

# Report on the Progress of Action Plan Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2018 to 2022

## Hotwater Physa



2025

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## Preface

The *Species at Risk Act* (S.C. 2002, c.29) (SARA), requires reporting on the implementation of the action plan for a species at risk (via a progress report) 5 years after the final action plan was published on the Species at Risk Public Registry. This reporting must be done by the competent Minister.

The Minister of Fisheries is the competent minister under SARA for Hotwater Physa and has prepared this progress report.

Reporting on the progress of action plan implementation requires reporting on the collective efforts of the competent minister, provincial and territorial governments, and all other parties involved in conducting activities that contribute to the species' recovery. An action plan provides the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. Some of the identified broad strategies and recovery measures are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a report on the progress of action plan implementation.

As stated in the preamble to SARA, success in the recovery of species at risk depends on the commitment and cooperation of many different groups that will be involved in implementing the directions set out in the recovery strategy and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. The cost of recovering species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy and action plan for the benefit of Hotwater Physa and Canadian society as a whole.

## Acknowledgments

This progress report was prepared by Emma Branquinho (Fisheries and Oceans Canada [DFO]) with input from Maggie Boothroyd (DFO), Ahdia Hassan (DFO), Oliver Barker (DFO), Rowshyra Castaneda (DFO), and Heather Bettger (DFO). To the extent possible, this progress report has been prepared with input from the Government of British Columbia. DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of Hotwater Physa.

## Executive summary

Hotwater Physa (*Physella wrighti*) was listed as endangered under the *Species at Risk Act* (SARA) in 2003. The “Action Plan for the Hotwater Physa (*Physella wrighti*) in Canada” was finalized and published on the [Species at Risk Public Registry](#) in 2018 ([Fisheries and Oceans Canada \(DFO\) 2018](#)). The action plan provided detailed recovery planning that supports the strategic direction set out in the “Recovery Strategy for the Hotwater Physa (*Physella wrighti*) in Canada”, which was finalized and published on the Species at Risk Public Registry in 2007 ([Heron 2007](#)). Two progress reports on recovery strategy implementation have been published, the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2007 – 2015”, which was published in 2016 ([DFO 2016](#)) and the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2016 to 2021”, which was published in 2022 ([DFO 2022](#)).

The main threats identified for Hotwater Physa include: change to the flow regime as a result of human activities; introduction of deleterious substances; physical habitat destruction or alteration; introduced species; and collecting.

The action plan outlines recovery measures that provide the best chance of achieving the recovery goal. The recovery goal for Hotwater Physa is to maintain and protect the population(s) of the species within its natural geographic range and within its current variation of abundance at the Liard River Hot Springs complex.

The “Report on the Progress of Action Plan Implementation for Hotwater Physa (*Physella wrighti*) in Canada for the Period 2018 to 2022” reports on the progress made by DFO and its partners towards implementing the action plan and achieving its objectives. During this time period, progress has been made in:

- surveys at Liard River Hot Springs Provincial Park (LRHSPP) to assess population and habitat status and to collect baseline data for future monitoring of threat impacts
- aerial imaging and mapping of the LRHSPP to increase knowledge of the hot springs complex
- genetic studies to investigate taxonomy of Hotwater Physa
- research on captive rearing to investigate life history parameters and fill knowledge gaps of Hotwater Physa
- threats monitoring including collection of data to assess potential impacts of recreational users in LRHSPP
- educating park users on Hotwater Physa and its threats through the design and installation of signage throughout LRHSPP

The status of the species is believed to be stable based on continued detection during periodic monitoring, however, population abundance and distribution trend data were not available during the reporting period. Further work is required to support the survival and recovery of Hotwater Physa and its habitat. Priority next steps may include, but are not limited to: updating standardized protocols for population, habitat, and distribution surveys, long-term monitoring of population and habitat parameters, continuing development of the updated park management plan for LRHSPP, developing a threats monitoring plan, monitoring of recreational users to assess potential impacts, and research to address knowledge gaps including critical habitat attributes, potential parasites, life history parameters, and taxonomy.

DFO remains committed to the survival and recovery of Hotwater Phyllis. Work started and completed to date has built a strong foundation for continued research and recovery of this species. Progress made to date would not have been achieved without the contributions of our partners. DFO looks forward to continued collaboration and welcomes the participation of additional partners.

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# 1 Introduction

The “Report on the Progress of Action Plan Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2018 to 2022” (herein referred to as the progress report) outlines the progress made towards meeting the recovery measures listed in the “Action Plan for the Hotwater Physa (*Physella wrighti*) in Canada” (herein referred to as the action plan; [Fisheries and Oceans Canada \[DFO\] 2018](#)) during the indicated time period. The action plan provides the detailed recovery planning that supports the strategic direction set out in the “Recovery Strategy for the Hotwater Physa (*Physella wrighti*) in Canada” (herein referred to as the recovery strategy; [Heron 2007](#)). This progress report is part of a series of documents for this species that are linked and should be taken into consideration together; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report ([COSEWIC 2008](#)), the “Recovery Potential Assessment for the Hotwater Physa (*Physella wrighti*)” ([DFO 2009](#)), the recovery strategy (Heron 2007), the action plan (DFO 2018), the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2007 – 2015” ([DFO 2016](#)), and the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2016 to 2021” ([DFO 2022](#)).

Section 2 of the progress report provides an overview of key information on the threats to the species, recovery goal and recovery objectives, and recovery measures. For more details, readers should refer back to the recovery strategy and action plan. Section 3 reports on the progress made towards the recovery measures identified in the action plan that support achieving the recovery goal and recovery objectives identified in the recovery strategy.

## 2 Background

### 2.1 COSEWIC assessment summary and threats to the species and its critical habitat

The listing of Hotwater Physa as endangered under the *Species at Risk Act* (SARA) in 2003 led to the development and publication of the recovery strategy in 2007 and the action plan in 2018 (Heron 2007; DFO 2018). The recovery strategy and action plan are consistent with the information provided in the COSEWIC status report (Lee and Ackerman 1998) and the COSEWIC summary information is included below.

In 2008, COSEWIC re-examined and confirmed the status of Hotwater Physa as endangered (COSEWIC 2008).

**Assessment summary - April 2008****Common name**

Hotwater Physa

**Scientific name***Physella wrighti***Status**

Endangered

**Reason for designation**

This small snail is an endemic species living only within the hotsprings complex located in Liard River Hotsprings Provincial Park in British Columbia. The population is small, numbering fewer than 10,000 individuals and occupies an extremely restricted habitat around the margins of two pools and an outlet stream. Population size is believed to fluctuate by at least an order of magnitude in this short-lived snail (~1 year lifespan). The species is a habitat specialist requiring geothermally regulated water and substrates near the water/air interface in areas of no current. The hotsprings complex has been in use by humans for over 200 years. The species has survived structural modification and maintenance of the pools, the introduction of foreign substances such as soaps and shampoos and trampling. However a single event such as abrupt changes in water flow, chemical contamination or introduction of exotic species, could significantly affect persistence of this snail.

**Occurrence**

British Columbia

**Status history**

Designated endangered in April 1998. Status re-examined and confirmed in May 2000 and April 2008. Last assessment based on an updated status report.

Section 1.1 of the action plan provides information on the threats to the species' survival and recovery. These threats include: change to the flow regime as a result of human activities; introduction of deleterious substances; physical habitat destruction or alteration; introduced species; and collecting.

Critical habitat for Hotwater Physa was identified, to the extent possible, in section 2 of the action plan (DFO 2018). The action plan also provides examples of activities that are likely to result in destruction of critical habitat (that is, threats to critical habitat). The list of activities provided in table 4 of the action plan is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the recovery strategy and action plan. Refer to the action plan for more details on the activities likely to result in the destruction of critical habitat.

## 2.2 Recovery

This section summarizes the information, found in the recovery strategy (Heron 2007) and the action plan (DFO 2018), on the recovery goal and recovery objectives. As stated in section 4 of the action plan, reporting on implementation will be done by assessing progress toward implementing the broad strategies identified in the recovery strategy (DFO 2018).

Section 1 of the action plan restates the following recovery goal and objectives necessary for the recovery of the species, which were identified in the recovery strategy:

### Recovery goal

Maintain and protect the population(s) of Hotwater Physa within its natural geographic range and within its current variation of abundance at the Liard River Hot Springs complex.

### Recovery objectives<sup>1</sup>

1. to observe that the species' current distribution<sup>2</sup> within the Alpha and Beta pools and streams is maintained, and to refine the understanding of the current distribution to better quantify this objective by 2011; and,
2. to observe that the species' current relative abundance is maintained, and to develop methodology that increases survey precision by 2011

## 3 Progress towards recovery

The recovery strategy (Heron 2007) for Hotwater Physa divides the recovery effort into 5 broad strategies, and the action plan identifies 12 associated recovery measures (RM; see tables 1 and 2 in the action plan; DFO 2018):

### Broad strategy 1: monitoring

- Recovery measure 1: establish, refine, and implement standardized protocols for Hotwater Physa:
  - population monitoring at index sites
  - habitat occupancy and distribution surveys (including areas where the species is not known to occur)

### Broad strategy 2: protection

- Recovery measure 6: evaluate the necessity for and implement the means to regulate recreational activities within Liard River Hot Springs Provincial Park
- Recovery measure 7: monitor the dimensions of upper and lower Alpha Pool to ensure that bankside erosion is minimal, and that contours, size, shape and dimensions of the pools are maintained
- Recovery measure 8: consider incorporation of provisions regarding Hotwater Physa management and protection outlined in this Action Plan into:
  - the Liard River Hot Springs Provincial Park Master Plan when it is updated

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<sup>1</sup> Recovery objectives are time bound in the recovery strategy but apply beyond 2011.

<sup>2</sup> The Action Plan takes into consideration the expansion of Hotwater Physa distribution into additional locations within Liard River Hot Springs Provincial Park subsequent to the publication of Heron (2007); however, these locations are not identified herein to protect Hotwater Physa.

- any park policy or management documents developed in the future (including facility maintenance, compliance, and enforcement practices)
- any land use planning documents that would affect the park area
- Recovery measure 9: investigate, and apply as appropriate, mechanisms for the protection of the hot springs' recharge zone and the potential groundwater pathways between the recharge zone and the hot springs (outside of Liard River Hot Springs Provincial Park)
- Recovery measure 10: develop and apply appropriate standards and guidelines to mitigate potential impacts from oil and gas, mineral and geothermal exploration and extraction activities to the geothermal source of the hot springs

#### Broad strategy 3: threats monitoring

- Recovery measure 2: develop and implement a threats monitoring plan to provide for a clear indication of the progress towards maintaining and protecting the population(s) of Hotwater Physa within its natural geographic range and within its current variation of abundance at Liard River Hot Springs. Monitoring efforts may include:
  - water quality parameters (for example, oxygen, temperature and pH)
  - population trends and distribution of the hot springs complex aquatic communities (ecological dynamics)
  - introductions of invasive / exotic species
  - physical changes to critical habitat
- Recovery measure 5: monitor park users' behaviour for activities that are detrimental to Hotwater Physa or its critical habitat. Record and report any incidents to DFO

#### Broad strategy 4: knowledge gaps

- Recovery measure 3: identify, prioritize, and address a list of knowledge gaps for Hotwater Physa. This may include, but is not limited to, activities derived from technical reports (for example, Salter 2001), peer-reviewed literature, or operational documents, for example:
  - specific parameters of existing critical habitat attributes; potential parasites (for example, leeches) and predators (for example, ducks, geese, toads) of Hotwater Physa
  - effectiveness of artificial substrates as habitat
  - Hotwater Physa natural history (for example, reproduction, growth rates, population cycles, feeding preferences, and behavior)
  - systematics and taxonomy of Hotwater Physa and related species
- Recovery measure 4: conduct a detailed hydrogeological and geomorphological survey to refine knowledge about the geothermal source of Liard River Hot Springs and its pathways, which specifically:
  - characterizes shallow and deep groundwater regimes
  - assesses short and long term risks of any modification to these groundwater regimes and geological structures, and their subsequent influence over the recharge zone

#### Broad strategy 5: park education

- Recovery measure 11: promote Liard River Hot Springs Provincial Park regulations and best practices to park users, and encourage them to avoid:
  - actions that could result in introductions that may harm individuals or their habitat, for example:
    - use of personal care products (for example, sunscreen or insect repellent, perfumes, shampoo, soap, etc.)
    - spilling of beverages or other substances

- introducing copper (for example, tossing pennies)
  - introduction of non-native exotic species such as carp, fairy shrimp, turtles or other aquarium trade species
  - actions that could result in changes to water quality, levels or flows; and
  - harm to individual Hotwater Physa
- Recovery measure 12: ensure that park staff and any other relevant staff from provincial ministries are aware of the presence of Hotwater Physa within the park, its status under SARA and any relevant provisions from the Hotwater Physa Recovery Strategy and this Action Plan intended to protect the species and its habitat

Progress in carrying out these broad strategies and recovery measures is reported in section 3.1.

### 3.1 Activities supporting recovery

Table 1 provides information on the implementation of activities undertaken to address the broad strategies and recovery measures identified in the recovery strategy and the action plan, respectively (DFO 2018; Heron 2007). A number of recovery activities were implemented prior to 2018 and progress has been documented in the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2007 to 2015” (DFO 2016) and the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2016 to 2021” (DFO 2022).

**Table 1. Details of activities supporting the recovery of Hotwater Physa from 2018 to 2022.**

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
1	1: Monitoring	1: Establish, refine, and implement standardized protocols for Hotwater Physa: <ul style="list-style-type: none"> <li>• population monitoring at index sites; and</li> <li>• habitat occupancy and distribution surveys (including areas where the species is not known to occur)</li> </ul>	<p>A standardized monitoring protocol has not been established during the reporting period. However, the 2011 monitoring protocols (Lauzier et al. 2011) have been informally amended to reduce impacts to Hotwater Physa habitat (Heron pers. comm. 2023). Example amendments include placing an aquarium in the water for visualization while sampling snails and accessing survey sites through banks rather than wading through streams (Heron pers. comm. 2023).</p> <p>Hotwater Physa are counted and relocated during routine cleaning and maintenance of the upper and lower Alpha Pools of Liard River Hot Springs Provincial Park (LRHSPP) throughout each year; counts and observations suggest the population and habitat condition appeared stable over the reporting period (Batho pers. comm. 2024).</p> <p>Annual field studies, conducted between 2014</p>	BC’s Ministry of Environment and Climate Change Strategy, which includes BC Parks (BC ENV), <b>BC WLRS</b>

<sup>3</sup> When more than one participant is associated with implementation of a recovery measure, they are listed in alphabetical order and the lead is bolded.

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
			<p>and 2021 by the Province of British Columbia’s Ministry of Water, Land and Resource Stewardship (BC WLRS), collected population and habitat data that may inform the development of standardized protocols (Heron and Wilson pers. comm. 2023). Outcomes and results of the field studies include:</p> <ul style="list-style-type: none"> <li>• increased precision for distribution and habitat characterization surveys, which contributed to improved field data collection for Hotwater Physa</li> <li>• collection of distribution and population information for Hotwater Physa in LRHSPP and nearby springs<sup>4</sup></li> <li>• aerial imaging and mapping of the aquatic footprint of LRHSPP to provide more detailed data on the hot springs complex</li> <li>• characterization of Hotwater Physa habitat at LRHSPP through water quality and physical habitat data collection</li> <li>• initial data indicates other suitable habitat for Hotwater Physa is likely present throughout LRHSPP</li> </ul>	

<sup>4</sup> Toad River Hot Springs and Deer River Hot Springs. Data was also gathered from Beta, Gamma, Delta, Epsilon pools, and connecting streams within Liard Hot Springs.

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
2	2: Protection	6: Evaluate the necessity for and implement the means to regulate recreational activities within Liard River Hot Springs Provincial Park	<p>Field studies conducted by BC WLRS provide baseline information to assess potential impacts of recreational users on Hotwater Physa and its habitat (refer to row 1).</p> <p>Access to Hotwater Physa habitat is restricted using regulations provided under the <i>Park Act</i>. Park public access, yearly maintenance, and management is regulated by BC ENV. Recreational use is restricted to upper and lower Alpha Pool, which constitutes a small portion of the critical habitat. There is no public access to the remainder of the hot springs, wetlands, and pools within the LRHSPP.</p> <p>Critical habitat for Hotwater Physa was identified in the action plan (<a href="#">DFO 2018</a>). Legal protection was established through a critical habitat order made under the <i>Species at Risk Act</i> (SARA) in 2019, which prohibits its destruction. Activities likely to result in the destruction of critical habitat include threats related to recreational use, such as the introduction of deleterious substances, damage to the integrity of the pools, in-stream wading, and the deliberate or inadvertent introduction of non-native aquatic species.</p> <p>Any maintenance works that may impact Hotwater Physa critical habitat requires permitting by Fisheries and Oceans Canada (DFO) under SARA. Maintenance is typically limited to recreational use areas (for example, Alpha Pool).</p>	BC ENV, BC WLRS, DFO

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
3	2: Protection	7: Monitor the dimensions of upper and lower Alpha Pool to ensure that bankside erosion is minimal, and that contours, size, shape and dimensions of the pools are maintained	There has been no quantitative monitoring of the dimensions of upper and lower Alpha Pool. However, anecdotal observations suggest the upper and lower Alpha Pools may have widened. This may be due to recreational users intentionally and unintentionally removing wall substrates and bank undercutting in the lower Alpha Pool from waves caused by recreational users (Heron pers. comm. 2023). There has been no observation of lengthening of the pool (Heron pers. comm. 2023).	<b>BC WLRS</b>
4	2: Protection	8: Consider incorporation of provisions regarding Hotwater Physa management and protection outlined in this Action Plan into: <ul style="list-style-type: none"> <li>• the Liard River Hot Springs Provincial Park Master Plan when it is updated</li> <li>• any park policy or management documents developed in the future (including facility maintenance, compliance, and enforcement practices)</li> <li>• and, any land use planning documents that would affect the park area</li> </ul>	An updated park management plan for LRHSPP is being developed by BC Parks to replace the 1990 Master Plan, which is now outdated (BC Parks 2020; Batho and Somerville pers. comm. 2023). The draft plan considers long-term management priorities for LRHSPP including the effective management of Hotwater Physa within the park (Somerville. pers. comm. 2023). An online public comment period to solicit input on the updated plan was held between May to September 2020 (BC Parks 2020).  A weir maintenance protocol is in place at LRHSPP; park contractors monitor the weir and take appropriate action to maintain its integrity as recommended by weir engineers (Batho pers. comm. 2024).	<b>BC ENV</b>

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
5	2: Protection	9: Investigate, and apply as appropriate, mechanisms for the protection of the hot springs' recharge zone and the potential groundwater pathways between the recharge zone and the hot springs (outside of Liard River Hot Springs Provincial Park)	Mechanisms for the protection of the hot springs' recharge zone and potential groundwater pathways between the recharge zone and the hot springs have not been investigated during the reporting period.	N/A
6	2: Protection	10: Develop and apply appropriate standards and guidelines to mitigate potential impacts from oil and gas, mineral and geothermal exploration and extraction activities to the geothermal source of the hot springs	<p>Guidelines to mitigate the potential impacts to geothermal sources have not been developed during the reporting period.</p> <p>A Resource Review Area has been established for the protection of Hotwater Physa around LRHSPP, which restrict the sale of new tenure for subsurface petroleum and natural gas rights (Connolly pers. comm. 2024).</p>	<b>BC ENV</b> , BC Ministry of Energy, Mines and Low Carbon Innovation
7	3: Threats monitoring	<p>2: Develop and implement a threats monitoring plan to provide for a clear indication of the progress towards maintaining and protecting the population(s) of Hotwater Physa within its natural geographic range and within its current variation of abundance at Liard River Hot Springs. Monitoring efforts may include:</p> <ul style="list-style-type: none"> <li>• water quality parameters (for example, oxygen, temperature and pH)</li> <li>• population trends and distribution of the hot springs complex aquatic communities (ecological dynamics)</li> <li>• introductions of invasive / exotic species; and</li> <li>• physical changes to critical</li> </ul>	<p>A threat monitoring plan has not been developed during the reporting period. However, a number of activities have been conducted that have provided information on threats and provide a baseline for monitoring threat impacts.</p> <p>Field studies conducted since 2014 provide baseline information of Hotwater Physa and their habitat to assess potential impacts of threats to the physical habitat (Heron pers. comm. 2023; refer to row 1). Water samples periodically collected by BC WLRS have had minimal concentrations of deleterious substances, indicating a negligible impact on Hotwater Physa (Finlay pers. comm. 2020; Heron and Wilson pers. comm. 2023)</p> <p>Captive rearing studies at the Royal Saskatchewan Museum increased</p>	<b>BC ENV</b> , <b>BC WLRS</b> , Royal Saskatchewan Museum, University of Regina

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
		habitat	<p>understanding on how water temperature fluctuations affect life history parameters, including movement and amount of egg laying (Helmond et al. 2023). These captive breeding techniques could be effective in supporting an external breeding program to assist with a quick response plan for Hotwater Physa in the case of a catastrophic event (Helmond et al. 2023).</p> <p>Park contractors and Park Rangers regularly patrol the LRHSPP day use area (Alpha Pool), and periodically patrol areas closed to the public, to protect against deleterious substance introduction and to remove introduced materials (Batho pers. comm. 2024).</p> <p>Clearing of vegetation adjacent to boardwalks (to prevent human-wildlife conflict) is documented and depth of bank undercutting is measured to help inform and monitor impacts related to riparian structure changes (Heron pers. comm. 2023).</p> <p>There has been informal documentation of terrestrial invasive plants at LRHSPP (Batho pers. comm. 2020). Invasive species management objectives will likely be incorporated into the new management plan for LRHSPP (Somerville. pers. comm. 2020).</p> <p>BC has 2 regulatory documents which provide the provincial framework for invasive species management: the Invasive Species Strategy (from 2018 to 2022; Invasive Species Strategy for British Columbia 2017), and the Invasive Species Strategic Plan (Invasive Species</p>	

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
			Strategic Plan 2014). These documents provide guidance for preventing and managing threat of introduced species for Hotwater Physa.	
8	3: Threats monitoring	5: Monitor park users' behaviour for activities that are detrimental to Hotwater Physa or its critical habitat. Record and report any incidents to DFO.	<p>Park contractors and Park Rangers regularly patrol within the park, both within day-use areas (Alpha Pool) and those closed to the public (Batho pers. comm. 2024; refer to row 7).</p> <p>Field studies conducted since 2014 have helped characterize Hotwater Physa habitat requirements and provide baseline information to assess potential impacts of physical habitat changes by humans (refer to rows 1 and 7).</p>	<b>BC ENV, BC WLRS</b> , Royal Saskatchewan Museum, University of Regina
9	4: Knowledge gaps	<p>3: Identify, prioritize, and address a list of knowledge gaps for Hotwater Physa. This may include, but is not limited to, activities derived from technical reports (for example, Salter 2001), peer-reviewed literature, or operational documents, for example:</p> <ul style="list-style-type: none"> <li>• specific parameters of existing critical habitat attributes</li> <li>• potential parasites (for example, leeches) and predators (for example, ducks, geese, toads) of Hotwater Physa</li> <li>• effectiveness of artificial substrates as habitat</li> <li>• Hotwater Physa natural history (for example, reproduction, growth rates, population cycles, feeding preferences, and behavior); and</li> <li>• systematics and taxonomy of</li> </ul>	<p>Initial data from DNA barcoding suggests that Hotwater Physa in LRHSPP are genetically similar to physids found in Deer River Hotsprings (Heron and Wilson pers. comm. 2021). A phylogenetic tree of physids is in development (Heron pers. comm. 2023).</p> <p>BC ENV and the Royal Saskatchewan Museum, in collaboration, are using haplotype mapping and genetic barcoding to investigate hot spring snails genetics across multiple populations in the United States and Canada to determine whether Hotwater Physa should be considered a distinct species or a designatable unit of the Tadpole Snail (<i>Physella gyrina</i>; Sheffield. pers. comm. 2020; Heron pers. comm. 2023).</p>	<b>BC ENV, BC WLRS</b> , Royal Saskatchewan Museum, University of Regina

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
		Hotwater Physa and related species		
10	4: Knowledge gaps	4: Conduct a detailed hydrogeological and geomorphological survey to refine knowledge about the geothermal source of Liard River Hot Springs and its pathways, which specifically: <ul style="list-style-type: none"> <li>• characterizes shallow and deep groundwater regimes; and</li> <li>• assesses short and long term risks of any modification to these groundwater regimes and geological structures, and their subsequent influence over the recharge zone</li> </ul>	A hydrogeological and geomorphological survey has not been conducted during the reporting period.	N/A
11	5: Park education	11: Promote Liard River Hot Springs Provincial Park regulations and best practices to park users, and encourage them to avoid: <ul style="list-style-type: none"> <li>• actions that could result in introductions that may harm individuals or their habitat, for example:                             <ul style="list-style-type: none"> <li>○ use of personal care products (for example, sunscreen or insect repellent, perfumes, shampoo, soap, etc.)</li> <li>○ spilling of beverages or other substances</li> <li>○ introducing copper (for example, tossing pennies)</li> <li>○ introduction of non-</li> </ul> </li> </ul>	Hotwater Physa educational signage was designed and installed at LRHSPP (Tattam pers. comm. 2020).  DFO and BC ENV collaboratively designed Hotwater Physa, educational signage to replace existing outdated signage (Tattam pers. comm. 2020). One sign was installed at the pools and 2 more are planned for installation within LRHSPP (Bettger pers. comm. 2024).  Informational signage is present within the park encouraging users to shower before entering the hot pools. However, public showers are not available at LRHSPP (Tattam pers. comm. 2020).  A portable “mini-museum” for Hotwater Physa was designed and presented in 2017 at	BC ENV, DFO, Royal BC Museum

#	Broad strategy	Recovery measure	Descriptions and results	Participants <sup>3</sup>
		<p>native exotic species such as carp, fairy shrimp, turtles or other aquarium trade species</p> <ul style="list-style-type: none"> <li>actions that could result in changes to water quality, levels or flows; and</li> <li>harm to individual Hotwater Physa</li> </ul>	<p>LRHSPP, which can be loaned out to help raise awareness for Hotwater Physa recovery (Gough. pers. comm. 2020).</p> <p>A community outreach presentation regarding the biology and conservation of Hotwater Physa was delivered in 2019, in Prince George, BC by the Royal BC Museum (Choong. pers. comm. 2020).</p>	
12	5: Park education	12: Ensure that park staff and any other relevant staff from provincial ministries are aware of the presence of Hotwater Physa within the park, its status under SARA and any relevant provisions from the Hotwater Physa Recovery Strategy and this Action Plan intended to protect the species and its habitat	<p>LRHSPP staff receive informal training through virtual presentations as part of the onboarding process to inform of Hotwater Physa and critical habitat area present within LRHSPP (Heron pers. comm. 2023).</p> <p>LRHSPP staff receive training in how to safely and effectively capture and relocate Hotwater Physa from cleaning areas prior to periodic algae removal maintenance within the Alpha Pool (Batho pers. comm. 2024).</p>	BC ENV, BC WLRS

### 3.1.1 Critical habitat identification and protection

Critical habitat for Hotwater Physa was identified to the extent possible, using the best available scientific information in section 2 of the action plan (DFO 2018). The schedule of studies to identify critical habitat, included in the recovery strategy, were completed and reported on in the “Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2007 – 2015” (DFO 2016). Protection of Hotwater Physa critical habitat from destruction was accomplished in 2019 through a critical habitat order made under subsections 58(4) and (5), which invokes the prohibition in subsection 58(1) against the destruction of the identified critical habitat ([SOR/2019-21](#)).

### 3.1.2 Socio-economic impact

Under section 55 of SARA, the responsible federal minister is required to undertake “an evaluation of the socio-economic costs of the action plan and the benefits to be derived from its implementation”. This section summarizes the socio-economic costs and benefits associated with the implementing the recovery measures in the action plan between 2018 to 2022.

As per section 49(1)(e) of SARA, the action plan included a socio-economic evaluation of the costs of the action plan and the benefits to be derived from its implementation (section 3 of the action plan). Many of the economic costs associated with implementation of recovery measures have been, and will continue to be, borne by government agencies (for example, DFO, BC Parks, British Columbia’s Ministry of Water, Land and Resource Stewardship (BC WLRS)). The overall costs (financial and in-kind), as identified in the action plan, for DFO and collaborators are expected to be low. Costs and distribution of costs from implementation of guidelines, protocols, and protection implementation on potential future industrial activities are likely low (DFO 2018).

The socio-economic benefits that have resulted from the implementation of the action plan include contributing to meeting the population and distribution objectives for Hotwater Physa, as well as positive impacts on biodiversity and the value individuals place on preserving biodiversity (Federal, Provincial, Territorial Governments of Canada 2014). The implementation of the action plan also provides broader ecosystem benefits, as it relates to maintaining water quality and preventing aquatic invasive species.

A large part of the economic costs that are borne by the federal government for Hotwater Physa recovery are incurred through collaborative agreements between DFO and BC. Recovery implementation actions (maintaining water quality) and public outreach initiatives (installation of signage) are also likely to help in the recovery of Hotwater Physa.

### 3.1.3 Recovery feasibility

Recovery was determined to be feasible for Hotwater Physa within the recovery strategy (Heron 2007). No new information has been gathered that would suggest that Hotwater Physa no longer meet the recovery feasibility criteria laid out in the recovery strategy.

## 4 Concluding statement

Over the reporting period (2018 to 2022), through the implementation of activities supporting the broad strategies identified in the recovery strategy and their associated recovery measures identified in the action plan, progress has been made towards implementing the action plan and achieving its objectives for Hotwater Physa, including:

- surveys at Liard River Hot Springs Provincial Park (LRHSPP) to assess population and habitat status and to collect baseline data for future monitoring of threat impacts
- aerial imaging and mapping of the LRHSPP to increase knowledge of the hot springs complex
- genetic studies to investigate taxonomy of Hotwater Physa
- research on captive rearing to investigate life history parameters and fill knowledge gaps of Hotwater Physa
- threats monitoring including collection of data to assess impact of recreational users in the LRHSPP
- educating park users on Hotwater Physa and its threats through the design and installation of signage throughout LRHSPP

The status of the species is believed to be stable based on the continued detection through periodic monitoring, however, population abundance and distribution trends are not available. Further work is required to support the survival and recovery of Hotwater Physa and its habitat. Priority next steps may include, but are not limited to:

- refining and establishing standardized protocols for population, habitat, and distribution surveys for Hotwater Physa
- long-term monitoring of population and habitat parameters
- continuing development of the updated park management plan for LRHSPP
- developing a threats monitoring plan
- monitoring the impact of recreational users on Hotwater Physa and its habitat
- conducting research to address knowledge gaps for Hotwater Physa including critical habitat attributes, potential parasites, life history, and taxonomy

DFO remains committed to recovering Hotwater Physa. The work started and completed to date has built a strong foundation for continued research and recovery of this species. Progress made to date would not have been achieved without the contribution from our partners including BC WLRS, BC's Ministry of the Environment and Climate Change Strategy, including BC Parks, the University of Regina, Royal BC Museum, and Royal Saskatchewan Museum. DFO is looking forward to continuing this successful collaboration and welcomes the participation of additional partners.

## 5 References

- Batho, A., pers comm. 2020. Correspondence to M. McCabe. December 2020. Conservation Specialist – Omineca Peace Region. BC Parks and Conservation Officer Service Division, Prince George, British Columbia. Cited in DFO 2022.
- Batho, A. and A. Somerville., pers comm. 2023. Correspondence to E. Branquinho and M. Boothroyd. November 2023. Conservation Specialist and Planning Officer. BC Parks and Conservation Officer Service Division, Prince George, British Columbia.
- Batho, A., pers comm. 2024. Correspondence to E. Branquinho and M. Boothroyd. May 2024. Conservation Specialist – Omineca Peace Region. BC Parks and Conservation Officer Service Division, Prince George, British Columbia.
- BC (British Columbia) Parks. 2020. Liard River Hot Springs Management Plan. Retrieved October 2020.
- Bettger, H., pers comm. 2024. Correspondence to E. Branquinho and M. Boothroyd. March 2024. Senior Compliance Officer, DFO. Tofino, British Columbia.
- Choong, H., pers comm. 2020. Correspondence to M. McCabe. October 2020. Invertebrates Curator. Royal BC Museum. Victoria, British Columbia. Cited in DFO 2022.
- Connolly, A., pers comm. 2024. Correspondence to M. Boothroyd. August 2024. Senior Advisor. BC Ministry of Energy, Mines and Low Carbon Innovation. Resource Access and Stewardship Section, Victoria, British Columbia.
- COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2008. COSEWIC assessment and update status report on the Hotwater Physa *Physella wrighti* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. vii + 34 pp.
- DFO (Fisheries and Oceans Canada). 2010. Recovery potential assessment for Hotwater Physa (*Physella wrighti*). DFO Canadian Science Advisory Secretariat Science Advisory Report. 2009/072.
- DFO (Fisheries and Oceans Canada). 2016. Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2007 – 2015. *Species at Risk Act* Recovery Strategy Report Series. Fisheries and Oceans Canada, Ottawa. iii + 14 pp.
- DFO (Fisheries and Oceans Canada). 2018. Action Plan for the Hotwater Physa (*Physella wrighti*) in Canada. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa. iv + 22 pp.
- DFO (Fisheries and Oceans Canada). 2022. Report on the Progress of Recovery Strategy Implementation for the Hotwater Physa (*Physella wrighti*) in Canada for the Period 2016 to 2021. *Species at Risk Act* Recovery Strategy Report Series. Fisheries and Oceans Canada, Ottawa. iii + 20 pp.

- Federal, Provincial, and Territorial Governments of Canada. 2014. 2012 Canadian nature survey: Awareness, participation, and expenditures in nature-based recreation, conservation, and subsistence activities. Ottawa, ON: Canadian Councils of Resource Ministers. 188 pp.
- Finlay, K., pers comm. 2020. Correspondence to M. McCabe. November 2020. Associate Professor. University of Regina, Regina, Saskatchewan. Cited in DFO 2022.
- Gough, K., pers comm. 2020. Correspondence to M. McCabe. October 2020. Learning Program Developer. Royal BC Museum. Victoria, British Columbia.
- Helmond, E., K. Finlay, C. Sheffield, M. Hart, and J. Heron. 2023. Ascertaining the life history and thermal preferences and tolerances of the hot spring snail *Physella wrighti* Te and Clarke (Gastropoda: Physidae). Canadian Journal of Zoology 101:672-685.
- Heron, J. 2007. Recovery Strategy for the Hotwater Physa (*Physella wrighti*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vii + 27 pp.
- Heron, J. and Wilson, G., pers comm. 2021. Correspondence to M. McCabe. May 2021. Invertebrate Conservation Specialist and Aquatic Species-at-Risk Specialist, B.C. Ministry of Environment and Climate Change Strategy Series. Vancouver, British Columbia. Cited in DFO 2022.
- Heron, J. and G. Wilson., pers comm. 2023. Correspondence to E. Branquinho and M. Boothroyd. October 2023. Invertebrate Conservation Specialist and Aquatic Species-at-Risk Specialist, B.C. Ministry of Water, Land and Resource Stewardship. Vancouver, British Columbia.
- Heron, J., pers comm. 2023. Correspondence to E. Branquinho and M. Boothroyd. October 2023. Invertebrate Conservation Specialist, B.C. Ministry of Water, Land and Resource Stewardship. Vancouver, British Columbia.
- Invasive Species Strategic Plan. 2014. The BC Government Invasive Species Strategic Plan (BC Inter-Ministry Invasive Species Working Group). Retrieved May 28, 2021 from: [https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/imiswg/prov\\_is\\_strategy.pdf?v=1622150089677](https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/imiswg/prov_is_strategy.pdf?v=1622150089677)
- Invasive Species Strategy for British Columbia. 2017. Invasive Species Strategy for British Columbia 2018 – 2022. Retrieved May 28, 2021 from: [https://bcinvasives.ca/wp-content/uploads/2021/01/Invasive\\_Species\\_Strategy\\_for\\_BC-2018-180117-WEB.pdf](https://bcinvasives.ca/wp-content/uploads/2021/01/Invasive_Species_Strategy_for_BC-2018-180117-WEB.pdf)
- Lauzier, R., S.C. Davis, and J. Heron. 2011. Recovery potential assessment for Hotwater Physa (*Physella wrighti*). DFO Canadian Science Advisory Secretariat Research Document 2011/027. vi + 28 pp.

- Lee, J.S. and J.D. Ackerman. 1998. Status of the Hotwater Physa, *Physella wrighti* (Te and Clarke, 1985). Committee on the Status of Endangered Wildlife in Canada. Ottawa. iii + 22 pp.
- Salter, S.P. 2001. Management of hot water physa (*Physella wrighti*) in Liard River Hot Springs with observations on the Deer River and Grayling River Hotsprings. Report prepared for British Columbia Parks, Peace-Liard District, British Columbia. 38 pp.
- SOR/2019-21. *Species at Risk Act*. Critical Habitat of the Hotwater Physa (*Physella wrighti*) Order. Canada Gazette Part II, 153(3). Retrieved from the Canada Gazette website on Oct 13, 2021: <https://gazette.gc.ca/rp-pr/p2/2019/2019-02-06/html/sor-dors21-eng.html>
- Sheffield, C., pers comm. 2020. Correspondence to M. McCabe. November 2020. Curator of Invertebrate Zoology, Royal Saskatchewan Museum, Regina, Saskatchewan. Cited in DFO 2022.
- Somerville, A., pers comm. 2020. Correspondence to M. McCabe. November 2020. Planning Officer, BC Parks and Conservation Officer Service Division, Ministry of Environment and Climate Change Strategy, Prince George, British Columbia. Cited in DFO 2022.
- Somerville, A., pers comm. 2023. Correspondence to E. Branquinho and M. Boothroyd. November 2023. Planning Officer, BC Parks and Conservation Officer Service Division, Ministry of Environment and Climate Change Strategy, Prince George, British Columbia.
- Tattam, N., pers comm. 2020. Correspondence to M. McCabe. November 2020. Recreation Services Officer, BC Parks and Conservation Officer Service Division, Ministry of Environment and Climate Change Strategy, Fort St. John, British Columbia. Cited in DFO 2022.