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BIOLOGICAL ASSESSMENT

BIRD'S-FOOT VIOLET, *Viola pedata*

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Illinois Natural History Survey
607 East Peabody Drive
Champaign, Illinois 61820

Prepared for:

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1.0 Taxonomy

1.1 Scientific name: *Viola pedata* L.

1.2 Common name: Bird's-foot violet, Johnny-jump-up, crow-foot violet, pansy violet.

2.0 Identification

2.1 General Description

Perennial species, 3-6 inches high, nearly glabrous with leaves and flowers growing from a short vertical rootstock, but no rhizomes or stolons. Leaves are lobed and divided. The flowering stems extend above the leaves. Each flowering stem is curved with a single flower. Flowers, lilac purple, are 1½ inches wide, with five sepals and petals. All petals are hairless on the inside. Five stamens with large orange anthers are conspicuously exerted in the center of the flower. Capsules are yellowish-brown with reddish, tan or copper seeds. Seeds have a diplochore dispersal mechanism (Beattie and Lyons, 1975). The capsule will eject the seeds followed by ant exploitation.

This species has two phenotypes that have been recognized taxonomically. In the more common phenotype, all petals are either purple (normal) or white (in albinos, *V. pedata* L. var. *pedata*), while in the less common phenotype, the upper 2 petals are dark purple, and the lower 3 petals are white with dark purple veins but become completely white at base (*V. pedata* L. var. *linearíloba* DC) (Brooks and McGregor, 1991). In the Chicago region, all populations of *Viola pedata* L. are var. *linearíloba* DC. (Swink and Wilhem, 1994). Also, *Viola pedata* shows seasonal variation in both leaf blade structure and flower color.

2.2 Diagnostic characteristics

Pansy-like flowers with protruded stamens and no cleistogamous flowers. Leaves deeply segmented resembling the tract of a bird's foot.

3.0 Legal Status

3.1 National status: Not listed at the federal level in the USA. However, in Canada was designated threatened in 1990 (see following web site: www.nais.ccm.emr.ca/schoolnet/issues/risk/plant/eplants/brdsfoot.html). In Canada, this species is found only in southern Ontario. Populations are found in pockets isolated from the main USA populations.

3.2 State(s) status: Listed as threatened in Ohio (see following web site: www.dnr.state.oh.us/odnr/dnap/heritage/plants98.html).

3.3 TNC rank: The Nature Conservancy ranks this species G5 (global), meaning that the species is widespread and stable. TNC does not have a ranking for this species in the USA (i.e. S?).

4.0 Range Map

Total and state distributions of *Viola pedata* are shown on accompanying maps (see figure 1: www.itis.usda.gov/plantproj/plants/cgi_bin/fr_enter.cgi?earl=fr_qurymenu for general range, and figure 2: form Mohlenbrock and Ladd 1978 and www.fs.fed.us/ne/delaware/ilpin/V.htm for Illinois distribution).

5.0 Habitat

5.1 Natural Habitats: This species is found in dry-mesic prairie and dry-open woods (Rock, 1974).

5.2 Other habitats: Rare to locally common in rocky open woodlands, rocky or sandy prairies, roadside banks (Brooks and McGregor, 1991).

5.3 Limiting factors

5.3.1 Moisture: This species can be found in dry soils (William Handel personal communication).

5.3.2 Soils: *Viola pedata* can be found in acid, argillaceous, and siliceous soils (Brooks and McGregor, 1991; McKinney, 1992; Stevens, 1961).

5.3.3 Shade tolerance: *Viola pedata* is usually found in open sunny sites (William Handel personal communication).

6.0 Reproductive Ecology

6.1 Phenology

Viola pedata flowering and fruiting period is from April to June and occasionally from October to December (McKinney, 1992).

6.2 Breeding system

This species is self-incompatible, however this incompatibility is not complete since self-seeds can be obtained (Becker and Ewart, 1990).

6.3 Pollination mechanisms and pollinators

Viola pedata is visited by long-tongued bees, Diptera, and Lepidoptera (see following web site: www.inhs.uiuc.edu/~kenr/prairietable2.html). Because *Viola pedata* can be pollinated by a number of pollinators the pollination mechanisms associated for the species can be several. Studies associated with the pollination mechanisms of *Viola pedata* have not been conducted. Nonetheless, based upon other *Viola* species (Beattie, 1971), a pollinator can insert its proboscis with pollen from another *Viola pedata* flower into the petal-spur to try to reach the nectar. As the proboscis slide under the style it touches the stigma and pollen is deposited. As the pollinator attempts to reach the nectar, pollen can fall onto the dorsal surface of the proboscis and the head. The insect can remove its proboscis carrying pollen to next flower.

6.4 Other factors affecting seed production

This information is not available for *Viola pedata*. However as with many insect pollinated species with self-incompatibility, low abundance of pollinators may result in low fruit and seed set because of the lack of out-cross pollen. Also, intense herbivory can have a similar result.

7.0 Population Ecology

7.1 Demography/life history

Little information is available regarding the life history of this species. However William Handel (personal communication) indicates that it will take at least five years for *Viola pedata* to bloom from seed.

7.2 Abundance

Russell (1965) indicates that compared to other eastern *Viola* species, such as *V. sororia* and *V. pubescences* var. *eriocarpa*, *V. pedata* is less abundant. It is possible that the abundance of *V. pedata* is associated with the quality of the habitat. Swengel (1997) found *Viola pedata* abundance in undegraded habitats (i.e. prairies) was high compared to degraded habitats (i.e. grazed areas). However, in the same study, abundance in semi-degraded habitats was intermediate.

7.3 Trends

Because *V. pedata* is consider a conservative species (Swink and Wilhem, 1994) highly associated with undisturbed prairies, concern regarding the decline of this species in Illinois is evident.

7.4 Limiting factors for population viability

Several factors can limit the viability of *Viola pedata* populations, among them habitat destruction or degradation, herbivory, and reduced abundance of pollinators.

8.0 Genetic issues

Some controversy exists regarding the number of chromosomes in *Viola pedata*. In general, this species has a 2n = 54 (Canne, 1987; Gershoy, 1928, 1934). However, two studies done by Gershoy (1928, 1934) indicate that *V. pedata* can have a 2n = 56 or 54.

One potential genetic issue associated with *Viola pedata* concerns its genetic integrity. In contrast to other *Viola* species such as *V. pedatifida* and *V. sororia* (Brooks and McGregor, 1991), no hybridization has been found for *Viola pedata*. However, Russell (1965) indicates that *V. sororia* can hybridize with any stemless blue violet. For the genetic integrity of *V. pedata* to be maintained, when *V. sororia* is found in environments with *V. pedata*, precautions must be taken to avoid contact between these species.

9.0 Interactions with other organisms

9.1 Alleopathy

No evidence of alleopathy for this species has been reported.

9.2 Critical host plant for arthropods of conservation concern

This species serves as a host and a food source for the regal fritillary butterfly (*Speyeria idalia*), a watch list species in Illinois (Swengel, 1997). Females will lay single eggs on several violet plants, and then the caterpillars in the spring will feed on the leaves.

9.3 General food/shelter source for wildlife/insects

Viola pedata can be a host and food source for several fritillary species (*Speyeria* and *Boloria*) (Opler and Malikul, 1998; Swengel, 1997), as well as bumblebees (*Bombus* sp.), solitary bees, and syrphid flies (Beattie, 1978).

9.4 Effect of browsing/grazing by ungulates

Grazing by ungulates and rabbits can affect the new palatable growth and mature plants (William Handel personal communication). However, the effect of grazing on reproduction or other aspects of the biology of the species is unknown.

9.5 Seed production

Because *Viola pedata* is self-incompatible (Becker and Ewart, 1990) low abundance of pollinators carrying cross pollen can result in zero or low fruit and seed set. Also, intense herbivory can result as well in low fruit and seed set in *V. pedata.*

9.6 Other Herbivory

Beside the caterpillars of the several fritillary species, deer, cattle and rabbits are likely herbivores of *Viola pedata.* Because seedlings and plants are often grown in greenhouses for prairie restoration projects, common greenhouse pests that attack commercial violets can affect *V. pedata.* Many commercial viola species are attacked by the larvae of the violet sawfly (Order *Hymenoptera*, Suborder *Symphyta*), a smooth bluish-black larva of about ½ inch long, that eats the leaves at night (see the following web site: www.enter.net/~kshullpa/violets.html). Although there is only one generation of these sawflies, they may be active during the summer. Commercial insecticides effectively control this problem. Other herbivores such as slugs and cutworms can eat the leaves.

Seed herbivory is another potential problem. In a study by Beattie and Lyons (1975) ant species, such as *Myrmica spatulata, Tapioma sessile* and *Formica fusa*, were observed removing seeds and destroying the seed content.

9.7 Diseases and parasites (including galls)

This information is not available for *Viola pedata.* However, because seedlings and plants are often grown in greenhouses for prairie restoration projects, common greenhouse pests that attack commercial violets can affect *V. pedata.* Many commercial violets are attacked by anthracnose, causing large dead spots on the leaves (see the following web site: www.enter.net/~kshullpa/violets.html). Root rot is another occasional pest. If disease is found, sanitation and soil sterilization are necessary. Also the use of fungicide may help prevent anthracnose.

Another potential greenhouse pest is the violet gall midge, which rolls and twists the opening leaves. The use of insecticide when flies are active should control the problem (see the following web site: www.enter.net/~kshullpa/violets.html).

10.0 Fire effects/response

Swengel (1997) found no significant differences in the abundance of *V. pedata* between burn vs. non-burn management units.

11.0 Threats to species

The main threat to this species, as in the case of all prairie species, is the loss of habitat as a consequence of development, agriculture and grazing.

12.0 Preserve design to maintain viable population

As with many prairie species, this information is not available for *Viola pedata.* However, a large, unfragmented area will be generally be preferred over several small, isolated areas. This will allow several populations of *Viola pedata* to coexist within a large area. Nonetheless, having scattered populations near the preserve may help re-

colonize the site in the case that an extreme disturbance eliminates the populations within the site.

It is also important for the maintenance of a viable population of *Viola pedata* that the presence of other species associated with *Viola pedata* (see Swink and Wilhem, 1994) be considered. Having species with a similar flowering phenology will allow a steady supply of pollinators.

Finally, because *Viola pedata* is a host and a food source for the regal fritillary butterfly (*Speyeria idalia*) and other fritillary species, preserve design should take into account the interaction between these species. Swengel (1997) found that for high abundance the regal fritillary butterfly needs a large area (127-571 ha) and that *V. pedata* needs an intermediate area (9-36 ha). However, the quality of the site ultimately determines whether both of the species will be present.

13.0 Management

13.1 Case studies

In a study by Swengel (1997), burning did not affect the abundance of *V. pedata.*

13.2 Best management practices

Because much of the basic biology of the species is unknown, it is difficult to determine the effects of mowing, grazing, and burning on the species. Nonetheless, both grazing and prescribed burning are common practices of prairie management, and if done at the right time (i.e., when dormant in spring or fall), should have a minimal impact on *Viola pedata* and associated species such as regal fritillary butterfly (*Speyeria idalia*). However, because evidence suggests that for the regal fritillary butterfly, burning can result in low butterfly abundance (Swengel, 1997), low impact grazing or rotational haying may be the best management practice for both.

13.3 Detrimental management/control practices

Grazing by ungulates such as cattle can negatively affect the young plants or the young spring sprouts.

14.0 Propagation practices

14.1 Seed germination requirements

Seed should be collected during July. Seeds need cold-moist stratification at 34-40°F for 60-90 days (Rock, 1974; Steffen, 1997).

14.2 Vegetation propagation

Rock (1974) suggests that mature plants can be divided after blooming, cutting out a central core. Root cuttings can be used for vegetative propagation.

14.3 Best (most effective) propagation techniques

The most effective way to propagate *Viola pedata* is by seed (Rock, 1974). However, Wherry (1948) indicates that this species in cultivation does not survive long unless the soil can be maintained in an absolutely acid condition.

15.0 Monitoring protocols

15.1 Natural populations

Regular counts of individuals should be done to determine population status. Transects and quadrats should be used to determine the size of the population in a large area. Hand counts can be done if the population is small (less than100 individuals).

In addition to determining population size, plants should be classified as adults (flowering and non-flowering), juvenile, and seedlings. This classification will provide important demographical information regarding changes in the age structure of the population.

15.2 Restored populations

Because *Viola pedata* appears to be a difficult species to reintroduce in prairie restoration, plants should be counted regularly to detect increases in the population. If no significant changes are detected, re-evaluation of seeding techniques and management practices should be done to enhance the population.

16.0 Current research programs

Dr. Steven B. Carroll, a plant reproductive ecologist from Truman State University, Kirksville-MO, is studying the maintenance of polymorphism in *Viola pedata* (see the following web site: www.nemostate.edu/academics/sc/ricarroll.html). In Illinois, no active research program currently focuses on *Viola pedata.*

17.0 Research needs

Research needs associated with *Viola pedata* include: 1) Demographic studies to determine life span, reproductive age, etc.; 2) Studies to determine the effects of herbivory and fire on reproduction; 3) Studies to determine why *V. pedata* is difficult to reintroduce in restorations; 4) Genetic studies to determine genetic variability of populations; and 5) Studies examining potential problems of hybridization with other *Viola* species.

18.0 Summary

Viola pedata is a highly conservative species, found in undisturbed prairies in Illinois. If the genetic integrity of *V. pedata* is desired, precautions must be taken to avoid any hybridization between this species and others *Viola* species, such as *V. sororia.* One key role of *Viola pedata* in prairies is that it serves as a host and food source for the regal fritillary butterfly (*Speyeria idalia*) and other butterflies species. As a consequence of this, several aspects of the quality and management of the site are crucial for the co-existence of these species. High quality prairies (i.e. high species diversity) and low impact grazing will result in the highest abundance of these two species. Finally, the low abundance of this species in prairie restorations suggests that this species is not easily reintroduced.

19.0 Acknowledgements

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Figure 1) Distribution of *Viola pedata* in North America (www.itis.usda.gov/plantproj/plants/cgi_bin/fr_enter.cgi?earl=fr_qurymenu).

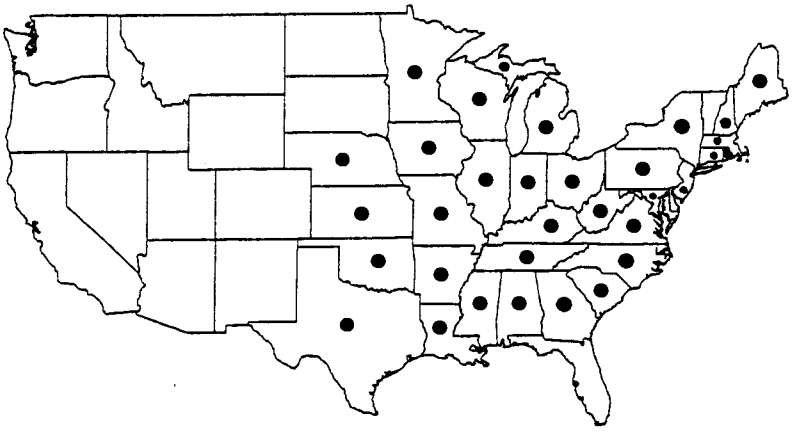

Figure 2) Distribution of *Viola pedata* in Illinois (form Mohlenbrock and Ladd 1978 and www.fs.fed.us/ne/delaware/ilpin/V.htm).