

Recovery Strategy for the Proud Globelet (*Patera pennsylvanica*) in Canada

Proud Globelet



2023



Government
of Canada

Gouvernement
du Canada

Canada

Recommended citation:

Environment and Climate Change Canada. 2023. Recovery Strategy for the Proud Globelet (*Patera pennsylvanica*) in Canada. *Species at Risk Act Recovery Strategy Series*. Environment and Climate Change Canada, Ottawa. 3 parts, 16 pp. + vi + 32 pp. + 8 pp.

Official version

The official version of the recovery documents is the one published in PDF. All hyperlinks were valid as of date of publication.

Non-official version

The non-official version of the recovery documents is published in HTML format and all hyperlinks were valid as of date of publication.

For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](#)¹.

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Également disponible en français sous le titre
« Programme de rétablissement de la patère de Pennsylvanie (*Patera pennsylvanica*)
au Canada »

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ISBN 978-0-660-49961-1

Catalogue no. En3-4/366-2023E-PDF

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¹ www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

RECOVERY STRATEGY FOR THE PROUD GLOBELET (*Patera pennsylvanica*) IN CANADA

2023

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of Ontario has given permission to the Government of Canada to adopt the *Recovery Strategy for the Proud Globelet (Patera Pennsylvanica) in Ontario* (Part 2) and the *Proud Globelet – Ontario Government Response Statement*² (Part 3) under Section 44 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Proud Globelet in Canada consists of three parts:

Part 1 – Federal Addition to the *Recovery Strategy for the Proud Globelet (Patera pennsylvanica) in Ontario*, prepared by Environment and Climate Change Canada.

Part 2 – *Recovery Strategy for the Proud Globelet (Patera pennsylvanica) in Ontario*, prepared by S. Wyshynski and A. Nicolai for the Ministry of the Environment, Conservation and Parks.

Part 3 – *Proud Globelet – Ontario Government Response Statement*, prepared by the Ontario Ministry of the Environment, Conservation and Parks.

² The Government Response Statement is the Ontario Government's policy response to the recovery strategy and summarizes the prioritized actions that the Ontario Government intends to take and support to achieve Ontario's recovery goal.

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Part 2 – *Recovery Strategy for the Proud Globelet (Patera pennsylvanica) in Ontario*, prepared by S Wyshynski and A. Nicolai for the Ontario Ministry of the Environment, Conservation and Parks.

Part 3 – *Proud Globelet – Ontario Government Response Statement*, prepared by the Ontario Ministry of the Environment, Conservation and Parks.

Part 1 – Federal Addition to the *Recovery Strategy for Proud Globelet (Patera pennsylvanica) in Ontario*, prepared by Environment and Climate Change Canada

Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)³ agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Proud Globelet and has prepared the federal component of this recovery strategy (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of Ontario (Ontario Ministry of the Environment, Conservation and Parks) as per section 39(1) of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (section 41(1) or (2)). The Ontario Ministry of the Environment, Conservation and Parks led the development of the attached recovery strategy for the Proud Globelet (Part 2) in cooperation with Environment and Climate Change Canada. The Province of Ontario also led the development of the attached Government Response Statement (Part 3), which is the Ontario Government's policy response to its provincial recovery strategy and summarizes the prioritized actions that the Ontario government intends to take and support to achieve Ontario's recovery goal.

It was determined that the recovery of the Proud Globelet in Canada is not technically or biologically feasible, as sufficient suitable habitat and recovery techniques are not available to support recovery. Critical habitat for Proud Globelet is not identified in this federal recovery strategy. Notwithstanding, the species may still benefit from general conservation programs in the same geographic area and will receive protection through SARA and other federal, and provincial or territorial, legislation, policies, and programs.

The feasibility determination will be re-evaluated as part of the report on implementation of the recovery strategy, or as warranted in response to changing conditions and/or knowledge.

A recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or in an action plan, SARA requires that critical habitat then be protected.

³ www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

In the case of critical habitat identified for terrestrial species, including migratory birds, SARA requires that critical habitat identified in a federally protected area⁴ be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

⁴ These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Bird Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

Acknowledgements

The original draft of the federal addition was prepared by Elisabeth Shapiro with assistance from Shady Abbas (Environment and Climate Change Canada, Canadian Wildlife Service – Ontario). Reviews and input were provided by Krista Holmes, Ken Tuininga and Elizabeth Rezek (Canadian Wildlife Service- Ontario). This document benefited from comments provided by the Ontario Ministry of the Environment, Conservation and Parks.

Acknowledgement and thanks is given to all other parties that provided advice and input used to help inform the development of this recovery strategy.

Executive Summary

The Proud Globelet (*Patera pennsylvanica*), is a large terrestrial snail in the Polygyridae family. In Canada, the snail is known from a single occurrence within the sandy oak forest habitat of the Black Oak Heritage Forest in Windsor, Ontario. General snail surveys in southern Ontario over the past century, including recent surveys between 2013-2017, have not detected the snail elsewhere. No live individuals have been recorded in Canada. In 1992 and 1996, freshly dead shells were documented, however only weathered dead shells were encountered during 2013 surveys. The species has not been confirmed as extant in Canada, and may be extirpated. Recovery is not considered technically and biologically feasible at the present time.

Given the uncertainty of the species' status in Canada, no threat assessment was completed. However, human caused habitat loss and degradation due to recreational activities and ecosystem modifications from invasive plants and animals, as well as pollution, urbanization, and climate change may have contributed to the species' apparent disappearance. Another native snail species likely disappeared from the same area at the same time. Limiting factors including low dispersal ability, limited gene flow, small population size, low physiological resistance to changing environmental conditions, and relatively long generation time may compound these potential threats.

Critical habitat is not identified for species whose recovery is considered non-feasible. Identifying critical habitat would require the confirmation of habitat occupancy and suitability in areas where shells have been found. Critical habitat may be identified in a revised recovery strategy or action plan(s) should more information become available.

The government-led and government-supported actions tables from the *Proud Globelet – Ontario Government Response Statement* (Part 3), are adopted as the conservation approach for Proud Globelet in Canada.

Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the Government of Ontario's *Recovery Strategy for the Proud Globelet (Patera pennsylvanica) in Ontario* (Part 2 of this document, referred to henceforth as "the provincial recovery strategy") and/or to provide updated or additional information.

Environment and Climate Change Canada is adopting the provincial recovery strategy (Part 2) with the exception of subsection 1.1 Species Assessment and Classification, and section 2.0 Recovery. Section 1.1, has been replaced by section 1. COSEWIC Species Assessment Information. In place of section 2.0, Environment and Climate Change Canada is adopting the province of Ontario's government-led and government-supported actions of the *Proud Globelet – Ontario Government Response Statement* (Part 3) as the conservation approach.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery strategy referring to protection of the species' habitat may not directly correspond to federal requirements. Critical habitat is not identified for the Proud Globelet in this recovery strategy at this time.

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, recovery of the Proud Globelet has been determined not to be biologically or technically feasible at this time. Recovery is considered not feasible when the answer to any of the following questions is “no”.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

No. It is unlikely that the species is extant in Canada. No live individuals have ever been collected and very little is known about the species. Fresh shells of the species were first recorded in Canada in 1992, and again in 1996. Extensive, targeted searches for this species in 2013 revealed shells that had been dead for 5-15 years at two sites in Windsor, Ontario. All shell records are from the Black Oak Heritage Forest in Windsor, and a nearby former light industrial site (COSEWIC 2015). Despite widespread general gastropod searches across southern Ontario between 2013- 2017, as well as other surveys throughout the 20th century, no other evidence of this species has been documented.

The fact that all 15 shells found in 2013 were at least 5 years old in contrast to the freshly dead shells found in 1992 and 1996 may suggest a decline in the population, if not total disappearance of mature individuals, from the site since 1996. Observations are now more than 20 years old and the lack of data on number of live mature individuals makes it unlikely that there are individuals capable of reproduction. Any rescue effect is unlikely, given the proximity of the Great Lakes and the highly urbanized landscape that separate Proud Globelet’s range in Canada from other jurisdictions in the United States.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Unknown Proud Globelet is thought to require wooded habitat such as ravines or sunny hillsides, or forest edge habitat with adjacent grassy or shrubby areas (Wyshynski and Nicolai 2018). The species is thought to be a specialist of exposed woodland or edge habitat (forest/grassland) which is extremely limited in southwestern Ontario (Wyshynski and Nicolai 2018). The sandy oak forest where shells of Proud Globelet have been recorded in Canada is a rare and highly fragmented habitat type, which is home to a unique array of species. Prior to European settlement, 72% of southwestern Ontario land cover was deciduous forest, with oak forests representing less than 10% of this total (Butt et al. 2005). Forest cover across southwestern Ontario now accounts for about 16% of land cover (Butt et al. 2005). Essex County, where Proud Globelet shells have been found, has approximately 4.5% of its original forest cover making it the least forested county in Ontario (ERCA 2013). The extent of oak forests in southern Ontario has been

greatly reduced, and remaining oak forest patches may be smaller than the required minimum viable habitat patch size for some gastropods (COSEWIC 2015).

Some land snails are sensitive to anthropogenic disturbances and can serve as indicators of biodiversity change (Douglas et al. 2013). Anthropogenic activities and urbanization can increase incidences of non-native or invasive species and reduce native species richness (Aronson et al. 2015); this can affect the ecological function of habitat and render it unsuitable for snail species (COSEWIC 2015). Some snails are sensitive to vegetation changes, as it provides integral food, habitat and winter refugia (COSEWIC 2015). The Black Oak Heritage Forest is a small black oak forest remnant within a highly fragmented natural landscape (COSEWIC 2015). Individuals of another native snail species, Whitelip (*Neohelix albolabris*), were also absent from the Black Oak Heritage Forest during recent surveys, and no live individuals, only old, weathered shells of a similar age to the Proud Globelet shells have been found (COSEWIC 2015). This suggests that both species may have disappeared from the forest at the same time for unknown reasons; a possible explanation is a high degree of anthropogenic disturbance (COSEWIC 2015).

Given the uncertainty surrounding the Proud Globelet's habitat requirements and status in Canada, additional suitable habitat mapping and surveying are warranted. This should include inventory work within the Black Oak Heritage Forest, the broader Windsor area, as well as Bois Blanc Island in the Detroit River where there is an unverified record of the snail, with no museum specimen, from 1906. Additional suitable sandy forests in Norfolk County and the Niagara escarpment could be included. However, there is a low likelihood that sufficient suitable habitat could be restored in a timely manner. Existing habitat fragments are surrounded by an extensive network of roads and a high degree of urbanization. Nearby suitable habitat fragments where the species has not been observed are likely too small to be managed for the species (COSEWIC 2015).

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Unknown. Since no live individuals have ever been collected in Canada and very little is known about the species, it is difficult to identify the specific causes of decline. Thus, the threats which led to the decline of the species are not fully understood. Potential threats to the species and its habitat include habitat loss and degradation from transportation and service corridors, human intrusions and disturbances, recreational activities, natural system modifications (e.g. due to residential and commercial development, invasive and other problematic species), genes and diseases, pollution, and climate change and extreme weather (Wyshynski and Nicolai 2018). It is not possible to assess whether the primary ongoing threats to the species can be avoided or mitigated as the species' persistence is not confirmed and no live individuals have ever been observed in Canada.

The knowledge gaps associated with the Proud Globelet are substantial. Primary efforts should focus on whether the species is still extant in Canada and information

sharing, including research to fill knowledge gaps related to the species' distribution, biology, habitat requirements and threats. Efforts to reduce invasive species that may directly threaten Proud Globelet should continue. Working with partners to identify opportunities for habitat creation, restoration and/or enhancement including creating refuge areas to improve available habitat should be investigated.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

No. Recovery is not considered technically and biologically feasible at the present time and as such, no population and distribution objectives have been developed for the Proud Globelet. There are no specific recovery techniques for the species. Given that the species may already be extirpated from Canada, it is unlikely that appropriate techniques can be developed within a reasonable timeframe to prevent extirpation. There are many knowledge gaps associated with the species life history, continued persistence in Canada, and the impact of potential threats. Standardized survey and monitoring protocols that include inventory and monitoring of populations, habitat conditions and site-specific threats are not yet available and should be developed and implemented. Public outreach and the encouragement of community science programs may support more timely information sharing. Research should be done in collaboration with the United States on extant populations to help identify causes of declines and requirements needed for persistence. Additional research is also needed to identify the extent and severity of potential threats to the species and its habitat, including recreational trail use, pollution, introduced species and climate change, to help inform appropriate management actions. While invasive species management within oak forest and grassland habitats can be implemented to improve habitat quality, the highly fragmented and small forest patches found in Essex County may be too small to support viable Proud Globelet subpopulations, and the species is unlikely to colonize suitable habitat based on limited dispersal ability (COSEWIC 2015). Finally, the Proud Globelet is at the northern extent of its North American distribution and may have always had a naturally limited distribution in Canada. This species may continue to be vulnerable to human-caused and natural stressors despite efforts to recover the species. Given the identified knowledge gaps, lack of species observations, and limited habitat availability, it is unlikely that recovery techniques could be developed to achieve objectives within a reasonable timeframe if such objectives were developed.

1. COSEWIC* Species Assessment Information

Date of Assessment: May 2015

Common Name (population): Proud Globelet

Scientific Name: *Patera pennsylvanica*

COSEWIC Status: Endangered

Reason for Designation: This large terrestrial snail is found in the upper mid-west of North America, with Canada's single recorded occurrence in and near a wooded park in Windsor, Ontario. General snail surveys conducted throughout southern Ontario over the last century have not detected this species anywhere else. Freshly dead shells were found in 1992 and 1996 but only dead, weathered shells were found in extensive surveys in 2013. Human intrusions and disturbances from recreational activities and ecosystem modifications from invasive plants and animals, the surrounding urbanization, pollution from local and regional sources, and climate change may have contributed to the species' demise; it appears another native snail disappeared from the same area at the same time.

Canadian Occurrence: Ontario

COSEWIC Status History: Designated Endangered in May 2015.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

The Proud Globelet is listed as Endangered⁵ on Schedule 1 of the *Species at Risk Act* (SARA) (S.C. 2002, c. 29). In Ontario, the species is listed as Endangered⁶ under the *Endangered Species Act, 2007* (ESA) (S.O. 2007, c. 6) and receives species and habitat protection under the ESA.

The global rank for the Proud Globelet is Apparently Secure (G4). It is considered Critically Imperiled (N1) in Canada and Critically Imperiled (S1) in Ontario (NatureServe 2019 Appendix A). The species is considered Apparently Secure (N4) in the United States; a complete list of subnational status ranks and definitions for occurrences in the United States is provided in Appendix 1.

It is estimated that 0.001% of the species' range is in Canada (COSEWIC 2015).

⁵ A wildlife species facing imminent extirpation or extinction.

⁶ A species that lives in the wild in Ontario but is facing imminent extinction or extirpation.

3. Threats

Based on the IUCN-CMP (International Union for the Conservation of Nature-Conservation Measures Partnership) unified threats classification system (Salafsky et al. 2008), threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this process.

A threat assessment is not presented for Proud Globelet, as no live individuals have ever been found in Canada, and despite targeted surveys no fresh shells of recently dead individuals have been observed since the mid-1990's (COSEWIC 2015) therefore, threats cannot be scored for scope⁷ or severity⁸ to determine individual threat impacts; nor is it possible to estimate the overall threat impact at this time.

Historical threats, indirect or cumulative effects of the threats, as well as threats that can be presumed to affect snails in locations where shells have been found are presented in Part 2: *Recovery Strategy for the Proud Globelet (Patera pennsylvanica) in Ontario*, section 1.6.) ,

4. Critical Habitat

4.1 Identification of the Species' Critical Habitat

Section 41(2) of SARA requires that if the recovery of a listed wildlife species is not feasible, the recovery strategy must include an identification of the species' critical habitat to the extent possible. Under SARA, critical habitat is "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species".

Critical habitat for Proud Globelet in Canada is not identified in this federal recovery strategy due to the need to confirm habitat occupancy and habitat suitability in areas where shells were found at Canadian location(s). Despite targeted searches in potentially suitable habitat, no live individuals have ever been documented in Canada (COSEWIC 2015), and it is not possible to determine the biophysical attributes of suitable habitat for the species. Critical habitat may be identified in the future, either in a revised recovery strategy or action plan(s) should more information become available.

⁷ 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%; Negligible <1%).

⁸ 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%; Negligible <1%; Neutral or Potential Benefit ≥0%).

Under the ESA, when a species becomes listed as endangered or threatened on the Species at Risk in Ontario List, individuals are automatically protected and receive general habitat protection. The Proud Globelet currently receives general habitat protection under the ESA; however, a description of the general habitat has not yet been developed. The *Proud Globelet – Ontario Government Response Statement* (Part 3) recommends filling knowledge gaps pertaining to Proud Globelet, its habitat and threats so that it may be used to review and adapt protection and recovery activities (MECP 2019).

5. Conservation Approach

The recovery of the Proud Globelet in Canada is not considered technically and biologically feasible at the present time. Recovery of the species may become feasible if individuals of the species are found in Canada and/or if reintroduction from an external source is deemed feasible and appropriate. The IUCN's Guidelines for Reintroductions and Other Conservation Translocations (IUCN 2013) should be used to assess the feasibility of population restoration and the associated risks.

In situations where recovery is determined not to be feasible, a conservation approach is developed to provide guidance on activities that would be beneficial for the species in Canada. The government-led and government-supported actions from the *Proud Globelet – Ontario Government Response Statement* (Part 3) are adopted as the conservation approach for the Proud Globelet in Canada.

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Appendix A: Conservation Status Ranks of Proud Globelet (*Patera pennsylvanica*)

Table A-1. Conservation ranks of the Proud Globelet (NatureServe 2019)

Proud Globelet (<i>Patera pennsylvanica</i>)				
Global (G) Rank	National (N) Rank (Canada)	Sub-national (S) Rank (Canada)	National (N) Rank (United States)	Sub-national (S) Rank (United States)
G4	N1	Ontario (S1)	N4	Illinois (SNR), Indiana (SNR), Kentucky (S3S4), Michigan (SNR), Missouri (SNR), Ohio (SNR), Pennsylvania (S1S2), West Virginia (S1)

Table A-2. Rank Definitions (Master et al. 2012)

Rank	Definition
N1 S1	Critically Imperiled- At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
N2 S2	Imperiled- At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
N3 S3	Vulnerable- At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats or other factors.
G4 N4 S4	Apparently secure- At a fairly low risk of extinction or elimination (G4), or extirpation in the jurisdiction (N4, S4) due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threat, or other factors.
N#N# S#S#	Range Rank- A numeric range rank (e.g., S2S3 or S1S3) is used to indicate any range of uncertainty about the status of the species or ecosystem. Ranges cannot skip more than two ranks (e.g., SU is used rather than S1S4).
SNR	Unranked- State/province conservation status not yet assessed

Appendix B: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)⁹. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s¹⁰ (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

Should Proud Globelet be confirmed to be extant in Canada, recovery planning impacts on non-target species within the confirmed site(s) will need to be taken into account. Any recovery planning activities for the Proud Globelet will be implemented with consideration of all co-occurring species at risk, such that there are no negative impacts to these species or their habitats (e.g., American Chestnut (*Castanea dentata*), Eastern Foxsnake (*Pantherophis vulpinus*), Slender Bush-clover (*Lespedeza virginica*), Willowleaf Aster (*Symphyotrichum praealtum*), Blanding's Turtle (*Emydoidea blandingii*), Purple Twayblade (*Liparis liliifolia*)).

The remnant sandy oak forest within which Proud Globelet shells have been documented is a rare and highly fragmented habitat type in Canada; many of the plants and animals found within it may also be considered rare. Measures recommended in the *Proud Globelet – Ontario Government Response Statement* (Part 3) and adopted by Environment and Climate Change Canada as the conservation approach will benefit select oak forests by working with partners where the species is found to collectively manage the habitat where appropriate (e.g., Black Oak Heritage Forest). This includes identifying and mitigating threats, identifying opportunities for habitat creation, restoration, and enhancement, increasing public awareness, and engaging the public in species at risk recovery.

⁹ www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html

¹⁰ www.fsds-sfdd.ca/index.html#/en/goals/

**Part 2 – *Recovery strategy for the Proud Globelet*
(*Patera pennsylvanica*) in Ontario, prepared by S. Wyshynski
and A. Nicolai for the Ministry of the Environment,
Conservation and Parks**



Proud Globelet

(Patera pennsylvanica) in Ontario

Ontario Recovery Strategy Series

2018

About the Ontario Recovery Strategy Series

This series presents the collection of recovery strategies that are prepared or adopted as advice to the Province of Ontario on the recommended approach to recover species at risk. The Province ensures the preparation of recovery strategies to meet its commitments to recover species at risk under the *Endangered Species Act 2007* (ESA) and the Accord for the Protection of Species at Risk in Canada.

What is recovery?

Recovery of species at risk is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

What is a recovery strategy?

Under the ESA a recovery strategy provides the best available scientific knowledge on what is required to achieve recovery of a species. A recovery strategy outlines the habitat needs and the threats to the survival and recovery of the species. It also makes recommendations on the objectives for protection and recovery, the approaches to achieve those objectives, and the area that should be considered in the development of a habitat regulation. Sections 11 to 15 of the ESA outline the required content and timelines for developing recovery strategies published in this series.

Recovery strategies are required to be prepared for endangered and threatened species within one or two years respectively of the species being added to the Species at Risk in Ontario list. Recovery strategies are required to be prepared for extirpated species only if reintroduction is considered feasible.

What's next?

Nine months after the completion of a recovery strategy a government response statement will be published which summarizes the actions that the Government of Ontario intends to take in response to the strategy. The implementation of recovery strategies depends on the continued cooperation and actions of government agencies, individuals, communities, land users, and conservationists.

For more information

To learn more about species at risk recovery in Ontario, please visit the Ministry of the Environment, Conservation and Parks Species at Risk webpage at: www.ontario.ca/speciesatrisk

Recommended citation

S. Wyshynski and Nicolai, A. 2018. Recovery Strategy for the Proud Globelet (*Patera pennsylvanica*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ministry of the Environment, Conservation and Parks, Peterborough, Ontario. vi + 32 pp.

Cover illustration: Photo by Robert Forsyth

© Queen's Printer for Ontario, 2018

ISBN 978-1-4868-2784-8 (HTML)

ISBN 978-1-4868-2785-5 (PDF)

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Acknowledgments

This recovery strategy was greatly improved by guidance from Tanya Pulfer. She reviewed the draft and made suggestions to complete the content. We thank Dwayne Lepitzki (COSEWIC Molluscs Specialist Subcommittee) and Michael Oldham (MNRF) for reviewing gastropod ecology in relation to recovery. Rebecca Rundell (SUNY-ESF) and Cody Gilbertson (SUNY-ESF) shared their experience on reintroduction and ex-situ rearing of the very rare Chittenango ovate amber snail in the US with us. In addition, Russ Jones (AMEC) and Karen Cedar (Naturalist, Ojibway Prairie Nature Centre) gave us information regarding the protection of Black Oak Heritage Forest. Robert Forsyth (Molluscs Specialist) provided species information and the cover photograph.

Declaration

The recovery strategy for the Proud Globelet was developed in accordance with the requirements of the *Endangered Species Act, 2007* (ESA). This recovery strategy has been prepared as advice to the Government of Ontario, other responsible jurisdictions and the many different constituencies that may be involved in recovering the species.

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

The recommended goals, objectives and recovery approaches identified in the strategy are based on the best available knowledge and are subject to revision as new information becomes available. Implementation of this strategy is subject to appropriations, priorities and budgetary constraints of the participating jurisdictions and organizations.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy.

Responsible jurisdictions

Ministry of the Environment, Conservation and Parks
Environment and Climate Change Canada – Canadian Wildlife Service, Ontario

Executive summary

Proud Globelet (*Patera pennsylvanica*), is a terrestrial land snail in the family Polygyridae. This species, with a yellowish round shell (15-20 mm diameter), lacks a tooth-like protuberance at the shell opening, unlike other species of the genus *Patera*. Proud Globelet ranges from southwestern Ontario to Iowa and Missouri and east to Pennsylvania. No living individual of this species has ever been documented in Ontario. The sole known population in Ontario was determined based on the presence of empty, fresh shells in 1992 and 1996, and empty weathered shells in 2013. Proud Globelet in Ontario may be restricted to the Black Oak Heritage Forest and a formerly built up industrial site adjacent to this forest, within the City of Windsor. Whether the species is still extant in Ontario remains unclear. The species is currently listed as endangered on the Species at Risk in Ontario (SARO) List under the *Endangered Species Act 2007*, (ESA).

While little is known specifically about Proud Globelet habitat requirements, they are thought to be specialized to exposed woodland or edge habitat (forest/grassland), which is extremely limited in southwestern Ontario. It is believed that, in the case of the single known Canadian population, the grassland next to the oak forest, where shells have been found, is most likely used as a feeding ground and the forest is most likely used for shelter and egg laying. Food requirements are unknown but may be fungi, leaf litter and fresh plant material. Terrestrial snails rely heavily on moisture and specific micro-climatic conditions, for egg laying and shelter against drought, and low temperature extremes. A greater understanding of the habitat requirements would aid in the protection and recovery of this species.

Proud Globelet is faced with many direct and indirect threats such as: habitat loss and degradation, human intrusion and disturbance, competition from and presence of non-native species, environmental contamination through soil, air and water pollution, in addition to severe weather and climate change. These threats are compounded by limiting factors such as: low dispersal capacity, small population size, relatively long generation time, and slow adaptation to changing conditions in its environment. The extent of any threats to Proud Globelet populations currently remains unknown and requires further investigation.

The recommended recovery goal is to ensure the persistence of Proud Globelet in Ontario by maintaining and protecting existing habitat, reducing known threats, and filling knowledge gaps that will allow for more specific actions to be undertaken, such as threat mitigation and potentially, reintroduction. The recommended protection and recovery objectives are to:

1. Confirm the presence/absence/distribution of Proud Globelet in Ontario by 2025;
2. Protect, maintain and improve the quality of habitat in and around the Black Oak Heritage Forest, where the species occurs/occurred;
3. Protect any newly discovered population(s) and supporting habitat, if found;

4. Address knowledge gaps related to biology, habitat requirements, and threats that may assist in recovery efforts; and
5. Reintroduce Proud Globelet to suitable habitat if deemed feasible.

As snail populations are usually composed of several hundred individuals, heterogeneously distributed over a habitat, and recognizing the cryptic nature of Proud Globelet, it is recommended that the entire Ecological Land Classification (ELC, Lee et al. 1998) ecosite polygon currently occupied by a population of Proud Globelet, and/or historically occupied by a population of Proud Globelet, be prescribed as habitat in a habitat regulation. Observations that have not been reconfirmed in more than 20 years should be considered historic (Hammerson et al. 2008). In addition, it is recommended that a buffer of 100 m be added to the ELC ecosite polygon, where suitable dispersal and edge habitat are present, to account for dispersal into neighbouring edge habitat. Information on spatial limits of habitat used by Proud Globelet is lacking. Defining habitat by using a contiguous ecological area plus a buffer increases the likelihood that all habitat elements required by Proud Globelet are included.

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1.0 Background information

1.1 Species assessment and classification

Table 1. Species assessment and classification of the Proud Globelet (*Patera pennsylvanica*). The glossary provides definitions for the abbreviations within, and for other technical terms in this document.

Assessment	Status
SARO List classification	Endangered
SARO List history	Endangered (2016)
COSEWIC assessment history	Endangered (2015)
SARA schedule 1	No schedule, no status
Conservation status rankings (NatureServe 2017)	GRANK: G4 (2009) NRANK: N1 (2015) SRANK: S1

1.2 Species description and biology

Species description

Proud Globelet is a member of the family Polygyridae with a thin shell which is yellowish olive and has 5¾ to 6 spirals in adults (Figure 1). The lip of the opening is white and narrowly reflected, and the central part of the underside of the shell is completely covered by the lip (Pilsbry 1940). Adult shells measure 15 to 20 mm in diameter. Morphologically, Proud Globelet is unlike any other species of the genus *Patera*, because it lacks a tooth on the shell wall in the opening and the last spiral is more markedly descending at the opening (Grimm et al. 2010). There is only one other species of the genus *Patera*, apparently introduced, in Ontario (Flat Bladetooth, *Patera appressa*, Forsyth et al. 2015).

Proud Globelet forms a single population in Ontario. No data are available on the population structure.



Photo credit: Robert Forsyth

Figure 1. Proud Globelet specimen from Black Oak Heritage Forest, Windsor, Ontario (April 19, 1996), collected by Michael J. Oldham and stored at the Canadian Museum of Nature (catalogue number CMNML 096170).

Species biology

Proud Globelet is an air-breathing (pulmonate), simultaneous hermaphrodite snail where both members of a mating pair exchange sperm and produce eggs (Pilsbry 1940). Mating in Polygyridae occurs in fall or early spring, egg laying in spring to late summer (clutch size: 20-80 eggs), and hatching 20 to 60 days after egg laying, depending on temperature and moisture (van Cleave and Foster 1937, Blinn 1963, Steensma et al. 2009).

In terrestrial snails, growth occurs only during periods of activity (spring to fall), and species of the size of Proud Globelet usually reach their adult shell size after one to two years (Barker 2001). Polygyridae sexual maturity is reached after 2 to 3 years and lifespan has been estimated to range between 3 and 5 years (Stiven and Foster 1996, Steensma et al. 2009).

Hibernation in Polygyridae extends from early-October until mid-April. The snails close the shell opening with a calcareous epiphragm (Blinn 1963) and stay, with the shell opening up (Carney 1966), in shallow depressions in the forest floor covered with leaf litter or at soil depths of 5 to 10 cm (Pearce and Örstan 2006).

In general, terrestrial snails require calcium from soil, bedrock or plants for shell formation, reproduction (Barker 2001), and physiological processes, e.g. heat resistance in eggs (Nicolai et al. 2013).

Terrestrial snails are prone to freezing in winter. Different strategies that are somewhat plastic have evolved to enable survival at sub-zero temperatures (see review by Ansart and Vernon 2003). Mortality during hibernation is around 40% in some species and drives population dynamics (Peake 1978, Cain 1983). Burch and Pearce (1990) suggest refuges with buffered environmental conditions, such as temperature and humidity, may be the most important factor limiting terrestrial snail abundance. Indeed, snails rely on buffered microsites because high temperature variability (temperatures ranging between below and above zero degrees) from fall to spring increases mortality (Nicolai and Ansart 2017).

In temperate regions, many species only aestivate for a short period of time in extreme summer conditions and have developed biochemical stress reactions that protect cells and maintain survival mechanisms, such as membrane fluidity, osmoregulation and enzyme activity. However, unusually long heat and drought periods increase mortality (Nicolai et al. 2011).

Nothing is known of Proud Globelet's diet. It is potentially herbivorous (feeding on fresh or dead plant material or both) and/or fungivorous (feeding on fungi).

Active dispersal distances and home ranges sizes are unknown for Proud Globelet, but other Polygyridae species of similar size moved between 120 and 220 cm per day within a home range of 80 to 800 m² over a 100-day study (Pearce 1990). A three-year study showed a maximal dispersal of 32.2 m (Edworthy et al. 2012), whereas a four-year study confirms that snails return to suitable hibernation sites and have home ranges greater than 50 m² (Blinn 1963).

1.3 Distribution, abundance and population trends

Globally, the Proud Globelet occurs/occurred mainly in the eastern and mid-states of North America, ranging from Ontario, southward to Kentucky, westward to Missouri and eastward to Pennsylvania (Figure 2). Current population size and distribution throughout the United States is unclear at this time. The only known Canadian population of Proud Globelet occurs/occurred in southwestern Ontario.

NatureServe (2017) and CESSC (2016) provides the following ranks:

Global Rank: G4

National Rank (Canada): N1

National Rank (US): N4

Sub-national ranks (S-ranks) in Canada and the USA are as follows:

1. Canadian Provinces where Proud Globelet occurs

Ontario: S1 (CESCC 2016).

2. US States adjoining southwestern Ontario

Michigan: SNR and SC (Michigan Natural Features Inventory 2013)

Pennsylvania: S2 (Pennsylvania Natural Heritage Program 2017)

Ohio: SNR (Ohio Department of Natural Resources 2012)

New York: not present (Hubricht 1985; Schlesinger 2017)

3. Other US states where Proud Globelet occurs

Iowa: SNR (Natural Resource Commission Iowa 2009)

Illinois: SNR (Cummings and Phillips 2013)

Indiana: SNR (Indiana Department of Natural Resources 2013)

Kentucky: S3S4 (Kentucky State Nature Preserve Commission 2013)

West Virginia: S2 (West Virginia Natural Heritage Program 2016)

Missouri: SNR (Missouri Department of Conservation 2018)

(G4 – apparently secure, N1 – critically imperiled nationally, N4 – apparently secure. SNR – not ranked sub-nationally, SC – special concern (at the state level), S1 – critically imperiled sub-nationally, S2 – imperiled sub-nationally, S3 – vulnerable sub-nationally, S4 – apparently secure sub-nationally)

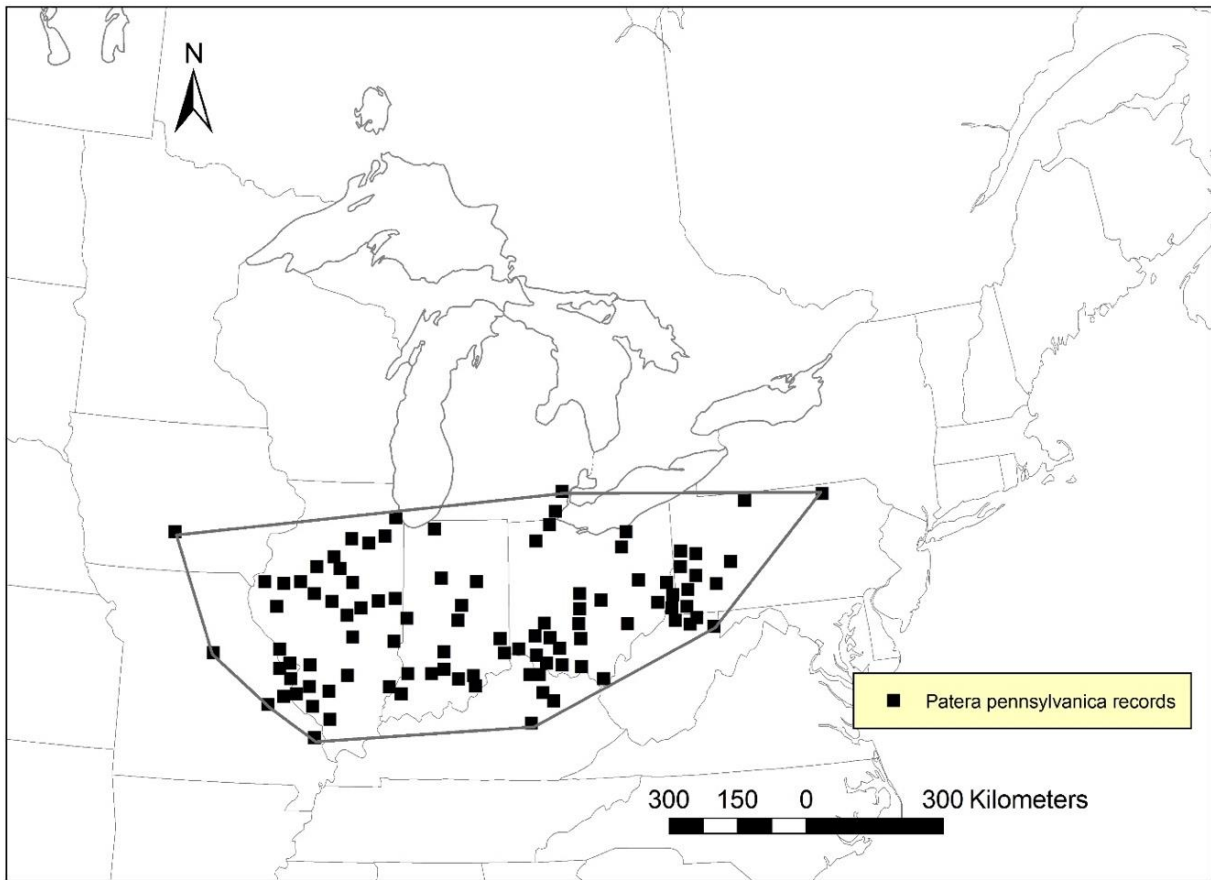


Figure 2. Global range of the Proud Globelet. Data includes records from between 1882 and 2013, along with records without dates (COSEWIC 2015). Whether these populations are currently extant is unknown.

In Ontario, and Canada, Proud Globelet is restricted to the south border of the Black Oak Heritage Forest and to a formerly industrial built-up site adjacent to the south side of this forest in the City of Windsor (Figure 3). The extent of occurrence (EOO) and the Index Area of Occupancy (IAO) are 4 km² (COSEWIC 2015), representing 0.001% of the global range (COSSARO 2016). This population may be genetically isolated from other populations in the United States. No living individuals of Proud Globelet have ever been documented in Canada. Empty, fresh shells of this species were first found in the Black Oak Heritage Forest in 1992 (collector Oldham, CMNML 096171, COSEWIC 2015). Empty, fresh shells were found again in the same place in 1996 (collector Oldham, CMNML 096170, COSEWIC 2015), indicating recently dead individuals (Pearce 2008), thus an extant population at the time (COSEWIC 2015). However, in a targeted survey at the same location in 2013, only old, weathered shells (15 adults and juveniles that died 5-15 years ago) were found (collector Nicolai, CMNML 096184, COSEWIC 2015). Similarly, in 2013, one old, weathered shell on a formerly industrial built-up area south of the Black Oak Heritage Forest was found (collector Oldham, MJO 41549, COSEWIC 2015). An unverified record of Proud Globelet, with no museum specimens, occurs on Bois Blanc Island, Ontario in the Detroit River (Figure 3, Walker

1906). This occurrence was cited as a Michigan record in both Walker (1906) and La Rocque (1953) and therefore does not appear in COSEWIC (2015).

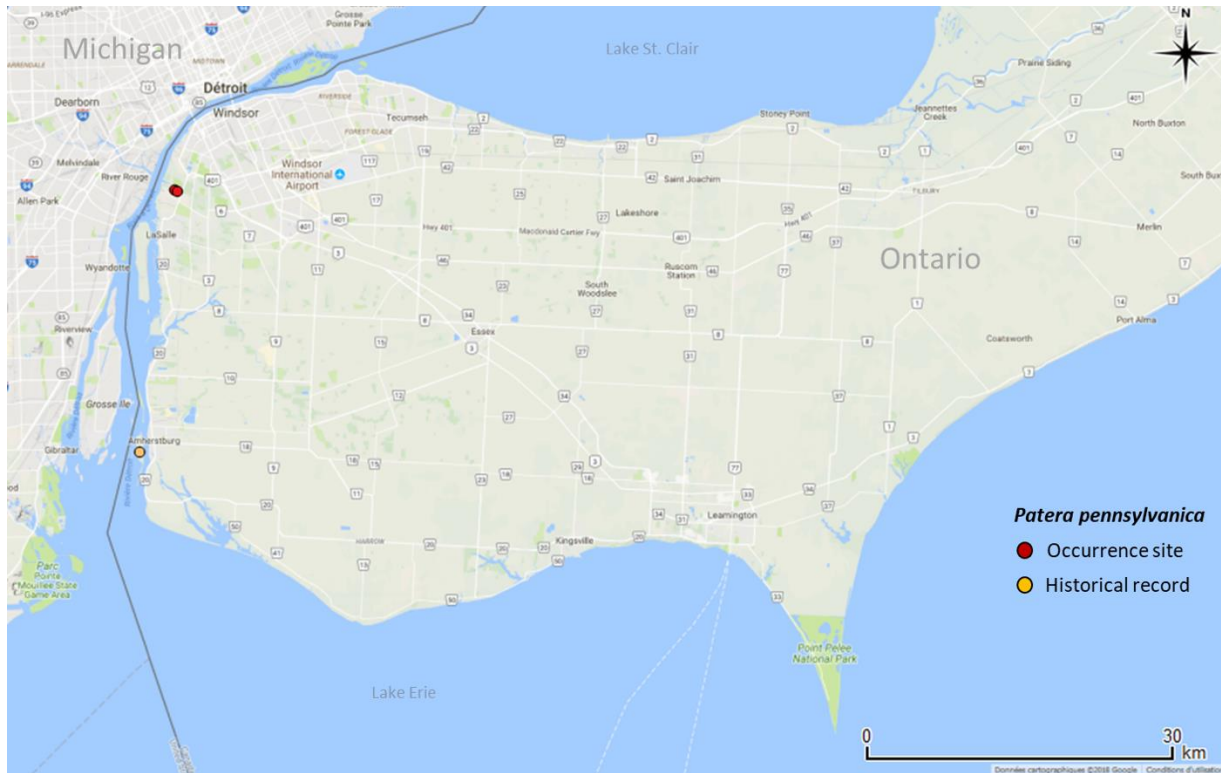


Figure 3. Historical (yellow) and current (red, based on shell records) distribution of Proud Globelet in Ontario.

The closest records from outside Canada are in Monroe County, Michigan, United States (Michigan State University Collection of Zoology, MCZ 152070, and Walker 1906), but the exact locations are unknown. It is unclear whether the species is still extant in Michigan because no other, recent records are available.

Large water bodies such as the Detroit River represent natural dispersal barriers for ground dwelling terrestrial snails (Gittenberger 2007), making rescue from outside Canada unlikely.

1.4 Habitat needs

Hubricht (1985) described Proud Globelet's habitat in the United States as "wooded hillsides or ravines, under leaf litter and stones". The habitat Proud Globelet has been found in, in Canada, is sandy oak forest and disturbed (former industrial site with building rubble) shrubby prairie at the southern border of the sandy oak forest (COSEWIC 2015). From these select observations, it can be inferred that Proud Globelet likely needs exposed (towards the sun) wooded habitat (ravines, hillsides) or forest edge habitat including adjacent grassy or shrubby area. General observations of

terrestrial gastropods (e.g. COSEWIC 2014, COSEWIC in press, Nicolai and Ansart 2017) showed that exposed hillside or edge habitat allows the snails to take advantage of sunny and warm moments for activity (usually after a rain or early morning), while being close to shelter against drought and cold (under leaf litter, wood logs, in the sandy and humus-rich soil). Snails in such habitat seem to feed on herbaceous plants that are present in exposed woodland or adjacent grassland, and to use the forest for egg laying in the humus-rich forest soil and for feeding on decaying wood or fungi (if this is part of their diet).

Terrestrial snails, being prone to freezing and drying, rely on three general microhabitat attributes: (i) snow cover in winter that buffers cold temperature or temperature variability, (ii) leaf litter and wood logs that keep moisture in dry conditions during the summer or buffer cold temperature during the spring and fall, when snow is absent (Nicolai and Ansart 2017), and (iii) humus-rich soil for egg laying to keep eggs in constant moisture and temperature conditions.

1.5 Limiting factors

The Canadian population of Proud Globelet is extremely isolated and small. The habitat in the two occurrence sites is surrounded by a heavily industrialized and urbanized area and the Detroit River. Terrestrial gastropods are generally limited by their low dispersal capacity that can be increased by habitat specialization (Dahirel et al. 2015). Proud Globelet seems to be specialized to exposed woodland or edge habitat (forest/grassland), which is particularly limited in southwestern Ontario. The fidelity of Polygyridae to hibernation sites and the specific requirements for hibernation and aestivation sites might also be limiting factors. Terrestrial snails heavily rely on moisture and specific micro-climatic conditions. Their adaptability to changing climate conditions might be limited (Nicolai and Ansart 2017). Additionally, small population size makes Proud Globelet susceptible to stochastic events and low reproductive potential.

1.6 Threats to survival and recovery

The threats for Proud Globelet were organized following the International Union for Conservation of Nature (IUCN) Threats Classification Scheme (Version 3.2).

Transportation and service corridors

The Detroit River International Crossing project for transportation of goods between Canada and the U.S. will increase traffic volume in the area north of the Black Oak Heritage Forest. Although the road, customs inspection plaza and the bridge construction will not directly affect Proud Globelet habitat, air- and waterborne pollution (e.g. heavy metals and road salt) represents a potential threat to the species (Viard et al. 2004).

Human intrusions and disturbances – recreational activities

The Black Oak Heritage Forest has a high trail density and is intensively visited for recreation. Data on visitor numbers and activities are not available. Large trails represent barriers for Proud Globelet movement (Wirth et al. 1999). Moreover, trampling by pedestrians is a known threat for some snail species (Baur and Baur 1990a).

Residential and commercial development

Urban and industrial development in the surrounding area of Proud Globelet habitat can have a negative impact on this species. Construction of industrial facilities adjacent to Proud Globelet habitat can reduce edge habitat, alter soil composition, structure and hydrology, and change vegetation composition thereby reducing food sources (Charrier et al. 2013). Proud Globelet shells were found on a former industrial site, which has partially re-naturalized (no active restoration has taken place). While there are currently no new development proposals for the site, the vacant land is available for redevelopment (Cedar pers. comm. 2018).

Approximately 20 years ago, a wood dump site was created by the City of Windsor on the southern border of the Black Oak Heritage Forest. The dump was created as a place to discard wood from urban forestry practices, such as thinning, pruning and removal of trees on city owned land. The wood dump has reduced edge habitat by occupying former grassland that was adjacent to the forest and was probably used as feeding grounds by Proud Globelet. The dumped wood reaching heights of 4-5 m also changed light and micro-climatic conditions at the forest edge.

Invasive and other problematic species, genes and diseases

There are several highly invasive plants in southern Ontario, including Garlic Mustard (*Alliaria petiolata*). They have been observed displacing native vegetation and altering soil nutrient cycles, thereby slowing restoration (Catling et al. 2015). Although a positive impact of an invasive plant on land snail diversity has been documented in western Pennsylvania (Utz et al. 2018), invasive plants can also lead to a decrease in endangered snail abundance, as shown in Europe (Stoll et al. 2012).

Non-native earthworms have invaded parts of Canada relatively recently. They have been shown to have major impacts on ecosystems (CABI 2016) and could indirectly affect terrestrial snail communities (Norden 2010, Forsyth et al. 2016). Earthworms, such as the Asian genus *Amyntas* (Qiu and Turner 2017), already recorded in Windsor (Reynolds 2014), alter forest floor habitats by reducing or eliminating the natural leaf litter layer and digging up and mixing the mineral soil with the organic surface layer. Besides the leaf litter loss, other negative consequences for snails include altering understory vegetation composition (Drouin et al. 2016) by feeding on forest plant seeds (Cassin and Kotanen 2016) or by altering plant-fungi mutualism (Paudel et al. 2016) and thus reducing available food plants and microhabitat.

Competition with exotic terrestrial gastropods is also a potential threat (Whitson 2005, Grimm et al. 2010, Campbell et al. 2014) through aggression (Kimura and Chiba 2010), density effects and/or food competition (Baur and Baur 1990b). Dusky Arion (*Arion subfuscus*), Grey Fieldslug (*Deroceras reticulatum*), Grovesnail (*Cepaea nemoralis*) and White Heath Snail (*Xerolenta obvia*) are present in the Proud Globelet's habitat (COSEWIC 2015). It is difficult to estimate an impact on Proud Globelet, because no data are available on inter-specific interactions with terrestrial snails or slugs.

Polygyridae have been noted to be one of the intermediate hosts of the Meningeal Worm (*Parelaphostrongylus tenuis*) (Rowley et al. 1987). In general, parasitic mites are also common in snails. The infection rate within a population ranges between 45-75%. Depending on the mite species, infections can cause high mortality, reproduction perturbations, and reduced cold hardiness (Baur and Baur 2005). Parasites could therefore be a potential threat, especially in combination with other environmental factors, such as climate change or pollution.

Natural system modifications

Prescribed fire has become an important management tool for prairie and forest conservation in North America (Gottesfeld 1994, Williams 2000), particularly to limit the invasion of exotic species (Brooks and Lusk 2008) and to promote growth and reproduction of native prairie species (Towne and Owensby 1984). Burning directly and indirectly affects survival of ground nesting animals, litter dwelling organisms, and soil invertebrates, including snails (Nekola 2002). Fire reduces and modifies organic substrates and residues, which buffer and shelter these organisms, in addition to being sources of nutrients. Fire also changes microclimates when post-burn bare soil is heated by the sun, thereby increasing soil evaporation (reviewed by Saestedt and Ramundo 1990; Knapp et al. 2009). Fire destroys the upper part of soil habitat, the litter and uppermost humus layer, which is the most important factor affecting survival for litter-soil organisms (Bellido 1987).

Black Oak Heritage Forest has been subjected to prescribed fire (Windsor Star 2008), and may be again in the near future to enhance habitat for species at risk and control for invasive plants. Direct impact of fire on snail populations may be reduced when habitat is widespread and recolonization from unburned areas is possible. When habitat areas are small, larger fires are expected to be detrimental to populations, while fires that are very patchy and restricted to an overall small area would be less harmful.

Pollution

The high degree of industrialization surrounding the Black Oak Heritage Forest suggests some level of soil, water and air pollution that could negatively affect Proud Globelet and/or its habitat. Heavy metals in soil and plants are accumulated in tissues (Notten et al. 2005) and are known to decrease food consumption, growth and fecundity (number of clutches per season) in snails (Laskowski and Hopkin 1996) which can

affect population dynamics and maintenance in the area. The exact level of impact on Proud Globelet has not been studied.

The high amount of garbage in Proud Globelet's habitat can also lead to soil pollution with microplastics that might have a negative impact on leaf litter / soil biota (Duis and Coors 2016).

While there are no agricultural effluents in Proud Globelet's habitat, invasive plant management very often includes herbicide use. Population level impacts of herbicides on terrestrial snails and slugs were not detected in agricultural (Roy et al. 2003) or forested (Hawkins et al. 1997) landscapes, but laboratory studies have shown that exposure to some herbicides increases mortality of some snail species (Koprivnikar and Walker 2011) and could affect reproduction (Druart et al. 2011). Until now, invasive plants were not controlled in Black Oak Heritage Forest, but a future management plan could consider such measures.

Climate change and severe weather

In temperate regions, climate change will involve increases in both average temperatures and the frequency of extreme weather events such as heat waves, drought and increased precipitation (Della Marta et al. 2007). Abnormal temperature extremes and variations represent a threat to snails (Nicolai and Ansart 2017). Heat waves and drought could cause high mortality to Proud Globelet due to heat or dehydration stresses (Nicolai et al. 2011). High temperature variations during spring and fall or during winter when snow is absent can increase mortality in land snails (Nicolai and Ansart 2017). Windsor has experienced high temperature variations during past years, e.g. March 1998: highest temperature 22.4°C followed by lowest temperature - 15.9°C (Climate Canada 2014), but the impact on Proud Globelet has not been studied.

1.7 Knowledge gaps

Proud Globelet is an understudied species with a small Canadian range. Knowledge on species distribution is limited and biology, specifically diet, physiological responses to environmental factors and interaction with exotic species, are unknown, which may hinder the efficacy of protection strategies. Research on the following knowledge gaps would contribute to a more complete understanding for the protection and recovery of the species and its habitat.

- Canadian presence/absence and distribution: It remains unclear as to whether there is an extant population of Proud Globelet in Canada. Southwestern Ontario has been surveyed for terrestrial gastropods of conservation concern; however, additional inventory work in the Black Oak woods along with other areas in Windsor and vicinity would be helpful in confirming presence of any living individuals. Additionally some sites and areas which have not been explored yet that may be

good locations to focus efforts include: Bois Blanc Island (historical record in Walker 1906), sandy forests in Norfolk County and the Niagara escarpment.

- Population viability analysis.
- Life history traits: growth, reproduction, life span, dispersal.
- Habitat requirements: diet, physico-chemical parameters in the soil and litter, habitat structure (physical elements, vegetation composition).
- Rearing in captivity: the long-term success of rearing in captivity depends heavily on the knowledge of species' specific diet requirements. Short-term rearing in captivity has been successful with about 30 different species of terrestrial snails in Europe (see Ansart et al. 2014), but it has yet to be tested with Proud Globelet.
- Reintroduction: genetic structure using different markers across the closest U.S. populations to understand genetic variability within the species and determine a potential source population (if within-species genetic variability for the COI gene marker is low, barcoding could help detect the species in citizen science surveys using mucus swabs as described by Morhina et al. 2014).
- Inter-specific interactions: especially the impact of exotic terrestrial gastropods and earthworms through habitat changes or competition for food and shelter (density effects).
- Physiological tolerances and adaptability: heat and cold resistance, responses to pollution, and changes in climatic conditions and soil characteristics.
- Estimation of trampling mortality.

Research on the previously mentioned knowledge gaps would contribute to a more complete understanding for the protection and recovery of the species and its habitat; however, it should be noted that while there is no known living population of Proud Globelet in Canada, research to fill these knowledge gaps may not be possible. Additionally, it is unclear as to whether or not there are any populations of Proud Globelet in the U.S. large enough to conduct research on, and if there are, whether any research findings can be applied to the Ontario population.

1.8 Recovery actions completed or underway

Black Oak Heritage Forest: To-date no management plan has been implemented in the natural area (COSEWIC 2015), but actions, such as closing sections of the forest to the public, have been implemented to avoid further damage to the habitat (Jones pers. comm. 2018). The City of Windsor plans to develop a management plan in the near future (Cedar pers. comm. 2018).

2.0 Recovery

2.1 Recommended recovery goal

The recommended recovery goal is to ensure the persistence of Proud Globelet in Ontario by maintaining and protecting existing habitat, reducing known threats, and filling knowledge gaps that will allow for more specific actions to be undertaken, such as threat mitigation and, potentially, reintroduction.

2.2 Recommended protection and recovery objectives

In order to meet the overall recommended recovery goal, short-term objectives focus on confirming whether Proud Globelet is still extant in Ontario, ensuring that existing habitat, which has become degraded, is improved and protected, and filling any knowledge gaps that could allow for more specific actions that can be taken to reduce threats. Long-term objectives focus on re-establishing or enhancing existing population at historic sites in addition to assisted colonization at sites with suitable habitat.

Table 2. Recommended protection and recovery objectives.

Number	Protection or recovery objective
1	Confirm the presence/absence/distribution of Proud Globelet in Ontario by 2025.
2	Protect, maintain and improve the quality of habitat in and around the Black Oak Heritage Forest, where the species occurs/occurred.
3	Protect any newly discovered population(s) and supporting habitat, if found.
4	Address knowledge gaps related to biology, habitat requirements, and threats that may assist in recovery efforts.
5	Reintroduce Proud Globelet to suitable habitat if deemed feasible.

2.3 Recommended approaches to recovery

Table 3. Recommended approaches to recovery of the Proud Globelet in Ontario.

Objective 1: Confirm the presence/absence/distribution of Proud Globelet in Ontario by 2025

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Short-term	Inventory and Monitoring	1.1 Develop identification material to aid in accurate recognition of this species and those with which it can be mistaken.	Knowledge gaps: <ul style="list-style-type: none"> • Snail identification resources for southern Ontario are limited.
Critical	Short-term	Inventory and Monitoring	1.2 Develop a standardized survey protocol for inventorying and monitoring Proud Globelet populations. Protocol should include: <ul style="list-style-type: none"> • consistent methods for documenting both positive and negative search effort; standardized monitoring protocols and direction on data submission to the Natural Heritage Information Centre; • guidance on appropriate marking techniques, frequency of monitoring, appropriate time of day and/or year; and • methods to identify and document threats to this species. 	Knowledge gaps: <ul style="list-style-type: none"> • Size and distribution of population unknown.
Critical	Ongoing	Inventory	1.3 Conduct targeted surveys throughout the Black Oak Heritage Forest and adjacent land where the species has occurred (light industrial area), with focused effort in and around locations where shells have previously been found.	Knowledge gaps: <ul style="list-style-type: none"> • Size and distribution of population unknown.

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Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Short-term	Research, Inventory	<p>1.4 Identify areas of probable habitat for Proud Globelet.</p> <ul style="list-style-type: none"> • Use Geographic Information System (GIS) modeling and local knowledge to identify suitable habitat. • Develop a habitat suitability index model of predicted habitat in Ontario once knowledge gaps have been filled and habitat parameters have been recorded. • Identify current landowner, management and land-use policies for these areas. 	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Size and distribution of population unknown.
Necessary	Ongoing	Inventory	<p>1.5 Conduct surveys for new populations of the species, in potentially suitable habitat, by qualified individuals.</p> <ul style="list-style-type: none"> • This should include, but not be limited to: Bois Blanc Island (historical record in Walker, 1906), sandy forests in Norfolk County and the Niagara Escarpment. 	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Size and distribution of population unknown.
Necessary	Short-term	Education and Outreach, Communication, Stewardship, Inventory	<p>1.6 Develop education and outreach material (e.g. signage, fact sheets) for the general public and staff working in the area around Black Oak Heritage Forest, to raise awareness and aid in the identification of this species.</p>	<p>Threats:</p> <ul style="list-style-type: none"> • Human disturbance • Loss / degradation of habitat.
Beneficial	Ongoing	Inventory	<p>1.7 Engage volunteers (e.g. local naturalists, land stewards, experts) to undertake surveys for this species to determine presence or absence.</p> <ul style="list-style-type: none"> • Include information on Proud Globelet in any ongoing bio-blitzes, or other citizen science initiatives. 	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Size and distribution of population unknown.

Objective 2: Protect, maintain and improve the quality of habitat in and around the Black Oak Heritage Forest where the species occurs/occurred.

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Ongoing	Management, Protection, Education and Outreach, Communication, and Stewardship	<p>2.1 Assess and implement actions that are needed and appropriate to protect and improve habitat, from human-caused disturbances that include but may not be limited to:</p> <ul style="list-style-type: none"> • Introducing signage and fencing to reduce trampling and re-direct trails; • Deactivating and reclaiming excessive trail networks; and • Reconditioning the soil layer and planting native vegetation in areas devoid of vegetation due to trampling. 	<p>Threats:</p> <ul style="list-style-type: none"> • Habitat degradation and loss, trampling. <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Best management practice.
Critical	Ongoing	Management, Protection, Education and Outreach, Communication, and Stewardship	<p>2.2 Assess and implement actions that are needed to protect and improve habitat from threats posed by non-native species.</p> <ul style="list-style-type: none"> • Investigate feasibility of reducing/controlling invasive species. • Encourage citizens to prevent dumping of construction materials and waste. 	<p>Threats:</p> <ul style="list-style-type: none"> • Invasive species. <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Best management practice.
Critical	Ongoing	Management, Protection	<p>2.3 Identify, protect and/or create refuge areas for Proud Globelet to move into in times of extreme temperatures and/or droughts.</p> <ul style="list-style-type: none"> • Explore options such as increasing the abundance and diversity (tree species and size) of downed logs in the habitat. 	<p>Threats:</p> <ul style="list-style-type: none"> • Climate Change and severe weather.

Recovery Strategy for the Proud Globelet in Ontario

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Ongoing	Communication, Management, Protection	<p>2.4 Liaise with City of Windsor on management of habitat.</p> <ul style="list-style-type: none"> • Develop and regularly review management plan for Black Oak Heritage Forest, to see if any changes or additions are needed for the protection and recovery of Proud Globelet. • Ensure that any prescribed burns in the Black Oak Heritage Forest are conducted in a way to minimize mortality of snails. • Ensure Proud Globelet habitat is identified in and protected through the municipalities' Official Plan. • Review any development proposals for Black Oak Heritage Forest and the adjacent industrial site to ensure measures are in place to protect Proud Globelet and its habitat. 	<p>Threats:</p> <ul style="list-style-type: none"> • Habitat degradation and loss, invasive species, trampling. <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Best management practice.
Necessary	Ongoing	Management	<p>2.5 Identify habitat restoration and/or enhancement opportunities to increase/improve habitat availability in Ontario.</p> <ul style="list-style-type: none"> • Identify existing or ongoing programs which may be mutually beneficial (e.g. pollinator habitat restoration projects). • Encourage connectivity between habitats to allow dispersal. 	<p>Knowledge Gaps:</p> <ul style="list-style-type: none"> • Habitat. <p>Threats:</p> <ul style="list-style-type: none"> • Habitat degradation and loss.
Necessary	Ongoing	Management, Protection	<p>2.6 As knowledge gaps pertaining to habitat requirements are filled, re-evaluate management and protection actions.</p>	<p>Threats:</p> <ul style="list-style-type: none"> • Habitat degradation and loss • Invasive species • Climate change / severe weather

Recovery Strategy for the Proud Globelet in Ontario

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Necessary	Ongoing	Protection	2.7 As knowledge gaps pertaining to habitat requirements are filled, develop a habitat description or habitat regulation to provide clarity on the area defined as habitat for Proud Globelet in Ontario.	Threats: <ul style="list-style-type: none"> Habitat degradation and loss.

Objective 3: Protect any newly discovered population(s) and supporting habitat, if found.

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Necessary	Ongoing	Management, Protection, Monitoring	3.1 If additional populations are found, assess habitat management and protection needs, as in Objective 2. <ul style="list-style-type: none"> Document habitat features that support Proud Globelet. Carry out regular inventory, monitoring and surveying for population, habitat parameters and threats. Engage landowners and land stewards to implement habitat management initiatives for the species. 	Threats: <ul style="list-style-type: none"> Habitat degradation and loss. Knowledge gaps: <ul style="list-style-type: none"> Size and distribution of population, habitat requirements.

Objective 4: Address knowledge gaps related to biology, habitat requirements, and threats that may assist in recovery efforts.

Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Critical	Short-term	Management	4.1 Investigate existing and/or former Proud Globelet habitat in order to gather information on current conditions, human activities and land uses which would be of use when developing and implementing programs for habitat restoration.	Threats: <ul style="list-style-type: none"> Habitat degradation and loss. Knowledge Gaps: <ul style="list-style-type: none"> Habitat degradation and loss. Protection needs.
Critical	Short-term	Research	4.2 Research the effects of human disturbance on terrestrial snails caused by walking and biking, and estimate potential trampling mortality for Proud Globelet as a result of these activities.	Threats: <ul style="list-style-type: none"> Trampling. Knowledge Gaps: <ul style="list-style-type: none"> Mortality risk due to trampling.
Critical	Short-term	Research	4.3 Engage the academic community to participate in researching knowledge gaps such as: <ul style="list-style-type: none"> habitat requirements; dispersal ability and home range size; minimum population viability; life history; and genetics. 	Knowledge gaps: <ul style="list-style-type: none"> Any or all, such as; habitat requirements; dispersal ability, home range size; minimum population viability; and genetics.
Critical	Short-term	Research	4.4 Research the effects of pollution, herbicides and/or insecticides on Proud Globelet.	Threats: <ul style="list-style-type: none"> Insecticides/herbicides. Industrial pollution. Knowledge gaps: <ul style="list-style-type: none"> Physiological tolerance.

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Relative priority	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Beneficial	Short-term	Research	4.5 Research adaptive strategies to climate variations including plasticity and evolvability of physiological responses combined with behavior.	Threats <ul style="list-style-type: none"> • Climate change Knowledge gaps: <ul style="list-style-type: none"> • Adaptability to climate variations
Necessary	Ongoing	Research	4.6 Research the effect of climate change on Proud Globelet. <ul style="list-style-type: none"> • Monitor microclimatic conditions in habitat. • Monitor snail performance regarding microclimatic variations (e.g. reproduction, feeding, dispersal). • Develop protection or rescue measures for extreme events. 	Threats <ul style="list-style-type: none"> • Climate change Knowledge gaps: <ul style="list-style-type: none"> • Effect of climate change • Protection needs
Necessary	Ongoing	Research	4.7 Research impacts of earthworms and non-native gastropods, such as Dusky Arion, Grovesnail and White Heath Snail, on Proud Globelet and its habitat.	Knowledge gaps: <ul style="list-style-type: none"> • Habitat degradation, inter-specific competition
Necessary	Ongoing	Communication, Research	4.8 Liaise with researchers and managers in the U.S. (e.g. Iowa, Pennsylvania, Michigan) where Proud Globelet is extant, to share any information regarding life history, habitat parameters, monitoring, global distribution, and threats.	Knowledge gaps: <ul style="list-style-type: none"> • Any or all

Objective 5: Reintroduce Proud Globelet to suitable habitat if deemed feasible.

	Relative timeframe	Recovery theme	Approach to recovery	Threats or knowledge gaps addressed
Beneficial	Long-term	Research, Management,	<p>5.1 Evaluate the feasibility of captive breeding to enable augmentation or reintroduction of the species.</p> <ul style="list-style-type: none"> • Determine if there are viable source populations (in Canada or the U.S. to augment/reintroduce the species). • Conduct population viability analysis of extant population to determine success of captive breeding and reintroduction. • Analyze population structure to determine which source populations could be used for reintroduction. 	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Lack of information on this option in the long-term recovery of this species. • Population size and distribution unknown.
Beneficial	Long-term	Management, Protection, Monitoring	<p>5.2 If feasible, based on population viability analysis, undertake a captive breeding program to enable conservation translocations into the natural environment and to enable research into Proud Globelet biology and ecology.</p>	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Success rate of breeding this species in captivity.
Beneficial	Long-term	Management, Protection, Monitoring	<p>5.3 Translocate snails into suitable habitat to mimic the natural dispersal of the snail and support existing populations.</p> <ul style="list-style-type: none"> • Monitor the success of the translocation. 	<p>Knowledge gaps:</p> <ul style="list-style-type: none"> • Methods of reintroduction.

2.4 Narrative to support approaches to recovery

The first priority in order to meet the overall recommended recovery goal is to determine whether or not Proud Globelet is extant in Ontario. Extensive targeted surveys need to be conducted throughout areas where shells have been found, in addition to areas that may be identified as potentially suitable habitat for Proud Globelet. This would include other areas in Windsor and vicinity, Bois Blanc Island (historical record in Walker, 1906), which has yet to be surveyed, sandy forests in Norfolk County and the Niagara Escarpment.

If any living individuals are found, they, along with their surrounding habitat, need to be studied. Habitat parameters required by Proud Globelet should be determined by studying any new populations found in Ontario but also by conducting research on Proud Globelet populations in the U.S. Without further understanding of life history traits such as diet, habitat, microhabitat conditions, dispersal, home range size, and minimum population viability, little can be done to recover Proud Globelet in Ontario. Additionally, research needs to be conducted to further understand any identified threats to Proud Globelet and its habitat, in order for the threats to be appropriately mitigated, and habitat protected.

While surveys are ongoing and research is being conducted, it is important to protect and improve any identified Proud Globelet habitat (Black Oak Heritage Forest), using what little is understood, so that the habitat will be available if the population recovers.

Once life history traits and habitat parameters are better understood, the focus of recovery can shift to restoring and enhancing habitat. If an extant population is found in Ontario, it is hoped that restoring and enhancing its habitat along with mitigating threats, will enable the population to re-establish itself. At this time, if no new populations have been found, or any newly found populations are struggling to persist, the possibility of augmenting or re-establishing populations in Ontario can be explored. However without a clear understanding first of the requirements necessary for persistence, there is little point to considering reintroduction. If research has been conducted, and there is a clear understanding of requirements for persistence, and appropriate size and condition of habitat exists and is protected in Ontario, populations should be analyzed to determine if there is a viable source population for reintroduction. If a viable source population is identified, then a captive breeding program can be established to enable the reintroduction program. Snails should be translocated into suitable habitat to mimic the natural dispersal of snails. It is important to monitor the success of the reintroduction.

2.5 Area for consideration in developing a habitat regulation

Under the ESA, a recovery strategy must include a recommendation to the Minister of the Environment, Conservation and Parks on the area that should be considered in developing a habitat regulation. A habitat regulation is a legal instrument that prescribes an area that will be protected as the habitat of the species. The recommendation provided below by the author will be one of many sources considered by the Minister when developing the habitat regulation for this species.

Proud Globelet are known to live in wooded hillsides, ravines and in forest/grassland edges. Within these habitats, specific attributes required for the survival or recovery of Proud Globelet are unclear. Once information becomes available and knowledge gaps have been addressed, the area prescribed as habitat should be revised and updated.

As snail populations are usually composed of several hundred individuals, heterogeneously distributed over a habitat, and recognizing the cryptic nature of this species, it is recommended that the entire Ecological Land Classification (ELC, Lee et al. 1998) ecosite polygon currently occupied by a population of Proud Globelet, and/or historically occupied by a population of Proud Globelet, be prescribed as habitat in a habitat regulation. Observations that have not been reconfirmed in more than 20 years should be considered historic (Hammerson et al. 2008). In addition, it is recommended that a buffer of 100 m be added to the ELC ecosite polygon where suitable dispersal and edge habitat are present, to account for dispersal into neighbouring edge habitat, when available. This buffer of 100 m takes into account the longest dispersal distance measured in Polygyridae (32 m) (Edworthy et. al. 2012) plus an additional area to reduce edge effect and maintain microhabitat properties of the edge habitat. Additionally, the 100 m buffer would capture locations where Proud Globelet shells have been found but may not be able to be defined using the ELC, such as the 'light industrial' area.

Information on spatial limits of habitat used by Proud Globelet is lacking. It is believed that, in the case of the single known Canadian population, the grassland next to the oak forest is used as a feeding ground and the forest is used for shelter and egg laying. Defining habitat by using a contiguous ecological area plus an additional buffer area increases the likelihood that all habitat elements required by Proud Globelet are included.

Glossary

Aestivation: A period of deep and prolonged sleep or torpor that occurs in the summer or dry season in response to heat and drought.

Canadian Endangered Species Conservation Council (CESCC): The Council was formed in 1998 by federal, provincial and territorial Wildlife Ministers under the Accord for the Protection of Species at Risk in Canada. The Council is responsible for national leadership and direction for preventing wild species from becoming at risk. It has specific responsibilities for overseeing the listing and recovery of species that are at risk nationally, and plays a role in resolving issues under the Accord.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): The committee established under section 14 of the Species at Risk Act that is responsible for assessing and classifying species at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO): The committee established under section 3 of the *Endangered Species Act, 2007* that is responsible for assessing and classifying species at risk in Ontario.

Conservation status rank: A rank assigned to a species or ecological community that primarily conveys the degree of rarity of the species or community at the global (G), national (N) or subnational (S) level. These ranks, termed G-rank, N-rank and S-rank, are not legal designations. Ranks are determined by NatureServe and, in the case of Ontario's S-rank, by Ontario's Natural Heritage Information Centre. The conservation status of a species or ecosystem is designated by a number from 1 to 5, preceded by the letter G, N or S reflecting the appropriate geographic scale of the assessment. The numbers mean the following:

1 = critically imperilled

2 = imperilled

3 = vulnerable

4 = apparently secure

5 = secure

NR = not yet ranked

Ecological Land Classification (ELC): A system of classifying and describing land-units based on vegetation.

***Endangered Species Act, 2007* (ESA):** The provincial legislation that provides protection to species at risk in Ontario.

Epiphragm: A dry layer of calcified phosphate or mucus produced by certain land snails during hibernation which functions to cover the shell opening and prevent desiccation.

Osmoregulation: Maintenance by an organism of an internal balance between water and dissolved materials regardless of environmental conditions.

Species at Risk Act (SARA): The federal legislation that provides protection to species at risk in Canada. This act establishes Schedule 1 as the legal list of wildlife species at risk. Schedules 2 and 3 contain lists of species that at the time the Act came into force needed to be reassessed. After species on Schedule 2 and 3 are reassessed and found to be at risk, they undergo the SARA listing process to be included in Schedule 1.

Species at Risk in Ontario (SARO) List: The regulation made under section 7 of the *Endangered Species Act, 2007* that provides the official status classification of species at risk in Ontario. This list was first published in 2004 as a policy and became a regulation in 2008.

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List of abbreviations

CESCC: Canadian Endangered Species Conservation Council

COI: Cytochrome c oxidase subunit I

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

CWS: Canadian Wildlife Service

ELC: Ecological Land Classification

EOO: Extent of Occurrence

ESA: *Endangered Species Act, 2007*

IAO: Index Area of Occupancy

IUCN: International Union for Conservation of Nature

ISBN: International Standard Book Number

MECP: Ministry of the Environment, Conservation and Parks

SARA: *Species at Risk Act*

SARO: Species at Risk in Ontario

**Part 3 – *Proud Globelet* – Ontario Government Response
Statement, prepared by the Ministry of the Environment,
Conservation and Parks**

Proud Globelet

Ontario Government Response Statement



Photo: Robert Forsyth

Protecting and Recovering Species at Risk in Ontario

Species at risk recovery is a key part of protecting Ontario's biodiversity. The *Endangered Species Act, 2007* (ESA) is the Government of Ontario's legislative commitment to protecting and recovering species at risk and their habitats.

Under the ESA, the Government of Ontario must ensure that a recovery strategy is prepared for each species that is listed as endangered or threatened. A recovery strategy provides science-based advice to government on what is required to achieve recovery of a species.

Within nine months after a recovery strategy is prepared, the ESA requires the government to publish a statement summarizing the government's intended actions and priorities in response to the recovery strategy. The response statement is the government's policy response to the scientific advice provided in the recovery strategy. In addition to the strategy, the government response statement considered (where available) input from Indigenous communities and organizations, stakeholders, other jurisdictions, and members of the public. It reflects the best available local and scientific knowledge, including Traditional Ecological Knowledge where it has been shared by communities and Knowledge Holders, as appropriate and may be adapted if new information becomes available. In implementing the actions in the response statement, the ESA allows the government to determine what is feasible, taking into account social, cultural and economic factors.

The Recovery Strategy for the Proud Globelet (*Patera pennsylvanica*) in Ontario was completed on December 7, 2018.

Proud Globelet is a terrestrial snail with a yellowish, round shell that ranges from 15 to 20 mm in diameter. It lacks a tooth-like protrusion at the opening of the shell which distinguishes it from other species in its genus.

Protecting and Recovering Proud Globelet

Proud Globelet is listed as an endangered species under the ESA, which protects both the snail and its habitat. The ESA prohibits harm or harassment of the species and damage or destruction of its habitat without authorization. Such authorization would require that conditions established by the Ontario government be met.

Globally, the Proud Globelet occurs in North America, from southwestern Ontario to Iowa and Missouri in the south and Pennsylvania in the east. The only known Canadian population of Proud Globelet occurs in the City of Windsor and represents a very small percentage (0.001%) of the global range. Despite several surveys between 1992 to 2013, no living individuals have ever been documented in the province. Empty, fresh shells were found in Windsor in the Black Oak Heritage Forest in 1992 and 1996, and old, weathered shells were found in 2013 at the same location and in a nearby area that was formerly used as a light industrial site. An unverified historical record also occurs on Bois Blanc Island, Ontario in the Detroit River, but surveys have not been conducted to determine whether the species exists there.

The recent species assessment by the Committee on the Status of Species at Risk in Ontario (COSSARO) and provincial recovery strategy suggest that the species was extant in Ontario, although no live individuals have been documented in the province. Dead shells found in 2013 were estimated to be 5 to 15 years old, indicating the species was present at most 15 years ago from the time the survey was conducted. Currently, it is unclear whether the species is extant in Ontario; however, some areas have not yet been surveyed and additional efforts at existing and/or new locations with potentially suitable habitat would be helpful to confirm the presence of any living individuals.

Proud Globelet is a member of the Polygyridae family, which consists of air-breathing land snails. Very little is known about the biology and habitat requirements of the species throughout its range. In the United States the species has been found in exposed wooded (ravines, hillsides) or forest edge habitat. These types of habitat are believed to play an important role in providing shelter, egg laying and foraging habitat for Proud Globelet. In general, terrestrial snails rely heavily on moist microhabitats, such as soil, leaf litter and logs to provide refuge areas to prevent dehydration or freezing during extended periods of heat, drought or extreme cold. Proximity to exposed hillside or edge habitat also provides snails with exposure to warm and sunny conditions during periods of activity. In temperate regions, snow cover provides important insulation when snails hibernate during the winter months in the soil or under leaf litter. The dispersal ability of Proud Globelet is unknown but is thought to be limited based on the maximum dispersal distance (32 m) measured in other snails in the Polygyridae family.

There are extensive knowledge gaps regarding the diet and reproductive behaviour of Proud Globelet; until species-specific information is available, this information has been inferred from other species in the Polygyridae family of snails. Generally, mating in Polygyridae occurs in the fall or early spring, and individuals lay their eggs in the spring to late summer in humus-rich soil. The eggs hatch about 20 to 60 days later depending on temperature and moisture. The lifespan of Polygyridae is estimated to range between three and five years. The diet of Proud Globelet is unknown but may consist of dead or fresh plant material and fungi based on the diet of other Polygyridae. A greater understanding of the life history traits and habitat requirements specific to the Proud Globelet and populations in Ontario would help support the recovery of the species.

Because no live individuals have ever been collected in Ontario and very little is known about the species, it is difficult to identify the specific causes of decline. Potential threats to the species and its habitat include habitat loss and degradation, soil, water and air pollution including garbage accumulation, and human intrusion and disturbance (i.e., trampling from intensive recreational trail use). Invasive plant species such as Garlic Mustard (*Alliaria petiolata*), non-native earthworm (e.g., genus *Amyntas*) and other introduced gastropod species (e.g., slugs) such as Dusky Arion (*Arion subfuscus*), Grovesnail (*Cepaea nemoralis*) and White Heath Snail (*Xerolenta obvia*) may also negatively affect native snail populations by altering the soil composition, reducing the leaf litter layer and competing for habitat and food resources. Further research on the inter-specific interactions with exotic snails or slugs are needed to determine the impact and severity of this potential threat on the Proud Globelet. Climate change may also pose a threat to Proud Globelet through the increase in temperature and extreme weather events such as droughts or heat waves. Filling knowledge gaps related to the species' physiological tolerances and ability to adapt to changing climate and soil conditions would help to further inform recovery efforts.

The knowledge gaps associated with the Proud Globelet are substantial. As a result, the government supports focussing efforts on determining whether the species is still extant in Ontario and undertaking research fill knowledge gaps related to the species' distribution, biology, habitat requirements and threats. If Proud Globelet is found to be extant, consideration should be given towards minimizing threats and managing the habitat as appropriate. Once further information is available about the species, this information may be used to review and adapt protection and recovery activities and the goal may be re-evaluated.

Government's Recovery Goal

The government's goal for the recovery of Proud Globelet is to support the persistence of the species in Ontario and fill knowledge gaps related to the current state of the species, its habitat and threats in Ontario.

Actions

Protecting and recovering species at risk is a shared responsibility. No single agency or organization has the knowledge, authority or financial resources to protect and recover all of Ontario's species at risk. Successful recovery requires inter-governmental cooperation and the involvement of many individuals, organizations and communities. In developing the government response statement, the government considered what actions are feasible for the government to lead directly and what actions are feasible for the government to support its conservation partners to undertake.

Government-led Actions

To help protect and recover Proud Globelet, the government will directly undertake the following actions:

- Continue to implement the *Ontario Invasive Species Strategic Plan (2012)* to address the invasive species that may directly threaten the Proud Globelet.
- Educate other agencies and authorities involved in planning and environmental assessment processes on the protection requirements under the ESA.
- Encourage the submission of Proud Globelet data to the Ontario's central repository through the citizen science project that they receive data from (i.e., iNaturalist.ca) and directly through the Natural Heritage Information Centre.
- Undertake communications and outreach to increase public awareness of species at risk in Ontario.
- Continue to protect Proud Globelet and its habitat through the ESA.
- Support conservation, agency, municipal and industry partners, and Indigenous communities and organizations to undertake activities to protect and recover Proud Globelet. Support will be provided where appropriate through funding, agreements, permits (including conditions) and/or advisory services.
- Encourage collaboration, and establish and communicate annual priority actions for government support in order to reduce duplication of efforts.
- Conduct a review of progress toward the protection and recovery of Proud Globelet within five years of the publication of this document.

Government-supported Actions

The government endorses the following actions as being necessary for the protection and recovery of Proud Globelet. Actions identified as “high” may be given priority consideration for funding under the Species at Risk Stewardship Program. Where reasonable, the government will also consider the priority assigned to these actions when reviewing and issuing authorizations under the ESA. Other organizations are encouraged to consider these priorities when developing projects or mitigation plans related to species at risk.

Focus Area: Inventory and Monitoring

Objective: Increase knowledge of Proud Globelet presence in Ontario and if located, improve knowledge of existing populations, their habitat and site-specific threats.

The first step in supporting recovery of Proud Globelet is to determine whether the species is still extant in Ontario. Standardized surveys are required to confirm the presence of the species in areas where shells have been found and to survey in additional areas with suitable habitat. Involvement of volunteers including species experts, naturalists and land stewards should also be encouraged to maximize efforts. If any live individuals are found, monitoring of their status, habitat conditions and site-specific threats will be important to inform future recovery efforts.

Actions:

1. **(High)** Identify areas with potentially suitable habitat for Proud Globelet using modeling techniques and local knowledge to inform survey efforts.
2. **(High)** Develop, implement and promote a standardized survey protocol to survey for the presence/absence of Proud Globelet in Ontario and determine whether the species is currently extant. Surveys should:
 - be supplemented with identification material to accurately distinguish this species from other terrestrial snails; and,
 - prioritize survey efforts in and around areas where shells have previously been found or reported (e.g., Black Oak Heritage Forest, Bois Blanc Island) and in additional areas with suitable habitat.
3. At locations where the species is found to be present, develop and implement a monitoring protocol that includes inventory and monitoring of populations, habitat conditions and site-specific threats.
4. Engage volunteers to participate in surveys for this species to determine its presence or absence including citizen science programs (e.g., iNaturalist).

Focus Area: Research

Objective: Improve knowledge of the Proud Globelet biology, habitat requirements and threats.

Very little is known about the biology, habitat requirements and threats to the Proud Globelet throughout its global range. Further understanding of the life history traits of Proud Globelet such as diet, reproduction, dispersal, interspecific interactions with introduced species and physiological tolerances to changes in climate and soil conditions will be necessary to help inform recovery efforts. Research should be done in collaboration with the United States on extant populations to help identify causes of declines and requirements needed for persistence. Additional research is also needed to identify the extent and severity of potential threats to the species and its habitat, including recreational trail use, pollution, introduced species and climate change, to help inform appropriate management actions.

Actions:

5. If found to be extant, undertake collaborative research to fill knowledge gaps related to the species' distribution, biology, habitat requirements and threats to inform recovery efforts.

Focus Area: Habitat Management and Awareness

Objective: Maintain and improve the habitat for Proud Globelet and increase the level public awareness and engagement in protecting and recovering the species.

If an extant population of Proud Globelet is confirmed in Ontario, efforts should be focused on maintaining and/or improving habitat and minimizing threats. The Proud Globelet may be impacted by several threats including pollution, intensive recreational trail use and introduced species which can damage or destroy existing habitat. As specific habitat and life history requirements for this species are investigated, implementing actions to effectively mitigate and manage habitat will support the protection and recovery of this species. Increasing public awareness of this species and encouraging participation in management will also contribute towards recovery efforts.

Actions:

6. At locations where the species is found to be present, maintain and/or improve habitat by undertaking activities to minimize threats to the species and manage the habitat, as appropriate. Emphasis should be placed on:
 - identifying and mitigating threats affecting the species, such as minimizing impacts from human-caused disturbances (e.g., recreational trail use) and threats posed by introduced species;

- identifying opportunities for habitat creation, restoration and/or enhancement including creating refuge areas to improve available habitat; and,
 - working with partners where the species is found to effectively manage the habitat, where appropriate (e.g., Black Oak Heritage Forest).
7. Develop education and outreach material to promote the awareness of the species at existing locations. Information should include:
- how to identify the species;
 - protection afforded to the species and its habitat under the ESA; and,
 - actions that can be taken to avoid or minimize impacts to the species and its habitat including preventing garbage dumping and trampling.

Implementing Actions

Financial support for the implementation of actions may be available through the Species at Risk Stewardship Program. Conservation partners are encouraged to discuss project proposals related to the actions in this response statement with the program staff. The Ontario government can also advise if any authorizations under the ESA or other legislation may be required to undertake the project.

Implementation of the actions may be subject to changing priorities across the multitude of species at risk, available resources and the capacity of partners to undertake recovery activities. Where appropriate, the implementation of actions for multiple species will be coordinated across government response statements.

Reviewing Progress

The ESA requires the Ontario government to conduct a review of progress towards protecting and recovering a species no later than the time specified in the species' government response statement, or not later than five years after the government response statement is published if no time is specified. The review will help identify if adjustments are needed to achieve the protection and recovery of Proud Globelet.

Acknowledgement

We would like to thank all those who participated in the development of the Recovery Strategy for the Proud Globelet (*Patera pennsylvanica*) in Ontario for their dedication to protecting and recovering species at risk.

For additional information:

Visit the species at risk website at ontario.ca/speciesatrisk

Contact the Ministry of the Environment, Conservation and Parks

1-800-565-4923

TTY 1-855-515-2759

www.ontario.ca/environment