COSEWIC
Assessment and Status Report

on the

Warty Jumping-slug
Hemphillia glandulosa

in Canada

SPECIAL CONCERN
2003

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:

COSEWIC 2003. COSEWIC assessment and status report on the warty jumping-slug *Hemphillia glandulosa* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 19 pp.

Production note: COSEWIC would like to acknowledge Robert G. Forsyth and Kristina E. Ovaska for writing the status report on the warty jumping slug *Hemphillia glandulosa*, prepared under the contract with Environment Canada.

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Également disponible en français sous le titre Rapport du COSEPAC sur la situation de la Limace-sauteuse glanduleuse (*Hemphillia glandulosa*) au Canada

Cover illustration:
Warty jumping-slug — Photograph supplied by Kristina Ovaska.

Catalogue CW69-14/318-2003E-PDF
ISBN 0-662-34887-7
HTML: CW69-14/318-2003E-HTML
0-662-34888-5


Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – May 2003

Common name
Warty jumping-slug

Scientific name
Hemphillia glandulosa

Status
Special Concern

Reason for designation
Habitat loss and fragmentation through clear-cut logging forest practices are altering quantity and quality of coarse woody debris that provides refuges for the slugs and may be restricting dispersal movements. The species exists at the northern extremity of its range on southern Vancouver Island and the low numbers of scattered populations render it vulnerable to both natural and human disturbances.

Occurrence
British Columbia

Status history
Designated Special Concern in May 2003. Assessment based on a new status report.

COSEWIC
Executive Summary

Warty Jumping-slug
Hemphillia glandulosa

Species information

The warty jumping-slug, *Hemphillia glandulosa* Bland & W.G. Binney, 1875, is one of seven described species of jumping-slugs. The genus, a member of the gastropod family Arionidae, is endemic to western North America. There are no recognized subspecies of the warty jumping-slug; *H. burringtoni* Pilsbry, 1948, originally described as a subspecies of *H. glandulosa*, is now regarded as a separate species. The warty jumping-slug is a small species with length of adults usually about 20 mm. There is a prominent dorsal hump (containing the viscera) that is covered by the mantle, and a flattened shell that is visible through a slit in the mantle. The body is depressed below the dorsal hump, and raised into a high dorsal keel on the tail; the end of the tail has a caudal mucus pore, which is overhung by a fleshy protuberance, often called the caudal “horn.”

Distribution

The known range of the warty jumping-slug is from central Vancouver Island, British Columbia, through Washington to west-central Oregon; the species is absent east of the Cascade Ranges in Washington and Oregon. In Canada, the species is known from 14 localities from southern Vancouver Island, south of Nanaimo. There are no known records from the British Columbia mainland.

Habitat

This species occupies a variety of moist, forested habitats and riparian sites from low to middle elevations. The presence of adequate shelter is important. Suitable cover includes decaying logs, other woody debris, and leaf litter; the slugs also occur around the bases of sword ferns. The species occupies forests of different ages, from old growth to younger seral stages. It has been reported in Washington from stands <15 years old, although it appears to be more common in stands >35 years old.

Biology

The species is hermaphroditic and lays eggs. On Vancouver Island, mating has been observed in the autumn. Eggs are relatively large and deposited in small clusters

of 1 to 6 eggs over several months. The slugs mature within their first year and probably seldom live >1 year. All species of *Hemphillia*, including the warty jumping-slug, show a "jumping" behaviour that is unique among North American slugs. Followed by fleeing, this behaviour is thought to be a defensive mechanism against predation.

Population sizes and trends

In Canada, the warty jumping-slug appears to occur at low densities, but pockets of higher abundance occur at the most favourable sites. The first two accounts of the species in Canada (1900 and 1914) implied that it was apparently uncommon at that time. Nothing further is known of population trends in Canada, and surveys near historic localities on the eastern coast of Vancouver Island are needed.

Limiting factors and threats

Habitat loss and fragmentation through logging are probably the greatest threats to Canadian populations. Clear-cut logging in particular can restrict dispersal movements and gene-flow. Forest practices can also alter the quantity and quality of coarse woody debris, which provides refuges for the slugs. The warty jumping-slug exists at the northern extremity of the species range on Vancouver Island, and the low number of scattered populations renders it vulnerable to both natural and human disturbances.

Special significance of the species

The warty jumping-slug provides an important contribution to the biodiversity of west coast forests. At present, we do not know the degree of genetic differentiation of Canadian populations with respect to those in the United States. A molecular study of *H. glandulosa* is currently in progress in Washington State, but no specimens of British Columbia have been examined. A need exists to examine the taxonomic status of British Columbia populations. Because of their distinct appearance and remarkable escape behaviour, jumping-slugs might be useful as flagship species for promoting awareness and conservation of forest floor invertebrates and their habitats.

Existing protection or other status designations

There is no protection to the warty jumping-slug or other invertebrates offered by the British Columbia Wildlife Act; it is not listed by the IUCN, nor is it considered under the U.S. Endangered Species Act. The U.S. Bureau of Land Management's Northwest Forest Plan, which covers the management of mature and old-growth forest on federal lands from Washington to northern California, treats the warty jumping-slug as a "survey and manage" species and considers it to be at risk from forest harvesting activities. The species is given the global heritage status rank of G2 and, in Oregon, the state heritage status rank of S1. In Canada, only 3 or 4 of the 14 known localities for this species are within protected areas. The remaining localities are on lands subject to industrial forestry and/or private lands.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* 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.

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.

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SPECIES INFORMATION

Name and classification

The genus *Hemphillia* is a small group of slugs endemic to western North America from British Columbia south to Oregon and east to Alberta and Montana (Pilsbry 1948; La Rocque 1953). The currently accepted classification places *Hemphillia* within the subfamily Binneyinae in the otherwise largely Palearctic family Arionidae (Mollusca: Gastropoda: Pulmonata: Stylommatophora: Arionoidea: Arionidae: Binneyinae) (Pilsbry 1948).

Hemphillia glandulosa was the first of seven species of *Hemphillia* recognized, and there are no primary synonyms. *H. burringtoni* Pilsbry, 1948, originally described as a subspecies, is now regarded as a full species (Branson 1972, 1975; Turgeon *et al.* 1998). The genus is named after Henry Hemphill (1830–1914), an early and influential malacologist who collected extensively throughout the western United States (Coan and Roth 1987). The species epithet, *glandulosa*, refers to the "warts" or papillae on the visceral pouch.

Description

The genus *Hemphillia* is unique among Canadian slugs in having a distinct dorsal (visceral) hump that is covered by the mantle; the shell, a flattened plate, is visible through a slit in the mantle. The tip of the tail has a caudal mucus pore, which in some species is overhung by a fleshy protuberance, often called the caudal "horn."

Hemphillia glandulosa is one of the smaller species within the genus, with adults typically ca. 20 mm (Fig. 1). The body is depressed under the visceral hump, and behind this, the tail is raised into a prominent dorsal keel. The key feature for distinguishing slugs of this species is the presence of numerous, dense papillae that cover the mantle. The body is whitish or grey with darker markings; the tentacles and head are dark bluish; the flanks are lighter coloured. Anatomically, the inner wall of the penial stimulator is wrinkled (Pilsbry 1948; Branson 1972, 1975; Burke *et al.* 1999).

Figure 1. Warty Jumping-slug, *Hemphillia glandulosa*, from Vancouver Island. The length of the slug extended is about 20 mm. Photograph by K. Ovaska.

Hemphillia glandulosa is most similar to *H. burringtoni* Pilsbry, 1948. In the latter species, however, the mantle lacks the dense, numerous papillae, and the interior of the penial stimulator is smooth (Pilsbry 1948; Branson 1975). *H. pantherina* Branson, 1975, is also similar, and in *H. pantherina* the mantle does not cover the posterior one-third of the visceral pouch, the caudal "horn" is relatively larger, the mantle is heavily granular but not papillose, and the head and tentacles are white dorsally (Branson 1975). *Hemphillia dromedarius* and *H. camelus*—which also occur in Canada—differ externally from *H. glandulosa* by having a mantle that is not papillose, a body that is not depressed to receive the visceral pouch, and by their much larger size (Pilsbry 1948; Branson 1972, 1975).

DISTRIBUTION

Global range

The range of *H. glandulosa* is from central Vancouver Island, British Columbia through Washington to Multnomah and Clatsop Counties, northwestern Oregon (Fig. 2). It is absent east of the Cascade Ranges in Washington and Oregon (Pilsbry 1948; Burke *et al.* 1999). In Washington, it is known from King, Pierce, Thurston, Lewis, Skamania, Clallam, Grays Harbor, Pacific and possibly Whatcom counties (Burke *et al.* 1999). It does not occur on the east side of the Cascade Range (Branson 1972; Burke *et al.* 1999). Branson (1977, 1980) and Branson & Branson (1984) did not find it in their surveys of the Cascade and Olympic ranges. Astoria, Clatsop County, Oregon is the type locality.

Canadian range

In Canada, *H. glandulosa* is known from the southern portion of Vancouver Island; there are no records north of the Nanaimo River or from the mainland (Pilsbry 1948; Ovaska *et al.* 2001). As of February 2002, there are 14 known localities for *H. glandulosa* in Canada (Fig. 3). Pilsbry (1948) cited two earlier literature records: circa 3 miles [4.8 km] up Nanaimo River (Taylor 1900; repeated by Hanham 1926); and on the "Corvichan River" [=Cowichan River] (Hanham 1914, 1926). Taylor's record is of interest since it is the most northern locality known for the species. Cameron (1986) found this species in 1984 at three of 38 localities surveyed, on the road to Bamfield (his localities numbered 31–33). The remaining nine localities are all recent and discovered since 1999 (unpublished records, Royal British Columbia Museum; Staatliches Museum für Naturkunde Görlitz, Germany; and Ovaska *et al.* 2001). With the exception of the Royal British Columbia Museum and Staatliches Museum für Naturkunde Görlitz, no other museums reported collections of this species from Canada (see "Collections Examined").

Figure 2. North American distribution of *Hemphillia glandulosa*.

Previous surveys for terrestrial gastropods within potential habitats for the species include those of Cameron (1986), who surveyed 38 forested localities on Vancouver Island and in the Lower Fraser Valley. He found *Hemphillia glandulosa* at three sites. Since 1990, one of us (R. Forsyth) has searched for terrestrial gastropods throughout much of British Columbia, including the southwest coast, without locating this species (about 450 localities searched on the Lower Fraser Valley and southern Vancouver Island). These sites covered various habitats, including disturbed urban localities and forested sites. Most sites were visited once, and the (unrecorded) search effort was variable. Other recent surveys for terrestrial gastropods in the province include surveys by Ovaska *et al*. (2001) and Ovaska and Sopuck 2000, 2001, 2002a,b, 2003). During two field seasons, Ovaska *et al*. (2001) surveyed 142 forested localities (104 sites on Vancouver Island and 38 in the Lower Fraser Valley) for terrestrial gastropods deemed to be at risk; the search effort was 196.6 person-hours and most sites were visited only once. *H. glandulosa* was detected at 8 sites on Vancouver Island. Ovaska and Sopuck (2000, 2001, 2002a, 2003) surveyed 23 additional sites (22 on Vancouver Island; 1 near Powell River on the coastal mainland) for

terrestrial gastropods as a part of a study on the effects of logging on forest floor fauna. Several of these sites were surveyed intensively over multiple years. They located *H. glandulosa* at two sites. Ovaska and Sopuck (2002b) conducted surveys for terrestrial gastropods with emphasis on species at risk on three Department of National Defence properties near Victoria, Vancouver Island. They searched 56 transects (100 m long and 1 m wide) for a total of 71.6 person-hours. No jumping-slugs were found.

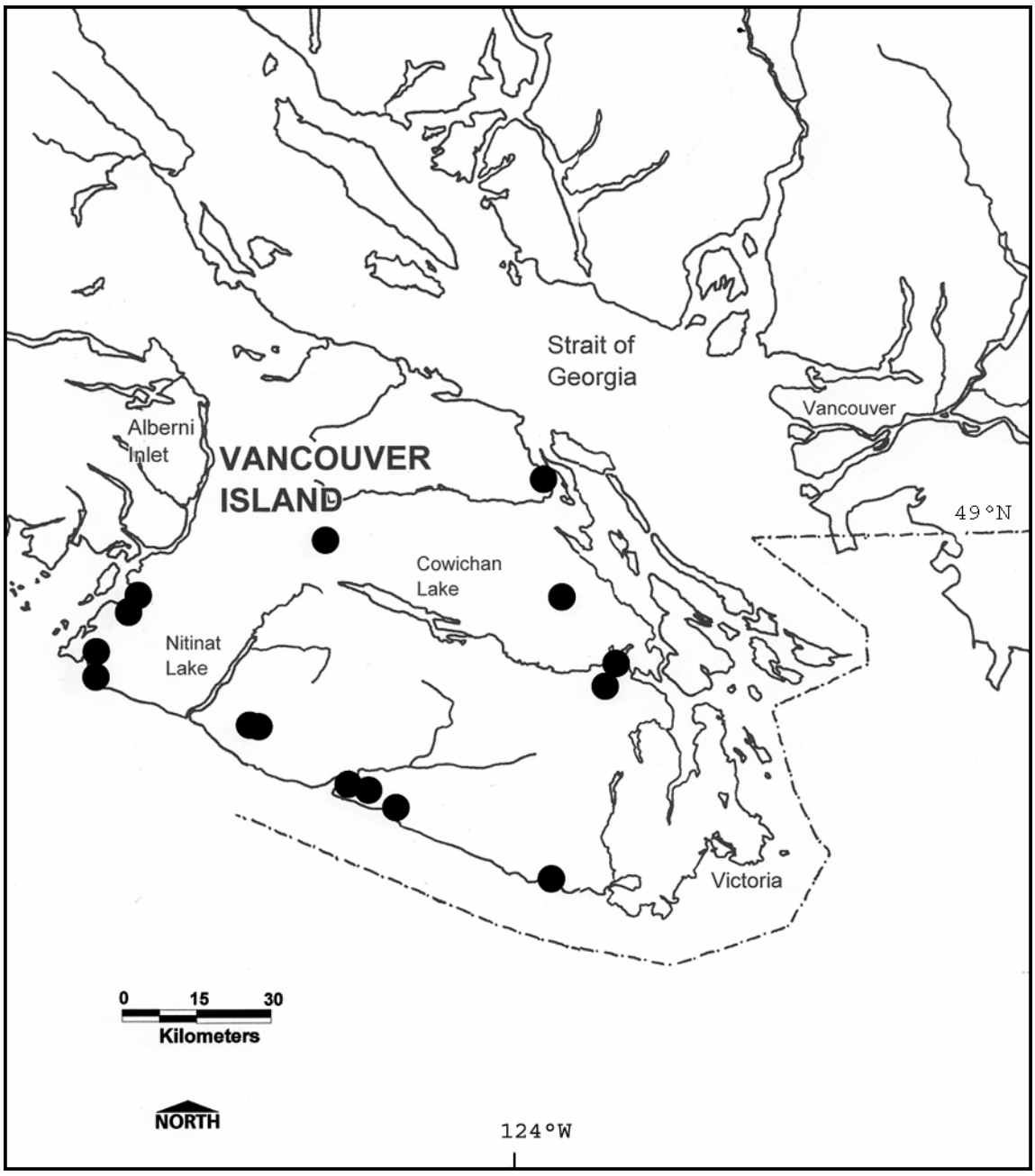

Figure 3. Canadian distribution of *Hemphillia glandulosa*.

Early accounts by Hanham (1914) and Taylor (1900), recent surveys in B.C. (see above), and knowledge of this species in Washington State (Kelley *et al.* 1999) suggest that *H. glandulosa* has a spotty distribution pattern. It does not appear to be widespread on southern Vancouver Island, but much of the area is still under-investigated for terrestrial mollusks. To our knowledge, the species has not been recently found in the Nanaimo River watershed, and further surveys in this area would be desirable.

The extent of the known occurrence of *H. glandulosa* in Canada is ca. 4,700 km^2. An estimation of the area of occupancy was not made for the following reasons: 1) the species does not occupy all available and apparently suitable habitat; 2) it is not limited to one habitat type but moist conditions appear to be the deciding factor; and 3) subpopulations are very small and isolated. On the west coast of the island (ca. 120 km stretch northwest from north of Sooke to Port Renfrew), the species occurs at several localities and may be more widespread. Localities on the east coast and in the interior of the island, however, appear to be isolated.

HABITAT

Habitat Requirements

This species occupies moist forested habitats and riparian sites from low to middle elevations (Frest & Johannes 1993; Ovaska *et al.* 2001). The elevational range of the known localities in British Columbia is from near sea level to 1060 m (Ovaska *et al.* 2001). Although it occurs in old-growth forest, it is not restricted to these habitats and occupies younger forests as well. In the Olympic National Forest, Washington, where surveys have been conducted since autumn 1998, the species occupies a variety of habitats and forest age classes (Ziegltrum 2001). Most known localities are from stands between 35 and 80 years old, but the species also occurs in young (11–15 year old) plantations. Moist conditions, rather than forest age, appear to be a deciding factor for its occurrence at a site. In British Columbia, *H. glandulosa* is known from marginally disturbed localities (Port Renfrew; Muir Creek), as well as from old-growth forest (Carmanah Valley).

The slugs live around logs and woody debris, on and in leaf litter, and under sword ferns (*Polystichum munitum*) (Taylor 1900; Hanham 1914; Frest & Johannes 1993; Ovaska *et al.* 2001). They are often associated with coarse woody debris, the presence of which appears to be very important.

Trends

Forest habitats on Vancouver Island have undergone extensive loss and fragmentation since European colonization. At that time about 70% of the land-base of the island was covered by old-growth forest. Much of the land base within the range of *H. glandulosa* is now industrial forestland. According to maps compiled by the Sierra Club (2002), 21% of the forests were logged by 1954, 45% by 1972, and 71% by 1999. Forestry

was initially confined to the southern and eastern portions of the island but has since spread northward and westward. Further encroachment into intact forests, such as remaining old growth at higher elevations, is likely to continue in the future, due to economic pressures.

Protection/ownership

Most of the known localities for *H. glandulosa* are privately owned or within industrial forestry lands. The largest parks within or adjacent to the range of *H. glandulosa* are the Pacific Rim National Park Reserve (49,962 ha), Carmanah-Walbran Provincial Park (16,450 ha) and Juan de Fuca Provincial Park (1,277 ha — Parks Canada 2002; B.C. Parks 2002). The Carmanah-Walbran Provincial Park contains the only significant continuous stretches of old-growth forest present on southern Vancouver Island.

Only two of the 14 localities for this species in British Columbia are within a protected area (Carmanah-Walbran Provincial Park). The species occurs in several localities immediately adjacent to the Juan de Fuca Provincial Park and most likely is present there.

The management of federal lands in the province is governed by the Forest Practices Code of British Columbia. This code and associated Biodiversity Guidebook make provisions for connectivity of habitats, old-growth retention, and seral stage distribution within logged landscapes. However, the measures outlined in the Biodiversity Guidebook are recommendations only, and their implementation is uncertain. Forest companies own much of the forested land-base on southern Vancouver Island, and the Forest Practices Code does not apply to privately owned lands.

BIOLOGY

General

Hemphillia glandulosa is hermaphroditic and lays eggs. On Vancouver Island copulating pairs have been observed in the autumn. Eggs are relatively large and deposited in small clusters over several months. The slugs mature within their first year and probably seldom live >1 year. Movements and home ranges are undocumented. The predators of *H. glandulosa* are unknown (Burke *et al.* 1999) but likely include those of other terrestrial slugs (carabid beetles; carnivorous snails—*Ancotrema* spp. and *Haplotrema vancouverense*). All species of *Hemphillia*, including *H. glandulosa*, show a “jumping” behaviour that is unique among North American slugs. Followed by fleeing, this behaviour is thought to be a defensive mechanism against predation.

Reproduction

Hemphillia glandulosa is a simultaneous hermaphrodite and oviparous. Several pairs of slugs were observed copulating on Vancouver Island during the autumn of 2001 (Reise, pers. comm.; Ovaska *et al.* 2001). In captivity, the slugs deposited small clusters

of eggs (1–6 eggs) repeatedly from October to December; the total number of eggs deposited by six individuals was 11–37 (KO, unpublished data). The eggs were tear-shaped, transparent, and about 3 mm long and 2 mm wide. Hatching at ambient temperatures of 9–15°C took about 3 months and was staggered over a period of several days. This strategy (deposition of many small clutches over an extended period) may be an adaptation to ensure that at least some eggs survive to hatching under unpredictable conditions. Alternatively, it may reflect constraints associated with a small body size. Under natural conditions, eggs may be deposited in the autumn and hatch the following spring. Suitable oviposition sites probably include leaf litter, decaying logs and other woody debris. These slugs are likely short-lived, and perhaps only a few individuals survive to their second year.

In most terrestrial gastropods, cross-fertilization appears to be the norm, but self-fertilization can occur in at least some species—including arionids—in the absence of potential mates (Runham & Hunter 1970; Duncan 1975). There is, however, no evidence of self-fertilization in *H. glandulosa*.

Movements/dispersal

Movements and home range of *H. glandulosa* are unstudied. These slugs are probably relatively sedentary and have poor dispersal abilities, as evidenced by the species' scattered distribution throughout its range. Small pockets of greater density and the presence of suitable but unoccupied habitat further suggest this possibility.

POPULATION SIZES AND TRENDS

Burke *et al.* (1999) stated that this species is not abundant. Branson (1977, 1980; Branson & Branson 1984) and Frest & Johannes (1993) did not record it at any of their sites in Washington and Oregon. Burke *et al.* (1999) implied that the species occurs at low densities, based on the capture of only 1–2 individuals per site. However, recent, extensive surveys in the Olympic National Forest suggest that the species might be more widespread and abundant than previously thought, at least over parts of its range; 541 new localities were found within this area from autumn 1998 to 2001 (J. Ziegltrum, pers. comm.).

On Vancouver Island the species appears to occur at low densities, but larger numbers of slugs are sometimes present in suitable moist habitats, if only in small pockets. Casual remarks by both Taylor (1900) and Hanham (1914) imply that *H. glandulosa* was not common in B.C., suggesting its apparent rarity at that time.

On Vancouver Island, individuals of two mountain populations (Mt. Brenton and Mt. Hooper) reached an usually large size in captivity (up to 42 mm, about twice the size of typical adults) within a few months (KO, unpublished data). The offspring of these individuals were also very large when compared to those of *H. glandulosa* from Washington, which were reared under the same conditions. Anatomical and molecular

studies are required to establish whether *H. glandulosa* from these localities represent separate populations from those on the west coast of Vancouver Island, where their distribution is more continuous, and from populations in Washington.

LIMITING FACTORS AND THREATS

For Washington and Oregon populations Frest & Johannes (1995) suggested that habitat loss due to urbanization and logging are threats to the continued existence of *H. glandulosa*. In Canada, urbanization probably is not at this time a threat, but this species might be adversely affected by logging through loss and fragmentation of habitats. Limited ability to colonize new habitat patches and restricted gene flow may result in changes to metapopulation dynamics and possibly to survival of populations. The minimum size of habitat patches that can support viable populations of *H. glandulosa* is unknown. At one Vancouver Island site (Port Renfrew), the slugs occupy a very small (ca. 10 m wide) habitat patch that is at least partially isolated by roadways on two sides and cleared residential property on another. The size of other occupied habitat patches within forests cannot be determined without additional surveys.

Although not restricted to older forests, the species could be adversely affected by logging if subpopulations become isolated before sufficient regeneration occurs to permit dispersal. In addition, the survival of populations is dependent on the presence of suitable cover for refuges, such as provided by decaying coarse woody debris. Forestry practices alter the amount and type of cover remaining on the forest floor, and if such cover is retained in inadequate quantities, distribution of decay classes or sizes of individual pieces, *H. glandulosa* could be adversely affected. The Canadian localities of *H. glandulosa* form the northern limit of the geographic distribution of this species; species near the limits of their distribution may be particularly vulnerable to climatic fluctuations and stochastic events, such as droughts or wildfires.

In addition to isolating populations, habitat fragmentation is expected to render these slugs more vulnerable to natural predators, such as carnivorous snails (*Haplotrema* and *Ancotrema* spp.) and carabid beetles. Native slugs may also be adversely affected by competition with introduced gastropods, which were found with *H. glandulosa* at three localities (Port Renfrew; Muir Creek; Keating Lake).

SPECIAL SIGNIFICANCE OF THE SPECIES

The presence of *H. glandulosa* is important to the biodiversity of the forest floor fauna. *Hemphillia glandulosa* occurs in moist forests from southern Vancouver Island, British Columbia, to northern Oregon and is not endemic to Canada. However, populations of species at the northern limits of their geographical range may possess unique adaptations (Scudder 1989) and thus be of scientific and conservation interest. Furthermore, we do not know the degree of genetic differentiation of Canadian

populations with respect to those in the United States; to date, there have been no anatomical or molecular comparisons of Canadian animals with southern examples. Genetic studies of *H. glandulosa* in Washington are presently in progress, but no specimens from British Columbia have been examined (J. Ziegltrum, pers, comm.).

There is no special status afforded to any other species of *Hemphillia* in Canada, but a COSEWIC status report on the Dromedary Jumping-slug, *H. dromedarius* Branson, 1972, is in preparation and recognizes the similarly restricted range and rarity of that species in Canada.

The species is relatively unknown to the general public, although accounts of jumping-slugs have appeared in some popular literature because of their distinctive appearance and behaviour; thus, jumping-slugs, including *H. glandulosa*, might be useful as flagship species for promoting awareness and conservation of forest floor invertebrates and their habitats. We were unable to find any evidence of Aboriginal traditional knowledge of *H. glandulosa* (N. Turner, pers. comm.).

EXISTING PROTECTION OR OTHER STATUS

The British Columbia Wildlife Act, which prohibits the collection, handling, and trade of all native wildlife species without a permit does not apply to invertebrates at present. Therefore, *H. glandulosa* and other native terrestrial gastropods in the province have no legal protection. Assessments for terrestrial gastropods have yet to be conducted for the British Columbia red and blue lists (S. Canning, pers. comm.).

Hemphillia glandulosa has the global heritage status rank of G2 (NatureServe Explorer 2001). In the United States, *H. glandulosa* is on the list of “survey and manage” species under the Bureau of Land Management’s Northwest Forest Plan; the plan covers the management of mature and old growth forest on federal lands from Washington to northern California (Burke *et al.* 1999; Kelley *et al.* 1999). This species is not listed by the IUCN (Hilton-Taylor 2000), nor considered under the U.S. Endangered Species Act (US Fish and Wildlife Service 2001). Frest & Johannes (1995) recommended that the species be listed as ‘threatened’ federally and in Washington, and ‘endangered’ in Oregon; the state rank for Oregon is S1 (NatureServe Explorer 2001)

SUMMARY OF STATUS REPORT

The warty jumping-slug, *Hemphillia glandulosa* Bland & W.G. Binney, 1875, is one of seven known species of jumping-slugs endemic to the area from southern British Columbia and Alberta south to Oregon. In Canada, this species is known only from the southern portion of Vancouver Island (south of Nanaimo), and records exist from 14 localities. It lives in moist forests and riparian sites from low to middle elevations. Not all apparently suitable habitat is utilized, and the species exhibits a patchy distribution

pattern. Much of the land base within its Canadian range is industrial forestland with minimal protection. Restricted geographic range in Canada, patchy distribution, and reliance on moist forest habitats with suitable cover render the species vulnerable to stochastic events and human activities, particularly logging. The ability of the species to persist in small habitat patches and to occupy second growth forest are ameliorating factors.

TECHNICAL SUMMARY

***Hemphillia glandulosa* Bland & W.G. Binney, 1875**
Warty Jumping-slug Limace sauteuse glanduleuse
British Columbia (southern Vancouver Island)

Extent and Area information	
• *extent of occurrence (EO)(km²)*	4700
• *specify trend (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	unknown
• *area of occupancy (AO) (km²)*	unknown (see text)
• *specify trend (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	unknown
• *number of extant locations*	
• *specify trend in # locations (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	unknown
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	declining (area)
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	1 yr?
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	unknown
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	unknown
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	unknown
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	probably
• *list each population and the number of mature individuals in each*	Southern Vancouver Island; number of individuals unknown
• *specify trend in number of populations (decline, stable, increasing, unknown)*	unknown
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	unknown
Threats (actual or imminent threats to populations or habitats)	
- habitat loss through forest harvesting activities	
Rescue Effect (immigration from an outside source)	
• *does species exist elsewhere (in Canada or outside)?*	Yes; in WA and OR (USA)
• *status of the outside population(s)?*	no special status
• *is immigration known or possible?*	not likely
• *would immigrants be adapted to survive here?*	yes
• *is there sufficient habitat for immigrants here?*	yes
Quantitative Analysis	

ACKNOWLEDGEMENTS

We thank Kelly Sendall (RBCM), Jean-Marc Gagnon (CMN), Jochen Gerber (FMNH), Tim Pearce (DMNH), Chad Walter (USNM) and Maureen Zubowski (ROM) for providing access to collection records and assisting in searches of databases for locality records. Joan Ziegltrum generously shared with us unpublished data on mollusk surveys within the Olympic National Forest. We also thank all people contacted and listed under “Authorities Consulted.” Lennart Sopuck prepared maps in Appendices.

Funding for this status report was provided by the Canadian Wildlife Service, Environment Canada.

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BIOGRAPHICAL SUMMARY OF CONTRATORS

Robert Forsyth is a dedicated amateur malacologist who since 1990 has traveled extensively throughout BC studying terrestrial molluscs. He is the author of ten refereed papers on British Columbia terrestrial molluscs and is currently completing an identification guide to the land snails and slugs of British Columbia (scheduled to be published by UBC Press/Royal British Columbia Museum in 2004). Mr. Forsyth is affiliated with the Royal British Columbia Museum as a volunteer and research associate doing fieldwork, identification and research. With Dr. Ovaska, he is also investigating the distribution of terrestrial gastropods deemed to be at risk in southwestern British Columbia (2000–2001; funded, in part, by the Endangered Species Recovery Fund). Mr. Forsyth is a member of COSEWIC's Mollusca Species Specialist Group.

Kristiina Ovaska, Ph.D., M.Sc., received her doctoral degree (biology) from the University of Victoria in 1987, after which she completed two post-doctoral studies in population biology and ecology of amphibians. Currently, she is senior ecologist with Biolinx Environmental Research Ltd. (Sidney, British Columbia) and research associate at the Department of Forest Sciences, University of British Columbia. Over the past 15 years, Dr. Ovaska has prepared several environmental impact assessments and status reports and conducted research on a variety of wildlife (vertebrates and invertebrates), including endangered species. She is the author of more than 30 publications in refereed scientific literature. Dr. Ovaska is a principal investigator of an ongoing project addressing the use terrestrial gastropods as indicators of forest-floor conditions in relation to different logging practices (project conducted for Weyerhaeuser Company Limited, 1999–2001). She is also a principal investigator of a study dealing with the distribution of terrestrial gastropods

deemed to be at risk in southwestern British Columbia (2000–2001; funded, in part, by the Endangered Species Recovery Fund).

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Turner, N.J. August 2001. Professor, Department of Environmental Studies, P.O. Box 1700, University of Victoria, Victoria, British Columbia, Canada V8W 2Y2.

Ziegltrum, J. November 2001, July 2002. Ecologist. Olympic National Forest, 1835 Black Lake Blvd. SW, Suite A, Olympia, Washington 98512-5623, U.S.A.

COLLECTIONS EXAMINED

Royal British Columbia Museum [RBCM], 675 Belleville Street, Victoria, BC, Canada V8V 1X4

Staatliches Museum für Naturkunde Görlitz [SMNG], PF 300154, D-2806 Görlitz, Germany

The following institutions reported that they have no holdings of *Hemphillia glandulosa* from Canada:

Canadian Museum of Nature [CMN], PO Box 3443, Stn. D, Ottawa, ON, Canada K1P 6P4

The Field Museum of Natural History [FMNH], 1400 S. Lake Shore Drive, Chicago, IL, USA 60605-2496

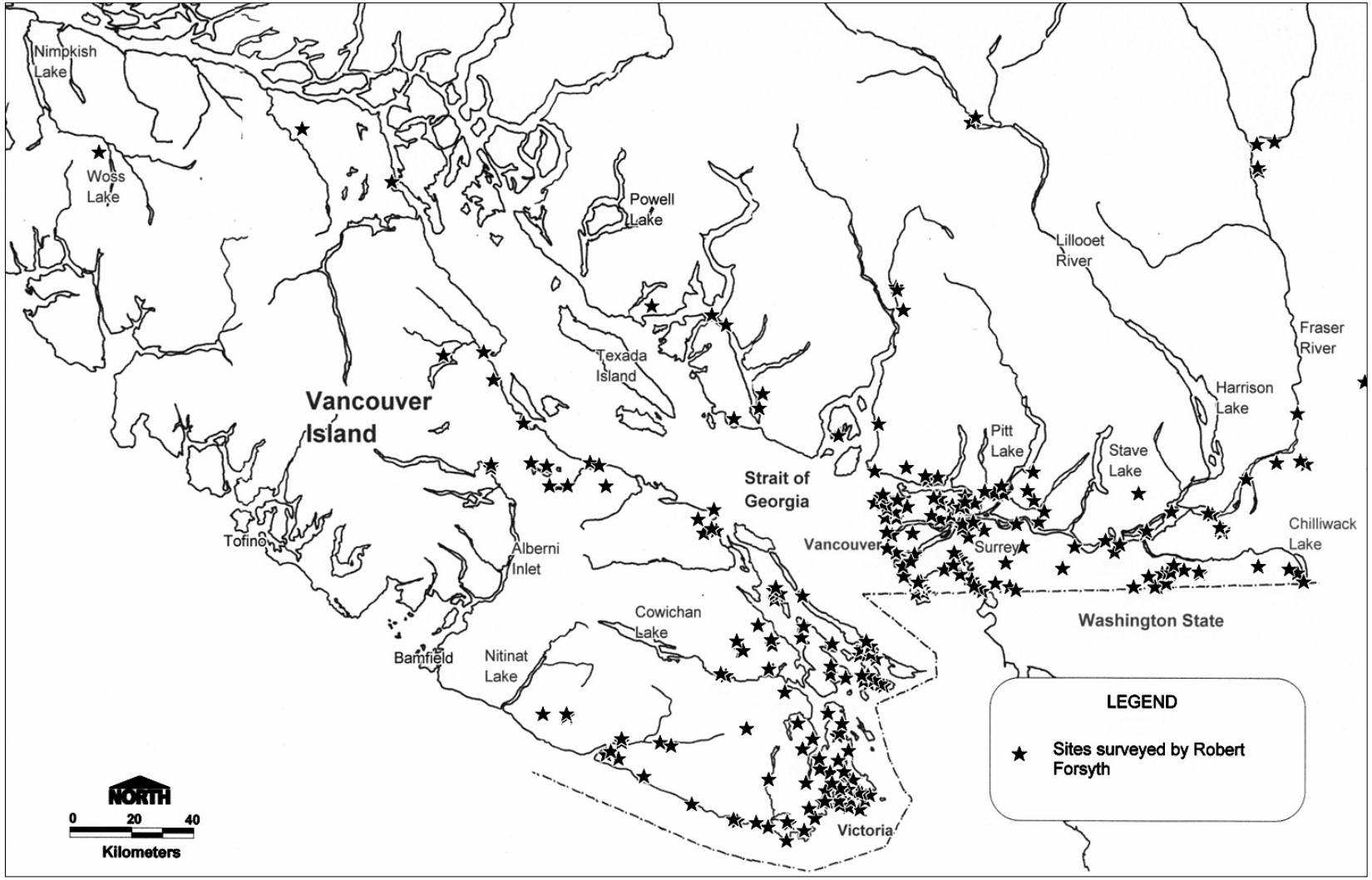
Delaware Museum of Natural History [DMNH], 4840 Kennett Pike, PO Box 3937, Wilmington, DE, USA 19807-0937

The Philadelphia Academy of Natural Sciences [ANSP], 1900 Benjamin Franklin Parkway, Philadelphia, PA, USA 19103

Royal Ontario Museum [ROM], 100 Queen's Park, Toronto, Ottawa, ON, Canada M5S 2G6

Smithsonian Institution [NMNH], Washington, DC, USA 20560-0163

Appendix 1. Localities surveyed for terrestrial gastropods in southwestern British Columbia by Robert Forsyth, 1990–2002.



Appendix 2. Localities surveyed for terrestrial gastropods in southwestern British Columbia by Ovaska *et al.* (2001) and Ovaska and Sopuck (2000, 2001, 2002a,b, 2003), 1999–2002.