COSEWIC
Assessment and Status Report

on the

Vancouver Island Shieldback
Steiroxys cf. *strepens*

in Canada

ENDANGERED
2022

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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Vancouver Island Shieldback — Photograph by James Miskelly.

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COSEWIC
Assessment Summary

Assessment Summary – May 2022

Common name
Vancouver Island Shieldback

Scientific name
Steiroxys cf. *strepens*

Status
Endangered

Reason for designation
This flightless shieldback katydid has an extremely limited distribution on southern Vancouver Island with fewer than 10 observations between 1990 and 2011. The only recent records are from a small urban park, Mount Tolmie, in Greater Victoria. The population inhabits Garry Oak ecosystems which have experienced historical and widespread habitat loss. The impacts from increased predation by invasive European Wall Lizards, and decline in habitat quality in an urban park threaten the existence of this shieldback in Canada.

Occurrence
British Columbia

Status history
Designated Endangered in May 2022.

COSEWIC
Executive Summary

Vancouver Island Shieldback
Steiroxys cf. *strepens*

Wildlife Species Description and Significance

Vancouver Island Shieldback (*Steiroxys* cf. *strepens* Fulton 1930) is a 25-30 mm (body length) katydid in the family Tettigoniidae. Shieldback katydids are characterized by their short, robust bodies and thin antennae that are longer than the body.

Distribution

The global range of Vancouver Island Shieldback is only known from Mount Tolmie Park in the District of Saanich, southeastern Vancouver Island.

Vancouver Island Shieldback is known from Canada based on five records from Mount Tolmie and one from southern Vancouver Island prior to 1985.

Surveys in the past 15 years for Vancouver Island Shieldback have focused on finding new occurrences and continued presence at Mount Tolmie. Between 2010 and 2018 more than 30 sites in potential habitat, and more than 30 hours of survey effort during active period of adults (July to September) occurred. In 2019 6 sites and in 2021 5 sites were targeted for more intensive search effort: a total of more than 97 hours and 75 kms. No Vancouver Island Shieldbacks were observed in 2019 or 2021.

Habitat

The natural habitat in Mount Tolmie Park is sparsely vegetated Garry Oak and associated scrub oak woodland. These open meadow habitats are sparsely treed with Garry Oak, Douglas-fir, Arbutus, and other species. Understory vegetation includes native and introduced grasses with a high diversity of forbs, and shrubs. These scrub oak woodlands can also occur on inland cliffs, bluffs, and rocky outcrops that have been formed by erosion, the collapse of rock faces or riverbanks, and cumulative deposition of organic matter over time. The soils on these cliffs and bluffs form within the ledges, bedrock fissures and crevices, which then support grasses, mosses, lichens, and stunted trees and shrubs. Such habitats are potential areas where Vancouver Island Shieldback could occur.

Shieldback katydids, in general, establish territories (the males), seek shelter, hunt, and remain camouflaged from predators.

Biology

The life cycle of Vancouver Island Shieldback is poorly understood and notes here are based largely on Noisy Shieldback and other *Steiroxys* spp. Nymphs resemble smaller versions of adults and grow through a series of moults until the species reaches maturity, at 25-30 mm, in mid-summer. Adults do not fly. Males call in a series of very short rasping chirps beginning with a few notes and increasing to a rapid flutter.

Population Sizes and Trends

No information on the Canadian population size or trends is available, although numbers are presumed to be small.

Threats and Limiting Factors

The highest impact threat to Vancouver Island Shieldback is likely predation by non-native European Wall Lizards and domestic cats. Human activity, both recreational and work to maintain the park, are also threats. The habitat quality at Mount Tolmie Park is inferred to be declining from the cumulative impacts of fire suppression and the subsequent encroachment of native and non-native/invasive plants. Road mortality may also be a threat.

Protection, Status and Ranks

Vancouver Island Shieldback is not protected under provincial or federal legislation. The species is not yet ranked globally. The conservation status rank (as Noisy Shieldback) is imperiled, nationally and provincially (N1, S1) (Gelling pers. comm. 2022).

TECHNICAL SUMMARY

Steiroxys cf. *strepens*

Vancouver Island Shieldback

Sauterelle de l'île de Vancouver

Range of occurrence in Canada: British Columbia

Demographic Information

Generation time	1 year
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	Yes, projected based on threats calculator
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations, whichever is longer up to a maximum of 100 years]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations, whichever is longer up to a maximum of 100 years].	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any period [10 years, or 3 generations, whichever is longer up to a maximum of 100 years], including both the past and the future.	Unknown
Are the causes of the decline a. clearly reversible, b. understood, and c. ceased?	a. No b. No c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence (EOO)	4 km² (actual EOO = 0.185 km², the area of Mount Tolmie Park)
Index of area of occupancy (IAO) (2x2 grid value).	4 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 b. No
Number of “locations”* (use plausible range to reflect uncertainty if appropriate)	1, based on non-native predator and only 1 known site
Is there an [observed, inferred, or projected] decline in extent of occurrence?	Unknown, possible decline to 0
Is there an [observed, inferred, or projected] decline in index of area of occupancy?	Unknown, inferred possible decline to 0
Is there an [observed, inferred, or projected] decline in number of subpopulations?	Unknown, inferred possible decline to 0
Is there an [observed, inferred, or projected] decline in number of “locations”*?	Unknown, inferred possible decline to 0
Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat?	Yes, observed decline in quality of habitat
Are there extreme fluctuations in number of subpopulations?	No
Are there extreme fluctuations in number of “locations”*?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (give plausible ranges)	**N Mature Individuals**
Low number of specimens collected, insufficient information to calculate mature individuals	
Total	Unknown

Quantitative Analysis

Is the probability of extinction in the wild at least [20% within 20 years or 5 generations whichever is longer up to a maximum of 100 years, or 10% within 100 years]?	Insufficient data: analysis not completed.

* See Definitions and Abbreviations on COSEWIC website and IUCN for more information on this term.

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

Was a threats calculator completed for this species? Yes, 12 April 2021.
Threat impact roll-up: High

8.1 Invasive non-native/alien species/diseases – Very High
6.1 Recreational activities – Medium impact
4.1 Roads and railroads – Medium-Low impact
7.1 Fire and fire suppression – Medium-Low (scored fire only)
7.3 Other ecosystem modifications – Low impact (fire suppression, invasive non-native plant species)
9.6 Excess energy – Unknown
10.2 Earthquakes – Unknown
11.2 Droughts – Unknown
11.3 Temperature extremes – Unknown

What additional limiting factors are relevant?

- Flightless, low dispersal ability, and vulnerable to predators
- Small population size

Rescue Effect (immigration from outside Canada)

Status of outside population(s) most likely to provide immigrants to Canada.	N/A
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	N/A
Is there sufficient habitat for immigrants in Canada?	N/A
Are conditions deteriorating in Canada?[+]	Yes
Are conditions for the source (i.e., outside) population deteriorating?[+]	N/A
Is the Canadian population considered to be a sink?[+]	No
Is rescue from outside populations likely?	No

Data Sensitive Species

Is this a data sensitive species?	No

Status History

COSEWIC: Designated Endangered in May 2022.

[+] See Table 3 (Guidelines for modifying status assessment based on rescue effect).

Status and Reasons for Designation:

Status:	**Alpha-numeric codes:**
Endangered	B1ab(iii,v)+2ab(iii,v)
Reasons for designation: This flightless shieldback katydid has an extremely limited distribution on southern Vancouver Island with fewer than 10 observations between 1990 and 2011. The only recent records are from a small urban park, Mount Tolmie, in Greater Victoria. The population inhabits Garry Oak ecosystems which have experienced historical and widespread habitat loss. The impacts from increased predation by invasive European Wall Lizards, and decline in habitat quality in an urban park threaten the existence of this shieldback in Canada.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable, insufficient data.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered B1 (EOO = 4 km^2) and B2 (IAO = 4 km^2). There is one location (threats from predation) and inferred continuing decline of (iii) quality of habitat due to invasive species - mainly wall lizards; and of (v) number of mature individuals (species known from one site with limited observations despite search effort).
Criterion C (Small and Declining Number of Mature Individuals): Not applicable, insufficient data.
Criterion D (Very Small or Restricted Population): Not applicable. Meets Endangered D1 if assumed <250 mature individuals. Meets Threatened D2 with the IAO <20 km² and only 1 location. But the number of mature individuals is unknown.
Criterion E (Quantitative Analysis): Not applicable, insufficient data.

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
(2022)

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

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

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

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

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

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

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Table 4. Results for the Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) threats assessment in Canada. The classification below is based on the IUCN-CMP (International Union for the Conservation of Nature–Conservation Measures Partnership) unified threats classification system. For a detailed description of the threat classification system, see the CMP web site (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat “impact” is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2009) and footnotes to this table. 24

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Phylum: Arthropoda – arthropods

Class: Insecta – insects

Order: Orthoptera – grasshoppers, crickets, and katydids

Suborder: Ensifera – long-horned orthoptera

Family: Tettigoniidae – katydids, long-horned grasshoppers

Subfamily: Tettigoniinae – shieldback katydids

Genus: *Steiroxys*

Species: *Steiroxys* cf. *strepens* Fulton 1930

Synonyms: none

English Common Names: Vancouver Island Shieldback.
Previously referred to as Noisy Shieldback (SINA 2020), Noisy Shield-backed Katydid (NatureServe 2020), Oregon Grass Decticid (Fulton 1930)

French Common Name: Sauterelle de l'île de Vancouver
Sauterelle bruyante (Canadian Endangered Species Conservation Council 2016)

Type locality: Holotype of *S. strepens*, male collected in "Northern America, Oregon, Benton County, 6 mi. N of Corvallis, Top of Jackson's Hill, USA". The specimen is housed at Smithsonian Institution, Washington, DC (Fulton 1930).

Taxonomic background and similarities:

The *Steiroxys* shieldback on Vancouver Island has been called *S. strepens* (Miskelly 2012; Lyons 2019). Here it is referred to as *S.* cf. *strepens*. Vancouver Island Shieldback is very similar to *S. strepens*. However, it is not clear that it is the same species. The *cf.* (*confer/conferatur*) denotes 'compare to' and that it is very similar to *S. strepens*. There is uncertainty as to whether it is this species or another unnamed, very similar species (see Bengston 1988 for context).

The taxonomy and systematics for genus *Steiroxys* is complex (Rentz and Birchim 1968) and remains unresolved (Vickery and Kevan 1985; Miskelly 2012; Lyons 2019; SINA 2020; iNaturalist 2020). Currently, there are four described species restricted to western North America. Three have been reported in Canada: Vancouver Island Shieldback, (previously Noisy Shieldback) (*S.* cf. *strepens*), Pale-palped Shieldback (*S. pallidipalpus*), and Three-lined Shieldback (*S. trilineata*) (SINA 2020).

No other *Steiroxys* occur on Vancouver Island (Vickery and Kevan 1985; Miskelly 2012). All evidence points to *Steiroxys* cf. *strepens* on southeastern Vancouver Island as unique in Canada, possibly an endemic subspecies or species (Miskelly 2012).

Vancouver Island Shieldback represents a discrete and evolutionarily significant unit of *Steiroxys*, where "significant" means that the unit is important to the evolutionary legacy of the species as a whole and if lost would likely not be replaced through natural dispersal.

Specimens of *S. strepens* barcoded from Oregon are unique in the Bar Code of Life Data System (BOLD). A specimen of Vancouver Island Shieldback was submitted from Mount Tolmie, but barcoding was unsuccessful (Miskelly pers. comm. 2021) and thus sequences from southern Vancouver Island are not available for comparison with those from Oregon and other *Steiroxys*. Therefore, whether the Oregon and Vancouver Island shieldbacks are conspecific is unknown, even though they have both been referred to as *S. strepens*.

Available molecular data suggest that there are several undescribed *Steiroxys* (BOLD Systems 2020). There are at least 10 different BINs (Bar Code Index Numbers) in BOLD for *Steiroxys,* more than double the current four described species (see Ratnasingham and Hebert 2007, 2013; BOLD Systems 2020). Further morphological and molecular work is required to confirm the relationship of the taxon from Vancouver Island with currently undescribed taxa and with the Oregon *S. strepens*. Given the restricted ranges of many species of *Steiroxys*, it is likely that those on Vancouver Island may be a separate, undescribed species. In this report they are referred to as Vancouver Island Shieldback, *S.* cf. *strepens*.

Morphological Description

Like all orthopterans, shieldback katydids develop through incomplete metamorphosis: eggs, nymphs that moult through a series of instars (typically 4-5) that grow bigger with each moult and resemble the adult. The final moult to adult results in mature genitalia. There are no similar species within the range of Vancouver Island Shieldback on southern Vancouver Island. The morphological description is summarized from Fulton (1930) and Lyons (2019) and as with other aspects of biology is based on what is known for *Steiroxys*, including *S. strepens*.

Adult:

Shieldback adults are 25-30 mm in body length, have a robust body, large thin hind legs, and long thin antennae that extend the length of their abdomen. The posterior part of the pronotum has lateral lobes nearly as deep as long and somewhat sinuate (wavy or rounded notches/lobes) at the posterior margins. The median and lateral carinae (elevated ridges) on the pronotum are distinct. The prosternum (vertical plate of the anterior end of the thorax) lacks spines. The male tegmina (forewings) are broad, overlapping, project about one-half length beyond pronotum. The hindwings are not large enough to support flight. The female tegmina are small and with rounded lateral pads that are almost

concealed by the pronotum. The male cercus (appendage at the end of the abdomen) is cylindrical and with a sharp and pointed apex (tip) that is bent inward and with a sharp tooth on the inner side. The female's ovipositor is curved slightly upward (Fulton 1930; Vickery and Kevan 1985).

Noisy Shieldback has rounded tips to the cerci while other *Steiroxys* have straight inward pointing tips to the cerci (Fulton 1930; Lightfoot 1985). The female subgenital plate is triangular, covers the basal end of the ovipositor and ends with two tooth-like projections with a triangular indentation (Fulton 1930; Lightfoot 1986; Lyons 2019; iNaturalist 2020).

Observations of Vancouver Island Shieldback adults at Mount Tolmie document variable shades of brown (see front cover photograph) consistent with Lightfoot's (1986) description of green, brown, or grey, often with dorsal yellow stripes.

Call:

Fulton (1930) for Noisy Shieldback "The presence of these insects was revealed by their song which is a series of very short rasping chirps. It starts with a few notes per second but quickly increases the speed to a rapid flutter which is kept up for a long period".

Population Spatial Structure and Variability

The population structure and variability of Vancouver Island Shieldback in Canada has not been studied. Individuals are not capable of flight.

Designatable Units

Vancouver Island Shieldback is being assessed as one designatable unit based on a single occurrence.

Special Significance

Vancouver Island Shieldback inhabits Garry Oak (*Quercus garryana*) associated ecosystems, which are among the rarest and most at-risk in Canada. There are four provincially imperilled (S1) ecological communities that contain Garry Oak (BC Conservation Data Centre 2020). Vancouver Island Shieldback is found in the *Quercus garryana* / *Holodiscus discolor* (Garry Oak / Oceanspray) ecological community, listed in BC as S1 (mapped on Mount Tolmie by the British Columbia Conservation Data Centre (BC CDC)). There are three additional Garry Oak communities found on southern Vancouver Island also listed as S1 and were targeted as part of the search effort. A total of 202 provincially at-risk species are linked to the Coastal Douglas-fir biogeoclimatic zone, in which the Garry Oak and associated ecosystems of Vancouver Island and Gulf Islands occur, with 100 of these species already assessed by COSEWIC (British Columbia Conservation Data Centre 2020).

There is no information that suggests this katydid has an important cultural or economic role for Indigenous peoples. However, there is literature on the cultural significance of plants associated with habitat in which Vancouver Island Shieldback occurs (Fuchs 2001). Katydids are of interest to entomologists and taxonomists because of their stridulations, and camouflage.

DISTRIBUTION

Global Range

The Vancouver Island Shieldback is restricted to Vancouver Island, British Columbia (Figure 1). The Noisy Shieldback occurs at three sites in Benton and Jackson Counties, Oregon (Lyons 2019, pers. comm. 2020).

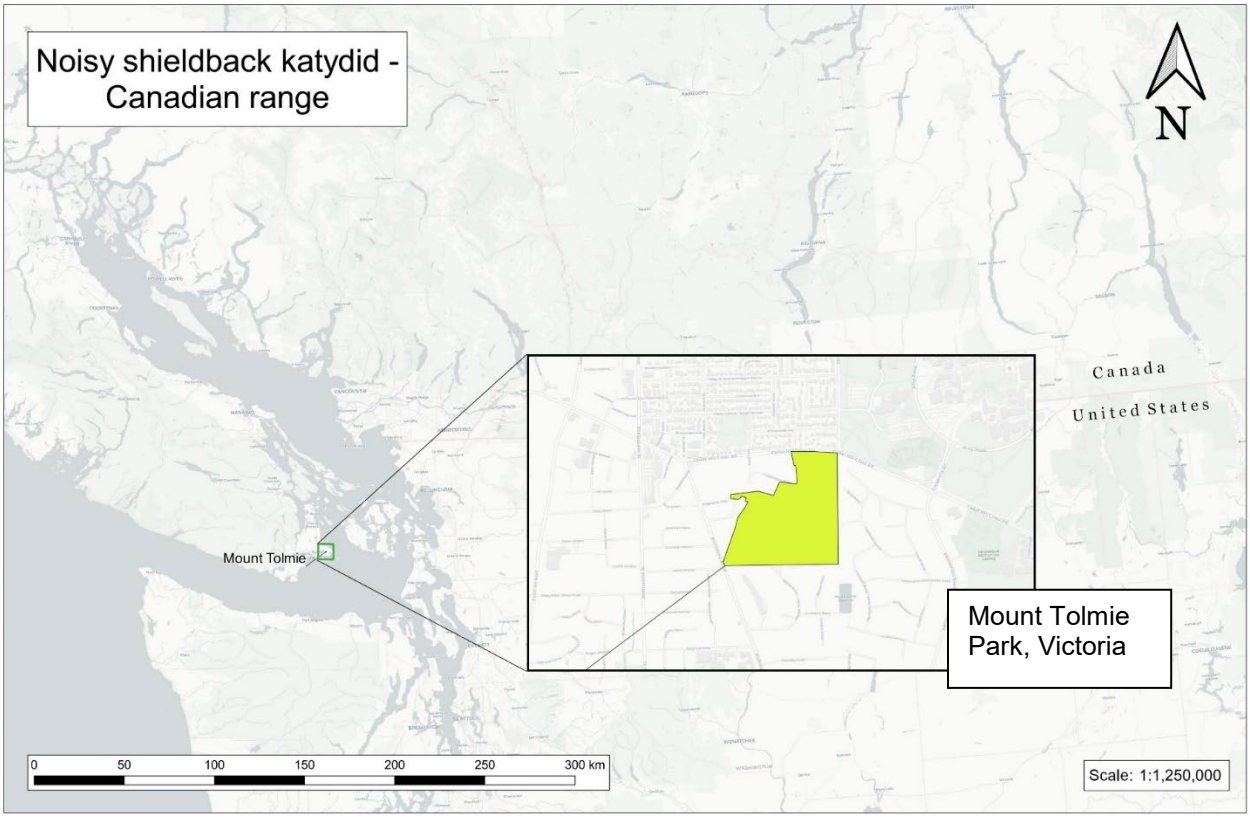

Figure 1. Canadian range for Vancouver Island Shieldback (*Steiroxys* cf. *strepens*), formerly known as Noisy Shieldback Katydid; one site at Mount Tolmie Park in Saanich, BC. Map by Greg Amos

Canadian Range

There is one extant occurrence on Mount Tolmie, Saanich District, Vancouver Island (Table 1; Figure 1). The species appears limited to the low elevation Garry Oak and associated ecosystems, including the coastal bluff and maritime meadow habitats (see **Habitat**).

Table 1. Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) museum, sight, and collection records in Canada.

Collection Locality Name and Land Ownership	Specimen # or reference	Sex	Life Stage	Day	Month	Year	Collector/ Observer/ Collection Method
Southern Vancouver Island (specific locality unknown)	Vickery and Kevan (1985). Dot on map (page 242); specimen and associated information unknown	-	-	-	-	Pre-1985	Mapped in Vickery and Kevan (1985); no additional information available.
Mount Tolmie Park, District of Saanich, Victoria, BC	Spencer Entomological Collection, Beaty Biodiversity Museum at the University of British Columbia; specimen # SEM-UBC GRY-0387	f	Adult	3	August	1990	S.G. Cannings; incidental observation and collection
	iNaturalist observation 49023880	f	Adult	8	September	2004	J. Miskelly; incidental observation and photograph posted to iNaturalist (https://inaturalist.ca/observations/49023880)
	Royal British Columbia Museum; specimen not yet catalogued	f	Adult	12	July	2009	J. Miskelly; collected during targeted katydid surveys; 'rescued' from a European Paper Wasp (*Polistes dominula*) but subsequently died (Miskelly pers. comm. 2021).
	Royal British Columbia Museum; specimen # RBCM ENT011-010915	f	Adult	30	August	2011	J. Miskelly; collected during targeted katydid surveys
	Royal British Columbia Museum; specimen not yet catalogued	f	Adult	18	September	2011	J. Gambling; incidental observation and collection as part of a University of Victoria biology course/insect collection

There are six records (Table 1). Five are from Mount Tolmie (four adult museum specimens, one photograph) and an unidentified *Steiroxy*s, presumed to be *S. strepens*, from southeastern Vancouver Island in Vickery and Kevan (1985). This record prior to 1985 suggests that Vancouver Island Shieldback has been on southern Vancouver Island for many decades. This genus is not known to be kept by people or regularly transported and corroborates that this species is a regular component of the Canadian fauna (see Vickery and Kevan 1985; Miskelly 2012).

Extent of Occurrence and Area of Occupancy

The measured EOO is less than 0.19 km^2 (Figure 1), which is the area of Mount Tolmie Park (Pollard pers. comm. 2020). The index of area of occupancy (IAO) is 4 km^2 (one 2 km x 2 km grid square). According to COSEWIC guidelines, the IAO cannot be less than the EOO, therefore the EOO is 4 km^2.

Search Effort

Numerous collections, online data sources, private individuals, and published material were consulted (see **Collections and Data Sources** and **Information Sources**).

Surveys for the Vancouver Island Shieldback in the past 15 years have focused on recording occurrence (Table 2). Adult shieldback katydids are surveyed by wandering transects through potential habitat, visually searching the shrubby and herbaceous vegetation, stopping periodically to gently disturb vegetation to flush out resting katydids. In addition, surveyors constantly listen for calling adults. Wandering transects allow the surveyor to change course depending on perceived habitat suitability. Wandering transects are a trade-off between costs and habitat area to be covered, hence a method of convenience (Longcore *et al*. 2010). These are appropriate when there is little information on preferred microhabitats for roosting, mating, resting, or calling.

Table 2. Search effort (diurnal/crepuscular, visual, wandering transects) for Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) within southeastern Vancouver Island and adjacent Gulf Islands 2012 – 2021.

Site Searched	City/ Region	Latitude	Longitude	Approximate Date(s)	Search Effort (X hours, X minutes)	Surveyor	Report Citation	Katydid (yes/ no)	Survey Method
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	24-Jul-19	1:38	Jennifer Heron	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
John Dean Provincial Park	District of Saanich	48.612009	-123.447395	25-Jul-19	1:14	Jennifer Heron	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	28-Jul-19	1:10	Jennifer Heron	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	01-Aug-19	4:00	Jennifer Heron	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	01-Aug-19	4:05	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	06-Aug-19	4:37	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mill Hill Capital Regional Park	Langford	48.4589449	-123.4771743	07-Aug-19	3:20	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect

Site Searched	City/ Region	Latitude	Longitude	Approximate Date(s)	Search Effort (X hours, X minutes)	Surveyor	Report Citation	Katydid (yes/ no)	Survey Method
Mount Tolmie Park	District of Saanich	48.458212	-123.325233	08-Aug-19	4:42	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	12-Aug-19	4:36	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	13-Aug-19	4:37	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	19-Aug-19	5:09	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Rathtrevor Beach Provincial Park	Parksville	49.32085	-124.257948	22-Aug-19	at least one hour	Staffan Lindgren	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45778	-123.3233	2021, 19-Jul	4:18	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Douglas Park	District of Saanich	48.49241	-123.3451	2021, 22-Jul	3:40	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45778	-123.3233	2021, 23-Jul	2:14	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
John Dean Provincial Park	North Saanich	48.61253	-123.4437	2021, 24-Jul	2:11	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Gowlland Tod Provincial Park	Highlands (greater Victoria)	48.53756	-123.5301	2021, 25-Jul	4:05	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Douglas Park	District of Saanich	48.49241	-123.3451	2021, 27-Jul	1:24	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45778	-123.3233	2021, 28-Jul	1:55	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Mount Douglas Park	District of Saanich	48.49241	-123.3451	2021, 29-Jul	2:54	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Goldstream Provincial Park	Langford (greater Victoria)	48.476922	-123.5455	2021, 31-Jul	3:04	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Gowlland Tod Provincial Park	Highlands (greater Victoria)	48.53756	-123.5301	2021, 01-Aug	3:58	Pascale Archibald	Heron pers. comm. 2021	none	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45778	-123.3233	2021, 04-Aug	2:08	Pascale Archibald	Heron pers. comm. 2021	none	Diurnal/ crepuscular, visual, wandering transect
John Dean Provincial Park	North Saanich	48.61253	-123.4437	2021, 07-Aug	3:12	Pascale Archibald	Heron pers. comm. 2021	none	Diurnal/ crepuscular, visual, wandering transect
Mount Tolmie Park	District of Saanich	48.45826	-123.325973	26-Aug-19	4:30	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect

Site Searched	City/ Region	Latitude	Longitude	Approximate Date(s)	Search Effort (X hours, X minutes)	Surveyor	Report Citation	Katydid (yes/ no)	Survey Method
John Dean Provincial Park	District of Saanich	48.612009	-123.447395	27-Aug-19	3:13	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
John Dean Provincial Park	District of Saanich	48.612009	-123.447395	28-Aug-19	1:52	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Goldstream Provincial Park	Langford	48.465459	-123.547721	29-Aug-19	2:48	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Gowlland Tod Provincial Park	Highlands	48.545054	-123.519618	05-Sep-19	1:50	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Goldstream Provincial Park	Langford	48.465459	-123.547721	10-Sep-19	4:34	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Gowlland Tod Provincial Park	Highlands	48.545054	-123.519618	11-Sep-19	4:20	Pascale Archibald	Heron pers. comm. 2021	no	Diurnal/ crepuscular, visual, wandering transect
Trial Islands Ecological Reserve (provincial protected area)	Oak Bay	48.398137	-123.305467	Approx. 2 – 5 days in late July – early September 2012 - 2019	at least one hour	James Miskelly	Miskelly, pers. comm. 2020	no	diurnal, visual, wandering transect
Mount Douglas Park	District of Saanich	48.493466	-123.346805		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Uplands Park (Oak Bay Park)	Oak Bay	48.44094	-123.298577		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Beaver Lake, Elk/Beaver Lake Capital Regional Park	District of Saanich	48.508023	-123.394734		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Observatory Hill/Little District of Saanich Mountain (Federal, Dominion Astrophysical Observatory)	District of Saanich	48.519991	-123.418894		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Thetis Lake Capital Regional District Park	Langford	48.46445	-123.468161		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Manuel Quimper	Sooke	48.419882	-123.660907		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Camas Hill (private conservation land)	Metchosin	48.395227	-123.598842		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mary Hill (Federal, Department of National Defence)	Metchosin	48.345367	-123.547085		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Rocky Point (Federal, Department of National Defence)	Metchosin	48.326177	-123.558074		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Tzouhalem Ecological Reserve (provincial protected area)	North Cowichan	48.790454	-123.63912		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Cowichan Garry Oak Preserve (private conservation land)	Duncan	48.808237	-123.631362		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Eagle Heights (Koksilah River Provincial Park)	Shawnigan Lake	48.654429	-123.731233		at least one hour	James Miskelly		no	diurnal, visual, wandering transect

Site Searched	City/ Region	Latitude	Longitude	Approximate Date(s)	Search Effort (X hours, X minutes)	Surveyor	Report Citation	Katydid (yes/ no)	Survey Method
Woodley Range Ecological Reserve (provincial protected area)	Ladysmith	49.026193	-123.824653		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Harewood Plains	Nanaimo	49.127552	-123.933962		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Cable Bay Trail (Nanaimo trail)	Nanaimo	49.133002	-123.826539		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Linley Valley Cottle Lake Park (Nanaimo Park)	Nanaimo	49.219238	-123.982983		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Neck Point Park (Nanaimo Park)	Nanaimo	49.235497	-123.964729		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Sugarloaf Mountain Park (Nanaimo Park)	Nanaimo	49.208842	-123.970568		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Benson Nanaimo Regional Park	Nanaimo	49.152858	-124.040345		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Lantzville, “The Foothills”	Lantzville	49.234382	-124.087667		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Nanoose Hill, Notch Hill Park (Nanoose Bay Park)	Nanoose Bay	49.27245	-124.160106		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Little Mountain	Parksville	49.294668	-124.324971		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Cokely	Nanaimo	49.239873	-124.587073		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Washington Alpine Resort	Comox-Strathcona	49.751382	-125.295757		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Becher	Comox-Strathcona	49.656007	-125.225058		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Albert Edward	Comox-Strathcona	49.677825	-125.427719		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Maxwell Provincial Park	Salt Spring Island	48.800732	-123.516871		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Tolmie Park	District of District of Saanich (Victoria)				at least ten hours	James Miskelly		no (earlier records, table 1)	Visual, wandering transect
Mount Tuam Ecological Reserve (provincial protected area)	Salt Spring Island	48.723971	-123.488506		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Helliwell Provincial Park	Hornby Island	49.517515	-124.600212		at least one hour	James Miskelly		no	diurnal, visual, wandering transect
Mount Maxwell Provincial Park	Salt Spring Island	48.800732	-123.516871	July 28, 2019	at least one hour	Jennifer Heron	Heron pers. comm. 2021	no	diurnal, visual, wandering transect

Noisy Shieldbacks call during the day (Fulton 1930; Lyons pers. comm. 2020). At Mount Tolmie, only female Vancouver Island Shieldback have been found and no one has recorded calls of this species. Surveys were done at various times of the day to account for this uncertainty. Males may stop calling when they sense a predator is nearing (e.g., human getting close to try and see them in the shrubbery); some surveys were sit-and-wait, where the surveyor was still and listened for calling activity.

Surveys by Miskelly (pers. comm. 2019-2021) during the adult activity period (i.e., late July-early September, from 2012-2019) tally a minimum of 30 hours over 31 sites[1] within the species' potential habitat and range of southeastern Vancouver Island (see Table 2 for the list of survey sites). Miskelly (pers. comm. 2019-2021) has focused on recording katydid diversity within the province for more than ten years.

Search effort specifically targeting Vancouver Island Shieldback took place in 2019 (6 sites) and 2021 (5 sites) within the potential range of the species (Figure 2) on southeastern Vancouver Island and the Gulf Islands. A total of 97 hours and 20 mins (2019: 62 hours and 15 minutes over 75.2 km; 2021: 35 hours and 5 minutes (about 56 km) was spent searching for the species, including Mount Tolmie Park (Figure 3).

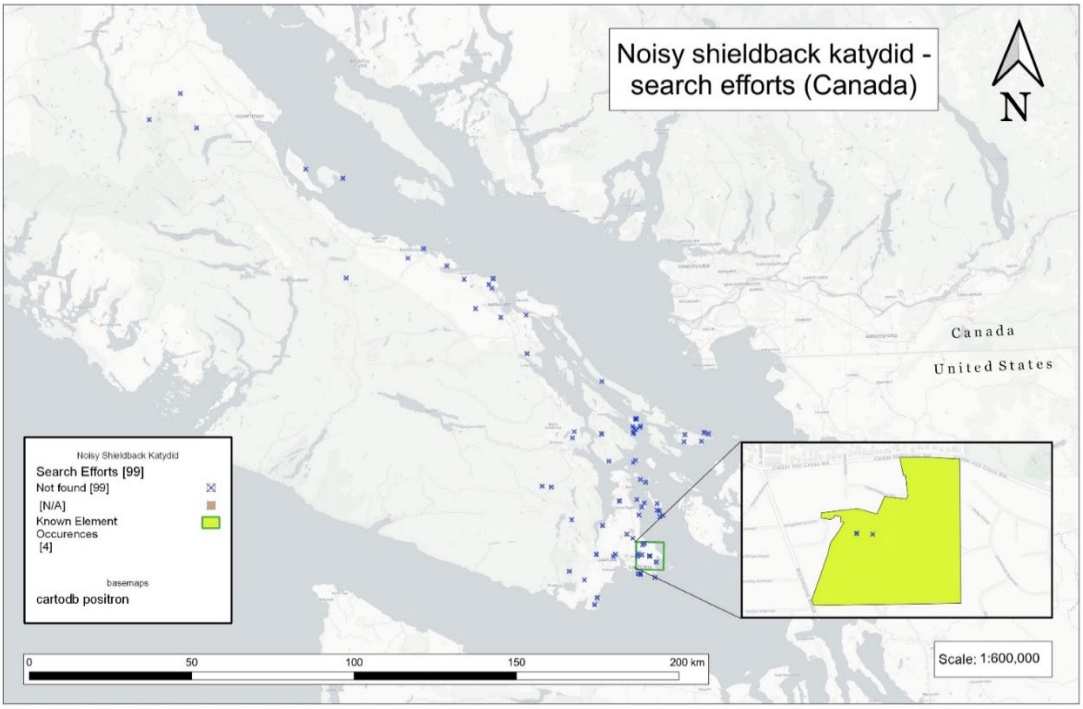

Figure 2. Search effort sites for Vancouver Island Shieldback (*Steiroxys* cf. *strepens*), formerly known as Noisy Shieldback Katydid, within potential Garry Oak (*Quercus garryana*) and associated habitats in British Columbia 1989-2021 (see Table 2). The two Xs in Mount Tolmie Park represent all surveys in 2019 and 2021 (also see Fig. 3). Map by Greg Amos.

[1] A site refers to a discrete area of contiguous potentially suitable habitat that Vancouver Island Shieldback could potentially occupy, given the habitat knowledge available.

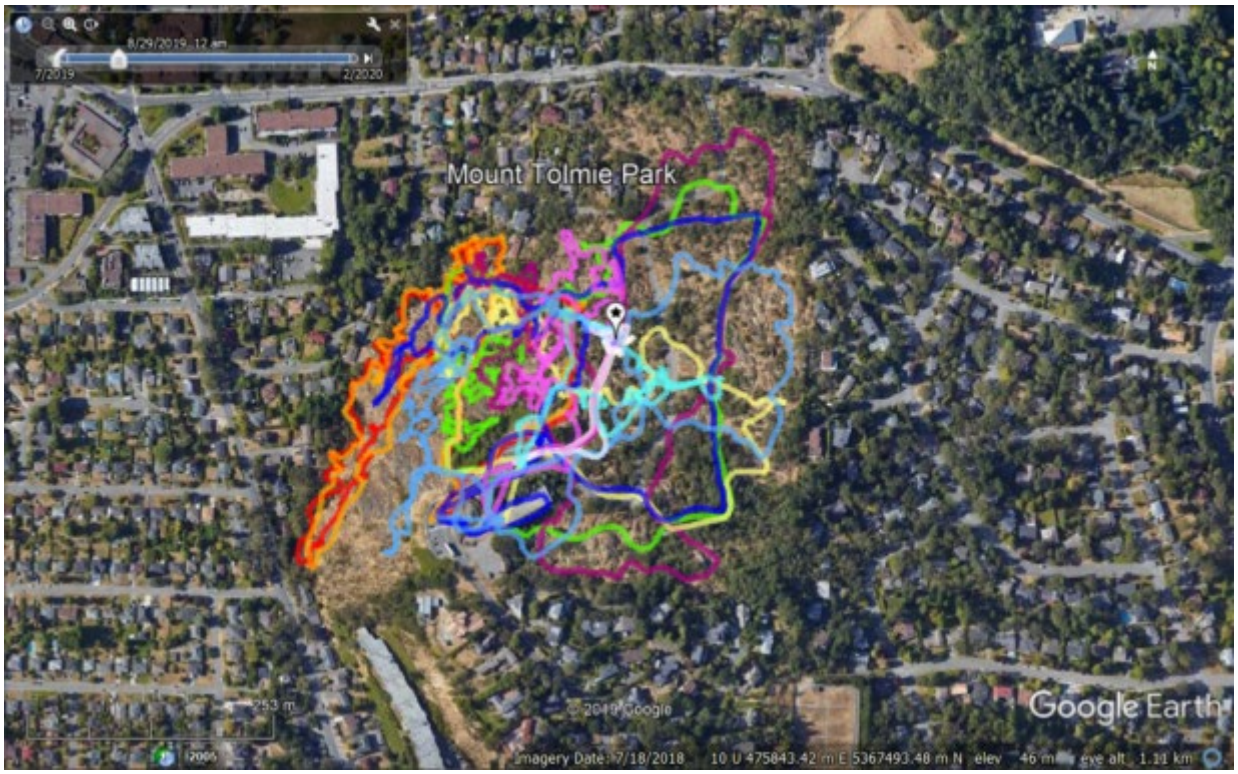

Figure 3. Wandering transect 2019 survey tracks (n=10) for Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) at Mount Tolmie Park, District of Saanich, BC White waypoint with black star indicates where katydid stridulations were heard (but no confirmed sighting of katydids). Map prepared by D. Marks. Map source GoogleEarth®.

The timing of surveys throughout the day varied from mid-day to dusk through full dark. Surveys were done at various times of day because the species' activity patterns are unknown. There were two instances at Mount Tolmie Park where a faint possible katydid song could be heard, but individuals were not located despite extensive surveyor patience and searching (Archibald pers. comm. 2020). No Vancouver Island Shieldback were recorded during these surveys.

Pitfall traps are a useful katydid survey method although it is unclear how efficient it is specifically for Vancouver Island Shieldback. Pitfall traps in the Okanagan caught other *Steiroxys* species (Miskelly pers. comm. 2020). More than 35,500 pitfall trap nights (more than 156 traps) have been set within the potential habitat of Vancouver Island Shieldback (Table 2, 3). Vancouver Island Shieldback has not been captured using pitfall traps. None were set at Mount Tolmie; however, some of the trap sites (in Table 2) were Garry Oak habitats similar to Mount Tolmie Park.

When more is learned about habitat use, mating behaviour, and feeding, it is anticipated better search methods will be developed.

The Canadian range of Vancouver Island Shieldback is the Victoria area on Vancouver Island where both recreational and research-related insect collecting has been done for more than 100 years. Researchers, naturalists, and biologists have conducted non-quantified surveys for orthopteran insects, concurrent with their own areas of focus. It is not possible to accurately quantify all search effort by these individuals. Vancouver Island Shieldback is a large and distinct species, and the auditory calls are distinct and of interest to many entomologists. It is therefore reasonable to conclude, solely based on historical collection information, that this species is not common. There is one record in Canada posted on iNaturalist from 2004 (as of December 10, 2020) (Table 1) and no records posted to BugGuide (as of December 10, 2020). The only Canadian specimens are in the two large BC collections, University of British Columbia (UBC), Vancouver, BC (collected in 1990), and the Royal British Columbia Museum (RBCM) Victoria, BC (collected 2009 and 2011).

HABITAT

Habitat Requirements

The natural habitat in Mount Tolmie Park is sparsely vegetated Garry Oak and associated ecosystem woodlands (Figure 4). These habitats are part of the Coastal Douglas-fir biogeoclimatic zone, a vegetation classification system that is used throughout the province (British Columbia Ministry of Forests 1991). These ecosystems occur on the eastern side of Vancouver Island, Victoria area north to the Comox area; throughout the southern Gulf Islands as far north as Savary Island in the Strait of Georgia; and two isolated pockets in the Lower Fraser Valley (Lea 2006).

In general, Garry Oak and associated ecosystems are open meadow habitats, sparsely treed with Garry Oak, Douglas-fir (*Pseudotsuga menziesii*), Arbutus (*Arbutus menziesii*), and other species (Fuchs 2001). Often, the growth of these three tree species is stunted due to the shallow, xeric soil and underlying and exposed bedrock. Understory vegetation includes native and introduced grasses with a high diversity of forbs, and various shrubs. For further descriptions and lists of the plants in this ecosystem refer to Fuchs (2001). The ecosystems are described in more detail by Roemer (1992), British Columbia Ministry of Environment, Lands and Parks (1993), and Erickson (1995, 1998).

Figure 4. Vancouver Island Shieldback habitat at Mount Tolmie Park. Note the exposed bedrock, scrubby Garry Oak (*Quercus garryana*) and open areas. Photo by P. Archibald, May 7, 2019.

Garry Oak ecosystems are further classified into two major types: parkland Garry Oak and scrub Garry Oak (Pojar 1980). Mount Tolmie Park is a shallow soil scrub Garry Oak community on bedrock (Lea 2006). The scrub oak are short, scrubby, and shrubby on shallow soils on rock outcrops, and benches. The habitat spans inland cliffs, bluffs, and rocky outcrops that have been formed by erosion, the collapse of rock faces or riverbanks, and cumulative deposition of organic matter over time (Ward *et al.* 1998). The soils on these cliffs and bluffs form within the ledges, bedrock fissures, and crevices, which then support grasses, mosses, lichens, and stunted trees and shrubs (Ward *et al.* 1998). Detailed vegetative components of scrub oak habitat types have not been described (Lea 2011).

Shieldbacks inhabit scrubby-type habitats where they establish territories (males), seek shelter, hunt, and remain camouflaged from predators. Structural elements may be more important than plant species.

The habitat of Noisy Shieldback in Oregon differs from that on Mount Tolmie. In Oregon at Jackson's Hill (now Dimple Hill) in Benton County the habitat is described as small patches of prairie plants and brake fern (= bracken fern [*Pteridium aquilinum* var. *pubescens*]) (Fulton 1930). Woodruff Meadows in Jackson County and Marys Peak habitat (Benton County) are described as open clearings and meadows, with sparsely growing

conifer overstory with abundant grasses and vegetation. Based upon photos provided by Lyons (pers. comm. 2020) the habitat at Woodruff Meadows (Jackson County) differs from Mount Tolmie. Lightfoot (1986) classifies the species as a 'meadow associate'.

Habitat Trends

Information on habitat trends for the Garry Oak and associated ecosystems where Vancouver Island Shieldback occurs is found in the Sensitive Ecosystem Inventory (SEI) project carried out between 1993 and 1997 on southeastern Vancouver Island (Ward *et al.* 1998) and in 2002 (Canadian Wildlife Service and British Columbia Ministry of Environment 2002; Kirkby and Cake 2004). Recent analysis by Shackelford *et al*. (2017) found that the Coastal Douglas-fir biogeoclimatic zone that includes Garry Oak ecosystems is one of the three most altered Biogeoclimatic Ecosystem Classification zones in BC. More than 85% of Garry Oak habitat has been anthropogenically altered and more than 50% has been subject to land conversion (Shackelford *et al*. 2017). A major structural change has been increased canopy closure, potentially reducing habitat suitability for Vancouver Island Shieldback. Road density has increased while connectivity has decreased (Shackelford *et al*. 2019), all reducing the overall habitat quality.

Much historical Garry Oak habitat has been lost to development or has been degraded owing to the cumulative ecosystem modifications through the ingrowth of native and invasive/non-native plants, human activities, large urban and agricultural development, and more recently climate change (**see Threats and Limiting Factors**). Large Garry Oak trees are often preserved during development (both historical and recent) but the natural plant communities under these trees, including the shrub oak that would enable the establishment of Vancouver Island Shieldback territories, are gone (e.g., now lawns and non-native plant gardens) (Lea 2006).

Most low elevation open forest and meadow ecosystems on southern Vancouver Island have been extensively modified in the past 100 years. Lea (2006) mapped historical Garry Oak ecosystems in Greater Victoria, Cowichan Valley, Comox Valley, Nanaimo, Nanoose, Salt Spring Island, and Hornby Island. Mapping was completed for both parkland and scrub oak ecosystem types (see **Habitat**) based on the original land surveys completed in the 1850s and 1860s, and recent forest stand history field observations. These ecosystems have been reduced to less than 10% of their original extent in BC (Lea 2006), and more have been lost to residential development since. In pre-European times, scrub oak habitat in the areas examined covered approximately 13,579 ha, whereas in 2006 it only covered about 1187 ha (Lea 2006).

It was estimated that the shallow soil (scrub oak) Garry Oak ecosystems were 44% of the original area (Lea 2006). These shallow soil areas were likely spared because they occur on rocky bluffs and areas that are difficult to develop for agricultural and other development (Lea 2006). Since 2005, the push for residential housing is putting pressure to convert more of these shallow soil Garry Oak ecosystems.

BIOLOGY

The natural history and biology of Vancouver Island Shieldback has not been studied. Information below is summarized from the description of Noisy Shieldback, *S. strepens* (Fulton 1930) and general information on shieldbacks (Vickery and Kevan 1985; Bailey and Rentz 1990; Gwynne 2001; Lyons 2019).

Life Cycle and Reproduction

Vancouver Island Shieldback has an annual life cycle with one generation per year. It overwinters as an egg, probably underground, which hatches as a nymph in the spring and grows through incomplete metamorphosis. Adults mature sometime in late July through early August and live for several weeks. From egg hatch to adult maturity is 60-90 days based on adult observations in BC.

Upon reaching maturity, males likely establish a loosely defined territory in shrubby vegetation and begin to call (i.e., chirp or brr) for receptive females. Female shieldbacks respond to calling males. Shieldback males produce a spermatophore, a gelatinous mass composed of two parts, the spermatophylax and the sperm ampulla (contains the sperm), which is transferred to the female during copulation (Alexander and Otte 1967). The spermatophylax is a nuptial gift, similar to courtship feeding in birds and other insects (Lack 1940; Thornhill 1976). The female consumes the nutrient-rich spermatophylax after mating (Gwynne 1983).

Physiology and Adaptability

Physiological information is not available for this species. Habitat specificity is not well understood.

Shieldback (*Steiroxys* spp.) males call at a specific frequency range, an adaptation in many species to be able to detect and respond to conspecific sounds in noisy environments. When anthropogenic noise impacts signalling and detection, some species can shift their calls to higher frequencies or call less frequently during noisy periods (e.g., see Gallego-Abenza *et al*. 2020). It is unknown whether Vancouver Island Shieldback changes calling activity in response to changes in anthropogenic noise (see **Threats**).

Dispersal and Migration

The dispersal ability of Vancouver Island Shieldback, and other *Steiroxys*, is unknown, but it is assumed to be a short distance. The species is flightless (both sexes) and unlikely to disperse more than a few hundred metres (by walking). Maximum adult movement in the similar Protean Shieldback (*Atlanticus testaceous*) was 170 m (Gangwere 1966). Vancouver Island Shieldback is non-migratory.

Interspecific Interactions

Little is known about the interspecific interactions of Vancouver Island Shieldback or *Steiroxys* katydids in general. Many shieldbacks are insect predators, while others consume plant material and/or scavenge dead insects (Vickery and Kevan 1985; Capinera *et al.* 2004). Vancouver Island Shieldback is likely omnivorous. Katydids are preyed upon by frogs, snakes, birds, and small mammals. The nymphs are also preyed upon by spiders, large predatory beetles, and other predatory insects. There is an observation of one individual of Vancouver Island Shieldback on Mount Tolmie being killed by a non-native paper wasp (*Polistes dominula*) (Miskelly pers. comm. 2021). Non-native lizards and domestic cats are perceived to be important predators of Vancouver Island Shieldback on Mount Tolmie (see Threats).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

More than 30 potential sites on southern Vancouver Island have been sampled since 2010, with intensive effort in 2019 and 2021. Methods for surveys are detailed in **Search Effort**. The number and extent of wandering transects and pitfall trapping are documented in Tables 2 and 3 and **Search Effort**.

Table 3. Compilation of pitfall trap search effort for Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) on southeastern Vancouver Island and adjacent Gulf Islands 1989 to 2012. Pitfall trapping information compiled during preparation of Audouin's Night-stalking Tiger Beetle (*Omus audouini*) status report (COSEWIC 2013).

Site with pitfall trap(s)	City/ Region	Latitude	Longitude	Approx. Date(s)	Search Effort (number of pitfall trap nights)	Surveyor	Katydid (yes/ no)
Mary Hill (Federal, Department of National Defence)	Metchosin	48.345367	-123.547085	Unknown	600 pitfall trap nights	John McLean	no
Rocky Point (Federal, Department of National Defence)	Metchosin	48.326177	-123.558074	Unknown	600 pitfall trap nights	John McLean	no
Cattle Point Park (Oak Bay Park)	Oak Bay	48.43821	-123.29443	28-May-10 to 02-Sep-10	one trap, 97 pitfall trap nights	Andy Teucher	no
Uplands Park (Oak Bay Park)	Oak Bay	48.44094	-123.298577	10-Jun-10 to 02-Oct-10	one trap, 114 pitfall trap nights	Andy Teucher	no
Mount Douglas Park (District of Saanich Park)	District of Saanich	48.493466	-123.346805	05-Jun-10 to 02-Sep-10	one trap, 89 pitfall trap nights	Andy Teucher	no

Site with pitfall trap(s)	City/ Region	Latitude	Longitude	Approx. Date(s)	Search Effort (number of pitfall trap nights)	Surveyor	Katydid (yes/ no)
Playfair Park (District of Saanich Park)	District of Saanich	48.462041	-123.357664	10-Jun-10 to 10-Aug-10	one trap, 61 pitfall trap nights	Andy Teucher	no
Holland Point Park (Victoria Park)	Victoria	48.409582	-123.374809	05-Jun-10 to 09-Sep-10	one trap, 96 pitfall trap nights	Andy Teucher	no
Beacon Hill Park (Victoria Park)	Victoria	48.40985	-123.364068	26-May-10 to 09-Sep-10	four traps, total of 407 pitfall trap nights	Andy Teucher	no
Swan Lake Christmas Hill Nature Sanctuary	Victoria	48.465104	-123.373391	02-Aug-12 to 27-Sep-12	16 traps, total of 896 pitfall trap nights	Unknown	no
Mount Douglas Park (District of Saanich Park)	District of Saanich	48.489709	-123.353595	18-May-12 to 21-Sep-12	11 traps, total of 1386 pitfall trap nights	Unknown	no
Beacon Hill Park (Victoria Park)	Victoria	48.40985	-123.364068	08-May-12 to 24-Sep-12	4 traps, total of 433 pitfall trap nights	Unknown	no
James Island Water Taxi Dock	James Island	48.594823	-123.354346	18-May-12 to 07-Sep-12	5 traps, total of 560 pitfall trap nights	Unknown	no
James Island Powder Dock	James Island	48.605364	-123.34343	18-May-12 to 07-Sep-12	5 traps, total of 560 pitfall trap nights	Unknown	no
James Island North Spit	James Island	48.615911	-123.373812	18-May-12 to 07-Sep-12	10 traps, total of 1120 pitfall trap nights	Unknown	no
Helliwell Provincial Park	Hornby Island	49.517515	-124.600212	15-May-12 to 25-Sep-12	9 traps, total of 1188 pitfall trap nights	Unknown	no
Fillongley Provincial Park	Denman Island	49.542855	-124.758301	16-May-12 to 25-Sep-12	10 traps, total of 1320 pitfall trap nights	Unknown	no
Neck Point Park (Nanaimo Park)	Nanaimo	49.235497	-123.964729	14-Aug-12 to 25-Sep-12	one trap, 42 pitfall trap nights	Unknown	no
Victoria Watershed		48.562387	-123.648108	20-May-92 to 17-Jun-92	one trap, 28 pitfall trap nights	Kathy Craig	no
Koksilah		48.656947	-123.769439	26-May-92 to 23-Jun-92	one trap, 28 pitfall trap nights	Kathy Craig	no
Mount Warburton Pike, Southern Gulf Islands National Park Reserve	Saturna Island	48.773628	-123.171961	10-May-04 to 29-Nov-04	8 traps, total of 1624 pitfall trap nights	Unknown	no
Lyall Creek, Southern Gulf Islands National Park Reserve	Saturna Island	48.793865	-123.167391	10-May-04 to 29-Nov-04	5 traps, total of 1015 pitfall trap nights	Unknown	no

Site with pitfall trap(s)	City/ Region	Latitude	Longitude	Approx. Date(s)	Search Effort (number of pitfall trap nights)	Surveyor	Katydid (yes/ no)
Narvez Bay, Southern Gulf Islands National Park Reserve	Saturna Island	48.773848	-123.098525	10-May-04 to 29-Nov-04	5 traps, total of 1015 pitfall trap nights	Unknown	no
Tumbo Island, Southern Gulf Islands National Park Reserve	Tumbo Island	48.794878	-123.06868	10-May-04 to 07-Oct-04	10 traps, total of 1500 pitfall trap nights	Unknown	no
Cabbage Island, Southern Gulf Islands National Park Reserve	Cabbage Island	48.798536	-123.086877	10-May-04 to 07-Oct-04	4 traps, total of 236 pitfall trap nights	Unknown	no
Hunterston Farm	Galliano Island	48.946015	-123.512227	12-May-10 to 23-May-10	6 traps, total of 66 pitfall trap nights	Laura Parkinson and Jennifer Heron	no
Brackman Island, Southern Gulf Islands National Park Reserve	Brackman Island	48.719017	-123.386361	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
S Acland Island	S Acland Island	48.81023	-123.373704	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
N Acland Island	N Acland Island	48.813698	-123.381203	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Big D'Arcy Island, Southern Gulf Islands National Park Reserve	Big D'Arcy Island	48.567092	-123.279772	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Tiny D'Arcy Island	Tiny D'Arcy Island	48.569911	-123.266856	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Forrest Island, Southern Gulf Islands National Park Reserve	Forrest Island	48.663075	-123.336038	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
S Hawkins Island, Southern Gulf Islands National Park Reserve	S Hawkins Island	48.838594	-123.369209	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
E Hawkins Island, Southern Gulf Islands National Park Reserve	E Hawkins Island	48.84037	-123.370707	1989	one trap, 60 pitfall trap nights	James Bergdhal	no

Site with pitfall trap(s)	City/ Region	Latitude	Longitude	Approx. Date(s)	Search Effort (number of pitfall trap nights)	Surveyor	Katydid (yes/ no)
N Hawkins Island, Southern Gulf Islands National Park Reserve	N Hawkins Island	48.841162	-123.373548	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Big Red Island, Southern Gulf Islands National Park Reserve	Red Islets	48.816163	-123.356026	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Bright Island, Southern Gulf Islands National Park Reserve	Bright Island	48.820299	-123.352736	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Glenthorne Island	Glenthorne Island	48.819978	-123.385846	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Big Sallas Island, Southern Gulf Islands National Park Reserve		48.584911	-123.29026	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Little Sallas Island, Southern Gulf Islands National Park Reserve		48.583133	-123.281374	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Sidney Island	Sidney Island	48.603177	-123.289941	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
SW Dock Island, Southern Gulf Islands National Park Reserve	SW Dock Island	48.671054	-123.358037	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Big Channel Island, Southern Gulf Islands National Park Reserve	Channel Island	48.799507	-123.384282	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Little Channel Island, Southern Gulf Islands National Park Reserve	Channel Island	48.801463	-123.382123	1989	one trap, 60 pitfall trap nights	James Bergdhal	no
Island View Beach,	District of Saanich	48.57246	-123.366942	2003-2004	15 traps, total of 10950 pitfall trap nights	Maxence Solomon	no

Site with pitfall trap(s)	City/ Region	Latitude	Longitude	Approx. Date(s)	Search Effort (number of pitfall trap nights)	Surveyor	Katydid (yes/ no)
Cabbage Island, Southern Gulf Islands National Park Reserve	Cabbage Island	48.798536	-123.086877	1989	one trap, 4000 pitfall trap nights	James Bergdhal	no
Tumbo Island, Southern Gulf Islands National Park Reserve	Tumbo Island	48.794878	-123.06868	1989	one trap, 3000 pitfall trap nights	James Bergdhal	no
Portland Island, Southern Gulf Islands National Park Reserve	Portland Island	48.725005	-123.37663	1989	one trap, 1400 pitfall trap nights	James Bergdhal	no

Abundance

There are few data from which to estimate Vancouver Island Shieldback abundance at Mount Tolmie Park and hence Canada.

Fluctuations and Trends

No information on population trends or fluctuations is available for Vancouver Island Shieldback or any other *Steiroxys* in western North America. Based on the low number of specimens/observations of the species, and its congeners, it likely does not exhibit extreme fluctuations in Canada nor within its global range.

Rescue Effect

Vancouver Island Shieldback is flightless and restricted to southern Vancouver Island, therefore rescue is not possible.

THREATS AND LIMITING FACTORS

Threats

The threats assessment for Vancouver Island Shieldback in Canada is based on the IUCN-CMP (International Union for Conservation of Nature – Conservation Measures Partnership 2016) unified threats classification system (see Salafsky *et al.* 2008; Master *et al.* 2012). A threats conference call to discuss this species was conducted in April 2021. Details are discussed below under the IUCN-CMP headings and numbering scheme (also Table 4).

Table 4. Results for the Vancouver Island Shieldback (*Steiroxys* cf. *strepens*) threats assessment in Canada. The classification below is based on the IUCN-CMP (International Union for the Conservation of Nature–Conservation Measures Partnership) unified threats classification system. For a detailed description of the threat classification system, see the CMP web site (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat "impact" is calculated from scope and severity. For information on how the values are assigned, see Master *et al.* (2009) and footnotes to this table.

Scientific Name	Vancouver Island Shieldback (*Steiroxys* cf. *strepens*)
Date:	April 12, 2021
Assessor(s):	David Fraser (COSEWIC facilitator), Brenda Costanzo (report writer), Jennifer Heron (report writer), David McCorquodale (Arthropods SSC Co-chair), Syd Cannings (Canadian Wildlife Service), James Miskelly (Royal British Columbia Museum), Claudia Copley (Royal British Columbia Museum), Darren Copley (District of Saanich Parks), Eva Riccius (District of Saanich Parks), Leah Ramsay (SSC), Jayme Lewthwaite (SSC), Jeff Ogden (SSC), Robert Buchkowski (SSC), Greg Wilson (BC COSEWIC rep), Isabelle Ceillier (ECCC), Ron Lyons (Oregon), Eric Gross (ECCC)
References:	

Overall Threat Impact:		**Level 1 Threat Impact Counts**	
Threat Impact		**high range**	**low range**
A	Very High	1	1
B	High	0	0
C	Medium	3	1
D	Low	0	2
Calculated Overall Threat Impact (not modified):		High	High

Threat		**Impact [1] (calculated)**	**Scope[2] (next 10 Yrs)**	**Severity[3] (10 Yrs)**	**Timing[4]**	**Comments**
1	Residential & commercial development					
1.1	Housing & urban areas					Not applicable.
1.2	Commercial & industrial areas					Not applicable.
1.3	Tourism & recreation areas					Not applicable.
2	Agriculture & aquaculture					
2.1	Annual & perennial non-timber crops					Not applicable.
2.2	Wood & pulp plantations					Not applicable.
2.3	Livestock farming & ranching					Not applicable.
2.4	Marine & freshwater aquaculture					Not applicable.
3	Energy production & mining					
3.1	Oil & gas drilling					Not applicable.
3.2	Mining & quarrying					Not applicable.
3.3	Renewable energy					Not applicable.
4	Transportation & service corridors	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	

Threat		Impact [1] (calculated)	Scope[2] (next 10 Yrs)	Severity[3] (10 Yrs)	Timing[4]	Comments
4.1	Roads & railroads	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	See text under threat heading in report.
4.2	Utility & service lines					Not applicable.
4.3	Shipping lanes					Not applicable.
4.4	Flight paths					Not applicable.
5	Biological resource use		Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals					Insect collection is not considered a threat.
5.2	Gathering terrestrial plants					Scored under 6.1
5.3	Logging & wood harvesting					Not applicable.
5.4	Fishing & harvesting aquatic resources					Not applicable.
6	Human intrusions & disturbance	Medium	Pervasive (71 - 100%)	Moderate (11 - 30%)	High (Continuing)	
6.1	Recreational activities	Medium	Pervasive (71 - 100%)	Moderate (11 - 30%)	High (Continuing)	See text under threat heading in report.
6.2	War, civil unrest & military exercises					Not applicable.
6.3	Work & other activities	Medium	Pervasive - Large (31-100%)	Moderate (11-30%)	High (Continuing)	See text under threat heading in report.
7	Natural system modifications	Medium-Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression	Medium – Low	Restricted – small (1 – 30%)	Extreme – Serious (31-100%)	Moderate (possible in the short-term < 10 years/3 generations	See text under threat heading in report.
7.2	Dams & water management/use					Scored under 10.2
7.3	Other ecosystem modifications	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	See text under threat heading in report.
8	Invasive & other problematic species & genes	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	
8.1	Invasive non-native/ alien species/diseases	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	See text under threat heading in report.
8.2	Problematic native species/diseases					The spread and increase in abundance of non-native plants is scored under 7.3 Other ecosystem modifications. Native deer may accidentally consume a katydid, while the deer is browsing; however, this is not considered a threat.
8.3	Introduced genetic material					Not applicable.

Threat		Impact [1] (calculated)	Scope[2] (next 10 Yrs)	Severity[3] (10 Yrs)	Timing[4]	Comments
8.4	Problematic species/ diseases of unknown origin					Not applicable.
8.5	Viral/prion-induced diseases					Not applicable.
8.6	Diseases of unknown cause					Not applicable.
9	Pollution	Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
9.1	Domestic & urban wastewater					Not applicable.
9.2	Industrial & military effluents					Not applicable.
9.3	Agricultural & forestry effluents					Not applicable.
9.4	Garbage & solid waste					Not applicable.
9.5	Air-borne pollutants					Not applicable.
9.6	Excess energy	Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Refers to noise pollution. See text under threat heading in report.
10	Geological events	Unknown	Pervasive (71-100%)	Unknown	Unknown	
10.1	Volcanoes					Not applicable.
10.2	Earthquakes/ tsunamis	Unknown	Pervasive (71-100%)	Unknown	Unknown	See text under threat heading in report.
10.3	Avalanches/ landslides					Not applicable.
11	Climate change & severe weather	Unknown	Pervasive (71-100%)	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	
11.1	Habitat shifting & alteration					Not applicable.
11.2	Droughts	Unknown	Pervasive (71-100%)	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	See text under threat heading in report.
11.3	Temperature extremes	Unknown	Pervasive (71-100%)	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	See text under threat heading in report.
11.4	Storms & flooding					Not applicable.
11.5	Other impacts					Not applicable.

[1]Impact – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each stress is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: very high (75% declines), high (40%), medium (15%), and low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity is unknown).

[2]Scope – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%)

[3]Severity – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%).

[4]Timing – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

The most serious threats, in decreasing order, are predation by non-native lizards and cats (8.1 Non-native/alien species/diseases), accidental killing and disturbance during recreation and work activities (6.1 and 6.3 Recreation, Work), potential for roadkill (4.1 Roads and railways), and declining habitat quality through natural systems modifications (7.1 and 7.3). There are additional threats applicable to potential habitat but they are not scored or discussed below (see the threats assessment Table 4). Potential threats scored as Unknown are discussed below.

<u>IUCN-CMP Threat 8. Invasive & other problematic species & genes (Very high threat impact)</u>

8.1 Invasive non-native/alien species/diseases (Very high threat impact)

Since their intentional release in 1967 and 1970 from a private zoo in the District of Saanich, European Wall Lizard (*Podarcis muralis*) has spread over much of southeast Vancouver Island (Engelstoft *et al*. 2000). The earliest record of Wall Lizard on Mount Tolmie was in 2015 (Engelstoft pers. comm. 2020). Since then, the species has become widespread and very abundant on Mount Tolmie (D. Copley pers. comm. 2020; iNaturalist accessed April 2021). The lizard is thought to have two (Engelstoft *et al*. 2020) or more clutches per year (Allan *et al*. 2006) and was present and abundant during surveys for Vancouver Island Shieldback in 2019 (Archibald pers. comm. 2019). This introduced lizard poses a predation threat to Vancouver Island Shieldback. European Wall Lizards eat both epigeal (surface crawling), flying, and tree and shrub-inhabiting arthropods and inhabit sunny rocky places and roadsides. These lizards are most active from April – October, but there are records of active Wall Lizards on sunny days from every month of the year (Engelstoft *et al*. 2020). The lizard is therefore present throughout the active period for the katydid, searching for prey during the same period katydids are maturing, mating, and laying eggs. Wall Lizards are faster and more agile than the native Northern Alligator Lizard (*Elgaria coerulea*) (Engelstof *et al*. 2020) and are found in densities much higher than any native reptile (Fraser pers. comm. 2020).

Domestic and/or feral cats (*Felis catus*) (Read and Bowen 2001), and possibly rats (e.g., *Rattus rattus* and *R. norvegicus*), can be predators of orthopterans. Frequency of predation on grasshoppers by cats has been reported to increase in the summer months (Molsher *et al.* 1999), and it is reasonable to expect they would pursue Vancouver Island Shieldback in the same way. Cats can locate orthopteran prey by the calls (Walker 1964). Domestic cats frequent Mount Tolmie Park because it is surrounded by houses with cats.

How some non-native plants change vegetation composition is scored and discussed under 6.1 and 7.3.

IUCN-CMP Threat 6. Human intrusions & disturbance (Medium threat impact)

6.1 Recreational activities (Medium threat impact)

Shieldback nymphs emerge in early summer and mature by mid-summer. This coincides with the high season of human recreational activity at Mount Tolmie Park. Although shieldbacks have persisted at this park for many generations, recreational activities have increased over the past decade (e.g., hiking, dog walking, bicycle races, tourist buses, and viewing). Foot traffic is extreme throughout the park and off trails, causing erosion, damaging vegetation, and generally degrading habitat, and could cause direct mortality of Vancouver Island Shieldback (Miskelly pers. comm. 2021). The area is also a popular place for social media photos (e.g., Instagram) and people are going off-trail to seek out places to pose for photographs. Off-leash dog-walking occurs regularly even though it is not permitted. Dogs may dig, defecate, trample, roll around, urinate, and pursue katydids.

Mount Tolmie Park has extensive patches of non-native Himalayan Blackberry (*Rubus armeniacus*) growing along trails and roadways throughout the park. Himalayan Blackberries mature mid-July to early August, coinciding with the emergence of Vancouver Island Shieldback. The public enjoy picking berries and may trample wandering katydids both on trails and when going off-trail in search of Himalayan Blackberry patches. It is unknown if Vancouver Island Shieldback establishes territories in the shrubby vegetation of Himalayan Blackberry, but this non-native plant could provide habitat for this species (see Threat 8.1 and 5.2).

6.3 Work & other activities (Medium threat impact)

Mount Tolmie is a high-use recreational park. There are ongoing research projects, and restoration activities. Permits issued by the District of Saanich include provisions for species at risk and the impacts on other species (Burger pers. comm. 2019; D. Copley pers. comm. 2020). There are environmental protocols in place; however, the Vancouver Island Shieldback is not a species of note in these protocols (D. Copley pers. comm. 2021). Any projects or maintenance work that occurs between May through September would be within the active period of Vancouver Island Shieldback.

IUCN-CMP Threat 4. Transportation & service corridors (Medium – Low threat impact)

4.1 Roads & railroads: (Medium – low threat impact)

Shieldbacks are susceptible to road mortality. They are cryptic and secretive, and are not likely to be in open areas. However, females may wander across roads and paths in response to calling males. Prior to laying eggs, females are slow-moving, pausing between movements during which time they are vulnerable to being killed on the road.

Mount Tolmie Park has a popular sight-seeing viewpoint and parking lot at the summit of the park. The summit is recognized as “The Best Place to View the City”, providing a panoramic view of Greater Victoria and the surrounding region (District of Saanich 2020). The park is bisected by a road, and the cover photograph of this report is of a Vancouver Island Shieldback on the road. The park is accessible 24 hours/day and vehicular traffic is highest during the summer months, particularly from late afternoon to dusk. Roadside expansion is unlikely as much of this infrastructure has been in place for decades.

IUCN-CMP Threat 7. Natural system modifications (Medium-Low threat impact)

7.1 Fire & fire suppression (Medium – low threat impact)

Historically, low intensity, frequent fires played an important role in the maintenance of Garry Oak and associated ecosystems (Daubenmire 1968; Agee 1993; McPherson 1997 cited in Fuchs *et al.* 2000). Prior to European contact, fires originated with lightning and Indigenous cultural burning (see Fuchs 2001 for a literature review). As Garry Oak and associated ecosystem habitats are extremely dry during the summer months, previously fire would have been one of the primary disturbance factors that maintained open habitat. Given the dry, shallow soils, fire suppression is unlikely to increase the growth of woody plants but could contribute to the build-up of fuel.

On Mount Tolmie, the largest fire was on the west side of the park where most of the Vancouver Island Shieldback records are from (Miskelly pers. comm. 2021). Today, accidental fires (e.g., a discarded cigarette caused a small grass fire in 2016) may occur on Mount Tolmie but are suppressed rapidly due to the proximity of houses. Any Vancouver Island Shieldback eggs may be offered protection from fire as they are in the soil and deposited by the long ovipositor of the female; however, any nymphs and adults in the vegetation would not be protected (Miskelly pers. comm. 2021).

7.3 Other ecosystem modifications (Low threat impact)

Non-native plants are present throughout much of Mount Tolmie Park. Scotch Broom (*Cytisus scoparius*), Spurge Laurel (*Daphne laureola*), English Ivy (*Hedera helix*), and Himalayan Blackberry have all been managed for removal from the park since 1994 (District of Saanich 2020). Scotch Broom is associated with suppressed native species richness (Rook *et al.* 2011), grows quickly, and can increase nitrogen in low fertility, sandy soils (Parker 2002; Haubensak and Parker 2004). This then changes the ability for native plants to grow and thrive. Numerous introduced grasses are present throughout the park (e.g., Sweet Vernal Grass (*Anthoxanthum odoratum*), Hedgehog Dogtail (*Cynosurus echinatus*), Orchard Grass (*Dactylis glomerata*), and Common Velvet Grass (*Holcus lanatus*)).

Ongoing fire suppression programs increase the rate of natural succession within suitable habitats (McCoy 2006). However, Mount Tolmie Park has extensive bedrock patches and the growth of conifers such as Douglas-fir and pines (*Pinus* spp.) is not extensive nor fast partially due to the shallow soils and drought conditions. The impacts of fire suppression at this site are not likely to increase the growth of plants as fast as other sites with deeper and wetter soils. Fire suppression will contribute to the build-up of dry vegetative debris and fuel load, leading to potentially more intensive fire (see 7.1).

IUCN-CMP Threat 9. Pollution (Threat impact unknown)

9.6. Excess energy (Unknown threat impact)

Noise pollution (9.6.3) is categorized here. Mount Tolmie Park is surrounded by urban housing, and busy roads (see GoogleEarth® imagery in Figure 3). There is constant traffic. Mount Tolmie is of higher elevation than the surrounding houses and roadway traffic and is open habitat. Therefore, noise from lawn mowers, leaf blowers, radio, and television is heard throughout the park.

How anthropogenic noise impacts acoustic guilds is complex. Shieldbacks use specific frequency ranges for conspecific communication. Sounds outside of those specific frequency ranges are usually not detected. This is an adaptation to be able to detect and respond to conspecific sounds in noisy environments. The calling frequency range of Vancouver Island Shieldback is unknown, and without this information it is not possible to say whether anthropogenic noise is a threat. It is unknown whether Vancouver Island Shieldback can adjust calling activity in response to noise pollution.

IUCN-CMP Threat 10. Geological events (Threat impact unknown)

10.2 Earthquakes and tsunamis (Unknown threat impact)

There are two reservoirs on Mount Tolmie: one maintained by the District of Saanich and another on the southeast side maintained by the Capital Regional District. The Tolmie Reservoir (maintained by the District of Saanich) could burst during an earthquake, and flow over Vancouver Island Shieldback habitat. The Tolmie Reservoir had a seismic upgrade (i.e., to make the reservoir structure more resistant to seismic activities) in 1998/1999 by the District of Saanich (Riccius pers. comm. 2020).

IUCN-CMP Threat 11. Climate change & severe weather (Threat impact unknown)

11.2 Droughts (Unknown threat impact)

Increased summer droughts are expected for southern Vancouver Island (Mote and Salathe 2010). Conversely, an increase in winter precipitation is projected for coastal areas such as east Vancouver Island. A recent global analysis from 1925 to 1999 showed that precipitation increased by 6.2 mm per decade in the latitude band of 50° - 70°N, which includes almost all BC (Zhang *et al.* 2007). How increased winter precipitation and summer drought will influence prey and habitat structure is not clear.

11.3 Temperature extremes (Unknown threat impact)

There is potential for behavioural responses by katydids due to increasing temperature from climate change. Results of a study on four katydid species (one in subfamily Tettigoniinae) showed statistically significant effect on interbuzz interval duration, pulse rate, and buzz duration for all species (Cusano *et al*. 2016). How such temperature changes will influence mating behaviour and reproduction is unknown. Temperature extremes may also impact adult activity patterns and/or direct mortality.

Limiting Factors

Limiting factors are generally not human-induced and include characteristics that make the species more vulnerable to ongoing threats. The main limiting factors for Vancouver Island Shieldback are likely a combination of the following.

Small population size

Vancouver Island Shieldback occurs in Canada at one site in a small, isolated, and limited habitat patch surrounded by urban development.

Vulnerability to weather patterns

Humidity and extreme winter temperatures affect egg survival. Shieldback growth and development depends on the ambient temperature, and how temperature interacts with precipitation.

Flightless

Both the males and females have short tegmina (forewings) and do not fly. Because they are flightless, they have limited capacity to avoid predators and disperse. Vancouver Island Shieldbacks are cryptic.

Number of Locations

There is one location for Vancouver Island Shieldback based on the threat of predation by non-native European Wall Lizards and domestic cats. A single threatening event could affect all Vancouver Island Shieldback individuals in Canada (see **Threats**).

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Vancouver Island Shieldback has not been listed or protected under provincial or federal legislation. The species is not known from provincial or federal parks or protected areas, although there are numerous parks with habitats that potentially could support a subpopulation.

Municipal protection

Mount Tolmie Park is zoned as a Natural Park (P-4N) by the District of Saanich. This designation functions to preserve and enhance the natural, historic or landscape features, and the park is to be used primarily for informal or passive recreation purposes (District of Saanich 2003). There is currently no direct protection for species at risk in this park (but see **Habitat Protection and Ownership**).

Non-Legal Status and Ranks

- Global Status: GNR (Not Yet Ranked) (NatureServe 2020). Canada National Status Rank: N1 (12 June 2017) (NatureServe 2020) (as Noisy Shieldback).

- BC Subnational Rank: S1 (BC CDC 2020; Gelling pers. comm. 2022) (as Noisy Shieldback).

- International Union for Conservation of Nature (IUCN) Red list Category: Not assessed.

Habitat Protection and Ownership

The known occurrence of Vancouver Island Shieldback is within Mount Tolmie Park, a municipal park owned and managed by the District of Saanich. Park operators and managers are aware of habitat needs, threats, and conservation status and include the species in their planning initiatives for the park (Burger pers. comm. 2020; D. Copley pers. comm. 2020; Pollard pers. comm. 2020).

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The cover photograph of Vancouver Island Shieldback is from Mount Tolmie (District of Saanich) Park, on September 8, 2004, by James Miskelly (photograph on iNaturalist and listed in Table 1).

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ONLINE DATA SOURCES AND COLLECTIONS EXAMINED

- University of Calgary, Insects & Invertebrate Zoology Museum, Department of Biological Sciences, Calgary, Alberta (no specimens, John Swann 2020)
- Northern Forestry Centre, Natural Resources Canada, Edmonton, Alberta (no specimens, Greg Pohl 2020)
- Strickland Entomological Museum, Department of Biology, University of Alberta, Edmonton, Alberta (no specimens, Danny Shpeley 2020)
- Invertebrate Zoology, Royal Alberta Museum, Edmonton, Alberta (no specimens, Matthias Buck 2019)
- Pacific Forestry Centre, Natural Resources Canada, Victoria, British Columbia (no specimens, Meghan Noseworthy 2020)
- Royal BC Museum, Victoria, British Columbia (see Table 1, Claudia Copley 2020)
- Spencer Entomological Collection, Beaty Biodiversity Museum, University of British Columbia, Vancouver, British Columbia (see Table 1, Karen Needham 2020)
- Manitoba Museum of Man and Nature, Winnipeg, Manitoba (no specimens, Randall Mooi 2020)
- Wallis Roughley Museum of Entomology, Department of Entomology, University of Manitoba, Winnipeg, Manitoba (no specimens, Jason Gibbs 2020)
- Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, Ottawa, Ontario (no specimens, online database 2020)
- Department of Environmental Biology, University of Guelph, Guelph, Ontario (no specimens, Steve Marshall 2020)
- Canadian Museum of Nature, The Natural Heritage Campus, Gatineau, Quebec (no specimens, Robert Anderson 2020)

- Royal Ontario Museum, Toronto, Ontario (no specimens, Doug Currie 2020)
- Royal Saskatchewan Museum, Regina, Saskatchewan (no specimens, Cory S. Sheffield 2020)
- iNaturalist® (see Table 1)
- BugGuide® (no observations)