COSEWIC
Assessment and Status Report

on the

Bert's Predaceous Diving Beetle
Sanfilippodytes bertae

in Canada

ENDANGERED
2009

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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Bert's Predaceous Diving Beetle — Photo provided by author.

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COSEWIC
Assessment Summary

Assessment Summary – November 2009

Common name
Bert's Predaceous Diving Beetle

Scientific name
Sanfilippodytes bertae

Status
Endangered

Reason for designation
Despite extensive searches, this Canadian endemic species is known from only two locations in southern Alberta, one of which has been destroyed. It is limited to springs and seepage areas along steep cliff edges or river bends. Its habitat is declining due to trampling by livestock and lowering of the water table due to withdrawals for irrigation.

Occurrence
Alberta

Status history
Designated Endangered in November 2009.

COSEWIC
Executive Summary

Bert's Predaceous Diving Beetle
Sanfilippodytes bertae

Species information

Bert's Predaceous Diving Beetle (*Sanfilippodytes bertae),* Roughley and Larson 2000, Coleoptera: Dytiscidae) is described from the springs and seepages in the arid grasslands of southern Alberta. There are no known subspecies or forms. The adult appearance is typical of the genus except in elytral markings. Adult specimens are less than 3 mm in length, rather broadly oval in shape (length:width = 1.84 to 1.94). The head and pronotum are dark brown and the elytra are yellowish brown without yellowish spots or markings.

Distribution

The historical distribution of Bert's Predaceous Diving Beetle includes 2 and possibly 3 localities: 1) the northwest bank of the Oldman River immediately upstream of the Highway 2 crossing west of Fort MacLeod, Alberta; 2) Fort MacLeod itself; and 3) the newly discovered locality near Head-Smashed-In Buffalo Jump. Localities #1 and 2 may represent the same locality and therefore the same population; however, this remains unclear. The only record since 1984 and the only extant population is location 3.

Habitat

The habitat of Bert's Predaceous Diving Beetle is limited to springs and seepage areas in the watershed region of the Oldman River in southern Alberta. With respect to localities 1 and 2, a key element of the spring and seepage habitat was that it flowed out of the river banks at about the level of the high water (vernal flood) mark. Field surveys of springs and seeps in the region surrounding the first sampling locales recovered one specimen from the output point source of a spring near Head-Smashed-In Buffalo Jump. The habitat at this spring was characterized by a faint trickle of water exiting a crevice approximately half-way down a rocky cliff. The cliff dropped below the normal landscape of smooth hills with high winds and low vegetation by approximately 5 m. The spring exited the cliff wall approximately half way down the cliff face. The crevice where the spring exited the rock contained wet mosses and algae. Small undisturbed remnants of the above-described spring and seep habitat are very scarce in southern Alberta and many have been destroyed by cattle.

Biology

The life history characteristics of Bert's Predaceous Diving Beetle remain a mystery. All predaceous water beetle larvae and adults are predaceous, principally eating invertebrates, probably enchytraeid worms and aquatic larvae of flies (Diptera). There is no evidence to suggest that the life cycle is anything but annual and likely involves vernal breeding and oviposition with larval development during the summer, followed by a brief terrestrial pupation. The over-wintering stage is the adult. Dispersal is probably minimal (despite presence of fully formed flight wings).

Population sizes and trends

Extensive spring, summer and fall sampling efforts over a period of 18 days (approx.180 hours) in 2008 resulted in only two specimens being recovered from a new location near Head-Smashed-In Buffalo Jump. Examination of specimens in 42 collections and extensive field work prior to this had revealed only 2 localities.

Only 42 specimens of this species were known previously (collected in 1984) from potentially two locales near Fort MacLeod. These specimens provided the material for the original description of the species. During the course of field research, no further specimens were collected at the type locality, near Fort MacLeod, Alberta despite repeated intensive search efforts in and around the Fort MacLeod area to locate this habitat. However, two additional specimens were collected at another locale near Head-Smashed-In Buffalo Jump (the oasis). The population size of Bert's Predaceous Diving Beetle is unknown, but as with most species, a minimum population of several hundred individuals would likely be required to sustain a viable population. The data at hand is insufficient to speculate about fluctuation of these populations.

Limiting factors and threats

Bert's Predaceous Diving Beetle appears to require a very specific habitat within springs and seepages in an undisturbed area with mosses over fine particulate soil (necessary for pupation) and the appropriate fine-grained substrate of sand and other fine particulates. The most serious threats to these fragile point sources of habitat are lowering water levels in the Oldman River Basin and aggregation of livestock at these fragile habitats. Other potential threats along the Oldman River Basin (along with the associated coulees, springs and seeps) include: high water withdrawals and demands for agricultural irrigation; increasing water demands resulting from a booming economy and subsequent rapid growth; impoundments which would drown the habitat; municipal and industrial development including oil and gas; increasing demands for water for use in industry and domestic use; groundwater withdrawals; ranching practices; feedlots; human recreation and climate change. On top of the anthropogenic forces affecting the habitats of Bert's Predaceous Diving Beetle, the required habitat is inherently sensitive. The Oldman River watershed lies within the Prairie Parkland Natural Ecozone. This ecozone includes flat and gently rolling hills covered mostly by dry mixed grasslands in southern Alberta. Since European settlement in this Ecozone, it has become one of the

most developed agricultural areas in the world. Of the Ecozone's total land area of 47 million hectares, 3% of the natural environment is believed to remain intact with 70% classified as cropland and 27% as rangeland and pasture.

Special significance of the species

Springs and seepages are biologically, chemically and physically complex and fragile. Bert's Predaceous Diving Beetle is indicative of the remaining, reasonably uncompromised, spring and seepage habitat found in southern Alberta. Springs and seeps are important because their arthropod fauna includes a limited number of species and diverse and specialized organisms, including groundwater, stream and water-film specialists. Bert's Predaceous Diving Beetle might act as an indicator of occurrence of other unusual or significant species. It should be considered rare or at risk throughout its range due its highly specific and geographically isolated habitat requirements and the current scarcity of these available habitats.

Existing protection

Bert's Predaceous Diving Beetle is currently not globally or regionally listed. A new locality for Bert's Predaceous Diving Beetle is immediately south of Head-Smashed-In Buffalo Jump, a UNESCO World Heritage site. Almost certainly this locality shares the groundwater system with the UNESCO site.

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 (2009)

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 Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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SPECIES INFORMATION

Name and classification

Kingdom Animalia: Animal, animals, animaux
Phylum: Arthropoda - arthropodes, arthropods, Artrópode
Subphylum: Hexapoda - hexapods
Class: Insecta - hexapoda, insectes, insects, inseto
Subclass: Pterygota - insects ailés, winged insects
Infraclass: Neoptera - modern, wing-folding insects
Order: Coleoptera Linnaeus, 1758 - beetles, besouro, coléoptères
Suborder: Adephaga, Schellenberg 1806
Family: Dytiscidae, Latreille 1802 - dytiscids, predaceous diving beetle
Subfamily: Hydroporinae, Aubé 1836
Tribe: Hydroporini, Aubé 1836
Genus: *Sanfilippodytes,* Franciscolo 1979
Species: *S. bertae,* Roughley and Larson 2000 – Bert's Predaceous Diving Beetle

Bert's Predaceous Diving Beetle (*Sanfilippodytes bertae* Roughley and Larson 2000) belongs to the Order Coleoptera, Family Dytiscidae. It is one of 25 species in the genus *Sanfilippodytes* Franciscolo 1979 (Nilsson 2001, pp. 182-183) including 8 species in Canada, four of which occur in Alberta (in addition to *S. bertae*, *S. compertus* (Brown 1942)*, S. edwardsi* (Wallis, 1933), and *S. pseudovilis* (Young 1953)0. For a key to the Canadian species see Larson *et al*. 2000, pp. 202-228. *Sanfilippodytes bertae* is only known to inhabit a very small region in Canada located in southern Alberta. This species is named in honour of Mrs. Bertha (Bert) F. Carr of Calgary who helped collect the type series. The following description is based on all of the material that is known (44 specimens), and the search for material included 42 insect collections in various museums and universities (listed by Larson *et al*. 2000, p. xiii).

Morphological description

The adult appearance is typical of the genus except elytral markings. Adult specimens are less than 3 mm in length, rather broadly oval in shape (length:width = 1.84 to 1.94). The head and pronotum are dark brown and the elytra are yellowish brown without yellowish spots or markings (Figures 1 and 2). Larvae of this species are not known; however, larvae belonging to the genus *Sanfilippodytes* are characterized in Larson *et al.* (2000, p. 857- as instar II and III larvae). As with all dytiscids there would be 3 instars of larvae with the first stage (instar I) being smaller in size and qualitatively distinct from later instar larvae.

HOLOTYPE. Male, in CNC. Ft. MacLeod, Alberta. 31 III 1984, Lot 1, B.F. and J.L. Carr.

ALLOTYPE. Female - same collection, locality and collector.

PARATYPES. 28 specimens from same locality and collector (16.iii.1980, 31.iii.1984, 5.v.1984) and 12 specimens labelled Alta, Old Man R., Ft. Macleod, May 5, 1984, Carr and Larson , deposited in various museums (ROM, CMN, Univ. Man.).

Species description

Length = 2.3 to 2.8 mm; width = 1.2 to 1.5 mm; length: width = 1.84 to 1.94. Body form oval, depressed, widest anterior to middle and relatively evenly rounded laterally.

Colour yellowish brown, with lighter elytra contrasting with brownish red head and pronotum. Head dorsally reddish yellow except anterior margin paler, yellow; head ventrally with gula yellowish and genae darker, yellowish red to brown. Antenna yellow to yellowish red; palpi yellow. Pronotum with medial area on disc dark brown to piceous with very broadly lighter, reddish to yellowish margins; elytron yellow to yellowish red, some specimens gradually darkening medially to very light brown; epipleuron yellow to yellowish red. Ventral surface largely brown, except pronotum laterally, metasternum medially, posterior margin of metacoxal plates and abdominal sterna laterally, yellowish. Legs yellowish.

Head with very small, moderately sparse and evenly spaced punctures. Pronotum with disc with small punctures medially (much larger than those on head), punctures somewhat larger and more dense toward margins, posterior margin with many punctures in subconfluent row, punctures dense on posterolateral angle. Elytron with punctures small, fine and not particularly dense, punctation dual with micropunctures obscured by microsculpture; epipleuron impunctate or with a few, scattered shallow punctures. Metasternum laterally with small, dense, subconfluent punctures, metacoxal plate with punctures very small and sparse on disc, punctures separated by 4 to 5 times their diameter, anterolaterally with punctures obscured by shallow, oblique impressions. Abdominal sterna laterally with fine, quite sparse punctures; sternum 6 with punctures very small and fine and quite sparse. Microreticulation evident over entire dorsal and ventral surface.

Pronotal bead narrower, not as wide as a median antennomere. Pronotum with posterolateral angle obtuse; basal margin sinuate on each side of basomedial lobe. Elytron with lateral margin gently curving upward in lateral aspect, epipleuron visible almost to shoulder. Prosternum without a medial convexity anterior to base of process; process with declivity poorly developed, file obsolete, prominence low and inconspicuous, blade relatively narrow and elongate, much longer than wide, with lateral margins broadly inflated and broadly excavated medially, medial convexity absent or low and rounded and visible only in apical ¼; apex broadly rounded. Metacoxal lines widely separated anterior to metacoxal processes, metacoxal lines almost parallel and diverging only slightly proximally. Metatrochanter relatively large, length of metafemur: length of metatrochanter less than 1.80.

Sternum 6 not dimorphic apically, with apex evenly rounded. Males and females very similar; males with protarsomeres 1 to 3 slightly expanded and with larger scales on ventral surface. Aedeagus (Figure 3), in ventral aspect, abruptly widened distally to form apical blade, with a small, shallow, U-shaped notch, in lateral aspect, the form is thick with the apical blade poorly differentiated, in dorsal aspect, with low but distinct dorsal flanges and wide, broad apical lobes (Roughley and Larson 1991).

Figure 1. *Sanfilippodytes bertae* specimen showing dorsal features collected near Fort MacLeod, AB from J.B. Wallis Entomology Collection at the University of Manitoba, Winnipeg, Manitoba, Canada. (Photo courtesy of R.E. Roughley, University of Manitoba.)

Figure 2. *Sanfilippodytes bertae* specimen showing dorsal features collected near Fort MacLeod, AB from J.B. Wallis Entomology Collection at the University of Manitoba, Winnipeg, Manitoba, Canada. (Photo courtesy of R.E. Roughley, University of Manitoba.)

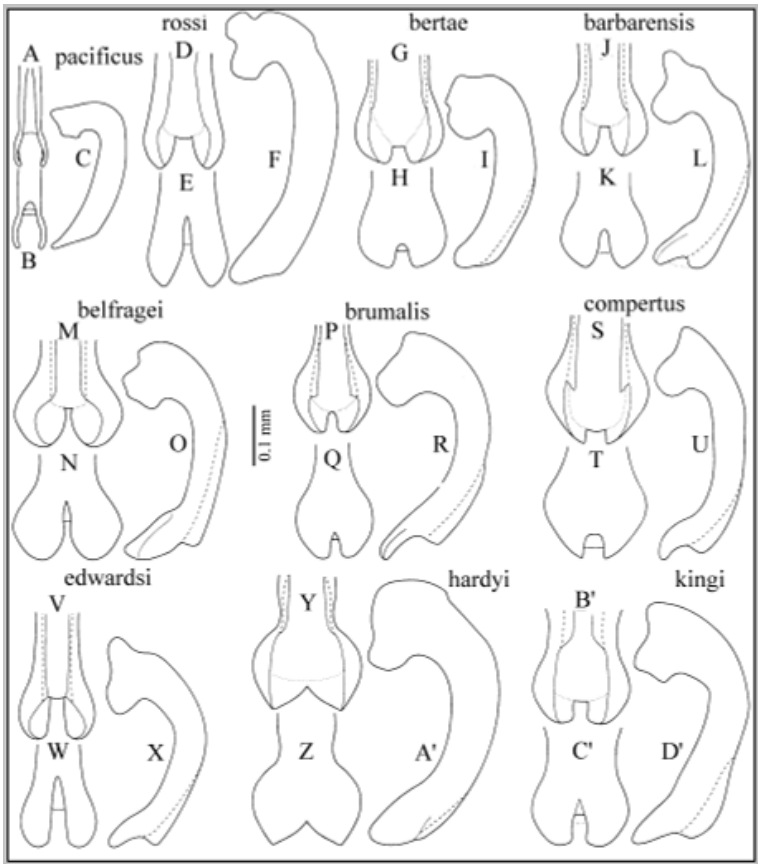

Figure 3. *Sanfilippodytes*, *S. pacificus*-group and *S. vilis*-group (in part). Male aedeagus. Sets of three consecutive letters indicate dorsal, ventral and lateral views. For *S. bertae*, G = dorsal, H =ventral and I = lateral.

Designatable units

There are no subspecies of Bert's Predaceous Diving Beetle nor is there noticeable variation among the available specimens and the entire taxon is confined to a very small geographic location. There is thus a single designatable unit.

DISTRIBUTION

Global range

The historical distribution of Bert's Predaceous Diving Beetle is one or two point source sampling locations along the north banks of the Oldman River at the crossing of Hwy 2, east of Fort MacLeod in southern Alberta. The species is only known from this locale and now the recently discovered locale at the oasis (Figure 5). The global range is thus confined to a small portion of Canada.

Figure 4. Global geographic locations of *Sanfilippodytes bertae* (Map courtesy of Ottomm Education).

Canadian range

The historical distribution of *S. bertae* (Figure 5) includes two and possibly three localities. These are: 1) the northwest bank of the Oldman River immediately upstream of the Highway 2 crossing west of Fort MacLeod, Alberta; 2) Fort MacLeod; and 3) the newly discovered locality near Head-Smashed-In Buffalo Jump. Localities #1 and 2 may represent the same locality and therefore the same population; however, this remains unclear. The only record since 1984 and the only extant population is location A. Substantial search effort in 2007 failed to reveal additional localities (see under Population Sizes and Trends - Search Effort), nor was the Fort MacLeod locality (or localities) rediscovered and they are thought to be destroyed.

Although it is possible that the distribution is more widespread throughout the northwestern Great Plains and Rocky Mountain foothills, the species is very rare and evidently geographically restricted, and substantial increases in area of occupancy at least are not anticipated. The extent of occurrence is 2 km^2 and the index of area of occupancy (based on a 2x2km grid value) is 4 km^2. However, the population actually occupies an area of only 2 m^2.

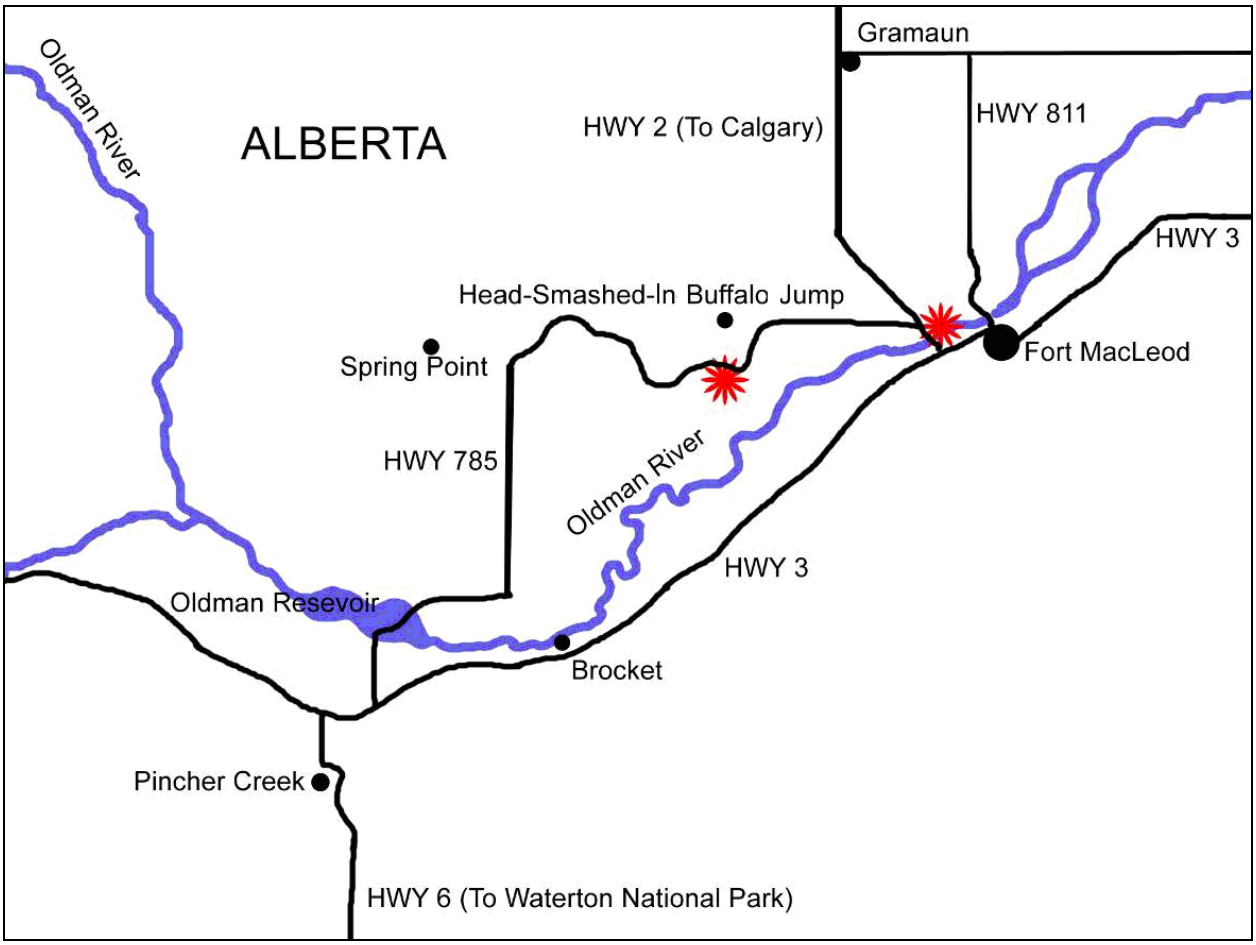

Figure 5. Geographic locations of *Sanfilippodytes bertae* captures in southern Alberta, Canada (Map Courtesy of Ottomm Education).

In addition to the search effort described under “Population Sizes and Trends - Search Effort” as part of this report, there has been extensive survey of museum collections and field work in the prairie provinces in connection with the National Research Council of Canada monograph on the diving beetles of Canada (Larson *et al*. 2000) of which the report writer is a co-author. Specifically this work involved in all collections with substantial holdings of Canadian material including 42 collections (listed by Larson *et al*. 2000, p. xiii). Many species equally small and equally inconspicuous as *S. bertae* are included in this monograph, and they are widespread with extensive distributions and often less specific habitat requirements. Field work by entomologists studying springs has been extensive involving the visitation of many hundreds of sites in the prairie region alone, and although not all of the habitat of *S. bertae* has been surveyed, enough has been surveyed to allow some reliable conclusions to be drawn. Consequently information on the distribution, status and habitat of *S. bertae* in Canada presented here is considered reliable.

HABITAT

Habitat requirements

The habitat of *S. bertae* is limited to springs and seepage areas and the mainstem or tributaries of the Oldman River in southern Alberta. With respect to locality #1, a key element is that the springs and seepage areas flowed out of the near-vertical river banks at about the level of the high water (vernal flood) mark. Field surveys of springs and seeps in the region surrounding the first sampling locale recovered one specimen from the output point source of a spring which was the headwater of a tributary to the Oldman River, near Head-Smashed-In Buffalo Jump (Locality 3, the “oasis”). The oasis, is not associated with a major river course but does represent spring and seep habitat in the area. The habitat at this spring was characterized by a faint trickle of water exiting a crevice approximately half-way down a rocky cliff (Figure 6). The cliff dropped below the normal landscape of smooth hills with high winds and low vegetation by approximately 5m. The crevice where the spring exited the rock contained wet mosses and algae. The spring drained into a narrow lush channel which contained a ground of saturated soil and grasses, a small near-stagnant channel and trees. This area was aptly nicknamed “the oasis” by the researchers (Figures 7 and 8). No other habitat like it was found in the area. The path of the outflow of the oasis could not be followed to its termination, but it would appear from aerial photos that it does not connect as tributary to the Oldman River. Currently small remnants of the above-described spring and seep habitat exist in southern Alberta. Further field studies are required to determine the full habitat requirements of *S. bertae.*

Figure 6. Current location of captures near Head-Smashed-In Buffalo Jump, Alberta (facing west). Detail of the spring habitat contained within the oasis area, observed in front of Dr. R.E. Roughley. Note lush moss vegetation along outlet of spring. The oasis area contained a lot of waste refuse likely blown into the crevice from the high winds observed in the area. (Photo courtesy of Jennie Knopp.)

Figure 7. The “oasis”, an area that drops below the normal landscape of smooth hills, high winds and low vegetation by approximately 5-8 m (facing east, Hwy 785 is to the north). A spring, which exited a crevice in the rock near the beginning of the dip into the oasis, contained wet mosses and algae. The spring drained into a narrow lush channel which contained a ground of saturated soil and grasses, a small near-stagnant channel and trees. (Photo courtesy of Jennie Knopp.)

Figure 8. The “oasis” view from bottom of the cliff area, facing the location of the spring (facing west). The spring drains into this narrow lush channel which contained a ground of saturated soil and grasses, a small near-stagnant channel, trees and shrubs. (Photo courtesy of Jennie Knopp.)

In general, Bert's Predaceous Diving Beetles require natural and relatively pristine spring and seep habitat along steep cliff edges or river banks for metamorphosis and adult refugia. As with some similar species, Bert's Predaceous Diving Beetles appear to require springs and seepage areas with the appropriate fine-grained substrate of sand and other fine particulates and an undisturbed area with mosses over fine particulate soil (necessary for pupation). It is unclear whether a constant flow of water out of the spring or seep is required to maintain the populations. Vegetation, such as mosses and algae at the outflow of the spring characterize the habitat at the oasis. The habitat required for overwintering is unknown but it is likely the beetles can move into the ground to escape cold temperatures by following the spaces in the substrate that water flows through during periods of peak flow.

Habitat trends

The only historical habitats for this species near Fort MacLeod appear to have been eliminated, perhaps due to a recent bridge upgrade at the Hwy 2 crossing of the Oldman River. Currently Bert's Predaceous Diving Beetle occurs only within the most highly altered landscape in Alberta. In this area cattle have congregated, in moist areas of springs, probably much more so than native ungulates ever did (e.g. Lockwood and DeBrey 1990). The result is extensive fouling and trampling of spring habitat, and this has continued up to the present and the number of undisturbed springs has continuously declined (Roughly and Larson 1991, p. 137).

The Oldman River watershed lies within the Prairie Parkland Natural Ecozone which stretches across the bottom of Alberta, Saskatchewan and Manitoba. This ecozone is described by flat and gently rolling hills covered mostly by dry mixed grasslands in southern Alberta. Since European settlement in this Ecozone, it has become one of the most developed agricultural areas in the world. Of the Ecozone's total land area of 47 million hectares, 3% of the natural environment is believed to remain intact with 70% classified as cropland and 27% as rangeland and pasture (Environment Canada 1996). Ranches, agriculture, feedlots, oil and gas, wind turbines and recreational sites dominate the landscape, with few natural areas remaining. The lands in the area are all private or First Nations owned, save for a few provincial recreational sites and the UNESCO World Heritage Site Head-Smashed-In Buffalo Jump. Although this region of southern Alberta appears stable due to the private ownership of most of the land (unlikely to have major developments unless the land is sold to developers), an oil and gas industry - and the rapid growth of towns, cities and infrastructure required to support immigration to the area during the development of this industry - may be a very real possibility in the future.

Habitat protection/ownership

Earlier-collected specimens (1984) were obtained along the steep, high river banks of the Oldman River near the Highway 2 crossing (Figure 5). This corresponds to latitude ~49°43′32″N 113°23′51″W. The river and its banks lie under the jurisdiction of the provincial and federal governments. Land north of the crossing is privately owned.

The land immediately southwest of the crossing is the Oldman River Recreation Area open for camping and picnics and it is under provincial legislation. The land southeast of the crossing appeared to be private lands and a privately owned campground. Maps show the area to be River Valley Wilderness Park, under provincial jurisdiction. Currently there is no protection in this area of previous historical records for *S. bertae*.

The site of the last known collection of *S. bertae* (2007), named "the oasis" by the researchers, is near the protected habitat of Head-Smashed-In Buffalo Jump (Figures 6, 7 and 8). Head-Smashed-In Buffalo Jump is a UNESCO World Heritage site, and the spring almost certainly shares the groundwater system with the UNSECO site. Although this area is not currently under major development, there is no specific protection of the habitat.

BIOLOGY

Introduction

The life history characteristics of Bert's Predaceous Diving Beetle remain unknown. Presently there are 24 described species assigned to this exclusively Nearctic genus (Nilsson 2001). Some aspects of the life history of this species can be assembled as a testable hypothesis that provides a basis for present and future observations. The species assigned to this genus live in a limited variety of habitats-from caves and winter-early spring rain pools to springs and seeps.

In terms of life history pattern, and based on collecting effort, this species appears to fall into one of five quite different categories of life history of temperate species outlined by Nilsson *et al*. (1986). Based on the dates of collection, this is likely a species with one generation per year that breeds in the spring, uses a good portion of the summer for larval development and overwinters in the adult stage.

Life cycle and reproduction

There is no evidence of the length of time required for the larvae to develop, pupate and emerge as adults, other than the observation of timing of collection of adults. There is also no evidence to suggest that the life cycle of *S. bertae* is anything but annual and likely involves spring breeding and oviposition with larval development during the summer, followed by a brief terrestrial pupation. The overwintering stage is the adult. Bert's Predaceous Diving Beetles require springs and seepage areas with the appropriate fine-grained substrate of sand and other fine particulates; and undisturbed areas with mosses over fine particulate soil (necessary for pupation).

All beetles undergo complete and radical metamorphosis with four discrete and distinctive stages – egg, larval, pupal and adult stages. Based on what is known about the biology of other species of predaceous diving beetles (Larson *et al*. 2000), the egg,

larval and adult stages are aquatic and are found in the hydrosphere. The pupal stage occurs in a nearby terrestrial, and dry, part of the habitat. There have been no life history studies published concerning *S. bertae* (Roughley and Larson 2000) or any other species within the genus *Sanfilippodytes* (Franciscolo 1979, Larson 2000).

Feeding and predation

All predaceous water beetle larvae and adult forms are predaceous, principally eating invertebrates, probably enchytraeid worms and aquatic larvae of flies (Diptera) (Larson *et al*. 2000).

Physiology

Adults of this genus are collected from the interstitial spaces among sand, small stones, moss, and bits of other plant debris at springs and seeps within the larger habitat of short-grass prairie or arid grassland. The clean water provided from groundwater sources appears to be a requirement of this species (Larson *et al*. 2000).

Dispersal/Migration

Dispersal overland or by means of flight is highly unlikely because finding the appropriate habitat by this means is problematic because it is so small and fragmented. Dispersal presumably does occur but unlike most insects which use their wings for dispersal, this species probably seldom flies. During routine dissection of male genitalia, presence of flight wings was noted for all specimens examined. Despite this observation, no flight records exist for any member of this genus, including *S. bertae* (based on decades of research on this group by the report writers). It is probable that local, regional dispersal occurs via movement within the hydrosphere to appropriate surface openings.

Adaptability

The extent to which Bert's Predaceous Diving Beetle could adapt to changing conditions is unclear but the habitat specificity suggests little adaptability.

POPULATION SIZES AND TRENDS

Search effort

In addition to searches of museum collections (see under "Distribution"), recent field work has also been carried out. Efforts to find *S. bertae* were conducted in the areas surrounding the collection of the original type specimens near the Highway 2 crossing of the Oldman River in southern Alberta. This field work was intended to: a) determine population sizes; b) confirm extreme rarity; c) gather information on threats; and d) acquire biological information relevant to assessment. Extensive spring, summer

and fall sampling efforts over a period of 18 days (approx.180 hours) resulted in only two specimens being recovered from a new location near Head-Smashed-In Buffalo Jump.

Field searches specifically for this species, the first efforts since the species was first described and collected in 2000, were conducted by Knopp, Roughley and De Kerckhove. Four field sampling sessions occurred in the spring (April 1-6), summer (July 1-4 and July 16-17) and fall (Sept. 1-6) of 2007. Rural roads and townships were driven to the approximate locations of potential spring and seep sites which were then accessed by foot. All accessible roads between RR 293 and Hwy 2 (west to east) and Hwy 3 north to Twp 112 were searched for suitable habitat and collecting sites. During the fall sampling session, the Oldman River was canoed, in addition to the searches by truck and foot, between RR 254 and RR 265 to search both the north and south banks for springs and seeps near the collected location of the type specimen. Over 50 potential aquatic habitat sites identified from maps and aerial photos were accessed by truck or by foot. Of these 50 sites, only seven had water present. All seven of these sites were sampled. The rest of the sites identified on maps and photos represented either dry coulees or simply depressions in the landscape. Only one spring was located along the banks of the Oldman River during the canoe sampling efforts. This spring was found within the boundaries of the town of Fort MacLeod and could have simply been water seeping out of the bank from storm water drainage (sewer) runoff. Waterton Springs Campground 3 km north of Waterton Park on Hwy 6 was identified as a site with springs and this habitat was searched for Bert's Predaceous Diving Beetle in the fall. Of all potential habitats identified on maps and aerial photos, only nine sites contained water or springs and seeps. Very few spring or seep sites were located. Two specimens were recovered from one new location. The habitat from which the type specimen was collected could not be located despite extensive search efforts.

Several people of the Peigan First Nations Reserve were questioned as to the presence of the beetle; however, no one had seen such an organism. They did refer us to spring or seep sites in the area said to be located on the hills behind the town of Spring Point, at the intersection of Spring Point Rd and Hwy 785. Despite extensive searching, these spring locations could not be located and are presumed to exist only for a short period early in the season.

Any wet areas, including stream and pond edges were sampled even if springs and seeps were not present. Sampling of these habitats occurred for two reasons: 1) there was very little water, including springs and seeps, in the entire area searched so any wet habitats found were sampled, and 2) the life history of the species is unknown therefore all aquatic habitats were searched for its presence.

A small green, thin-meshed dip net (similar to the ones used in home fish aquariums) was gently rubbed along the moss and algae or vegetation found along the springs/seeps or wetted areas in a sweeping motion with several passes to ensure the entire microhabitat was sampled. The contents of the net were then placed into the top of three circular metal sieves of decreasing mesh size (50, 100 and 250 µm) and left in

the sun. This forces aquatic organisms to move out of the heat at the top of the sieves into the very bottom layer where they are then separated from the detritus, vegetation and debris. Insects small enough to fit through the last sieve size (including specimens of *S. bertae*) were suctioned by mouth into an aspirator. The other layers of the sieve were searched visually for any invertebrates, which were removed by aspiration into a small vial. All insect and invertebrate specimens collected were immediately preserved in 95% ethanol and shipped to the University of Manitoba for expert identification by Dr. R.E. Roughley. The specimens are now housed in the J.B. Wallis museum at the University of Manitoba.

Abundance

Only 42 specimens of this species were known previously (collected in 1984) and only 2 additional specimens were collected recently. Population size is unknown, but as with most similar species, a minimum population of several hundred individuals would likely be required to sustain a viable population.

Fluctuations and trends

The data at hand is insufficient to speculate about fluctuation. There appears to have been a decline from 3 or 2 to 1 population since the populations at Fort MacLeod could not be relocated.

Rescue effect

Because the species is apparently endemic to Canada, rescue from outside cannot be anticipated.

LIMITING FACTORS AND THREATS

As with some other species of diving beetles such as *Hydroporus carrii,* Bert's Predaceous Diving Beetle has only been found in springs that have not or are little impacted by cattle (Roughley and Larson 1991). These species are rare compared to relatives of higher elevation that occupy pristine alpine springs. *Sanfilippodytes bertae* appears to require a very specific habitat within springs and seepages in an undisturbed area with mosses over fine particulate soil (necessary for pupation) and the appropriate fine-grained substrate of sand and other fine particulates. Major threats to the habitat of this species are limited water availability (Fig. 9) grazing, trampling and defecating of cattle (Figs. 10, 11, Roughley and Larson 1991) due to aggregation of livestock at these fragile habitats. Trampling from livestock hooves (and ranch vehicles) damages the outlets of springs and seepages often creating muddy conditions or simply destroying the habitat of *S. bertae* (Figure 10). Point sources of nutrients which can alter water chemistry also result from the feces of the ranched cattle which are spread across the landscape but appear to be concentrated near water where the cattle congregate (Figure 11).

Bert's Predaceous Diving Beetle populations are believed to be reproductively isolated. This is thought to be true because of the size of the beetle and the distances it would have to travel in an extremely windy climate to locate rare pockets of microhabitats which could only potentially result in finding another population. A new locality for Bert's Predaceous Diving Beetle immediately south of Head-Smashed-In Buffalo Jump represents only approximately 2.0 m^2 of suitable habitat. The connectivity of groundwater tables and the potential to locate other populations through this means is unknown.

Other serious threats to these fragile point sources of habitat are lowering water levels and less water availability in the Oldman River Basin. This situation is aggravated by groundwater withdrawals; ranching practices; feedlots; high water withdrawals and demands for agricultural irrigation; increasing water demands resulting from a booming economy and subsequent rapid growth. Impoundments which would drown the habitat as well as municipal and industrial development including oil and gas, also represent threats to the sensitive spring habitat. "There are almost 10,000 oil and gas wells in the Oldman River Basin, almost 600 confined livestock feeding operations [feedlots], about 50 recreational site developments and 85 wastewater treatment facilities" (Oldman River Basin Water Quality Initiative 2008).

Water is most scarce in southern Alberta where human water demands are the highest in the province (Alberta Environment 2008). Mean annual discharge in the Oldman River watershed is among the lowest in the province (Figure 9). Higher temperatures and subsequently evaporation in southern Alberta lead to even less water availability. Groundwater withdrawals for human consumption and agricultural use are particularly important to areas of the province with less water. Although groundwater withdrawals represent only 3% of all water withdrawals in Alberta, many Albertans depend on well water and groundwater for human consumption. There are approximately 500,000 domestic wells in Alberta and an average of 7,000 new wells are added each year across the province (Alberta Environment 2008). Withdrawals from the water table are of concern because this directly affects the habitat provided from the outflows (springs and seepages). Locations across southern Alberta rely on groundwater where surface water is not readily available. Alberta's groundwater sources are not well-known because exploration of this resource is expensive. The locations of major aquifers are known, however the water volumes, water quality, depth of producing zones and yields of these major aquifers are not well understood (Alberta Environment 2008).

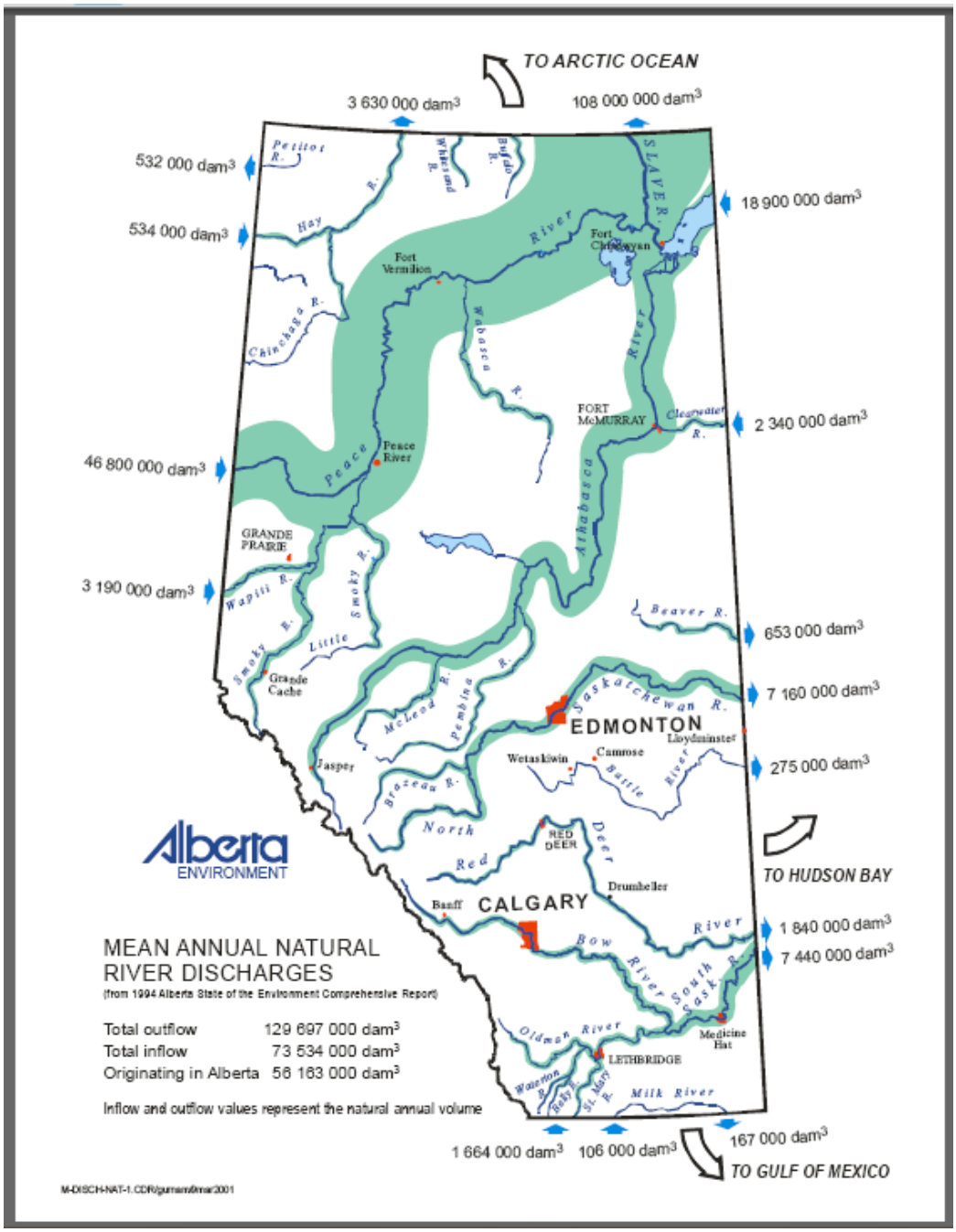

Figure 9. Map of mean annual natural river discharge for major rivers in Alberta, Canada. (Courtesy of Alberta Environment 2008.)

Figure 10. Current location of captures in the oasis near Head-Smashed-In Buffalo Jump, Alberta (top of the oasis cliff, facing west). This particular spring runs out of the grassy land above the depression which leads into the oasis. Notice the cattle trampling and farm vehicle tracks throughout the spring outflow habitat.

Figure 11. Cattle droppings within the oasis habitat. These droppings could result in contamination of the water quality in the surrounding aquatic habitat. (Photo courtesy of Jennie Knopp.)

Impoundments along the Oldman River would drown the spring or seep habitat or result in lowered water levels along the course of the river. Impoundments are present in great numbers along the Oldman River to divert water for crop irrigation (Figures 12 and 13), for the oil and gas industry as well as for human recreation creating a manmade lake for sailing and windsurfing at the Oldman River Resevoir. Crop irrigation and feedlot demands are the second largest use of water in Alberta. In 1989 4.7 million dam^3 (dam^3 = cubic decametre) of water was withdrawn in Alberta but only 2.6 million dam^3 were used for human consumption with the largest use of the other 2.1 million dam^3 being for irrigation. In 1989, 93% of the water used for irrigation in Alberta came from the Bow and the Oldman River systems (Alberta Environment 2008). Commercial and urban development is inevitable in a growing economy that results from an increase in human population in the province (Schindler and Donahue 2006).

Figure 12. Irrigation channel north of Head-Smashed-In Buffalo Jump (near Twp 102, facing south), used to divert water from nearby watercourses for use in agricultural irrigation. (Photo courtesy of Jennie Knopp.)

Figure 13. Irrigation equipment north of Head-Smashed-In Buffalo Jump (near Twp 104, facing south). (Photo courtesy of Jennie Knopp.)

Figure 14. South bank of the Oldman River immediately east of the Highway 2 bridge (in background), west of Fort MacLeod (facing west). Note massive snow plow scoop wedged into the bank. The spring and seep habitat required by *S. bertae* is so small that such anthropogenic disturbances could completely destroy the habitat. (Photo courtesy of Jennie Knopp.)

Figure 15. South bank of the Oldman River, immediately east of the Highway 811 bridge (in background), east side of the town of Fort MacLeod (facing southwest). Note manmade mesh bank armouring, likely to protect the bank from natural erosion forces. The spring and seep habitat required by *S. bertae* is so small that such anthropogenic disturbances could completely destroy the habitat. (Photo courtesy of Jennie Knopp.)

In addition to the anthropogenic forces affecting the habitats of Bert's Predaceous Diving Beetle, the required habitat is inherently sensitive due to its rare and fragile state. The Oldman River watershed lies within the Parkland Natural Ecozone which stretches across the bottom of Alberta, Saskatchewan and Manitoba. It is the most heavily altered ecosystem within Alberta and only 3% of the natural environment is believed to remain within this Parkland Ecozone which runs along the bottom of Alberta, Saskatchewan and Manitoba (Environment Canada 1996). Schindler and Donahue (2006) warn of the coming drought that Alberta will face in the next few decades as a result of human pressures on the system, natural environmental fluctuations and climate change, but there remains some debate on how serious this is likely to be. They also report that summer flows in the rivers of Alberta have declined in the last 100 years, with the watersheds in central and southern Alberta demonstrating the most dramatic declines. Fluctuating water levels could influence the availability of habitat sites for *S. bertae*.

Regardless of destruction by cattle, the cumulative impacts of an already highly altered ecosystem, the demands of a growing economy, continued development (Figures 14, 15) and the effects of climate change pose serious concerns of lowering groundwater tables and in turn the existence of the springs and seepages required by Bert's Predaceous Diving Beetle.

SPECIAL SIGNIFICANCE OF THE SPECIES

Springs and seepages are biologically, chemically and physically complex and fragile. Bert's Predaceous Diving Beetle is indicative of the remaining, reasonably uncompromised, spring and seepage habitat found in southern Alberta. Springs and seeps are important because as noted by Danks and Williams (1991) the arthropod fauna of springs contains a limited number of species and diverse, specialized organisms, including groundwater, stream and water-film specialists. Bert's Predaceous Diving Beetle might serve as an indicator species for other unusual or significant species. This phenomenon referred to as "species-packing" is demonstrated in some species of *Sanfilippodytes* which are restricted to California. These *Sanfilippodytes* species are found in the winter rain pools of Mendocino Co. This habitat is probably very little studied but it is of great interest due to the species-packing with at least three species-*S. setifer* (Roughley and Larson 2000), *S. bidessoides* (Leech 1941) and *S. adelardi* (Rochette 1983)-found only in this habitat and within this limited geographic area.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Sanfilippodytes bertae is currently not globally or regionally listed. The new locality for Bert's Predaceous Diving Beetle is immediately south of Head-Smashed-In Buffalo Jump, a UNESCO World Heritage site. Almost certainly this locality shares the groundwater system with the UNESCO site but there is no specific protection.

TECHNICAL SUMMARY

Sanfilippodytes bertae
Bert's Predaceous Diving Beetle Hydropore de Bertha
Range of Occurrence in Canada: southern Alberta

Demographic Information

Generation time (average age of parents in the population)	unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 or 5 years, or 3 or 2 generations].	unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 or 5 years, or 3 or 2 generations].	unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 or 5 years, or 3 or 2 generations] period, over a time period including both the past and the future.	unknown
Are the causes of the decline clearly reversible?	Not applicable
Are the causes of the decline understood?	Not applicable
Have the causes of the decline ceased?	Not applicable
[Observed, inferred, or projected] trend in number of populations	Decline – one or two historical sites no longer extant.
Are there extreme fluctuations in number of mature individuals?	unknown
Are there extreme fluctuations in number of populations?	unknown

Extent and Area Information

Estimated extent of occurrence	4 km²
[Observed, inferred, or projected] trend in extent of occurrence	Declined – two populations to one.
Are there extreme fluctuations in extent of occurrence?	unknown
Index of area of occupancy (IAO)	4 km²
[Observed, inferred, or projected] trend in area of occupancy	Declined – two populations to one
Are there extreme fluctuations in area of occupancy?	unknown
Is the total population severely fragmented? Any additional population would be isolated by inhospitable conditions and lack of mobility of the insect	yes
Number of current locations	1
Trend in number of locations	decline
Are there extreme fluctuations in number of locations?	unknown
Trend in [area and/or quality] of habitat Both general habitat type and specific occupied habitat have declined.	decline

Number of mature individuals in each population

Population	**N Mature Individuals**
	unknown
Total	unknown
Number of populations (locations)	unknown

Quantitative Analysis

	Not available

Threats (actual or imminent, to populations or habitats)

The most serious threats to the single known site and to these fragile point sources of habitat in general are lowering water levels in the Oldman River Basin and aggregation of livestock. Other potential threats along the Oldman River Basin (along with the associated coulees, springs and seeps) include: groundwater withdrawals; ranching practices; feedlots; high water withdrawals and demands for agricultural irrigation; increasing water demands resulting from a booming economy and subsequent rapid growth; impoundments which would drown the habitat; municipal and industrial development including oil and gas; increasing demands for water for use in industry and domestic use; human recreation, reproductive isolation; drought; and; climate change.

Rescue Effect (immigration from an outside source)

Status of outside population(s)? None USA:	
Is immigration known?	No
Would immigrants be adapted to survive in Canada?	Not applicable
Is there sufficient habitat for immigrants in Canada?	Not applicable
Is rescue from outside populations likely?	No

Current Status

COSEWIC: Endangered (November 2009)

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code:** B1ab(iii) + 2ab(iii)
Reasons for designation: Despite extensive searches, this Canadian endemic species is known from only two locations in southern Alberta, one of which has been destroyed. It is limited to springs and seepage areas along steep cliff edges or river bends. Its habitat is declining due to trampling by livestock and lowering of the water table due to withdrawals for irrigation.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. No population information.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1ab(iii)+2ab(iii). EO and IAO are below thresholds, the species is known from a single location, and there is a continuing decline in the quality of the species' habitat.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. No population information.
Criterion D (Very Small Population or Restricted Distribution): Meets Threatened D2 as it is known from a single location, and is prone to stochastic events with continuing threat of trampling and water withdrawal.
Criterion E (Quantitative Analysis): None available.

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This species is named in honour of Mrs. Bertha (Bert) F. Carr of Calgary who helped collect the type series. Bert, along with her husband, John, has been a tremendous source of specimens, information and inspiration for this project.

INFORMATION SOURCES

Alberta Environment. 2008. Alberta's water resource. Government of Alberta. In electronic format at: http://www3.gov.ab.ca/env/water/reports/water_overview.html

Bergsten, J.A. Töyrä, and A.N. Nilsson. 2001. *Intraspecific variation and intersexual correlation in secondary sexual characteristics of three diving beetles (Coleoptera: Dytiscidae).* Biological Journal of the Linnean Society. 73 (2): pp. 221-232.

Danks, H.V. and D.D. Williams. 1991. *Arthropods of springs, with particular reference to Canada: Synthesis and needs for research.* Memoirs of the Entomological Society of Canada.

Environment Canada. 1996. *State of Canada's Environment*. Government of Canada, Ottawa. In electronic format at: http://www.ec.gc.ca/soer-ree/English/SOER/1996report/Doc/1-1.cfm?StrPrint=true&

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa.

Lockwood and DeBrey, 1990 J.A. Lockwood and L.D. DeBrey, A solution for the sudden and unexplained extinction of the Rocky Mountain Grasshopper (Orthoptera: Acrididae), *Environ. Entomol.* 19 (1990), pp. 1194–1205.

Nilsson, A.N. 2001*. Dytiscidae.* World Catalogue of Insects, 3, 1–395.

Nilsson, A.N. and H. Söderberg. 1986*. Abundance and species richness patterns of diving beetles (Coleoptera, Dytiscidae) from exposed and protected sites in 98 northern Swedish lakes.* Hydrobiologia. 321 (1): pp. 83-88.

Oldman River Basin Water Quality Initiative. 2008. *Oldman River basin water quality initiative.* In electronic format at: http://www.oldmanbasin.org/orbwqi/ index.html

Roughley, R.E. and D.J. Larson. 1991. *Aquatic Coleoptera of springs in Canada.* Memoirs of the Entomological Society of Canada. 155: 125-140.

Schindler, D.W. and W.F. Donahue. 2006. *An impending water crisis in Canada's western prairie provinces.* Proceedings of the National Academy of Science. 103 (19): pp.710-7216.

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

The late Dr. Robert E. Roughley was a Professor of Entomology at the University of Manitoba. He studied the taxonomy and ecology of water beetles in Canada, Australia and Costa Rica for more than 25 years. He obtained his Ph.D. from the University of Alberta with a world revision of the genus *Dytiscus* (Coleoptera, Dytiscidae) in 1982. In addition, he conducted research on conservation and management of tallgrass and mixed grass prairie using invertebrate groups. He was also the curator of the J.B. Wallis Museum of Entomology, Department of Entomology, University of Manitoba, Winnipeg, Manitoba R3T 2N2.

Jennie A. Knopp has a B.Sc. in Zoology with a minor in Entomology from the University of Guelph in Ontario. Jennie has been a professional aquatic biologist for the past 5 years. She has worked on aquatic organisms, including aquatic insects, in Nunavut, Northwest Territories, Ontario and Alberta. Jennie is currently completing her M.Sc. degree on Integrating Scientific and Traditional Knowledge in Northern Aquatic Ecosystems, at Trent University in Ontario.

Rob and Jennie have worked together previously when they taught the 2006 Boreal and Arctic Entomology course, along with Dr. Peter Kevan, in Churchill Manitoba. The course was offered through the University of the Arctic.

COLLECTIONS EXAMINED

The only known record of the species was collected in 1984 and all specimens are presently housed at the J.B. Wallis Museum at the University of Manitoba. Specimens will be more widely distributed to other collections and museums in the future. Robert E. Roughley was the curator of the museum. The research of the senior report writer has included the examination of 42 collections (listed by Larson *et al*. 2000, p. xiii).