COSEWIC
Assessment and Status Report

on the

Western Blue Flag
Iris missouriensis

in Canada

SPECIAL CONCERN
2010

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC. 2000. COSEWIC assessment and update status report on the Western Blue Flag *Iris missouriensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 12 pp.

Gould, J., and B. Cornish. 2000. Update COSEWIC status report on the Western Blue Flag *Iris missouriensis* in Canada, *in* COSEWIC assessment and update status report on the western blue flag *Iris missouriensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-12 pp.

Wallis, Cliff, and Cheryl Bradley. 1990. COSEWIC status report on the Western Blue Flag *Iris missouriensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 36 pp.

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Western Blue Flag — Photograph courtesy of Joyce Gould, with permission.

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COSEWIC
Assessment Summary

Assessment Summary – April 2010

Common name
Western Blue Flag

Scientific name
Iris missouriensis

Status
Special Concern

Reason for designation
This showy perennial is restricted to ten native sites and is also present at a few sites where it is believed to have been introduced. It occurs primarily in the grasslands of southern Alberta. Several new populations have been discovered since the species was last assessed. The area occupied and total population size of native plants are now known to be larger than previously determined. The total Canadian population appears to be stable but fluctuates in size. The species is subject to ongoing competition from invasive plants, but trampling in areas heavily grazed by cattle has been largely mitigated by recovery actions.

Occurrence
Alberta

Status history
Designated Threatened in April 1990. Status re-examined and confirmed in May 2000. Status re-examined and designated Special Concern in April 2010.

COSEWIC
Executive Summary

Western Blue Flag
Iris missouriensis

Species information

Western Blue Flag, a long-lived perennial, is a member of the Iris family. Flowering stalks produce two to four showy flowers in various colours of pale to deep blue and lavender, with a rare white form found occasionally. Each flower has purple veins that radiate from a bearded yellow spot on each of three outer sepals (segments) that are recurved and spread outward. Three petals and three styles on the inner segments of the flower are erect or arch upwards and bloom sequentially, often on a leafless stem or sometimes having one leaf. Pale blue-green sword-like leaves folded lengthwise grow from the base of the stem, which reaches a height of 30 to 60 cm. The species is sometimes called the Rocky Mountain Iris.

Distribution

Western Blue Flag is a North American species that is widely distributed throughout the western United States. In Canada, the species is known from a site as far north as Banff National Park, Alberta, as well as sites in the Calgary region. However, these sites are of unknown origin and appear to be beyond the native range of the species which occurs within a narrow band near the U.S.-Canada border extending from the west portion of the Milk River Ridge to west of Carway, Alberta. In total, there are 17 documented populations (native and introduced), only 10 of which are considered native. The following seven populations are considered to be beyond the native range and are not included for assessment purposes; they are also of unknown or introduced origin or no longer extant: four extant populations of unknown origin (Fort Macleod, Calgary Airport, Banff National Park, and Park Lake), one introduced and extant population (Frank Lake), and two extirpated (University of Calgary and Picture Butte). The species was formerly considered to occur in British Columbia but those specimens are now considered to be another species, *Iris setosa* Pallas *ex* Link.

The species, including all 17 native, unknown, and introduced populations occurring from the U.S.-Canada border to Calgary and Banff National Park extends over an area of about 22,000 km^2. However, the actual range of the ten native populations near the U.S.-Canada border covers an area of only about 250 km^2. Most of the intervening area between the native populations and those northward as far as Banff is unsuitable habitat for the species with the actual area of habitat occupied by native plants being about 3 km^2.

Habitat

Native populations of Western Blue Flag are located in the Foothills Fescue and Foothills Parkland natural subregions in Alberta. Some populations of unknown origin are located in other subregions, including the Mixedgrass (Park Lake and Fort McLeod) and Montane (Banff). Habitat preference for the Western Blue Flag is within a narrow zone of moist meadows through a transition zone of drier upland slopes and wet meadows or seepage springs. Its occurrence is usually on level or slightly sloping ground with an abundance of subsurface moisture. Soil conditions in the spring are damp, but are well drained and drier by the middle of summer. Western Blue Flag is often found near willow thickets around moist depressions, with some sites on dry upland areas in Rough Fescue communities.

Biology

This species reproduces both sexually and asexually. The linear growth and branching of the rhizomes is able to withstand trampling and allows it to spread quickly when competing vegetation is removed. A three-chambered capsule containing the smooth, dark brown seeds can be dispersed by wind, water and other methods. Seeds require a germination period of two to three months, with flowers produced in the second or third year. Flowers appear from mid-June through early July in Alberta and are adapted to bee pollination.

Population sizes and trends

The total native Canadian population in 2009 was estimated at between 110,000 and 120,000 stems; however, some sites were not visited. This estimate has significantly increased since the last COSEWIC report in 1999 of 7500 stems. Since 1999, two populations previously recorded no longer exist and two are considered to possibly be extirpated. A number of new populations have been discovered within the known native range and a series of other populations have been found disjunct from the known native populations. The increase in population size and number of previously unidentified sites is more an indication of increased cooperation and participation by land managers and land owners, increased search effort and public interest in conservation and management activities of this species, than it is an actual increase in the number of existing populations; presumably, the “new” populations existed previously, but there are no data to confirm this.

Monitoring of these sites demonstrates naturally fluctuating numbers of stems and flowers over the years; however, the population appears to be stable.

Limiting factors and threats

The main limiting factors and threats to Western Blue Flag include the loss of habitat (including alteration and fragmentation of landscapes), competition from introduced/invasive species, grazing pressure, alteration of hydrology, collection for horticultural and medicinal uses and herbicide use. The species does benefit from light to moderate grazing.

Special significance of the species

Western Blue Flag has a narrow environmental tolerance with specific habitat requirements. The species is found in some of the most threatened landscapes in Alberta. No information has been found on Aboriginal or confirmed human use in Canada for Western Blue Flag; however, medicinal and ceremonial uses have been reported for first nations in the United States.

Existing protection

COSEWIC assessed this species as Threatened in May 2000 and it is currently listed on Schedule 1 of the *Species at Risk Act*. In Alberta, the species was also originally designated Threatened in 2000 but was later designated to a lower risk category of Species of Special Concern in 2005.

TECHNICAL SUMMARY

Iris missouriensis
Western Blue Flag Iris du Missouri
Range of occurrence in Canada: Alberta

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used) Clumps are known or estimated to live for as much as several decades expanding through asexual rhizomatous growth. Note: flowering begins at 2-3 years	Unknown but perhaps 10 or more years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	N/A
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	N/A
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	N/A
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	N/A
Are the causes of the decline clearly reversible and understood and ceased?	N/A
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	250 km² for native populations)
Index of area of occupancy (IAO)	68 km² (2x2 km grid) 31 km² (1x1 km grid)
Is the total population severely fragmented?	No
Number of “locations” (as per definition, in relation to threat) A total of 15 extant sites/populations are known but only 10 are considered native and with limited threats across much of the species’ native range in Alberta, the application of “locations”, for assessment purposes, may not be appropriate.	Not applied
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations?	No
Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations (as per definition, in terms of threat)?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each population)

Population	N Mature Individuals
List populations with number of mature individuals in each: 10 native populations but only 9 extant	[2009 data or year where specified] Note: information obtained from total # stem counts and monitoring plots
EO #01 (Whiskey Gap)	127
EO #02 (Carway North A)	6049 (2000)
EO #04 (Boundary and POPP East and West)	8597
EO #05 (Northeast of Whiskey Gap)	200-250 (1999)
EO #06 (Harrisville West and East)	1027
EO #07 (Mary Lake)	0 (2003)
EO #08 (Carway North B, South and East)	2217
EO #20 (Carway Customs)	148
EO #22 (Basin South, Central and North)	89,487[+]
EO #26 (Boundary School)	2365
Note: about 15,400 stems have been recorded from populations of unknown origin.	
Total:	~110,000-120,000

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	None available

Threats (actual or imminent, to populations or habitats)

General threats: Habitat loss, alteration and fragmentation; invasive (non-native) species; grazing pressure; hydrology alteration

Rescue Effect (immigration from an outside source)

Status of outside population(s)? USA: abundant	
Is immigration known or possible?	Not known
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Possible?

Current Status

COSEWIC: Special Concern (April 2010)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Special Concern	n/a
Reasons for Designation: This showy perennial is restricted to ten native sites and is also present at a few sites where it is believed to have been introduced. It occurs primarily in the grasslands of southern Alberta. Several new populations have been discovered since the species was last assessed. The area occupied and total population size of native plants are now known to be larger than previously determined. The total Canadian population appears to be stable but fluctuates in size. The species is subject to ongoing competition from invasive plants, but trampling in areas heavily grazed by cattle has been largely mitigated by recovery actions.	

Applicability of Criteria

Criterion A (Declining Total Population): Not applicable. Population likely stable.
Criterion B (Small Distribution, and Decline or Fluctuation): Not applicable. Population likely stable.
Criterion C (Small Total Population Size and Decline): Not applicable. Total population size, including only populations of native origin, exceeds threshold values and is likely stable.
Criterion D (Very Small Population or Restricted Distribution): Not applicable. Population size and IAO exceed threshold values for the native populations.
Criterion E (Quantitative Analysis): None available.

PREFACE

Previously thought to occur at seven populations with a total stem count of only 7500, more extensive surveys and monitoring activities have increased the number of populations known to 17. However, only ten of these near the U.S.-Canada border are considered native with nine extant in 2009. The estimate of total stems for the native populations is between 110,000 and 120,000.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2010)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Western Blue Flag

Iris missouriensis

in Canada

2010

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SPECIES INFORMATION

Name and classification

Scientific Name: *Iris missouriensis* Nutt.
Common Name: Western Blue Flag, Rocky Mountain Iris, Iris du Missouri, Western Iris
Species Authority: Thomas Nuttall, 1834- Journal of the Philadelphia Academy of Natural Sciences 7:58
Synonyms: *Iris longipetala* Hebert
Iris missouriensis Nutt. var. *arizonica*
Iris missouriensis Nutt. var. *perlogonus*
Iris pariensis Welsh
Iris tolmieana Hebert
Family: Iridaceae, Iris
Major Plant Group: Monocot flowering plant

Morphological description

Western Blue Flag is a long-lived perennial herb, growing from thick (1 cm to 1.5 cm) underground tuberous rhizomes. The plant is from 30 cm to 60 cm tall with pale blue-green sword-like leaves (10 cm to 40 cm long and 5 mm to 10 mm wide) growing from the base and folded lengthwise. Flowering stalks produce two to four showy flowers per stem; flowers can be pale blue, deep blue and lavender in colour; a rare white form also occurs (Canada Western Blue Flag Maintenance/Recovery Team 2002; Alberta Sustainable Resource Development (ASRD) and Alberta Conservation Association (ACA) 2005; Alberta Fish and Wildlife Division 2008) (Figure 1).

Figure 1. Flower of Western Blue Flag. (Photograph courtesy of Joyce Gould, with permission.)

Flowers bloom sequentially and often appear on leafless stems but may sometimes have one leaf. Purple veins radiate from a bearded yellow spot on each of the three outer sepals (segments) that are often recurved and spreading. Inner segments (three petals and three styles) are erect or arch upward (Alberta Sustainable Resource Development 2002) (Figure 2).

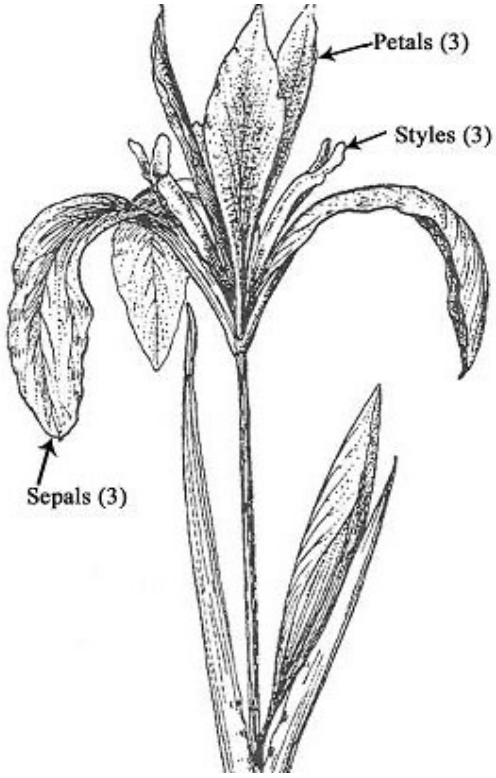

Figure 2. Flower segments illustration of the Western Blue Flag. (Line drawing courtesy of ANHIC, artist John Maywood.)

The fruiting structure is a three-chambered oblong capsule, 2 cm to 5 cm long, turning from green to brown, splitting at the top when ripe to release the 20 - 80 (dark brown globose, smooth-skinned seeds (Dykes 1913; Stevens 2003; Government of Canada 2004; ASRD and ACA 2005; Environment Canada 2008). The seedling leaves are similar to the mature plant but much smaller.

Spatial population structure and variability

There are few data on the genetic diversity of this species. Gould and Cornish (1999) mention that clones, genetically identical plants, are formed through asexual reproduction and that the number of clones versus the genetically distinct individuals in Alberta is unknown (pg. 3). DNA analysis completed in 2003 on populations in southern Alberta and neighbouring sites in northern Montana reveal historical and/or current gene flow (ASRD and ACA 2005). The analysis also found that the southern Alberta sites had some genetic diversity and individual plants, within 1 m of each other, can have a substantial genetically distinct structure (Romanchuk, Ernst and Quinlan 2004; ASRD and ACA 2005).

Designatable units

A single designatable unit is recognized for Western Blue Flag. No infraspecific taxa are recognized for this species and it occurs almost exclusively within a single Ecological Area (Prairie) recognized by COSEWIC with no significant differences in threats across its range in Alberta. The single population in Banff National Park, Alberta (EO 11), occurs in the Southern Mountain Ecological Area but its origin is unknown and its occurrence within the native range of the species in Canada is in doubt.

DISTRIBUTION

Global range

Western Blue Flag is distributed throughout the western United States in Montana, Oregon, Idaho, South Dakota, California, Washington, Colorado, Nevada, Arizona, New Mexico, Wyoming, Utah, and northern Mexico with its extreme northern limit occurring in southwestern Alberta in Canada. The plant is also found in Nebraska and North Dakota but is relatively rare. It has been reported for Minnesota (MacGregor 1977) but is not considered part of the wild flora of the state (Ownbey and Morley 2009). It is absent in Wisconsin (ASRD and ACA 2005) (Figure 3). As the species was not documented in Canada until 1964, there is no information on the species' Canadian historical range.

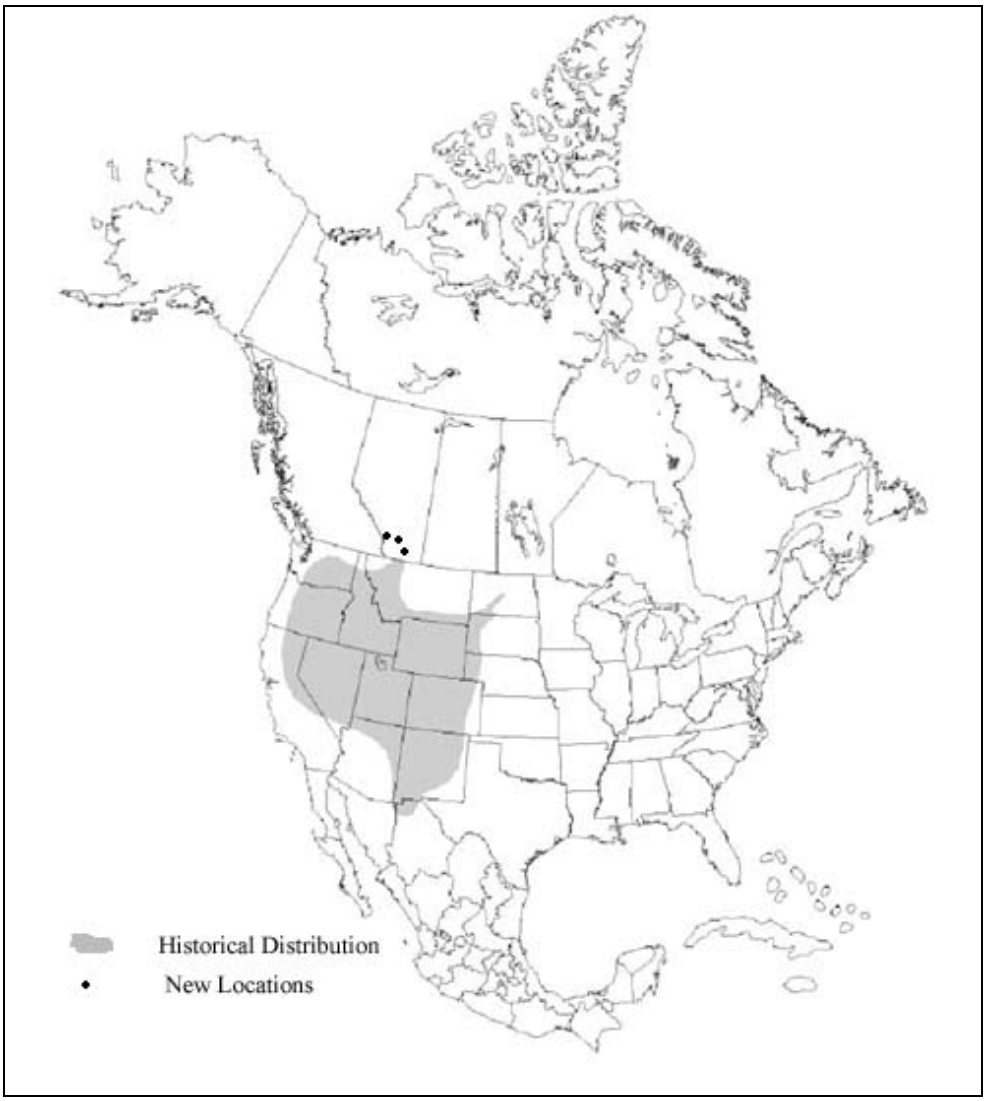

Figure 3. North American distribution of Western Blue Flag. (In Alberta Sustainable Resource Development and Alberta Conservation Association 2005.)

Canadian range

Less than 1% of Western Blue Flag's global range is found in Canada. A total of 17 populations have been documented with 15 known or assumed to be extant: 10 are of native origin, four of unknown origin, one was introduced. Of the two extirpated populations one was introduced and the origin of the other is unknown but possibly introduced (Appendix 1). The populations of native origin occur in the Prairie Ecological Area within a narrow band in the Foothills Fescue and Foothills Parkland Natural Subregions in southwestern Alberta (ASRD and ACA 2005; ANHIC 2008, ANHIC 2010b). The populations of unknown or introduced origins extend this range into both the Mixed Grass Natural Subregion, as well as the Montane Natural Subregion (which is contained within the Rocky Mountain Natural Area). Most of the known native

population occurs along the United States-Canada border in an area approximately 25 km by 10 km from the western portion of the Milk River Ridge to west of Carway, Alberta (ASRD and ACA 2005) (Figure 4). Although there is suitable habitat along the Milk River Ridge, no populations have been found (Wallis 1989).

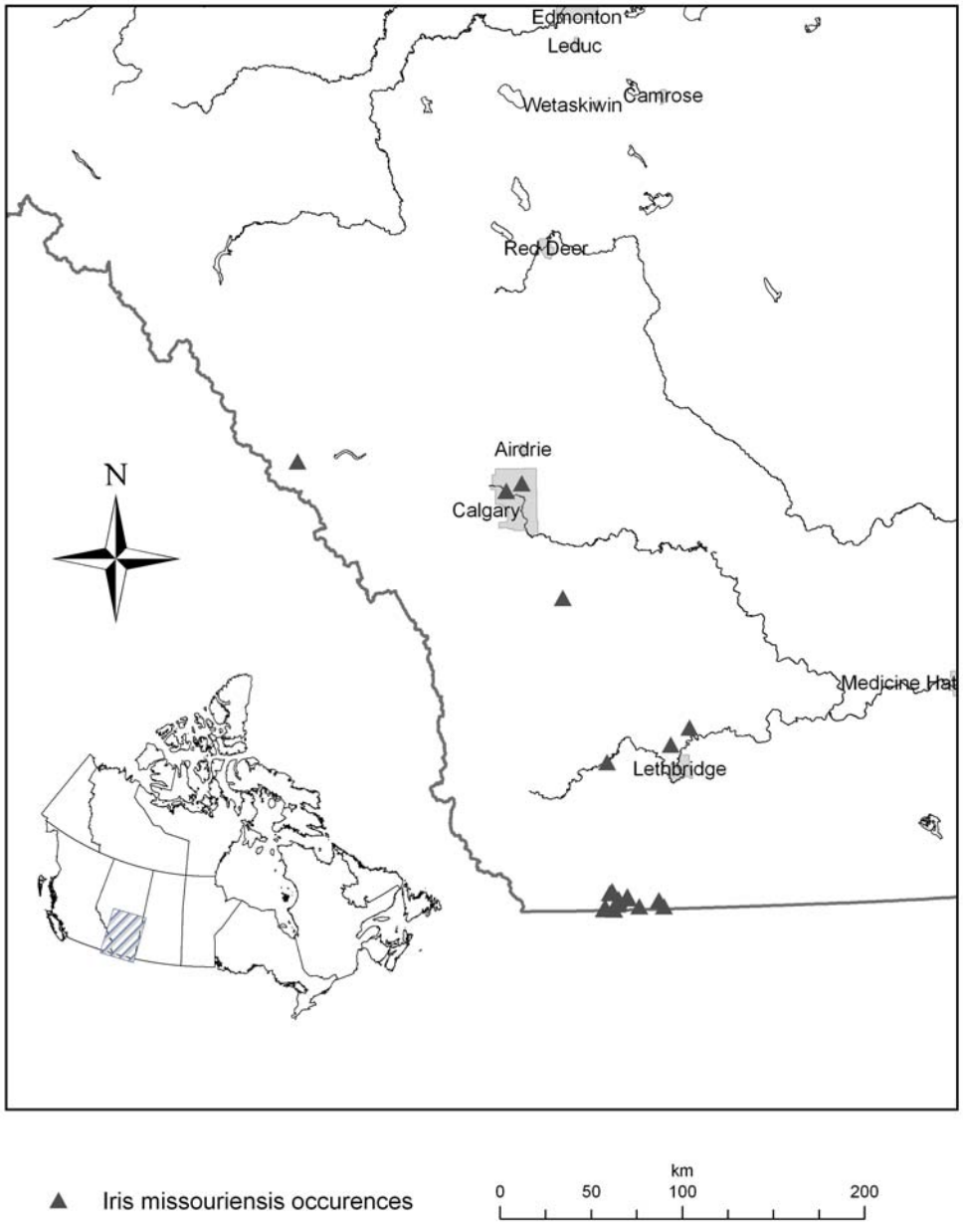

Figure 4. Canadian distribution of Western Blue Flag occurrences. Populations of known native range occur along the U.S.-Canada border.

A number of sites have been identified in more remote locations: in the city of Calgary [Calgary International Airport (EO 10)], Banff National Park (EO 11, Johnson Canyon area), and Fort Macleod (EO 24). The populations in Calgary and Banff National Park (approximately 235 km and 400 km respectively, from the core population) both exhibit evidence of being introduced, but this cannot be confirmed. The large number of stems that were counted and the advanced age of the plants in the Banff populations (ASRD and ACA 2005) suggest that they have existed there for potentially more than 25 years (Sharp pers. comm. 2008). The Fort Macleod site (unknown origin - EO 24, approximately 65 km from the core population) was surveyed in 2004 and occurs in habitat atypical for Western Blue Flag. However, it is located in the Oldman River floodplain, where the river channel may have been located at one time. A search in 2004 (ASRD and ACA 2005) identified suitable habitat for the species between Cardston and Fort Macleod; however, no populations were found. Additionally, Western Blue Flag occurs at Park Lake (EO 25, approximately 80 km from the core population), north of Lethbridge, Alberta; Frank Lake (EO 12, approximately 200 km from the core population), southeast of Calgary, Alberta, and at the University of Calgary (EO 09, approximately 230 km from the core population). The population at Park Lake is small (once presumed extirpated after a survey found no plants, but rediscovered in 2006). The population at Frank Lake may be extirpated as a result of competition from non-native species and the University of Calgary population is extirpated by top soil stripping and removal of plants.

A reported occurrence south of Grand Prairie, in northern Alberta, revealed the plant was a domestic variety. Other isolated populations in British Columbia thought to be of this species have since been reclassified as *Iris setosa* Pallas *ex* Link (ASRD and ACA 2005).

The extent of occurrence was estimated using the recommended IUCN/COSEWIC guidelines of a convex hull polygon encompassing all locations where Western Blue Flag is found. Including all extant populations (whether native or of unknown origin) this was 22,000 km^2 using XTools Pro in ArcGIS. Excluding populations whose origins are unknown (i.e., using only the 10 native extant populations), the extent of occurrence is about 250 km^2 (T. Kemper, pers. comm. 2010).

The index of area of occupancy (IAO) for all extant populations was determined as 116 km^2 based on the number of occupied map grid squares using the recommended scale of 2x2 km. The IAO for all extant populations using a 1x1 km grid is 42 km^2. Excluding all populations whose origins are unknown (i.e., using only the 10 populations that are native and extant), the IAO is estimated at 68 km^2 using a 2x2 km grid and 31 km^2 using a 1x1 km grid (T. Kemper pers. comm. 2010). The cumulative area of habitat occupied by known populations is approximately 3 km^2.

HABITAT

Habitat requirements

Western Blue Flag populations inhabit areas between moist depressions or meadows, stream margins and drier upland communities. Sites that have early season moisture (snowmelt or subsurface flow) followed by drier soils and warmer conditions through summer into early fall are ideal. The species is intolerant of heavy shading or permanently wet conditions (ASRD and ACA 2005).

Populations are located on level ground or gently sloping terrain where moisture conditions are hygric or subhygric through the majority of the growing season (Wallis 1988; Cornish 1998). Many stands occur in close proximity to willow thickets, shrub and sedge communities located near depressions or drainages (Wallis and Bradley 1990; Gould 1999). Western Blue Flag in Alberta occurs at elevations between 914 m and 2800 m (ANHIC 2008).

Associated species include those found in the transitional areas between Shrubby Cinquefoil/Rough Fescue (*Potentilla fruticosa/Festuca campestris*) and Tufted Hairgrass (*Deschampsia caespitosa*) habitat in northern Montana (ASRD and ACA 2005). Wallis (1989) identified the dominant species at many of the earlier sites as Kentucky Bluegrass (*Poa pratensis*) and Inland Bluegrass (*Poa interior*) with Canada Goldenrod (*Solidago canadensis*) and Heart-leaved Alexander (*Zizia aptera*) as ground cover. The current monitoring plots in Alberta indicate that sedges (*Carex spp*.), Kentucky Bluegrass and Smooth Brome (*Bromus inermis*) are the dominant species present with associated species including Northern Bedstraw (*Galium boreale*), Star-flowered Solomon's Seal (*Smilacina stellata*), and Wild Strawberry (*Fragaria virginiana*). Blue Camas (*Camassia quamash*), a rare species in Alberta, (Ernst 2003; ASRD and ACA 2005) is also commonly present.

The dominant native species associated with the Foothills Fescue Subregion and also found at several of the Western Blue Flag plots are Foothills Rough Fescue (*Festuca campestris*), Idaho Fescue (*Festuca idahoensis*), Kentucky Bluegrass, June Grass (*Koeleria macrantha*), Parry Oatgrass (*Danthonia parryi*), Western Porcupine Grass (*Stipa curtiseta*), Columbia Needle Grass (*Stipa columbiana*); and Awned (*Agropyron unilaterale*) and Northern (*Agropyron dasystachyum*) Wheat Grasses. Several forb species found with Western Blue Flag include Silvery Lupine (*Lupinus argenteus*), Three-flowered Avens (*Geum triflorum*), Common Yarrow (*Achillea millefolium*), Northern Bedstraw and Many-flowered Aster (*Aster ericoides*) (ASRD and ACA 2005).

The United States Department of Agriculture (2008) identifies Western Blue Flag as having a rapid growth rate and colonization form. This species is a colonizer and in some cases weedy (in various states throughout the western United States).

Habitat trends

Since European settlement, the native prairie landscape has been modified and plowed, with less than 100 km^2 of potentially suitable Western Blue Flag habitat remaining uncultivated[1] in the Foothills Grassland Natural Region (Wallis 1989). However, the current trend for the Canadian habitat of this plant is stable due to the increased knowledge, identification, monitoring activities and added protection (Rangeland Conservation Service Ltd. 2003; ASRD and ACA 2005).

The habitat and population of Western Blue Flag that are widespread throughout the western United States are currently considered stable (ASRD and ACA 2005).

Habitat protection/ownership

The majority of extant Western Blue Flag populations in Canada are located on private land. Two sites occur within the boundaries of Provincial Parks, one site is in a municipal natural reserve, one occurs on federally owned land (an international airport), and another within the boundaries of a National Park. The populations located within Provincial Parks are protected under the *Alberta Provincial Parks Act*. The population located within a National Park is also protected under the *National Parks Act* and this population and the one on federally owned land are also protected under Canada's *Species at Risk Act*.

Another eight sites are protected through voluntary stewardship initiatives. The Western Blue Flag Conservation Program, which was started as a response to the provincial status of the species, encourages voluntary stewardship and management of privately owned lands to benefit Western Blue Flag. The program started in 2001 and has been successful in engaging several of the landholders whose lands encompass Western Blue Flag in protecting the species. Surveys in 2005 and 2009 show an increased number of stems indicating the success of voluntary stewardship in protecting Western Blue Flag (Romanchuk *et al*. 2004, McLeod 2007; Ernst 2009). One additional privately owned site is protected by a Conservation Easement through Nature Conservancy of Canada. Two sites are confirmed extirpated and two sites have not been successfully relocated and are thought to no longer harbour populations of Western Blue Flag.

[1] Remaining from the original estimated 750 sq km of potentially suitable Western Blue Flag habitat pre-European settlement.

BIOLOGY

Information on the biology of Western Blue Flag is limited; however, there are significant data about the genus *Iris* that are applicable.

Life cycle and reproduction

In Alberta, Western Blue Flag flowers from mid-June through early July (Wallis and Bradley 1990; Cornish 1998; Gould 1999; ASRD and ACA 2005). Reproduction of the Western Blue Flag occurs through asexual and sexual processes. Asexual reproduction occurs through branching and linear growth of the rhizome.

Iris fruits are typically three-chambered capsules that split in around early August to release the globose, dark brown smooth-skinned seeds. There are data on germination triggers, but it is presumed that the seed coat opens and germination occurs after seeds are exposed in autumn to the freezing temperature and moisture of winter and spring, as "propagation of the seed is obtained by cold wet stratification of the seeds" (B. Grieg, pers. comm. *in* ASRD and ACA 2005, pg. 3; Stevens 2003). Although observation of seed germination in natural settings is unknown, horticulturalists suggest that the germination period is one to three months long and flowers are produced in the second or third year (Gould and Cornish 1999; ASRD and ACA 2005).

There are no data on the lifespan of Western Blue Flag in a controlled (horticultural) or natural environment; however, Wallis (1989) reported Dr. George Scotter's personal observation that one colony was able to sustain itself (without flowering) for 25 years. Recent observations of clumps at the Banff National Park site (EO 11), based on their size (clumps are approximately 2 m in diameter), have existed for possibly 20-30 years (Sharp pers. comm. 2008). The exact age of these plants is unknown. Field observations estimate that one to four fruits are produced per stalk. This suggests that the more flowers there are on a stem, the greater the likelihood of increased numbers of capsules per plant in any particular year. Climate and soil conditions may determine the growth and number of capsules (Clayton, pers. comm. 2009). It is unknown how to age these plants, because the date of establishment is unknown and many of the original plants may possibly have died allowing newer plants to grow in their place (Clayton pers. comm. 2009, Ernst pers. comm. 2009). Gardenguides.com (2009) identifies the Rocky Mountain Iris reaching a height of about 30 cm at 20 years of age (it is unknown if this is under native conditions or horticultural), but this could suggest iris can exist for at least 25 years or longer.

Because no data are available on average clump diameters at extant populations, it is not possible to estimate generation time based on such anecdotal information as that of the Banff National Park (EO 11) Western Blue Flag colonies. Considering that the maximum age of a genet (clump) is likely several decades and flowering from seed is known to occur within several years, the generation time may be in the order of 10 or more years.

Herbivory

Western Blue Flag is unpalatable to cattle because of its bitter taste (Wallis 1989; Wallis and Bradley 1989; ASRD and ACA 2005; California Department of Food and Agriculture 2009). Whether this is true for other mammals is unknown. Browsing damage has been observed on some of the plants, during inspections at number of the sites. Cattle may have browsed these plants, but it could also be the result of native ungulate foraging (Gould and Cornish 1999; Downey pers. comm. 2009; Ernst pers. comm. 2009).

Physiology

The active growth period for the Western Blue Flag occurs during high moisture conditions in the spring and continues throughout the warmer summer months (Wallis and Bradley 1989; Gould and Cornish 1999). Leaves die back during periods of drought and when temperatures fall below freezing (California Department of Food and Agriculture 2009). Plants prefer open areas and are not tolerant of shade (Stevens 2003).

Dispersal

Iris seeds typically fall to the ground directly below or close to the parent plant. Southern Alberta experiences a considerable amount of intense wind throughout the year. Thanks to the small size and significant numbers of seed capsules, wind can disperse the seeds over a considerable distance. Passing animals and water can also contribute to seed dispersal (ASRD and ACA 2005).

Interspecific interactions

Competing invasive non-native vegetation such as Smooth Brome and Kentucky Bluegrass will move into native plant communities where soil moisture is available (Gould and Cornish 1999; Adams *et al*. 2003). Encroachment of these types of plants in Western Blue Flag populations, that are also dependent on moisture for reproduction, poses a potential threat to their survival and rhizome stability (Adams *et al*. 2003).

Iris are primarily pollinated by bees and other insects including flies (ASRD and ACA 2005). The flowers provide ideal surfaces for landing and entering the plant to obtain nectar and deposit pollen from the insect, while picking up more pollen from the anthers. The style and stigma face away from the anthers, reducing the possibility of self-pollination (ASRD and ACA 2005). The iris' floral structure is considered highly specialized and unique (Wallis 1989).

Several insects, including ants, are known to reside in or forage on iris flowers but the nature and extent of their use of Western Blue Flag is unknown. Hummingbirds and lepidopterans (butterflies and moths) have been seen to feed on the nectar of many iris plants, but their use of this species is also poorly understood (ASRD and ACA 2005).

Adaptability

The large, showy flower of the Western Blue Flag is one adaptation that may allow the plant to compete more readily with other plants for pollinators. With its large sepals and petals, pollinators are perhaps more readily attracted to this plant than to other nearby species with smaller flowers.

Fire was common across the grasslands prior to European settlement; more recently it has been absent from, or infrequent on, the landscape. Activities, such as livestock grazing, control invasive grass species and act as a form of weed management. Grass fires aid in reducing competition for many plant species and are believed to help other plants, particularly those with extensive rhizomes like the Western Blue Flag, survive and sometimes thrive in its altered habitat (Suighara 2006).

This species is likely tolerant of fire (United States Department of Agriculture 2008). Sugihara, (2006), identified that, in California, the response of understory species was enhanced by fire, noting that many perennial species with rhizomes, corymbs and stolons (Western Blue Flag was one such species identified) sprouted after fire. The effect of fire on Alberta populations is unknown.

POPULATION SIZES AND TRENDS

Search effort

The first observations of Western Blue Flag in Canada were made at two sites at Carway (EO 02) and Whiskey Gap (EO 01) (1964) in Alberta (deVries 1966). Additional searches occurred in 1987 and 1989 (Wallis and Bradley 1989), 1998 (Gould and Cornish 1999) and annual monitoring and searching were implemented from 2000 through 2004 (Ernst 2002, 2003, ASRD and ACA 2005). Surveys of existing populations were completed in 2009 (Ernst 2009).

A monitoring program was initiated to inventory plants over many years (Wallis 1988; Ernst 2003). This program was evaluated and new monitoring goals and survey protocols have been established to provide a better assessment of changes over time. Included in the evaluation are new methods for analyzing population trends relative to landscape range condition. In 2002, 10 permanent sites with 62 monitoring plots were established (Rangeland Conservation Service Ltd. 2003). In 2009, additional plots were added at 2 sites (Ernst 2009).

Abundance

New inventory and census data indicate a greater number of sites and total population size than were previously known. This is likely due to increased search effort and the participation of land owners and land managers in the *Western Blue Flag Conservation Program*.

Earlier COSEWIC status reports (Wallis and Bradley 1990; Gould and Cornish 1999) indicated seven naturally occurring populations, as well as one identified as both extirpated and introduced [Picture Butte (EO 03)]. The Alberta status reports by Gould (1999) and ASRD and ACA (2005) confirmed five of the six original naturally occurring populations. An additional nine populations have been identified since 1999 (total of 17 sites, Appendix 1). Of the nine newly discovered populations, five occur near Carway (south of Cardston) in the proximity of the naturally occurring populations and the other four are disjunct [Fort Macleod (EO 24), Calgary airport (EO 10) and Banff National Park (EO 11), Park Lake (EO 25)]. The Alberta Natural Heritage Information Centre (ANHIC) identified two sites where the plant was also observed, but they appear to no longer exist [Picture Butte (EO 03) and University of Calgary (EO 09)]. Frank Lake (EO 12) and Mary Lake (EO 07) populations are still considered extant until more surveys confirm their extirpation.

There has been an increased stem count since 1999 (Table 1), when the estimated number in Canada was approximately 7,500 at seven native sites (Gould and Cornish 1999). In 2004 it had risen to approximately 83,000 stems at 12 sites, not all of which were native (ASRD and ACA 2005). A population inventory in (2009) suggested stability of the population, with between 110,000 and 120,000 stems estimated (Ernst 2009). This population range represents an estimate for the native populations. The large range in numbers reflects the inclusion of an estimate for a large healthy population at one site where permission to survey was not granted in 2009. It is important to note that several stems can grow from a single rhizome or rhizome segment and that the plant must be removed to provide a better estimate of the total numbers of plants (Wallis and Bradley 1990). Interpretation of these numbers should be done with caution because surveys were completed in different years and at different sample sites and might be influenced by year-to-year changes in weather conditions. These numbers are not an indication of trend but are a result of an increase in the number of sites previously overlooked and yearly fluctuations.

Table 1. Summary of Total Estimated Western Blue Flag Stem Count Surveys from 1999-2004; 2009.

Survey Year	Estimated Stem Count	Number of Sites Surveyed
1999	7500	7
2000	9275	7
2001	14757	10
2002	69200	10
2003	73000	11
2004	83000	14
2009	110,000 – 120,000	12

Extant populations are not considered to be severely fragmented. All of the populations are spatially well separated and appear to be viable based on generally having numbers of plants ranging from at least 100 stems to many thousands and, as well, able to propagate themselves readily by rhizomes. Of the ten populations that are considered to be of natural occurrence, several contain the bulk of the plants and cover more than one-half of the area occupied.

Fluctuations and trends

Infrequent surveys for the species have occurred since 1964. The majority of data for this report was taken from such historical survey records (ANHIC 2010a, ASRD and ACA 2005). However, because of inconsistent reporting and inventory collection methods, it is difficult to determine search effort and exact population. Based on the information available from the late nineties, the population was estimated to be approximately 7500 stems at seven sites (Gould 1999). Since 2001, a consistent inventory and search method has been used to monitor known populations and search for new sites (Ernst 2002, Romanchuk *et al*. 2004, Ernst 2009). These methods resulted in a portion of the sites being monitored in 2002, 2003, 2004, 2005, and 2008. Each of the sites was monitored at least once during each year (Romanchuk *et al*. 2004, ANHIC 2010a.).

Full inventories were conducted in 2002, 2004 and 2009 (Ernst 2002, Romanchuk *et al*. 2004 and Ernst 2009). As there was an increase in the number of sites between each survey period, it is difficult to discern trends. However, the native population has increased along with the increase in number of sites, from approximately 7500 stems at seven sites in 1999 (Gould 1999) to between 110,000 and 120,000 stems at 12 sites with confirmed extant populations in 2009[2] (Ernst 2009). This value included several smaller populations that are not considered presently as of native occurrence. Based on the raw survey data in ANHIC(a), the populations appear to be stable at each site with limited increases or decreases in population sizes (Table 2). Changes in the numbers of stems and flowering plants over these years do not reflect a significant change in the populations. Factors such as climate can result in small fluctuations. For example, flowering was delayed and a decrease in reproductive stems was recorded in 2004; dry conditions in 2003 and 2004 may account for this decline. The inventory completed in 2009 shows that after the last full inventory, 5 years ago (Year 2004–83000 stems), the populations appear to be stable to increasing (Ernst 2009).

[2] Of the 15 populations considered to be exant, two (Frank Lake – EO 12 and Mary Lake – EO 07) have not been relocated and one (Northeast of Whiskey Gap – EO 05) has not been resurveyed due to lack of access.

Table 2. Monitoring plot inventory data of Western Blue Flag populations in southern Alberta, 2002-2004; 2009. Source: ASRD and ACA 2005; Ernst 2009.

Site (EO #)	# of Plots	Total # Stems				Total # Fruits/Flowers			
		2002	2003	2004	2009	2002	2003	2004	2009
04 (Boundary POPP, East and West)	4 3**	161	168	148 *2007- 133*	*131* *3000***	29	16	13 *2007-17*	*19* *450***
06 (Harrisville East)	8	356	367	432	390	46	40	48	56
08 (Carway North A)	10	425	417	425	1024	67	20	14	60
08 (Carway North B)	6	418	418	388	257	41	26	17	22
08 (Carway South)	4	96	83	95	33	7	6	3	0
10 (Calgary Airport)	4	n/a	359	n/a	n/a	n/a	6	n/a	n/a
20 (Carway Customs)	2	253	219	234	148	3	8	9	0
22 (Basin Central and Basin North)	26	2124	2732	982*	957*	248	354	80*	n/a

*n/a – information not available (no previous data, or data not collected)
** data collected at Boundary site, inventories only completed in 2001 and 2009.

Rescue effect

Outside of Alberta there are no accurate population estimates for Western Blue Flag; however, the core range is in western United States and the species is considered abundant in some states (ASRD and ACA 2005). The population of Western Blue Flag in the state of Montana that borders the Canadian population is considered locally abundant (Wallis and Bradley 1989). ASRD and ACA (2005, pg. 8) based on a student report of DNA analysis that the proximity of the nearest Montana populations to the Canadian populations is within 1 km of the Canada-United States border and approximately 4.5 km from a native population. No additional published information exists for populations south of the border. The ability of this plant to repopulate naturally from populations in the United States is unknown; however, exchange is likely given the closeness of populations.

LIMITING FACTORS AND THREATS

Several limiting factors and threats can limit Western Blue Flag's occurrence, particularly with its very specific habitat requirements. Degradation of this habitat by human activities and natural processes poses a threat to its survival on the landscape.

Habitat loss, alteration and fragmentation

The historical range of Western Blue Flag in Canada is unknown. At the time of its discovery in 1964, it was thought to be uncommon, particularly because of its specific habitat requirements. Alteration of the habitat, through the conversion of native grassland to pasture land and cropland, is the likely cause for loss of some populations that existed in pre-settlement time (ASRD and ACA 2005).

Introduced species competition

Smooth Brome, likely an invader from nearby cultivated fields (Cornish 1998; Ernst 2003, McLeod 2007), is an ongoing concern at Police Outpost Provincial Park (EO 04). Several other native plant species were killed at this site when flooding occurred, leaving sediment and providing the opportunity for brome to establish.

Additional non-native species may potentially threaten Western Blue Flag, including Kentucky Bluegrass and Timothy; both are species that will thrive when ideal conditions are available for expansion (Adams *et al*. 2003).

Grazing intensity and timing

Grazing is likely beneficial to the maintenance of viable populations of Western Blue Flag. Grazing intensity and timing is relevant to the survival of this species and the overall condition of the native prairie. Heavy grazing is a cause for loss of some plants and populations (ASRD and ACA 2005, Wallis and Bradley 1990, Cornish 1998 and Wallis 1989). Livestock, particularly cattle, are the main grazers on Western Blue Flag, but are believed to feed only incidentally on the plants. Plants would likely be destroyed by heavy or sustained trampling (Cornish 1998; Wallis 1989; Wallis and Bradley 1990; Ernst 2002; ASRD and ACA 2005). Wallis and Bradley (1989) mention heavily grazed sites have possible detrimental effects on the health of Western Blue Flag populations. They also identified one site where low populations could be threatened by cattle grazing damage, hydrology changes or a combination of both.

A lack of grazing can also be detrimental to the plant's population as is the case at Police Outpost Provincial Park (EO 04). Litter build-up and competition from Smooth Brome and non-native grass encroachment make it difficult for the Western Blue Flag to survive and reproduce (ASRD and ACA 2005). Wallis (1989) argued that moderate grazing reduces competition from non-native and invasive plants.

Hydrology alteration

Heavy trampling (i.e. cattle grazing) can alter the hydrology and drainage of a site. The ability of soils to retain moisture is necessary for Western Blue Flag to sustain itself. Alteration of water sources away from the plants is also a concern. Wallis (1989) found that low plant vigour at one particular location may have been a result of cattle-induced diversion of a spring to another ephemeral stream channel.

Drought and flooding may also affect Western Blue Flag populations (ASRD and ACA 2005). Southern Alberta has a semi-arid climate that can experience extreme weather conditions, including significant dry periods and severe rain/snow storms. However, Western Blue Flag is presumably adapted to these as judged by the fluctuation in flowering stems produced between years. Changes in temperature of the surface soil layers is a concern for plants that require cool, moist soils. Loss of open wet meadow habitats and invasion by shrubs could also affect iris populations. Willows have

been identified encroaching on Western Blue Flag sites, particularly at Police Outpost Provincial Park (Wallis and Bradley 1989).

Increased water levels at Police Outpost Lake can saturate the soil throughout much of the growing season and not allow Western Blue Flag to grow until the area has dried out (ASRD and ACA 2005). Plants submerged under water for extended periods of time have a difficult time recovering (Clayton pers. comm. 2009).

Horticultural and medicinal use

Western Blue Flag is an attractive species for domestic gardens and medicinal uses, and can be subject to private collection from native sites. Unlike the situation with the threatened Alberta Soapweed (*Yucca glauca*) populations, collection is currently not a significant threat; however, as the Western Blue Flag sites become more widely known, this may change (Downey 2009). Ongoing collection of the seeds and/or the rhizomes from any particular native population could reduce the population leading to a potential loss in regeneration of the species at that site.

The plant can also be purchased from various gardening sources, but mostly in seed packets (Stevens 2003; ASRD and ACA 2005). The source of these seeds is unknown but likely from the United States. Introduced cultivars could invade the province's remaining native *Iris* habitat and contaminate the native gene pool, potentially making the species more susceptible to disease or cold weather (ASRD and ACA 2005).

Climate change

No specific research has been conducted on the potential effects that climate change could have on the Western Blue Flag. In general, climate change is projected to have a negative effect on all vascular plant species in North America, which could have a magnitude of 7% to 11% if the temperature increases by 3^{o}C (Morse *et al*. 1993 in ASRD and ACA 2005). However, Purdy (1998) suggested that a population of a species at the northern edge of its range (such as Western Blue Flag in Alberta) may respond better to climate change because it is more likely to adapt to the climate, soils and local photoperiod of the new latitude it has moved to. Therefore, marginal habitat now may become favourable habitat for the species in the future.

Pests and disease

To date, there has been no documentation of whether the Canadian population of the Western Blue Flag is subject to specific pests or disease (as discussed in more detail under Herbivory).

Herbicides

Some counties in the United States consider Western Blue Flag to be a noxious weed. Control of weeds has included the use of herbicides such as 2, 4 D and glyphosate (also known as Roundup). Wallis and Bradley (1989) commented that 2, 4 D was 91-100% and glyphosate was 100% effective at suppressing and eradicating this species. Effects of newer herbicides currently being used to treat noxious weeds is unknown.

The use of herbicides at known sites in Alberta currently under specific management regimes (see management program) is discouraged. The level of threat posed by agricultural herbicides for range management has not been studied and historical use in Alberta is also unknown but herbicide use is understood to be a potential threat to the plant (Canada Western Blue Flag Maintenance/Recovery Team 2001).

Small population size and limited dispersal capabilities

Western Blue Flag has unique adaptations for survival such as the showy flowers and rhizome, but the strategy for survival through its seeds could be a limiting factor. Seeds are not easily dispersed because they are heavy and are likely to drop only in a relatively small area around the parent plant or population (Clayton pers. comm. 2009). Seed transport farther away, other than wind, may occur with wildlife caching or human distribution. If the small population does not regenerate itself (i.e. healthy seeds or lack of production of seeds), the population may also deteriorate and eventually die off.

Locations based on threats

The application of “location” as defined under IUCN/COSEWIC guidelines may not be appropriate. Several populations are impacted through competition with invasive grasses but, overall, there are limited threats over most of the species’ native range in Alberta.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Canadian population of Western Blue Flag only occurs in southwestern Alberta. It has specific habitat requirements and a narrow environmental tolerance and is subject to population fluctuations based on climate conditions, range management practices and other potential threats. The species occurs in one of the most threatened landscapes in Alberta. The Canadian population is considered stable as a result of increased information from new sites being found over the last 20 years. In the United States, this species is considered stable or even a pest and is grown for landscaping and horticultural use.

Written documents and internet websites identify the use of Western Blue Flags for a variety of medicinal purposes and the roasted seeds as a coffee substitute (Stevens 2003; ASRD and ACA 2005). The leaves of this plant are generally unpalatable and bitter, but provide strong fibres that can be made into cordage such as ropes, fishing line and snares (Stevens 2003).

Blackfoot tribe members in southern Alberta do not have knowledge of the plant for their usage or any recollection of its value from their ancestors (ASRD and ACA 2005). There appears to be no documentation of Western Blue Flag for Aboriginal use or confirmed human use in Canada to date.

The ethnobotanical database at the University of Michigan (http://herb.umd.umich.edu/) provides information on medicinal and ceremonial uses of this species.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

COSEWIC assessed this species as Threatened in May 2000 and it is currently listed on Schedule 1 of the *Species at Risk Act*. The province of Alberta listed the species as Threatened in 2000, then later designated it to a lower risk category of Special Concern in December 2005 due to the increased number of sites identified, resulting in an increased population estimate (Fish and Wildlife Division 2008).

Other designations for Western Blue Flag include a Global Conservation Status Rank of G5, United States National Conservation Status Rank of N5? (subnational conservation rank in Nebraska of S1, North Dakota of S2, Montana S4 and Wyoming S4; other states not yet ranked.), and Canadian National Conservation Status Rank of N1. In Alberta the current rank is S1 (Gould 2006) but this is subject to review in 2009).

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INFORMATION SOURCES

Adams, B.W., R. Ehlert, D. Moisey and R.L. McNeil. 2003. Rangeland Plant Communities and Range Health Assessment Guidelines for the Foothills Fescue Natural Subregion of Alberta. Rangeland Management Branch, Public Lands Division, Alberta Sustainable Resource Development. Lethbridge, Pub. No. T/038 85 pp.

Alberta Natural Heritage Information Centre (ANHIC). 2008. Element occurrence data. Parks Division, Alberta Tourism, Parks and Recreation. Edmonton, AB. Accessed July 23, 2008.

Alberta Natural Heritage Information Centre (ANHIC). 2010a. Element occurrence data. Parks Division, Alberta Tourism, Parks and Recreation. Edmonton, AB. Accessed February 2010.

Alberta Natural Heritage Information Centre (ANHIC). 2010b. Alberta distribution- *Iris missouriensis*. Parks Division, Alberta Tourism, Parks and Recreation. Accessed February 2010.

Alberta Sustainable Resource Development and Alberta Conservation Association (ASRD- ACA). 2005. Status of the western blue flag *(Iris missouriensis)* in Alberta: update 2005. Alberta Sustainable Resource Development, Wildlife Status Report No. 21 (Update 2005), Edmonton, AB. 28pp.

Alberta Sustainable Resource Development. 2002. Alberta western blue flag *(Iris missouriensis)*: threatened. Alberta Sustainable Resource Development, Alberta Conservation Association. Fact Sheet

Allen, L., pers. comm. 2008. Telephone correspondence. July 2008. Alberta Natural Heritage Information Centre. Edmonton, AB.

California Department of Food and Agriculture. 2009. Iris genus. http://www.cdfa.ca/gov/phpps/ipc/weedinfo/iris.htm. (accessed August 10, 2008).

Canada Western Blue Flag Maintenance/ Recovery Team. 2002. Maintenance and recovery plan for western blue flag *(Iris missouriensis)* in Canada. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 1, Edmonton, AB. 18pp.

Canada Western Blue Flag Maintenance/ Recovery Team. 2001. Internal team minutes.

Clayton, T., pers. comm. 2009. Telephone correspondence. September 2009. Western Blue Flag Maintenance and Recovery Team member, Alberta Native Plant Council Representative. Lethbridge, AB.

Cornish, B. 1998. Western blue flag *(Iris missouriensis)* monitoring program in southwestern Alberta: 1998 population assessment. Prepared for Alberta Environmental Protection, Edmonton, AB. 8 pp. plus appendices.

DeVries, B. 1966. *Iris missouriensis* Nutt. in southwestern Alberta and in central and northern British Columbia. Canadian Field Naturalist 80:158-160.

Downey, B., 2009 & 2008. pers. comm. September 2008. Species at Risk Biologist, Alberta Fish and Wildlife Division, Sustainable Resource Development. Lethbridge, AB.

Dykes, W.R. 1913.The genus *Iris*. The University of Chicago Press, Chicago, IL. 245 pp.

Environment Canada, Species at Risk. 2008. Western Blue-flag. http:// www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?speciesID-235 (accessed July 15, 2008)

Ernst, R. D. 2002. A census and recommendations for management for western blue flag *(Iris missouriensis)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No.38. Edmonton, AB. 9 pp.

Ernst, R. D. 2003. Inventory and monitoring protocol for naturally occurring western blue flag *(Iris missouriensis)* in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Species at Risk Report No. 66, Edmonton, AB. 12 pp.

Ernst R.D. 2009. Western Blueflag in Alberta: Population estimate and trends for 2009. Unpublished Alberta Sustainable Resource Development Fish and Wildlife Division. 63 pp.

Ernst, R.D., pers. comm. 2009. Email correspondence to B. Downey. September 2009. Ecologist. Lethbridge, AB.

Fish and Wildlife Division. 2008. Report of Alberta's Endangered Species Conservation Committee: June 2006. Alberta SRD, FWD. Edmonton, AB. 44 pp.

Gardenguides.com (2009) Rocky Mountain Iris. http://www.gardenguides.com/plants/plant.asp?symbol=IRMI (accessed September 3, 2009).

Gould, J. 2006. Alberta Natural Heritage Information Centre tracking and watch lists- vascular plants, mosses, liverworts and hornworts. Alberta Community Development, Parks and Protected Areas Division. Edmonton, AB.

Gould, J. 1999. Status of the western blue flag *(Iris missouriensis)* in Alberta. Alberta Environmental Protection, Fisheries and Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report No. 21. Edmonton, AB. 22pp.

Gould, J. and B. Cornish. 1999. Update COSEWIC status report on western blue flag *(Iris missouriensis)*. Draft report. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. 10 pp.

Government of Canada. 2004. Species at Risk at Public Registry. URL: http://www.sararegistry.gc.ca/default_e.cfm (accessed July 24, 2008).

International Union for Conservation of Nature. 2001. *IUCN red list categories and criteria: Version 3.1*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.

Kemper, T., pers. comm. 2009. Email correspondence to G. Berg. September 2009. Senior Botanist, Alberta Natural Heritage Information Centre, Edmonton, AB.

Kemper, T. pers.comm. 2010. Email correspondence to G. Berg. February 2010. Senior Botanist, Alberta Natural Heritage Information Centre. Edmonton, AB.

McGregor, R.L. 1977. Atlas of the flora of the Great Plains. Ames, Iowa, Iowa State University Press, 550 pp.

McLeod, C. 2007. Interim and final/annual report, Habitat Stewardship Program. Alberta Tourism, Parks, Recreation and Culture; Parks, Conservation, Recreation and Sport Division. Internal document. 2007HSP4401. Lethbridge, AB.

Morse, L.E., L.S. Kutner, G.D. Maddox, J.T. Kartesz, L. I. Honey, C.M. Thurman and S.J. Chaplin, 1993. The potential effects of climate change on the vascular flora of North America: a preliminary climate envelopes analysis. Palo Alto, California Electric Power Research Institute. Report no. EPRI TR-103330.

Ownbey, G.B. and T. Morley. 2009. Vascular plants of Minnesota: a checklist and atlas. University of Minnesota Press, Minneapolis, MN. 306 pp.

Purdy, B. 1998. Conservation of genetic diversity: considerations for protected areas establishment and management. Prepared for Alberta Natural Heritage Information Centre, Alberta Environmental Protection, Edmonton, AB. 24 pp.

Rangeland Conservation Service Ltd. 2003. Program evaluation and monitoring plan for the western blue flag conservation program. Prepared for Alberta Conservation Association and Alberta Fish and Wildlife Division, Lethbridge, AB. 22 pp plus appendixes.

Romanchuk, K.A., R.D. Ernst and R.W. Quinlan. 2004. Western blue flag conservation program: 3-year summary report. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 85, Edmonton, AB. 21 pp.

Sharp, W., pers. comm. 2008. Telephone correspondence to L. Cerney. November 2008. Retired University of Lethbridge Biologist and Member of the Western Blue Flag Recovery/Maintenance Team, Lethbridge, AB.

Suigihara N.G. 2006. Fire in California's Ecosystems. University of California Press. 596 pp.

Stevens, M. 2003. Plant Guide: Western blue flag *Iris missouriensis* Nutt. United States Department of Agriculture, Natural Resources Conservation Service. 3 pp.

United States Department of Agriculture. 2008. Conservation plant characteristics: Iris missouriensis Nutt. Rocky Mountain Iris. Natural Resources Conservation Service, http://plants.usda.gov/java/charProfile?symbol=IRMI. Accessed September 2008.

Wallis, C. 1988. Western blue flag *(Iris missouriensis)* monitoring program in southwestern Alberta. Report prepared for Alberta Forestry, Lands and Wildlife, Alberta Recreation and Parks and World Wildlife Fund Canada, Edmonton, AB, 29 pp.

Wallis, C. 1989. Western blue flag *(Iris missouriensis* Nutt.) management plan. Prepared for Prairie for Tomorrow, World Wildlife Fund Canada, Edmonton, AB. 36 pp.

Wallis, C. and C. Bradley. 1990. Status report on the western blue flag *Iris missouriensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. 29 pp.

BIOGRAPHICAL SUMMARY OF REPORT WRITER

Linda Cerney holds a BSc from the University of Lethbridge, Lethbridge, Alberta. She has served as team member and secretary on the Western Blue Flag Maintenance and Recovery Team, assisted land managers involved with the Western Blue Flag Conservation Program from 2001- 2005, participated in treatment (hand picking) activities at the Police Outpost Provincial Park sites, inventory counts and public presentations on this species. She has been employed as a wildlife technician and private contractor for over 10 years. For 7 years, she has been a member of the Alberta Prairie Conservation Forum, has served as their chair in 2004 and currently sits on their education committee. She has memberships with the Alberta Native Plant Council, Alberta Chapter of the Wildlife Society, Oldman Watershed Council and Interpretation Canada. As a Lethbridge Naturalists Society member, she has served in various executive committee roles including president and coordinated field trips and yearly species counts. She has also acted as an advisor/adjudicator on the rare bird committee for southern Alberta during the 2nd update of the Alberta Bird Atlas, and participates on the Southern Alberta Community for Environmental Educators (SACEE).

COLLECTIONS EXAMINED

The following botanical collections were examined by Wallis and Bradley (1989):

Department of Agriculture, Ottawa, ON

University of Calgary, Calgary, AB

University of Alberta, Edmonton, AB

Canadian Museum of Nature, Ottawa, ON

Royal British Columbia Museum, Victoria, BC.

Appendix 1. Inventory information for all known Western Blue Flag sites in Alberta, 1989-2004, 2007-2009 including sites that are presumed to be recently extirpated.

Site (Numbers are element occurrence designations by the ANHIC)	Date	Total # Stems	# of Fruits/Flowers
01 (Whiskey Gap)	1989	203	0
	1998	111	2
	2000	171	2
	2002	233	10
	2003	201	2
	2004	153	0
	2009	127	0
02 (Carway North A)	1989	5000	n/a
	2000	6049	256
	2002	425	67
	2008	533	34
	2009	1024	60
03 (Picture Butte)[1,2]	1979	Present (unknown)	unknown
	1989	0	n/a
04 (Boundary, POPP East and West)	1989	650	6
	1998	325	1
	2000	219	14
	2001	5376	581
	2002	656	85
	2003	661	56
	2004	660	50
	2007	543	45
	2009	8597	450
05 (Northeast of Whiskey Gap)	1989	Small	unknown
	1992	Present (unknown)	unknown
	1999	200-250	unknown
06 (Harrisville West and East)	1989	1500	n/a
	2000	2091	304
	2002	956	n/a
	2009	1027	60
07 (Mary Lake)	2000	0	n/a
	2003	0	0
08 (Carway North B, East and South)	2002	2749	309
	2008	1329	116
	2009*	2217	22
09 (University of Calgary)[1,2]	1993	small	unknown
10 (Calgary Airport)[3]	2003	3774	55
	2008	4870	256
	2009	3299	147
11 (Banff National Park)[3]	2004	7774	771
	2008	7023	1188
	2009	11800	108
12 (Frank Lake)[1]	1995	unknown	unknown
	2004	0	n/a
20 (Carway Customs)	2002	264	3
	2009	148	0
22 (Basin South, Central and North)	2002	44636	6863
	2009	89487**	7500
24 (Fort MacLeod)[3]	2004	101	3
	2008	60	8
	2009	72	6

Site (Numbers are element occurrence designations by the ANHIC)	Date	Total # Stems	# of Fruits/Flowers
25 (Park Lake)[3]	1998	20	3
	2000	0	n/a
	2006	26	unknown
	2007	277	53
	2008	170	12
	2009	215	15
26 (Boundary School)	2009	2365	

***** Only Carway South surveyed in 2009

** An estimated additional 10,000 stems were visible on inaccessible land

[1] Introduced population

[2] Extirpated populations

[3] Unknown origins

[4] Presumed extirpated