COSEWIC
Assessment and Status Report

on the

Dwarf Hesperochiron
Hesperochiron pumilus

in Canada

ENDANGERED
2019

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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COSEWIC would like to acknowledge Carrina Maslovat for writing the status report on Dwarf Hesperochiron, *Hesperochiron pumilus*, in Canada, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Del Meidinger, Co-chair of the COSEWIC Vascular Plants Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment and Climate Change Canada
Ottawa, ON
K1A 0H3

Tel.: 819-938-4125
Fax: 819-938-3984
E-mail: ec.cosepac-cosewic.ec@canada.ca
https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife.html

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Cover illustration/photo:
Dwarf Hesperochiron — Photo: Carrina Maslovat.

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COSEWIC
Assessment Summary

Assessment Summary – May 2019

Common name
Dwarf Hesperochiron

Scientific name
Hesperochiron pumilus

Status
Endangered

Reason for designation
This small, perennial plant is restricted to seasonally wet montane forest openings at four sites in a small area of southeastern British Columbia. The total number of mature individuals is very small (under 200). All Canadian sites are on Provincial Crown Land and potentially subject to logging of surrounding areas and/or road building activity with subsequent changes to site hydrology. Negative impact on the thin substrate by mountain-biking activity has been noted close to one occurrence. Competition from non-native plants, most notably Spotted Knapweed, is the most significant threat expected to lead to habitat degradation over time. Drought and atypically intensive natural fire, as per climate-change projections, could potentially damage or eliminate one or more occurrences within three generations.

Occurrence
British Columbia

Status history
Designated Endangered in May 2019.

COSEWIC
Executive Summary

Dwarf Hesperochiron
Hesperochiron pumilus

Wildlife Species Description and Significance

Dwarf Hesperochiron is a perennial, herbaceous plant that grows up to 10 cm tall from a slender stem connected to smaller offshoots by thin, fragile rhizomes. The generally hairless simple leaves grow in a basal rosette. There are from one to eight solitary, showy flowers per plant. The flowers are 1-3 cm wide, 5-lobed, with white petals and hairy, yellow throats. There are often striking purple markings on the petals. The fruits are oval capsules with many small seeds.

Dwarf Hesperochiron is a showy species and a desirable horticultural plant. Although it is widespread in the western United States, it is rare in Canada and is at the northern limit of its range.

Distribution

In Canada, Dwarf Hesperochiron is restricted to the Selkirk and Monashee mountains in southern British Columbia, where it is known from four subpopulations within a 25 km radius of Castlegar. It is widespread throughout the western United States from Washington, south to California and east to Arizona, Wyoming, and Montana.

Habitat

Dwarf Hesperochiron grows in small meadows with shallow bedrock outcroppings within a larger forested matrix. Plants grow at the edge of seepages in loamy soils that are over 20 cm deep. The slope position ranges from middle to lower slope with slopes varying from 5-40 degrees. Aspect ranges from east to south and the elevation is from 719-1169 m. Dwarf Hesperochiron grows on soil that is saturated with water in the early spring and is easily compacted or sloughed away by trampling. Dwarf Hesperochiron often grows in bare, exposed soil or with a sparse cover of forbs and bryophytes. Shrubs are usually absent, although they may be present at the edges of the seeps.

Biology

Dwarf Hesperochiron is associated with spring seepage and it flowers and sets seed when moisture is available. In British Columbia, plants flower in May and the short-lived flowers are pollinated by mining and sweat bees. Seeds appear to require cold stratification

for germination. Dwarf Hesperochiron plants produce multiple ramets that are connected by slender rhizomes that can become separated from the parent plant.

Population Sizes and Trends

In 2017, there were 168 mature flowering plants plus approximately 4360 smaller non-flowering ramets (mostly consisting of one leaf). The non-flowering plants are presumed to be offshoots connected to the main plant but may also be immature seedlings. Dwarf Hesperochiron was found in four distinct subpopulations separated by greater than one kilometre. Population fluctuations and trends for this species are unknown.

Threats and Limiting Factors

All known subpopulations occur on provincial crown land. Logging is planned for the parcel with the two largest subpopulations. Upslope logging and road building may alter hydrologic patterns, impacting downslope seepage and encouraging the spread of non-native invasive plants. The most serious non-native competitor is Spotted Knapweed, which competes with Dwarf Hesperochiron for water and other resources. Shrub and conifer encroachment associated with succession will degrade habitat over time. Recreational activities, including mountain biking and hiking, can increase compaction, trample plants and dislodge soil and associated plants. Well-worn trails can alter hydrology, diverting flows from seepage areas.

Small isolated populations can suffer from limited genetic diversity and inbreeding depression.

Protection, Status and Ranks

Dwarf Hesperochiron currently has no legal protection in Canada. In British Columbia, Dwarf Hesperochiron is red-listed and ranked Imperilled—S2 (2017). In Canada, it is nationally ranked N2 (Imperilled) with a global rank of G4 (Apparently Secure). In Canada, all four currently known subpopulations are on provincial crown land. It is SNR (unranked) nationally in the United States.

TECHNICAL SUMMARY

Hesperochiron pumilus

Dwarf Hesperochiron

Hespérochiron nain

Range of occurrence in Canada: British Columbia

Demographic Information

Generation time	2-5 yrs. Generation time is a rough estimate based on report writer's observation and presumptions about plant age.
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, inferred based on impact of threats.
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Suspected reduction of 3-30% based on impact of threats.
[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.	Unknown
Are the causes of the decline a. clearly reversible and b. understood and c. ceased?	Not applicable
Are there extreme fluctuations in number of mature individuals?	Unknown

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	52 km²
Index of area of occupancy (IAO) (Always report 2x2 grid value).	16 km²
Is the population "severely fragmented" i.e., is >50% of its total area of occupancy in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a) No, most of the area appears to support viable subpopulations based on counts of all individuals; b) unknown, but possibly.
Number of "locations" (use plausible range to reflect uncertainty if appropriate)	4 Each of the four subpopulations is considered a location based on combination of threats.
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Unknown

Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Unknown
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Unknown
Is there an [observed, inferred, or projected] decline in number of “locations”?	Unknown
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, inferred decline in quality and area of habitat.
Are there extreme fluctuations in number of subpopulations?	Unknown, but likely not.
Are there extreme fluctuations in number of “locations”?	Unknown, but likely not.
Are there extreme fluctuations in extent of occurrence?	Unknown, but likely not.
Are there extreme fluctuations in index of area of occupancy?	Unknown, but likely not.

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals (2017)**
Fairview Meadow	74
Beavervale Meadow	3
Lloyd’s Meadow	78
Lloyd’s Meadow- east subpopulation	13
Total	168

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations, or 10% within 100 years]?	Calculation not done

Threats (direct, from highest impact to least, as per IUCN Threats Calculator)

Was a threats calculator completed for this species? Yes

Overall threat impact of medium, based on:

i. Invasive Non-native/alien Species (8.1) – Medium impact
ii. Recreational Activities (6.1) – Medium to low impact
iii. Dams and Water Management/Use (7.2) – Low impact
iv. Other Ecosystem Modifications (7.3) – Low impact
v. Fire and Fire Suppression (7.1) – Unknown impact

What additional limiting factors are relevant?
Small isolated populations can suffer from limited genetic diversity.

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada. Closest voucher specimen in the United States is in Ferry County, Washington, 147 km away	S3 (Vulnerable)
Is immigration known or possible?	Not known, unlikely
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Possibly
Are conditions deteriorating in Canada?	Yes, projected decline in quality and area of habitat.
Are conditions for the source (i.e., outside) population deteriorating?	Unknown
Is the Canadian population considered to be a sink?	No
Is rescue from outside populations likely?	Unknown. The species does not appear to have long-distance dispersal mechanisms.

Data Sensitive Species	
Is this a data sensitive species?	No

Status History

COSEWIC: Designated Endangered in May 2019.

Status and Reasons for Designation:

Status: Endangered	**Alpha-numeric codes:** B1ab(iii)+2ab(iii); C2a(i); D1
Reasons for designation: This small, perennial plant is restricted to seasonally wet montane forest openings at four sites in a small area of southeastern British Columbia. The total number of mature individuals is very small (under 200). All Canadian sites are on provincial crown land and potentially subject to logging of surrounding areas and/or road building activity with subsequent changes to site hydrology. Negative impact on the thin substrate by mountain-biking activity has been noted close to one occurrence. Competition from non-native plants, most notably Spotted Knapweed, is the most significant threat expected to lead to habitat degradation over time. Drought and atypically intensive natural fire, as per climate-change projections, could potentially damage or eliminate one or more occurrences within three generations.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not met. Available data do not indicate trends in number of mature individuals. A future reduction in mature individuals, of unknown rate, is inferred from a continuing decline in quality and area of habitat but the magnitude of the declines are unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered, B1ab(iii)+2ab(iii) as EOO and IAO are well below thresholds, there are fewer than 5 locations, and there is an inferred decline in habitat quality and area due to ongoing threats.

Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered C2a(i) as current population size (168) is below threshold of 2,500; no subpopulation is greater than 250 mature individuals; and continuing decline is inferred due to a decline in habitat quality and area. No subpopulation has greater than 95 percent of individuals so C2a(ii) does not apply. C1 is not applicable as the continuing decline cannot be estimated.
Criterion D (Very Small or Restricted Population): Meets Endangered D1 as population is fewer than 250 mature individuals. Meets Threatened D2 with small IAO (16 km^2) and number of locations (4), and population could become critically endangered in a short period of time.
Criterion E (Quantitative Analysis): Data not available to conduct analysis.

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 (2019)

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.

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

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Hesperochiron pumilus

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2019

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Scientific name: *Hesperochiron pumilus* (Griseb.) Porter

Synonyms: *Villarsia pumila* (Douglas ex Grisebach); *Hesperochiron villosulus* (Greene) Suksd., *Capnorea pumila* (Douglas ex Griseb.) Greene

Common name: Dwarf Hesperochiron, Dwarf Monkey-fiddle

French common name: Hespérochiron nain

Dwarf Hesperochiron is in the Hydrophyllaceae (waterleaf) family within an unnamed clade that also includes the genera *Draperia, Tricardia,* and *Howellanthus* (Ferguson 1999; Walden *et al.* 2014; Luebert *et al.* 2016). *Hesperochiron* is different from other plants in the family because it is the only genus to have solitary, stalked flowers (Patterson and Walden *in prep.*).

Morphological Description

Morphological description is adapted from Patterson and Walden (*in prep.*) and Douglas *et al.* (1999) based on personal observation of the plants in British Columbia (Maslovat pers. obs. 2017).

Dwarf Hesperochiron is a perennial, herbaceous plant that grows up to 10 cm tall from a slender stem (Figures 1 and 2). The main stem is connected to smaller offshoots by thin, fragile rhizomes (Figure 3). The simple ovate leaves grow in a basal rosette that is either upright or spreads next to the ground. The leaf blades are up to 10 cm long, roughly equal to the length of the petiole. The leaves usually lack hair on the upper surface but sometimes have sparse, tiny to short hairs along the leaf margins. There are 1-8 solitary, showy, rotate or campanulate flowers with 5 (rarely 6) lobes that measure 1-3 cm wide. The petals are white with hairy, yellow throats and often have striking purple markings extending outward from the throat (Figure 4). The fruit are oval capsules with many small seeds, measuring 1-1.5 mm.

There are only two species of *Hesperochiron* in North America: Dwarf Hesperochiron and California Hesperochiron (*H. californicus*) (Patterson and Walden *in prep.*). The range of the two species in the United States is similar (University of Washington Herbarium 2017) but California Hesperochiron is not known from Canada (NatureServe 2017).

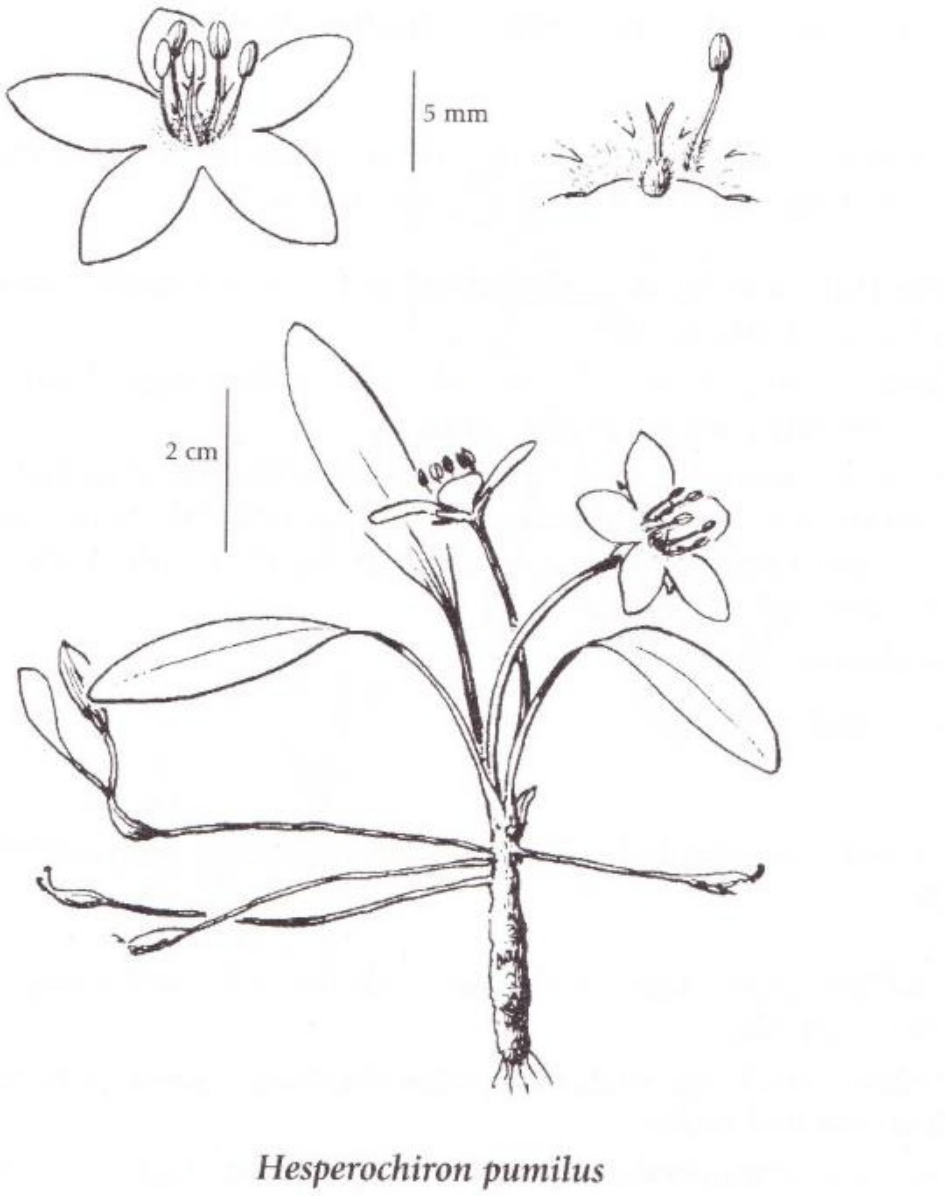

Figure 1. Illustration of Dwarf Hesperochiron. Reprinted with permission of the University of Washington Press. From Hitchcock, C. Leo, and Arthur Cronquist. Flora of the Pacific Northwest: An Illustrated Manual. Pp. 730. © 1973.

Figure 2. Mature Dwarf Hesperochiron showing root structure (rhizomes were broken during excavation so offshoots are not seen). Photo: C. Maslovat. (May 14, 2017, Fairview Meadow).

Figure 3. Entire Dwarf Hesperochiron plant showing slender rhizomes connecting offshoots. Photo: C. Maslovat. (May 14, 2017, Fairview Meadow).

Figure 4. Flower variation in Dwarf Hesperochiron in British Columbia with some plants showing striking purple markings. Photos: R. Batten. Top left (May 10, 2017, Lloyd's Meadow), top right (May 25, 2013, Clockum Pass), bottom left (May 10, 2017, Lloyd's Meadow), bottom right (May 11, 2017, Fairview Meadow).

Population Spatial Structure and Variability

For Dwarf Hesperochiron, the COSEWIC term “subpopulation” (COSEWIC 2015) corresponds reasonably well to the habitat-based plant element occurrence delimitation standards (NatureServe 2004) where a subpopulation is defined as a group of occurrences that are separated by less than 1 km; or if separated by 1 to 3 km, with no break in suitable habitat between them exceeding 1 km; or if separated by 3 to 10 km but connected by linear water flow and having no break in suitable habitat between them exceeding 3 km. Further surveys are required to determine population variability and spatial structure. The habitat is specialized within isolated patches of meadow and it is likely that geographical barriers to movement restrict the distribution.

Designatable Units

There are no recognized subspecies/varieties or discrete/evolutionary significant populations within its small Canadian range that could be recognized as separate designatable units.

Special Significance

Dwarf Hesperochiron is a showy species and a desirable horticultural plant, especially for rock gardens (Robinson 1880; Kruckeberg 2012). Although it is widespread in the western United States, it is rare in Canada and is at the northern limit of its range. It occurs in specialized habitat with other plants of conservation concern.

There is no published information on Aboriginal Traditional Knowledge of this species. It is a small plant with a limited distribution and no obvious medicinal properties or utilitarian purpose; it is unlikely to have significance to First Nations.

DISTRIBUTION

Global Range

Dwarf Hesperochiron is widespread throughout the western United States from Washington, south to California and east to Arizona, Wyoming and Montana (Figure 5) (NatureServe 2017).

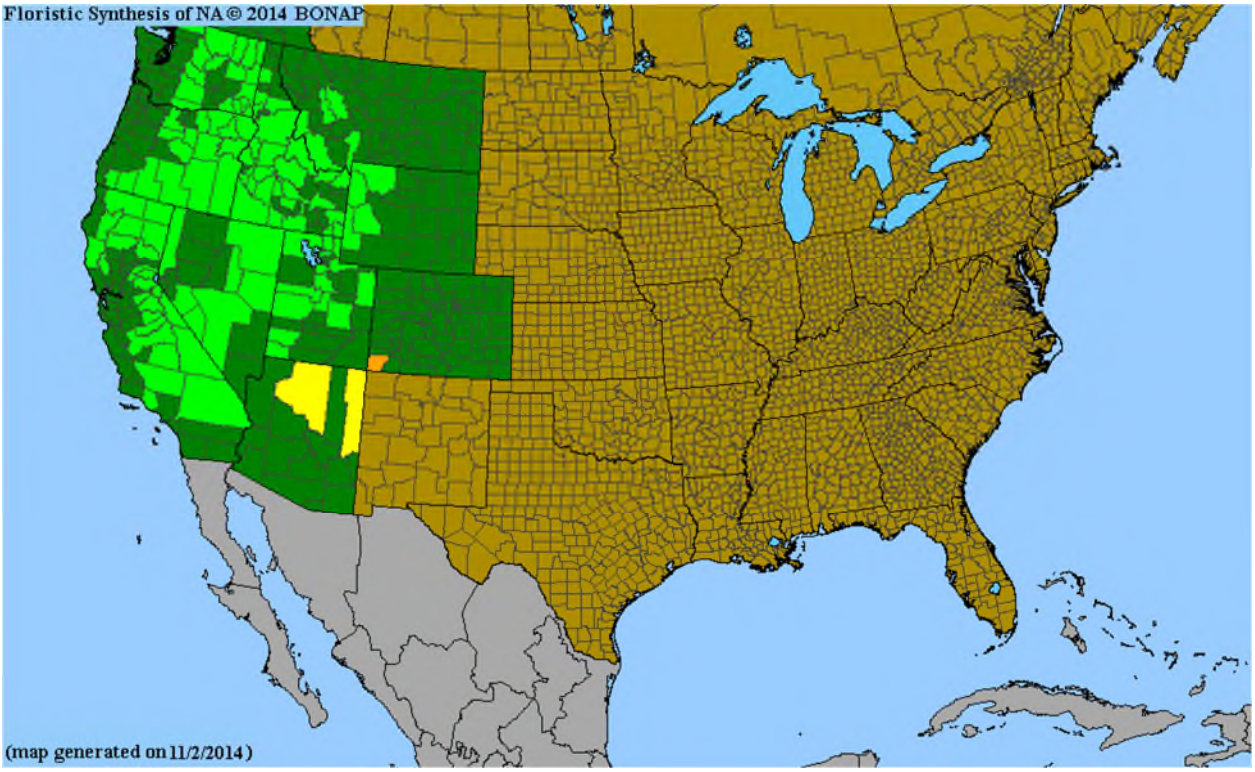

Figure 5. Global Distribution of Dwarf Hesperochiron (Kartesz (The Biota of North America Program) 2014). Light green = species present in county (not rare); dark green = native species present in state or province; yellow = species present and rare; orange = species extirpated (historic).

Canadian Range

In Canada, Dwarf Hesperochiron is restricted to the Selkirk and Monashee mountains in southern British Columbia. It is known from four subpopulations, all within a 25 km radius of Castlegar (Figure 6). Less than 1% of the global species range occurs in Canada.

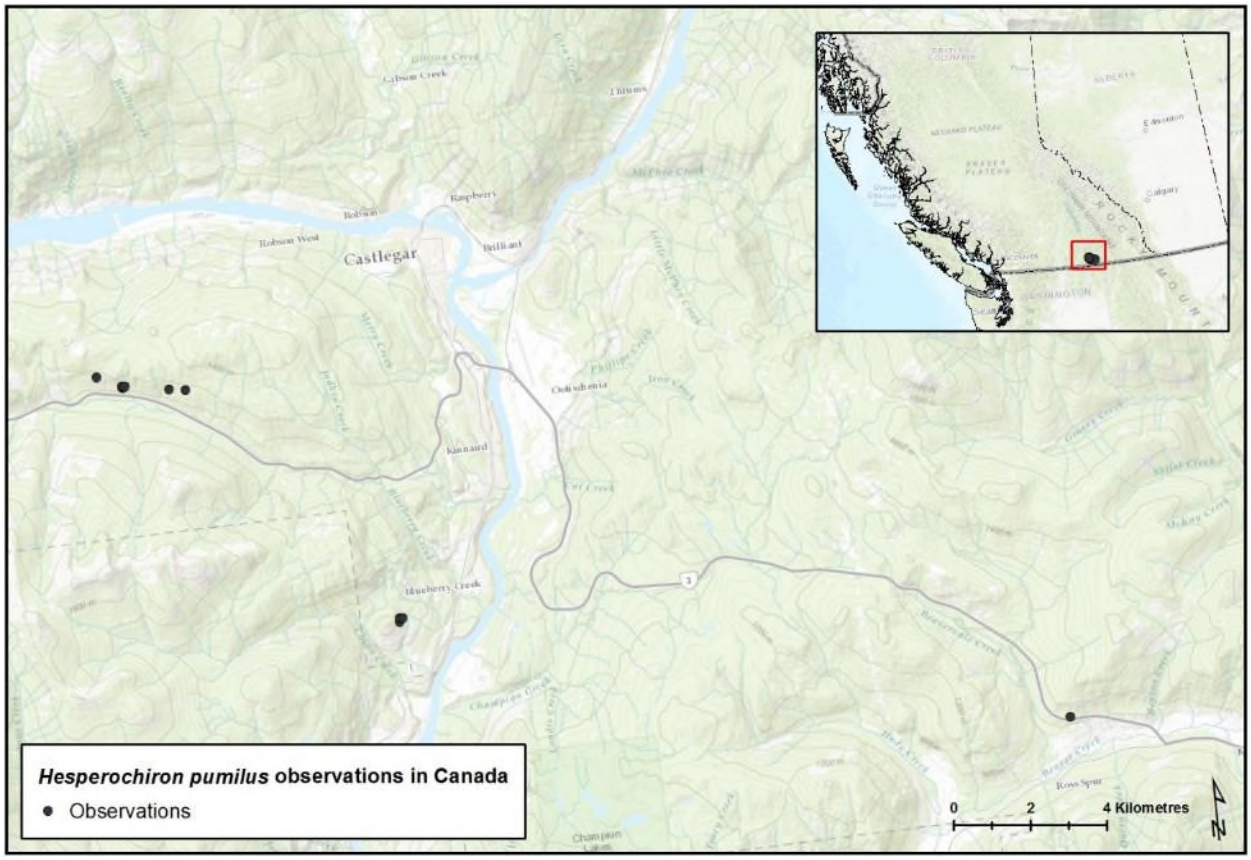

Figure 6. Distribution of Dwarf Hesperochiron in Canada. Map produced by COSEWIC Secretariat.

Extent of Occurrence and Area of Occupancy

The extent of occurrence based on a minimum convex polygon around all observations is 52 km^2. The index of area of occupancy based on a 2 km x 2 km grid over the observations is 16 km^2.

Search Effort

In Canada, the first record of Dwarf Hesperochiron is from a herbarium specimen which was collected by Jean Cuming on May 29, 1989 at Beavervale Meadow (east of Castlegar) with determination by Chris Brayshaw (V: V141731). The same site was visited on May 13, 1991 by Adolf Ceska who collected a second herbarium sample (V: V149185). A subpopulation at Lloyd's Meadow (west of Castlegar) was found on May 6, 2014 by Ryan Batten (British Columbia Conservation Data Centre 2014).

In May 2017, both previously known subpopulations were surveyed and suitable potential habitat was searched. Two new Dwarf Hesperochiron subpopulations were found (Fairview Meadow and Lloyd's Meadow-east).

Search effort included surveys in meadows next to known subpopulations and in suitable habitat southwest of Rossland, east of Christina Lake, and west of Creston. A highway survey to identify potential habitat in the area north of Rossland, west of Salmo, and east of Christina Lake found few areas with suitable habitat (Figure 7). This area likely describes the geographic extent of the species in Canada. The interior parts of the bounded area included mountainous terrain that would not support this species. The total search effort included 37.9 km of targeted search and 57 search hours in potential habitat at a time when the plants could be easily identified (Maslovat and Batten 2017).

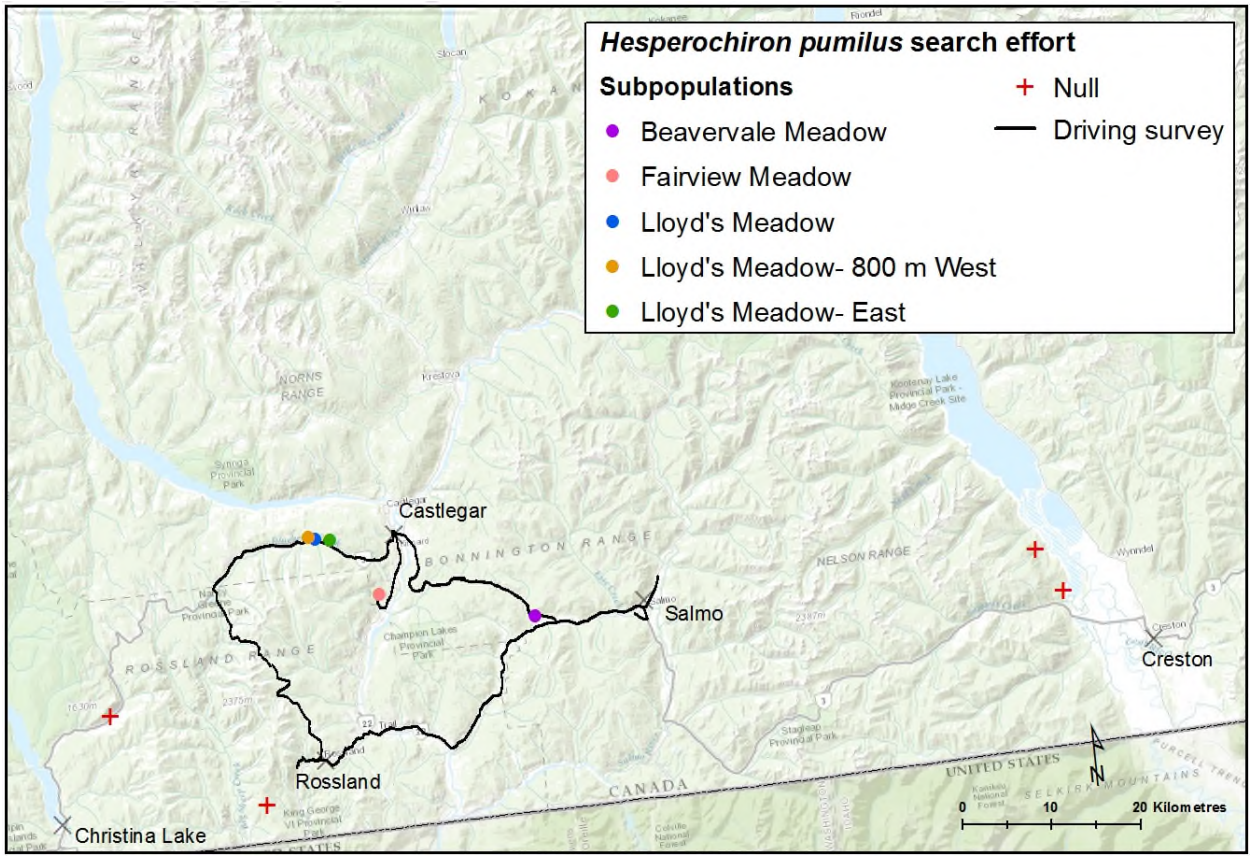

Figure 7. Search effort for Dwarf Hesperochiron in 2017. Map produced by COSEWIC Secretariat.

It is difficult to determine additional potential habitat outside the geographic extent. Although larger glades were identified on orthophotos, it was not possible to determine if the suitable microhabitat was present at that scale. On the ground surveys in areas that appeared suitable from orthophotos did not contain the spring seepage required by this species. The habitat is naturally uncommon within the landscape and is limited to sites with south- to east facing aspect, sustained spring seepage, thin soil, and proper slope within non-forested meadows. Habitat also appears to be restricted to a narrow range of elevation within a narrow geographic area.

Dwarf Hesperochiron is a small plant that flowers for a short time early in the spring. When it is not flowering, it is easily overlooked and, superficially, the leaves look like those of Pretty Shootingstar (*Primula pauciflora*). However, the area has been the subject of previous botanical surveys including by Botany BC, an annual field-based meeting of botanists and plant enthusiasts, and the highly specialized habitat is extremely limited in the landscape. It is possible, although unlikely, that additional subpopulations will be found in a wider geographical area (Penny and Douglas 1999).

HABITAT

Habitat Requirements

In Canada, Dwarf Hesperochiron is found in the Interior Cedar – Hemlock (ICH) biogeoclimatic zone. Dwarf Hesperochiron grows in small meadows that occur because of near-surface rock outcroppings within a larger forested matrix. It has a patchy distribution and requires specialized habitat next to small spring seepages (Figure 8). The thin soils of the seepages prevent the establishment of larger, more vigorous plant species that would compete for light, moisture and nutrients. Dwarf Hesperochiron generally grows along the edges of the seepages where deeper soils (over 20 cm deep) are deposited Maslovat pers. obs. (2017).

Figure 8. Dwarf Hesperochiron specialized habitat showing seepage area and loose sloughy soils. Photo: R. Batten. (May 15, 2017, Lloyd's Meadow - East).

In the United States, Dwarf Hesperochiron is found in wet meadows, slopes and flats (Patterson and Walden *in prep.*). Most sites have less than 6 degrees slope with varying aspect. Elevation ranges from 400-3000 m with most sites occurring from 1000-2000 m (University of Washington Herbarium 2017). In Washington, sites are described as wet meadow, shrub-steppe, sagebrush slope, scabland, damp prairie, open pasture, moist wood, wet swale, alpine slope, and subalpine meadow. Substrates include clayey loam, deep loam, and stony and sandy soils (University of Washington Herbarium 2017).

In Canada, Dwarf Hesperochiron occurs primarily in full sun but also in smaller glades where there is some shade from adjacent tree cover . Sites are either middle or lower slope. Soils are loamy and rich, accumulating nutrients from seepage flows. Slopes range from 5-40 degrees and elevation from 719-1169 m. Aspect ranges from east to south, and sites tend to be free from snow early in the spring.

Dwarf Hesperochiron grows on soil that is saturated with water in the early spring and is easily eroded by trampling from people or ungulates. There is often bare, fluffy, exposed soil directly next to the plants, although some plants are found next to herbaceous vegetation. The role of disturbance by ungulates and small mammals is unclear: at several sites, hoof prints and ungulate faeces were visible next to Dwarf Hesperochiron plants and rodent digging was also observed (Batten pers. obs. 2017). Disturbance may help reduce competing vegetation and may spread vegetative propagules by separating offshoots from the parent plants. Dwarf Hesperochiron does not appear to depend on disturbances such as fire or flooding.

Vegetation is sparse and sites are dominated by bare soil with small numbers of forbs. The plant community changes dramatically through the spring and early summer (Figure 9). Shrubs are usually absent although they may be present at the edges of the seeps. Associated species are listed in Table 1. The invasive plant Spotted Knapweed (*Centaurea stoebe* ssp. *micranthos*) is present at most sites.

Figure 9. Dwarf Hesperochiron habitat taken May 15th and July 4th showing changes in vegetation over the season. Photos: R. Batten. (2017, Lloyd's Meadow).

Table 1. Species associated with Dwarf Hesperochiron by site.

Species	Subpopulation Names and Sites (Referenced to Field Report) F=Fairview, B=Beavervale, L=Lloyd's						
Meadow	**F**	**F**	**F**	**B**	**L**	**L**	**L**
Site	**A**	**C**	**E**	**C**	**1**	**B**	**C**
Achillea millefolium	x	x	x	x	x		
Aspidotis densa	x	x					
Bromus squarrosus	x	x				x	x
Bryum weigelii			x	x	x		
Castilleja hispida				x			
Centaurea stoebe ssp. *micranthos*	x	x	x	x	x	x	x
Cerastium glomeratum	x						
Clarkia pulchella						x	x
Claytonia lanceolata					x		x
Collinsia parviflora	x	x			x		x
Delphinium nuttallianum	x	x		x			x
Dicentra uniflora					x		
Drymocallis glandulosa					x		x
Elymus trachycaulus				x	x		
Festuca idahoensis			x		x		x
Floerkea proserpinacoides		x				x	x
Fritillaria pudica						x	
Geum triflorum					x		x
Hypericum perforatum	x	x	x				x
Lithophragma parviflorum		x		x	x	x	x
Lomatium ambiguum		x			x		x
Microsteris gracilis				x		x	
Montia linearis		x	x				x
Nemophila breviflora							x
Orobanche uniflora	x	x			x	x	x
Perideridia gairdneri ssp. *borealis*	x	x	x	x	x	x	x
Poa compressa	x	x					x
Polygonum douglasii						x	x
Primula pauciflora	x	x	x	x	x		
Rosa woodsii	x	x	x				
Sedum stenopetalum	x	x	x	x	x	x	
Suksdorfia ranunculifolia	x	x				x	x
Symphoricarpos albus		x					
Toxicoscordion venenosum	x	x	x	x	x		

Species	Subpopulation Names and Sites (Referenced to Field Report) F=Fairview, B=Beavervale, L=Lloyd's						
Meadow	**F**	**F**	**F**	**B**	**L**	**L**	**L**
Site	**A**	**C**	**E**	**C**	**1**	**B**	**C**
Triteleia grandiflora				x			
Veronica arvensis		x					
Woodsia oregana	x	x	x	x	x	x	x

Habitat Trends

Habitat availability is naturally fragmented in the larger forested landscape. Although two new subpopulations were found in 2017, these areas had been previously surveyed and Dwarf Hesperochiron was not detected because the plants were not flowering. Although Dwarf Hesperochiron may occur in unsurveyed or under-surveyed areas, new habitat is not likely to become available. Ongoing land use conversion will likely result in a net decrease of available habitat over time. The rate of habitat change over the last 10 years is unknown.

BIOLOGY

The information provided below is based on the report writer's field experience, fieldwork done in preparation for the status report and limited references published on closely related species.

Life Cycle and Reproduction

Dwarf Hesperochiron is associated with spring seepage and its lifecycle is connected to the seasonal availability of moisture. During the dry season, the leaves shrivel, and the plant is supported by the tuberous thickenings on the rhizomes. No phenological studies have been done on Dwarf Hesperochiron but it is presumed that the leaves emerge in the spring shortly following snow melt. Age to maturity and longevity of plants is unknown but given plant size, flowering is presumed to occur in 2-5 year old plants. Further research is necessary to confirm generation time but 2-5 years is suggested in the absence of any research on the matter so far.

Herbarium specimens from the United States record flowering time from April-August with most records dated from May and June (University of Washington Herbarium 2017). In British Columbia, herbarium records with flowering plants were collected in May (Royal British Columbia Museum Herbarium specimens V: V037180; V: V141731; V: V149185). The flowers are short-lived and fade quickly (Maslovat pers. obs. 2017).

Many plants in the family Hydrophyllaceae have secondary dormancy and produce long-lived seed banks (Gamboa-deBuen and Orozco-Segovia 2008). A dominant trait in this

family is physiological dormancy that is broken by environmental cues related to habitat: germination capacity has been observed to vary with differences in elevation (Gamboa-deBuen and Orozco-Segovia 2008).

Ex situ propagation of Dwarf Hesperochiron seed required a three-month cold stratification period (Emery 1988). Gibberellic acid was found to promote germination of the closely related *H. californicum* (Deno 1996).

Dwarf Hesperochiron plants produce multiple offshoots that are connected by slender rhizomes. Rhizomes up to 10 cm long were observed but rhizomes may be longer because they break easily and are difficult to excavate (Maslovat pers. obs. 2017). Dwarf Hesperochiron can be propagated for horticulture by separating these offshoots (Foster in Kruckeberg 2012) and it seems likely that vegetative reproduction occurs when these offshoots become separated from the parent plant. Multiple small leaves next to mature flowering plants are presumed to be primarily offshoots rather than new seedlings (Figure 3). It is presumed that plants must be at least two years old to produce rhizomes with ramets, but further research is necessary.

Physiology and Adaptability

No information known. There have been no comprehensive studies on the physiology or adaptability of Dwarf Hesperochiron or California Hesperochiron.

Dispersal

Dispersal distance for Dwarf Hesperochiron seed is unknown. Other plants in the Hydrophyllaceae primarily disperse without an external vector or are adapted for wind dispersal (Gamboa-de Buen and Orozco-Segovia 2008). There are no obvious wind dispersal mechanisms on Dwarf Hesperochiron seed so it is presumed that most seeds fall close to the parent plant. It is likely that short-distance dispersal occurs when seeds are carried downstream in water and sloughing soil when the seepages are actively flowing.

It is possible that short-distance vegetative dispersal also occurs when offshoots are separated from the parent plant. Many of the sites had minor disturbance from ungulate hooves and it is possible that ramets are dislodged with clumps of soil which may re-establish downslope.

Suitable habitat is naturally fragmented and is separated from other habitat patches by forest, which is the dominant vegetation type. Although further research is required to determine dispersal mechanisms and distances, in particular long-distance dispersal, the distances between habitat patches are probably larger than the species can be reasonably expected to disperse over the short term.

Interspecific Interactions

There was no evidence of any grazing on Dwarf Hesperochiron plants even though ungulate hoof prints and faeces were observed next to the plants (Maslovat pers. obs. 2017).

Pollination has been observed by short-tongued polylectic bees that collect pollen from a variety of flowers from unrelated plants. Pollinator species were identified as *Andrena* sp. in the Mining Bee Family (Andrenidae) (LaBerge 1989; Maslovat pers. obs. 2017) and *Lasioglossum* sp. in the Sweat Bee Family (Halictidae) (Maslovat pers. obs. 2017). No comprehensive pollination studies have been done.

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Surveys were done when surrounding vegetation was short and poorly developed and Dwarf Hesperochiron was in full bloom. To determine abundance, each flowering plant was counted by temporarily marking it with a painted wooden skewer. Estimates were made of the number of non-flowering ramets by counting the number in a small area (i.e. 10 cm x 10 cm square) and estimating the total number at each site.

Abundance

In 2017, 168 mature flowering plants plus approximately 4360 smaller non-flowering ramets (most consisting of a single leaf) were counted (Table 2). The non-flowering plants are presumed to be primarily offshoots connected to the main plant but may also be immature seedlings (without excavation of the plant, it is impossible to determine). Dwarf Hesperochiron was found in four distinct subpopulations separated by greater than one kilometre. One kilometre was used as the minimum distance between subpopulations because the species occurs in specific habitats that are fragmented at that scale, and because it matches the treatment of the British Columbia Conservation Data Centre (Penny pers. comm. 2017; see **Population Spatial Structure and Variability**).

Table 2. Number of individuals counted in each subpopulation in May 2017

Site Name	BC CDC Name	BC CDC Element Occurrence ID Number	Number of Mature Individuals	Number of Ramets
Lloyd's Meadow	Robson Ridge, 1.8 km SE of, "Lloyd's Meadow"	12468	78	2660 - 2860
Fairview Meadow	Columbia River/ Blueberry Creek, 2.2 km W of confluence	14786	74	1000 - 1300

Site Name	BC CDC Name	BC CDC Element Occurrence ID Number	Number of Mature Individuals	Number of Ramets
Beavervale Meadow	Beavervale Creek, 12 km W of Salmo	835	3	300 - 350
Lloyd's Meadow - East	Robson Ridge, 2.8 km SE of, SW of Castlegar	14787	13	400
Total			**168**	**4360 - 4910**

The population is not considered "severely fragmented" as most of the area of occupancy is in habitat patches that appear to be large enough (including all individuals) to support a viable population.

Fluctuations and Trends

A previous report from Lloyd's Meadow estimated 250-500 plants; however, many of these were single leaves of either non-flowering offshoots or seedlings (British Columbia Conservation Data Centre 2014). There is no record of plant numbers at other sites from previous years. Dwarf Hesperochiron is not known to undergo extreme fluctuations and there are no data to determine whether fluctuations occur.

The fieldwork done in preparation for this status report was the first comprehensive count of the Dwarf Hesperochiron population in Canada. Further research is needed to determine the fluctuations and trends for this species.

Rescue Effect

Dwarf Hesperochiron has a limited distribution and although the agents and frequency of dispersal are unknown, the species does not appear to have long-distance dispersal mechanisms. Although it is not rare in the United States (490 herbarium specimens in the Consortium of Pacific Northwest Herbaria as of October 2017), the closest known site with a voucher specimen is in Ferry County, Washington, 147 km away from the closest Canadian subpopulation (University of Washington Herbarium 2017). Were extirpation to occur in Canada, rescue would be unlikely from naturally dispersing US populations.

THREATS AND LIMITING FACTORS

Direct threats facing Dwarf Hesperochiron assessed in this report were organized and evaluated based on the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (Master *et al.* 2012). Threats are defined as the proximate activities or processes that directly and negatively affect the population and result in population decline. Results on the impact, scope, severity, and timing of threats are presented in tabular form in Appendix 1. The overall calculated and assigned threat impact is Medium for Dwarf Hesperochiron. The numbers associated with the threats

listed below correspond to IUCN threat categories.

Threats

8.1 Invasive non-native/alien species (Medium impact)

The invasive plant Spotted Knapweed is present in large numbers at most Dwarf Hesperochiron sites. Early in the season, Spotted Knapweed is small and does not appear to compete directly for light or moisture with Dwarf Hesperochiron plants. However, later in the season Spotted Knapweed dominates these sites (Batten pers. obs. 2017). Premature drying of spring seepages has been tied to decreased reproductive success of other species by causing immature flowers and fruit to abort (Fairbarns 2005).

Experiments show that sites with Spotted Knapweed show increased runoff and sediment yield with fall rains compared to sites dominated by native bunchgrasses because there is more bare soil and less litter (Lacey *et al.* 1989). It is unknown if Spotted Knapweed in Dwarf Hesperochiron habitat would cause long-term hydrological changes associated with erosion, which may in turn impact reproductive success.

Research has confirmed that Spotted Knapweed is allelopathic, releasing chemical compounds that have negative effects on the native plant community (e.g., Lesica and Shelly 1996; Ridenour and Callaway 2001; Thorpe *et al.* 2009; Bais and Kaushik 2010; but see Lau *et al.* 2008; Duke *et al.* 2009). The impacts on Dwarf Hesperochiron from Spotted Knapweed are unknown.

The impacts from less abundant invasive plants including Common St. John's Wort (*Hypericum perforatum*) on Dwarf Hesperochiron are unknown. The biocontrol beetle, *Chrysolina hyperici,* was observed feeding on Common St. John's Wort at Lloyd's Meadow (Batten pers. obs. 2017; Ministry of Forests, Lands and Natural Resource Operations 2017).

All known subpopulations of Dwarf Hesperochiron in Canada are found on provincial crown land and all three sites have old logging roads nearby. There is a timber licence on the site that includes two subpopulations (Lloyd's Meadow and Lloyd's Meadow-east) and the largest number of plants (Penny pers. comm. 2017). Recent timber cruising survey tape was observed in June 2017 (Batten pers. obs. 2017). Although Dwarf Hesperochiron is found in glades where there is no harvestable timber, machinery in areas adjacent to the glades can spread non-native invasive plants which may compete with Dwarf Hesperochiron and degrade the habitat. It is unlikely that logging and wood harvesting would create potential new habitat through glade creation and shrub suppression; invasion of non-native plants in disturbed areas will likely preclude Dwarf Hesperochiron establishment.

6.1 Recreational Activities (Medium to low impact)

All known subpopulations are publicly accessible because they are on crown land. One site (Fairview Meadow) is used for mountain biking and possibly dirt biking. The Dwarf Hesperochiron habitats are subject to frequent use because they are treeless and can thus be easily traversed. A bike track was observed within several metres of Dwarf Hesperochiron plants and tools for maintaining the trail (a broom and mattock) were found on the property (Maslovat pers. obs. 2017). At the same site, all-terrain vehicles (ATVs) use an old road less than ½ kilometre away. There is new housing being built close to this site which could increase recreational use over time. At a second site, there was a trail marked with flagging nearby which does not appear to be regularly used.

Recreational activities can trample plants and well-worn trails can alter hydrology, diverting flow from the sensitive seepage areas. When the soils are saturated with water in the winter and spring, trampling or biking can easily dislodge soil clumps and associated plants. Recreational activities can also spread invasive non-native plants which may compete with Dwarf Hesperochiron.

7.2 Dams and Water Management/Use (Low impact)

Logging and road building in upslope areas and recreational activities will alter hydrologic patterns and may impact the seepage areas. Machinery in meadow habitats would directly alter waterflow and may damage existing seepage sites. The logging company is aware of species at risk in the area and has stated it will design any roads and logging to avoid meadows and changes to hydrology. The company will check with the British Columbia Conservation Data Centre during planning stages (Cordeiro pers. comm. 2018).

7.3 Other Ecosystem Modifications (Low impact)

The glades where Dwarf Hesperochiron occurs are probably maintained by a combination of fire and thin soils. Historical imagery over the last decade seems to show the meadows getting noticeably smaller as shrubs and trees colonize the edges. Succession in the long-term should be considered a threat because it decreases the available habitat and changes the hydrology on which these plants depend.

7.1 Fire and Fire Suppression (Unknown impact)

Fires are suppressed at all sites. At one subpopulation (Beavervale Meadow), there has been an observed change in structure as shrubs, such as Saskatoon (*Amelanchier alnifolia*) establish over time within the meadow areas, likely due to succession associated with fire suppression. Shrub growth may eventually shade out Dwarf Hesperochiron and may draw moisture from the spring seeps. Fire may create new habitat through shrub and tree removal provided seepages are present and soils are thin enough to prevent woody plants from growing long enough for Dwarf Hesperochiron plants to establish. Alternatively, fire may degrade habitat by increasing erosion and altering hydrology. It is unclear what will

be the long-term impact of both fire and fire suppression on Dwarf Hesperochiron. Increased residential development may increase fire suppression.

Limiting Factors

Small isolated populations such as those of Dwarf Hesperochiron in Canada can suffer from limited genetic diversity and inbreeding depression (e.g., Ilves *et al.* 2003; Reed and Frankham 2003; Leimu *et al.* 2006; Szczecińska *et al.* 2016) but there is no evidence on the extent to which these effects are acting upon Dwarf Hesperochiron in Canada.

Number of Locations

There are four known subpopulations in Canada, separated from each other by a distance greater than 1 km. Each of the four subpopulations is considered a location due to the combination of threats at each. Within each of these subpopulations, the number of sites ranges from 3 to 4.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Dwarf Hesperochiron currently has no legal protection in Canada. It is not listed under the Convention on International Trade in Endangered Species (CITES), the USA *Endangered Species Act*, or assessed by the IUCN (IUCN 2017).

Non-Legal Status and Ranks

In British Columbia, Dwarf Hesperochiron is red-listed and was ranked S2 (Imperilled) in 2017 (British Columbia Conservation Data Centre 2017). The national status is N2 (Imperilled) in Canada and in 1999 it was given a global rank of G4 (Apparently Secure) (NatureServe 2017).

In the United States, it is unranked in California, Idaho, Utah, and Montana. It is ranked S4 (Apparently Secure) in Oregon (Kagan pers. comm. 2017), S3 (Vulnerable) in Nevada (Johnson pers. comm. 2017) and Washington (Fertig pers. comm. 2017), S2 (Imperiled) in Arizona and Wyoming, and SH (possibly extirpated) in Colorado (NatureServe 2017). It has not been ranked nationally in the United States (NatureServe 2017).

Habitat Protection and Ownership

All four currently known subpopulations are on provincial crown land.

In 1957, Lloyd's Meadow was designated a Section 17 Designated Use Area held by the British Columbia Ministry of Environment for environment, conservation and recreation purposes. This designation is still active (GATOR 2017). The Section 17 reserve creates a "Withdrawal from Disposition" that precludes or prevents the acceptance of crown land applications and disposition of crown land (Ministry of Forests, Lands and Natural Resource Operations 2015). The designation does not preclude timber harvest which is currently planned for this site. In 2017, the timber company contacted the British Columbia Conservation Data Centre for information about species at risk on the site (Penny pers. comm. 2017).

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Batten, Ryan. Botanist. Victoria, British Columbia.

Enns, Amie. National Data Manager. NatureServe Canada. Vancouver, British Columbia.

Fertig, Walter. Washington Natural Heritage Program. Washington Department of Natural Resources. Olympia, Washington.

Fraser, Dave. Unit Head, Species Conservation Science, Conservation Science Section. Victoria, British Columbia.

Johnson, Janel. Botanist. Nevada Natural Heritage Program, Carson City, Nevada.

Jones, Neil. Scientific Project Officer and ATK Coordinator, COSEWIC Secretariat. Gatineau, Quebec.

Kagan, James. Director, Oregon Biodiversity Information Center, Institute of Natural Resources, Oregon State University, Corvallis, Oregon.

Lake, Randal. Head, Conservation and Planning, Environment and Climate Change Canada. Delta, British Columbia.

Legler, Ben. Informatics Specialist, University of Washington, Seattle, Washington.

Lomer, Frank. Associate, University of British Columbia. Vancouver, British Columbia.

MacKillop, Deb. Research Ecologist, Ministry of Forests, Lands and Natural Resources. Nelson, British Columbia.

Millikin, Rhonda. Population Assessment Head, Canadian Wildlife Service. Delta, British Columbia.

Penny, Jenifer. Botanist. British Columbia Conservation Data Centre. Victoria, British Columbia.

Pipp, Andrea. Program Botanist, Montana Natural Heritage Program. Helena, Montana.

Pruss, Shelly. Ecosystem Scientist III, Parks Canada Agency. Fort Saskatchewan, Alberta.

Robillard, Cassandra. Botany Collections Technician, Canadian Museum of Nature. Ottawa, Ontario.

Tonn, Sabra. Program Supervisor, Arizona Heritage Data Management System, Phoenix, Arizona.

Walden, Genevieve. Botany Lab and Herbarium (CDA), California Department of Food and Agriculture. Sacramento, California.

Wheeler, Erica. Royal British Columbia Museum Herbarium. Victoria, British Columbia.

Wu, Jenny. Scientific Project Officer, COSEWIC Secretariat, Canadian Wildlife Service Environment and Climate Change Canada, Gatineau, Quebec.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Carrina Maslovat works as a consultant in plant communities at risk, primarily Garry Oak Ecosystems. She has inventoried rare plants in regional, municipal, federal and provincial parks, finding new subpopulations of species at risk and monitoring rare plant populations' abundance and vitality over time. She has developed management plans for nature reserves and created Best Management Practices to minimize impact to species at risk. She is the writer of three COSEWIC status reports, two status report updates and several recovery planning documents. Recently, she has been working to restore wetland and upland habitat for species at risk.

COLLECTIONS EXAMINED

Canadian Museum of Nature: No specimens.

Consortium of Pacific Northwest Herbaria: Online access.

Department of Agriculture, Ottawa: No specimens.

Royal British Columbia Museum: V: V037180, collected by Hitchcock and Muhlick, Malheur County Oregon, May 29, 1962; V: V141731, collected by Jean Cuming, May 29, 1989, Determination by Chris Brayshaw; V: V149185, collected by A. Ceska, R. Walker and R. Grimm, Collected May 13, 1991.

University of British Columbia: No specimens.

Appendix 1. Threat Calculator for Dwarf Hesperochiron.

Species or Ecosystem Scientific Name	Dwarf Hesperochiron - *Hesperochiron pumilus*		
Element ID		**Elcode**	
Date (Ctrl + ";" for today's date):	25/09/2018		
Assessor(s):	Ryan Batten, Carrina Maslovat, Dave Fraser, Del Meidinger, Andy MacKinnon, Bruce Bennett, Jenifer Penny		
References:			

Overall Threat Impact Calculation Help:

Threat Impact		**Level 1 Threat Impact Counts: high range**	**low range**
A	Very High	0	0
B	High	0	0
C	Medium	2	1
D	Low	1	2
Calculated Overall Threat Impact:		Medium	Medium
Assigned Overall Threat Impact:		**C = Medium**	
Impact Adjustment Reasons:			
Overall Threat Comments		Generation time 2-5 years; three generations up to 15 years.	

Threat		**Impact (calculated)**		**Scope (next 10 Yrs)**	**Severity (10 Yrs or 3 Gen.)**	**Timing**	**Comments**
1	Residential & commercial development						
1.1	Housing & urban areas						Two or three new homes in Fairview Meadow site area; residents may use trails or mountain bike.
1.2	Commercial & industrial areas						
1.3	Tourism & recreation areas						
2	Agriculture & aquaculture						
2.1	Annual & perennial non-timber crops						
2.2	Wood & pulp plantations						
2.3	Livestock farming & ranching						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2.4	Marine & freshwater aquaculture						
3	Energy production & mining						
3.1	Oil & gas drilling						
3.2	Mining & quarrying						
3.3	Renewable energy						
4	Transportation & service corridors		Not Calculated (outside assessment timeframe)	Large (31-70%)	Serious - Slight (1-70%)	Low (Possibly in the long term, >10 yrs/3 gen)	
4.1	Roads & railroads						Logging company operating in area of sites aware of species and will avoid building roads on sites.
4.2	Utility & service lines		Not Calculated (outside assessment timeframe)	Large (31-70%)	Serious - Slight (1-70%)	Low (Possibly in the long term, >10 yrs/3 gen)	Lloyd's meadow sites registered for possible utility lines. Flagged as a corridor that may be of interest in future. Impact depends on where they put pylons or roads.
4.3	Shipping lanes						
4.4	Flight paths						
5	Biological resource use						
5.1	Hunting & collecting terrestrial animals						
5.2	Gathering terrestrial plants						
5.3	Logging & wood harvesting						No direct impact as roads would by-pass sites. Potential changes to hydrology scored under 7.2.
5.4	Fishing & harvesting aquatic resources						
6	Human intrusions & disturbance	CD	Medium - Low	Restricted - Small (1-30%)	Serious (31-70%)	High (Continuing)	
6.1	Recreational activities	CD	Medium - Low	Restricted - Small (1-30%)	Serious (31-70%)	High (Continuing)	Fairview Meadow site is used for mountain biking, and possibly dirt biking. ATV's use an old road about 1/2 km away.
6.2	War, civil unrest & military exercises						
6.3	Work & other activities						
7	Natural system modifications	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.1	Fire & fire suppression		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Fire suppression likely increases shrub growth at sites; fires may create new habitat by removal of shrubs and trees, if seeps present and if there are thin soils to limit the establishment of competitive plants. Fire may degrade site by increasing erosion or altering hydrology. Fire severity may increase due to climate change and could impact on population.
7.2	Dams & water management/use	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Changes to hydrology of seeps from recreation and logging. Logging company operating in the area is aware of the at-risk plant species on the rocky seeps and has stated that they will design any roads and logging to avoid meadows and changes to hydrology, and will check in with Conservation Data Centre on any plans. Severity scored lower as logging company will attempt to alleviate any impact.
7.3	Other ecosystem modifications	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	These openings were probably maintained by a combination of fire and thin soils. They contain species associated with succession and a comparison of historical imagery over the last decade seems to show the meadows getting noticeably smaller as shrubs and small trees colonize the fringes. Succession in the long term should be considered a threat, not only does it close up available habitat but it also changes the hydrology on which these plants depend. Shrub encroachment especially an issue at Beavervale Meadow (2% of population).
8	Invasive & other problematic species & genes	C	Medium	Large (31-70%)	Moderate (11-30%)	High - Moderate	
8.1	Invasive non-native/alien species/diseases	C	Medium	Large (31-70%)	Moderate (11-30%)	High - Moderate	Spotted Knapweed, an allelopath, is present in large numbers as at most sites. Common St. John's Wort present but biocontrol beetle also observed.
8.2	Problematic native species/diseases						
8.3	Introduced genetic material						

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.4	Problematic species/diseases of unknown origin						
8.5	Viral/prion-induced diseases						
8.6	Diseases of unknown cause						
9	Pollution						
9.1	Domestic & urban waste water						
9.2	Industrial & military effluents						
9.3	Agricultural & forestry effluents						
9.4	Garbage & solid waste						
9.5	Air-borne pollutants						
9.6	Excess energy						
10	Geological events						
10.1	Volcanoes						
10.2	Earthquakes/tsunamis						
10.3	Avalanches/landslides						
11	Climate change & severe weather						
11.1	Habitat shifting & alteration						At the northern extent of its range; species should be able to tolerate the predicted increase in temperature. It also flowers in the early spring when there is usually ample moisture available from snow melt.
11.2	Droughts						Drought could increase in intensity due to climate change; may impact on population.
11.3	Temperature extremes						
11.4	Storms & flooding						
11.5	Other impacts						
Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).							