associated with the species may be the limiting factor in the persistence of populations in an area or in the reintroduction of the species to an area.

3. 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 seedlings are found.

4. Determine the effect of herbicides on the species. Because herbicides may be needed to control noxious weed or exotic species determining how and which herbicides may affect the species is important to prevent a negative impact to the species.

5. Determine the impact of introducing this species in natural communities because of its weedy nature in cultivation. If this species is aggressive, then it can become a problem (e.g. encroaching other species) in a natural or restored community.

6. Develop a Population Viability Analysis. 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.

7. 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.

REFERENCE LIST

a) Literature cited

Carroll, C. J. and J. White. 1997. Integrated Pest Management Methods for Control of Invasive Exotic Plant Species at Midewin National Tallgrass Prairie. Unpublished report by Ecological Services for the Illinois Department of Natural Resources, Springfield, IL.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd ed. New York Botanical Garden, Bronx, NY.

Hanski, I., A. Moilanen, and M. Gyllenbergl. 1996. Minimum viable metapopulation size. The American Naturalist 147: 527-541.

Husband, B. C. and S. C. H. Barrett. 1996. A metapopulation perspective in plant population biology. Journal of Ecology 84: 461-469.

Iltis, H. H. 1963. Napaea dioica (Malvaceae): Whence came the type? American Midland Naturalist 170: 90-109.

Key, J. Jr., C. Carpenter, S. Hooks, F. Koenig, W. H. McNab, W. Russell, and M. L. Smith. 1995. Ecological Units of the Eastern United States-First Approximation (map and booklet of map unit tables). U.S. Department of Agriculture-Forest Service, Atlanta, GA.

Laatsch, J. and B. Loebach. 1997. Midewin Ecological Unit Map and Summaries. Unpublished report by Division of Natural Heritage-Illinois Department of Natural Resources, Springfield, IL.

Levins, R. 1969. Some demographical and genetic consequences of environmental heterogeneity for biological control. Bulletin of the Entomological Society of America 15: 237-240.

Levins, R. 1970. Extinction. In Lectures on Mathematics in the Life Sciences, 2. ed. M. Gerstenhaber. Pp. 77-107. American Mathematical Society, Providence, RI.

Menges, E. S. 1992. Stochastic modeling of extinction in plant populations. In Conservation Biology: The Theory and Practice of Nature Conservation, Preservation, and Management. eds. P. L. Fiedler and S. Jain. Pp. 253-275. Chapman and Hall, New York, NY.

Mohlenbrock, R. H. and D. M. Ladd. 1978. Distribution of Illinois Vascular Plants. Southern Illinois University Press, Carbondale, IL.

Robertson, K. R. and L. R. Phillippe. 1992. The current status of Napaea dioica L. in Illinois. Technical Report 1992 (3). Illinois Natural History Survey-Center for Biodiversity. 607 East Peabody Drive. Champaign, Illinois 61820.

Schwegman, J. E., G. D. Fell, J. Hutchinson, G. Paulson, W. M. Shepard, and J. White. 1973. Comprehensive Plan for the Illinois Nature Preserve Commission. Part II - The Natural Divisions of Illinois. Illinois Nature Preserve Commission, Springfield, IL.

Swink, F. and G. Wilhelm. 1994. Plants of the Chicago Region. 4th ed. Indiana Academy of Science, Indianapolis, IN.

TNC-BioSources. 1999. An electronic database housed in The Nature Conservancy.

Utech, F. 1970. Preliminary reports on the flora of Wisconsin. No. 60 Tiliaceae and Malvaceae-basswood and mallow families. Transactions of the Wisconsin Academy of Sciences, Art, and Letters 58: 301-323.

b) Web pages cited

www.fs.fed.us/ne/delaware/ilpin/N.htm

c) Personal communications

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Figure 1) Distribution of Napaea dioica in the United States of America (Iltis, 1963).

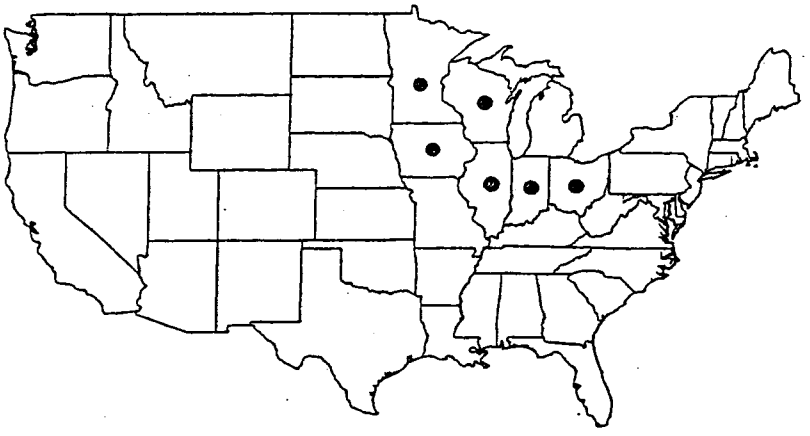

Figure 2) Distribution of Napaea dioica in Illinois (form Mohlenbrock and Ladd 1978 and www.fs.fed.us/ne/delaware/ilpin/S.htm).