



## Consultation on Species Listing Eligibility and Conservation Actions

### *Galaxias lanceolatus* (tapered galaxias)

You are invited to provide your views and supporting reasons related to:

- 1) the eligibility of *Galaxias lanceolatus* (tapered galaxias) for inclusion on the EPBC Act threatened species list in the Critically Endangered category; and
- 2) the necessary conservation actions for the above species.

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform on conservation actions and further planning. As such, the below draft assessment should be considered to be **tentative** as it may change following responses to this consultation process.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment.

Responses are to be provided in writing by email to:  
[species.consultation@environment.gov.au](mailto:species.consultation@environment.gov.au)

Please include species scientific name in Subject field.

or by mail to:

The Director  
Bushfire Affected Species Assessments Section  
Department of Agriculture, Water and the Environment  
John Gorton Building, King Edward Terrace  
GPO Box 858  
Canberra ACT 2601

**Responses are required to be submitted by 04 April 2022.**

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## General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at: <https://www.awe.gov.au/environment/biodiversity/threatened>.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at: <http://www.awe.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2021.pdf>.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at: <https://www.awe.gov.au/environment/biodiversity/threatened/nominations>.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at: <https://www.awe.gov.au/environment/biodiversity/threatened/recovery-plans>.

## Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the '[Common Assessment Method](#)' (CAM). As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: <https://www.awe.gov.au/about/commitment/privacy> .

### **Information about this consultation process**

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

## **Consultation questions for *Galaxias lanceolatus* (tapered galaxias)**

### **SECTION A - GENERAL**

1. Is the information used to assess the nationally threatened status of the species robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.
2. Can you provide additional data or information relevant to this assessment?
3. Have you been involved in previous state, territory or national assessments of this species? If so, in what capacity?

## **PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT**

### **SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SPECIES? (If no, skip to section C)**

#### **Biological information**

4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?
5. Do you have any additional information on the ecology or biology of the species/subspecies not in the current advice?

### **SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES? (If no, skip to section D)**

#### **Population size**

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.
7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the species? If not, please provide justification for your response.
8. If not, can you provide a further estimate of the current population size of mature adults of the species (national extent)? Please provide supporting justification or other information.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species numbers, and also choose the level of confidence you have in this estimate:

Number of mature individuals is estimated to be in the range of:

☐ <250 ☐ 250 – 1,000 ☐ 1,000 – 5,000 ☐ 5,000 – 10,000 ☐ >10,000

Level of your confidence in this estimate:

- ☐ 0–30% - low level of certainty/a bit of a guess/not much information to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, information suggests this range
- ☐ 95–100% - high level of certainty, information indicates quantity within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

**SECTION D**    **ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SPECIES? (If no, skip to section E)**

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

**Evidence of total population size change**

10. Are you able to provide an estimate of the total population size during the early 2010s (*at or soon after the start of the most recent three generation*)? Please provide justification for your response.

If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible species numbers, and also choose the level of confidence you have in this estimate.

Number of mature individuals is estimated to be in the range of:

- ☐ <250   ☐ 250 – 1,000   ☐ 1,000 – 5,000   ☐ 5,000 – 10,000   ☐ >10,000

Level of your confidence in this estimate:

- ☐ 0–30% - low level of certainty/a bit of a guess/not much information to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, information suggests this range
- ☐ 95–100% - high level of certainty, information indicates quantity within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

11. Are you able to comment on the extent of decline in the species' total population size over the last approximately 9 to 12 years (i.e. three generations)? Please provide justification for your response.

If, because of uncertainty, you are unable to provide an estimate of decline, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of decline, and also choose the level of confidence you have in this estimated range.

Decline estimated to be in the range of:

☐ 1–30% ☐ 31–50% ☐ 51–80% ☐ 81–100% ☐ 90–100%

Level of your confidence in this estimated decline:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, suggests this range of decline
- ☐ 95–100% - high level of certainty, information indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data are accurate within this range

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

**SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SPECIES? (If no, skip to section F)**

**Current Distribution/range/extent of occurrence, area of occupancy**

13. Does the assessment consider the entire geographic extent and national extent of the species? If not, please provide justification for your response.
14. Has the survey effort for this species been adequate to determine its national distribution? If not, please provide justification for your response.
15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.
16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.
17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy?

If, because of uncertainty, you are unable to provide an estimate of extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of extent of occurrence, and also choose the level of confidence you have in this estimated range.

**Current extent of occurrence** is estimated to be in the range of:

☐ <100 km<sup>2</sup> ☐ 100 – 200 km<sup>2</sup> ☐ 200 – 500 km<sup>2</sup> ☐ >500 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% - high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of area of occupancy, and also choose the level of confidence you have in this estimated range.

**Current area of occupancy** is estimated to be in the range of:

- ☐ <10 km<sup>2</sup> ☐ 10 – 100 km<sup>2</sup> ☐ 100 – 500 km<sup>2</sup> ☐ >500 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% - high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

**SECTION F ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SPECIES? (If no, skip to section G)**

**Past Distribution/range/extent of occurrence, area of occupancy**

18. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.
19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy?

If, because of uncertainty, you are unable to provide an estimate of past extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past extent of occurrence, and also choose the level of confidence you have in this estimated range.

**Past extent of occurrence** is estimated to be in the range of:

- ☐ <100 km<sup>2</sup> ☐ 100 – 200 km<sup>2</sup> ☐ 200 – 500 km<sup>2</sup> ☐ >500 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% - high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of past area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past area of occupancy, and also choose the level of confidence you have in this estimated range:

**Past area of occupancy** is estimated to be in the range of:

- ☐ <10 km<sup>2</sup> ☐ 10 – 100 km<sup>2</sup> ☐ 100 – 500 km<sup>2</sup> ☐ >500 km<sup>2</sup>

Level of your confidence in this estimated extent of occurrence:

- ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on
- ☐ 31–50% - more than a guess, some level of supporting evidence
- ☐ 51–95% - reasonably certain, data suggests this range of decline
- ☐ 95–100% - high level of certainty, data indicates a decline within this range
- ☐ 99–100% - very high level of certainty, data is accurate within this range

## **PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS**

### **SECTION G DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SPECIES? (If no, skip to section H)**

20. Do you consider that all major threats have been identified and described adequately?
21. To what degree are the identified threats likely to impact on the species in the future?
22. Are the threats impacting on different populations equally, or do the threats vary across different populations?
23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the species at any stage of its life cycle?
24. Can you provide supporting data/justification or other information for your responses to these questions about threats?



**SECTION H**    **DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SPECIES? (If no, skip to section I)**

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species? To what extent have they been effective?
26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the species?
27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species?

**SECTION I**    **DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES?**

28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?
29. Are you aware of any cultural or social importance or use that the species has?
30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the species?
31. How aware of this species are land managers where the species is found?
32. What level of awareness is there with individuals or organisations around the issues affecting the species?
  - a. Where there is awareness, what are these interests of these individuals/organisations?
  - b. Are there populations or areas of habitat that are particularly important to the community?

**PART 3 – ANY OTHER INFORMATION**

33. Do you have comments on any other matters relevant to the assessment of this species?



## Conservation Advice for *Galaxias lanceolatus* (tapered galaxias)

**This draft document is being released for consultation on the species listing eligibility and conservation actions**

The purpose of this consultation document is to elicit additional information to better understand the status of the species and help inform conservation actions, further planning and a potential recovery plan. The draft assessment below should therefore be considered **tentative** at this stage, as it may change as a result of responses to this consultation process.

Note: Specific consultation questions relating to the below draft assessment and preliminary determination have been included in the consultation cover paper for your consideration.

This document combines the approved conservation advice and listing assessment for the species. It provides a foundation for conservation action and further planning.



*Galaxias lanceolatus* (tapered galaxias) © Copyright, Tarmo A. Raadik

## Conservation status

*Galaxias lanceolatus* (tapered galaxias) is proposed to be listed in the Critically Endangered category of the threatened species list under the *Environment Protection and Biodiversity Conservation Act 1999*.

*Galaxias lanceolatus* was assessed by the Threatened Species Scientific Committee to be eligible for listing as Critically Endangered under criteria 1 and 2. The Committee's assessment is at Attachment A. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: A3ce: Critically Endangered
- Criterion 2: B1ab(i,ii,iii,iv,v): Critically Endangered
- Criterion 3: C2a(ii): Endangered
- Criterion 4: D Vulnerable
- Criterion 5: Insufficient data

The main factors that make the species proposed for listing in the Critically Endangered category are very severe population reduction, very restricted distribution and locations, and continuing decline due to multiple threats: introduced species, fire, climate change, and other habitat loss, disturbance and modification impacts. The species also has small population size.

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the [Species Profile and Threat Database](#).

## Species information

### Taxonomy

Conventionally accepted as *Galaxias lanceolatus* Raadik (2014).

*Galaxias lanceolatus* (tapered galaxias) was previously known as *Galaxias olidus* Günther (1866) (mountain galaxias), an unresolved species complex (Raadik 2011). In 2014, this complex was revised and subsequently this new taxon, tapered galaxias, was formally described (Raadik 2014).

### Description

The tapered galaxias (family Galaxiidae) is a small, native freshwater fish, which has an elongate, tubular and scaleless body with a lateral line and evenly arched dorsal and ventral profiles. The species commonly grows to 65–70 mm length to caudal fin (LCF) but can reach a maximum of 84 mm LCF and 6 g in weight. The body is predominantly brown to grey-brown on the back and upper sides above lateral line, becoming brown to tan on the lower lateral sides and light brown to cream ventrally; juveniles are paler. The body is overlain by diffuse, pale to dark brown blotches and long, narrow vertical to chevron bars, with a faint mid-lateral band of gold flecks. The head and snout are small and flattened, with a large mouth and copper eyes. The fins are soft-rayed, strongly rounded, translucent and grey. The gill cover is translucent with a small golden patch. This description is drawn from Raadik (2011, 2014).

The species can be distinguished from other species in the mountain galaxias complex by its comparatively flattened head/snout, and elongate body shape with evenly arched dorsal and ventral profiles (Raadik 2011, 2014).

## Distribution

### Current distribution

The tapered galaxias is a non-migratory, freshwater resident, which is endemic to Victoria (Vic) (Map 1). It is only known from the headwaters of Stoney Creek (approximately 340–545 m above sea level (ASL)), which is a tributary of the Thomson River catchment in West Gippsland (Thomson River Basin (River Basins of Victoria); Mitchell-Thomson River Region (Australian Hydrological Geospatial Fabric River Regions)) (Map 1) (Raadik 2011, 2014).

The tapered galaxias is the only species in the mountain galaxias complex known from Stoney Creek (Raadik 2014). *Galaxias gunaikurnai* (Shaw galaxias) also occurs in the Thomson River Basin, but it is geographically isolated by approximately 70 km to the north-east (Raadik 2014).

The tapered galaxias is known from a single subpopulation in the upper reaches of Stoney Creek, where it is estimated to occur over a 12 km long reach from upstream of Stoney No. 5 Track to 2.5 km downstream of Stoney No. 4 Track (Raadik 2021. pers comm 4 November). It has been collected from several sites between Stoney No. 4 Track and Stoney No. 5 Track (Raadik 2011; Raadik & Nicol 2013; Raadik 2014; Raadik 2021. pers comm 4 November). This equates to approximately 0.02 km<sup>2</sup> of habitat occupied by the species (Raadik 2021. pers comm 15 November). The species was not recorded further downstream below a natural instream barrier (waterfall), where the predatory brown trout (*Salmo trutta*) was present (Raadik 2011; Raadik & Nicol 2013; Raadik 2014).

Note: all distances (in km) are river distance.

Predation by introduced salmonids, including the brown trout and the rainbow trout (*Oncorhynchus mykiss*), has been implicated in the decline of *Galaxias* species throughout Australia, including other members of the mountain galaxias complex (Tilzey 1976; Wager & Jackson 1993; Cadwallader 1996; Lintermans 2000; McDowall 2006; Lintermans 2013; Lintermans et al. 2020). Predation on *Galaxias* species by introduced salmonids has been directly documented via gut contents analyses (Vidal et al. 2020) and the distribution of *Galaxias* species and salmonids are usually mutually exclusive (e.g. Tilzey 1976; Lintermans 2000), suggesting that *Galaxias* species have been eliminated by salmonid predation. Indeed, the role of salmonids in the fragmentation of *Galaxias* subpopulations has been well documented in Australia (Lintermans 2000; Raadik & Kuitert 2002; Green 2008b). So, it is likely the tapered galaxias only persists upstream of this barrier (Raadik & Nicol 2013; Raadik 2014; Threatened Species Recovery Hub 2018).

The tapered galaxias was not recorded elsewhere in the Thomson and La Trobe River catchments, nor further downstream in the Stoney Creek catchment (Raadik & Nicol 2013). It was not collected from a tributary that joined Stoney Creek downstream of Stoney No. 3 Track, Glenmaggie Creek and the headwaters of Mt Useful Creek (Raadik 2011; Raadik & Nicol 2013; Raadik 2014). Accordingly, the species is unlikely to occur more broadly than the headwaters of Stoney Creek.

### **Past distribution and decline**

The species is likely to have been historically more widespread and may have occupied the entire Stoney Creek system, portions of the Thomson River system (including the Deep Creek system) and possibly the lower Macalister River system (Raadik 2014).

The species' density declined at Stoney No. 5 Track due to sedimentation following fires (in 2007) and drought stress (Raadik & Nicol 2013), and at Stoney No. 4 track due to sedimentation following fires (in 2013 and 2019) (Raadik 2021. pers comm 15 November) (see Appendix A for more detailed information).

### **Distribution of translocations**

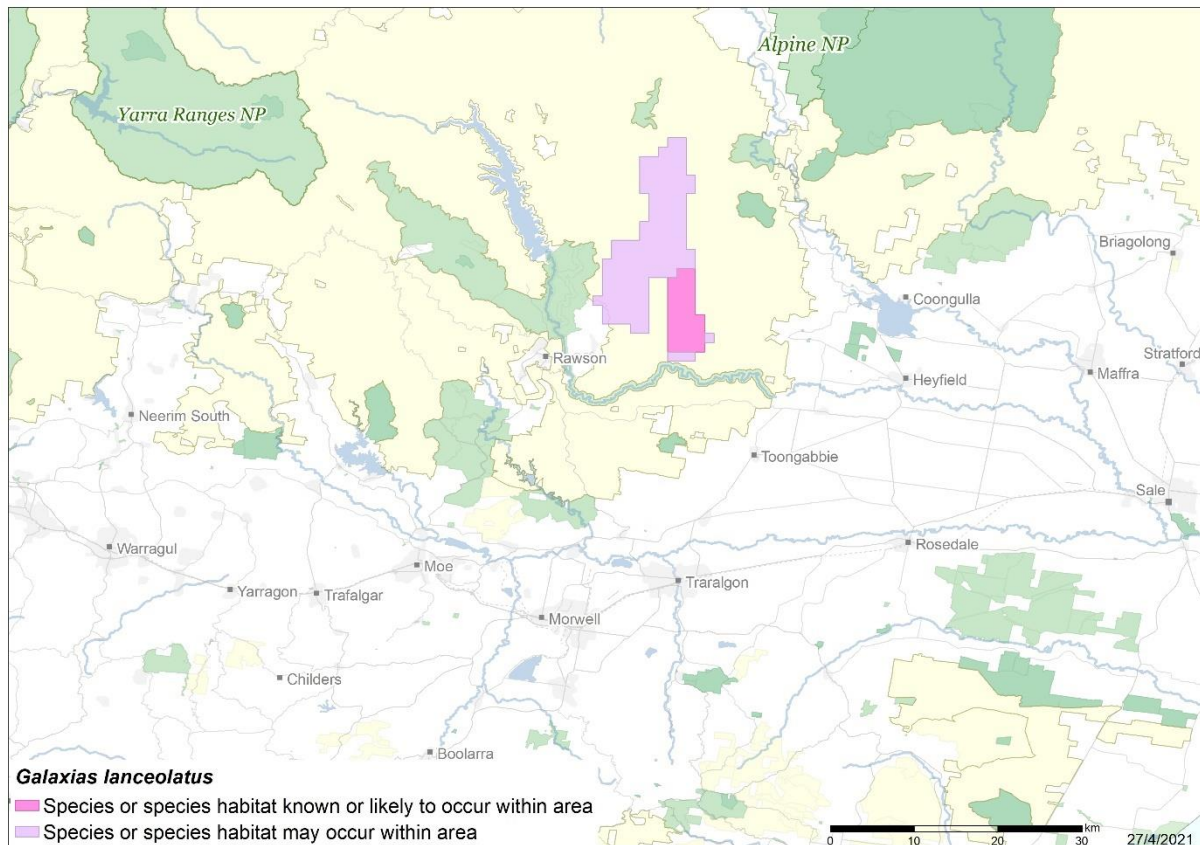
Given the ongoing threat of salmonid incursion and predation, which is likely to cause the extinction of the species, translocations are required to ensure species persistence (Threatened Species Recovery Hub 2018). Two translocations have been conducted (within the same area as the source subpopulation) into a trout-free reach of Glenmaggie Creek East Branch (Raadik 2021. pers comm. 4 November). Both have been unsuccessful, and no individuals have survived (Raadik 2021. pers comm. 4 November).

### **Unconfirmed subpopulations and further surveys**

One *Galaxias* sp. individual (purportedly belonging to the mountain galaxias complex) was recorded from Glenmaggie Creek (another tributary of the Thomson River) in 1988 (Hall 1989). The specimen was not retained, so the presumed subpopulation in this system requires clarification (Raadik 2011, 2014). Assuming the identification at the time (mountain galaxias) was correct, the individual (and presumed subpopulation) may have been the tapered galaxias (Raadik 2011, 2014).

Further surveys of the headwater reaches of the Thomson River catchment are required to identify if any further remnant subpopulations exist and accurately delineate the small distribution of this species (Raadik 2011, 2014).

## Map 1 Modelled distribution of the tapered galaxias



**Source:** Base map Geoscience Australia; species distribution data [Species of National Environmental Significance](#) database.

**Caveat:** The information presented in this map has been provided by a range of groups and agencies. While every effort has been made to ensure accuracy and completeness, no guarantee is given, nor responsibility taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect of any information or advice given in relation to, or as a consequence of, anything containing herein.

**Species distribution mapping:** The species distribution mapping categories are indicative only and aim to capture (a) the specific habitat type or geographic feature that represents to recent observed locations of the species (known to occur) or preferred habitat occurring in close proximity to these locations (likely to occur); and (b) the broad environmental envelope or geographic region that encompasses all areas that could provide habitat for the species (may occur). These presence categories are created using an extensive database of species observations records, national and regional-scale environmental data, environmental modelling techniques and documented scientific research.



## **Cultural and community significance**

### **Cultural and community significance to Indigenous Australians**

The significance of the ecological community, particular species, spiritual and other cultural values are diverse and varied for the many Indigenous peoples that live in the area and care for Country. This section describes some examples of this significance but is not intended to be comprehensive or applicable to, or speak for, all Indigenous people. Such knowledge may be only held by Indigenous groups and individuals who are the custodians of this knowledge.

The tapered galaxias and its habitat occur on Country belonging to the Gunaikurnai people. The Gunaikurnai people are recognised by the Federal Court and the State of Victoria as the Traditional Owners of a large area of Gippsland spanning from Warragul (west) to the Snowy River (east), and from the Great Divide (north) to the coast (south) (GLaWAC 2021c). The Gunaikurnai people see their land (Wurruk), waters (Yarnda), air (Watpootjan) and every living thing as one (GLaWAC 2021b). All things come from Wurruk, Yarnda and Watpootjan and they are the spiritual life-giving resources, providing the Gunaikurnai people with resources and forming the basis of their cultural practices (GLaWAC 2021b).

The cultural significance of the tapered galaxias to Traditional Owners is unknown. However, given the acknowledged importance to Aboriginal peoples of Connection to Country and the widespread importance of Caring for Country (which includes biodiversity, 'place', custom and totemic elements) it is considered likely that the species has or is associated with some cultural and/or community significance.

Approximately 13 percent of Gunaikurnai Country was burnt during the 2019-20 bushfires (GLaWAC 2021a), however the immediate area and upstream of where the species occurs was not impacted. The Gunaikurnai Bushfire Recovery Crew works across the fire footprint, monitoring the impacts of bushfire and the recovery of species that are significant for their culture and people (GLaWAC 2021a).

### **Cultural and community significance to commercial/recreational fishing**

The mountain galaxias complex is not a commercial or recreational fishing target (Native Fish Australia 2021).

## **Relevant biology and ecology**

### **Habitat ecology and associated species**

The tapered galaxias has been recorded from Stoney Creek, a small (average width: 0.5–1.5 m; average depth: 0.1–0.5 m), clear, cool, slow-flowing creek in a forested catchment (Raadik 2011, 2014). The substrate in this creek consists predominantly of cobble, with some gravel, bedrock and sand (Raadik 2011, 2014). Instream cover is provided predominantly by rock and small amounts of undercut banks, timber debris and vegetation overhang (Raadik 2011, 2014). The species microhabitat preferences are unknown. However, individuals were captured mainly around/among cobble on the stream bed in shallow (0.15–0.20 m), gently-flowing riffles or glides and were almost absent from still water areas near banks or in deep pools (Raadik & Nicol 2013). *Galaxias* species can burrow into substrate to escape declining water level during periods of surface water loss (unpublished data cited in Raadik et al. 2010).

### **Co-occurring species**

The tapered galaxias has been collected with *Anguilla australis* (southern shortfin eel), *Galaxias brevipinnis* (climbing galaxias), *Euastacus kershawi* (Gippsland spiny crayfish), *Euastacus woiwuru* (central highland spiny crayfish), *Paratya australiensis* (Australian glass shrimp) (Raadik 2011, 2014). The brown trout is present downstream of a natural instream barrier in Stoney Creek (Raadik 2011; Raadik & Nicol 2013; Raadik 2014).

### **Diet**

The diet of the tapered galaxias has not been reported. However, the species is likely to be macroinvertebrate, as observed in other species of the mountain galaxias complex, and consume benthic, drifting aquatic and terrestrial invertebrates, such as insects, crustaceans, molluscs, worms and spiders (Cadwallader et al. 1980; Closs 1994; Raadik 2014).

### **Generation length**

The generation length of the tapered galaxias is unknown. However, it is likely to be similar to other species in the mountain galaxias complex, which is between two and four years (Allen et al. 2002; Raadik 2019a).

### **Reproductive ecology**

The reproductive ecology of the tapered galaxias is largely unknown. The spawning period is undocumented, but thought to be from late winter to spring (Raadik 2014). Approximately 70 percent of individuals collected in early May (late Autumn) were at a mature stage of gonad development (gonads filling nearly the entire body cavity), with some males running ripe (Raadik & Nicol 2013).

Other members of the mountain galaxias complex have low fecundity (<400 eggs annually) with the sticky eggs generally attached to the underside of rocks in riffles (Cowden 1988; O'Connor & Koehn 1991; Lintermans 2007). Eggs in other members of the mountain galaxias complex are small (approximately 2 mm in diameter), spherical, demersal and adhesive, and hatch after 20–30 days (Cowden 1988; O'Connor & Koehn 1991). Larvae in other members of the mountain galaxias complex are approximately 9 mm long upon hatching (O'Connor & Koehn 1991).

### **Habitat critical to the survival**

The tapered galaxias is only known from the headwaters of Stoney Creek in West Gippsland, approximately 340–545 m ASL (Map 1) (Raadik 2011, 2014). Although the microhabitat preferences of this species are unknown, it has been recorded from a small, clear, cool, slow-flowing creek in a forested catchment (Raadik 2011, 2014). Individuals were captured mainly around/among cobble on the stream bed in shallow (0.15–0.20 m), gently-flowing riffles or glides and were almost absent from still water areas near banks or in deep pools (Raadik & Nicol 2013). Accordingly, such habitat is likely to be necessary for long-term maintenance and evolutionary development of the species.



The habitat critical to the survival of the tapered galaxias includes the area of occupancy of known subpopulations; areas of similar habitat adjoining known subpopulations (as described above), which provide potential habitat for natural range extension; areas of similar habitat that may contain the species or be suitable for translocations (as described above, in particular, areas where introduced salmonids are absent or have been removed, and barriers exist or can be erected to prevent their return); and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Actions required to preserve the species' habitat are identified in the Conservation and Recovery Actions.

No Critical Habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat.

### **Important populations**

In this section, the word population is used to refer to subpopulation, in keeping with the terminology used in the EPBC Act and state/territory environmental legislation.

All populations of the tapered galaxias are important for the long-term recovery and survival of this species.

### **Threats**

The threats impacting the tapered galaxias are similar to those impacting other *Galaxias* species in south-eastern Australia.

The tapered galaxias is primarily threatened by predation by introduced salmonids, which is likely to have substantially reduced the species' distribution and abundance (Table 1) (Raadik 2011; Raadik & Nicol 2013; Raadik 2014). The species' very restricted distribution and very small population size could increase its' likelihood of extinction due to genetic decline (Frankham et al. 2002; IUCN 2012), and render the species more vulnerable to other threats, including further incursion by introduced salmonids, inappropriate fire regimes, the impacts of climate change, other habitat loss, disturbance and modification impacts, and disease (Table 1). Indeed, Lintermans et al. (2020) used expert elicitation to predict that the tapered galaxias had ≥70 percent probability of extinction by 2040 without additional conservation actions. Additionally, preliminary results from population genetic analysis also indicate that the tapered galaxias has lost most of its genetic diversity and has a high level of inbreeding (Raadik 2021. pers comm 4 November).

Threats in Table 1 are noted in approximate order of highest to lowest impact, based on available evidence.

Table 1 Threats impacting the tapered galaxias

Threat	Status <sup>a</sup>	Evidence
Introduced species		
Predation by introduced salmonids	<ul style="list-style-type: none"> <li>• Timing: current/future</li> <li>• Confidence: inferred</li> <li>• Likelihood: likely</li> <li>• Consequence: catastrophic</li> <li>• Trend: unknown</li> <li>• Extent: across the entire range</li> </ul>	<p>Predation by introduced salmonids, including the brown trout and the rainbow trout (<i>Oncorhynchus mykiss</i>), has been implicated in the decline of <i>Galaxias</i> species throughout Australia, including other members of the mountain galaxias complex (Tilzey 1976; Wager &amp; Jackson 1993; Cadwallader 1996; Lintermans 2000; McDowall 2006; Lintermans 2013; Lintermans et al. 2020). Predation on <i>Galaxias</i> species by introduced salmonids has been directly documented via gut contents analyses (Vidal et al. 2020) and the distribution of <i>Galaxias</i> species and salmonids are usually mutually exclusive (e.g. Tilzey 1976; Lintermans 2000), suggesting that <i>Galaxias</i> species have been eliminated by salmonid predation. Indeed, the role of salmonids in the fragmentation of <i>Galaxias</i> subpopulations has been well documented in Australia (Lintermans 2000; Raadik &amp; Kuiter 2002; Green 2008b).</p> <p><i>Galaxias</i> species do not respond with avoidance behaviour to odour cues from the rainbow trout, but do respond with such behaviour to odour cues from the native predator, the southern shortfin eel (McLean et al. 2007). This suggests that <i>Galaxias</i> species may lack an effective anti-predator response to introduced salmonids (McLean et al. 2007).</p> <p>Although this threat was included in the key threatening process 'Novel biota and their impact on biodiversity' listed under the EPBC Act (DSEWPac 2013), salmonid restocking occurs regularly in Vic, mostly in lakes and impoundments, with minor stocking in wild rivers (VFA 2021). Additionally, both the brown trout and the rainbow trout now successfully breed in many Victorian waterways and have formed self-sustaining populations (DSEWPac 2013), including in Stoney Creek (Raadik 2011; Raadik &amp; Nicol 2013; Raadik 2014).</p> <p>The tapered galaxias is thought to have historically occupied the entire Stoney Creek system, portions of the Thomson River system (including the Deep Creek system) and possibly the lower Macalister River system prior to the introduction of salmonids (Raadik 2014). However, the species now only occurs in the headwaters of a single creek, where salmonids are absent, and their invasion is prevented by a natural barrier (Raadik 2011; Raadik &amp; Nicol 2013; Raadik 2014).</p> <p>As all size classes of the tapered galaxias are within the optimal prey size range for the brown trout (3–97 mm) (Bannon &amp; Ringler 1986; Sánchez-Hernández &amp; Cobo 2015), rapid and severe population decline is anticipated following further invasion or stocking beyond the natural barrier (Threatened Species Recovery Hub 2018; Lintermans et al. 2020). This could occur through natural drown-out in high flow events or illegal translocation/stocking (either deliberately or accidentally) by anglers (Threatened Species Recovery Hub 2018).</p>

Threat	Status <sup>a</sup>	Evidence
Competition with introduced salmonids	<ul style="list-style-type: none"> <li>• Timing: current/future</li> <li>• Confidence: inferred</li> <li>• Likelihood: likely</li> <li>• Consequence: major</li> <li>• Trend: unknown</li> <li>• Extent: across the entire range</li> </ul>	<p>To a lesser extent than predation, competition with introduced salmonids has also been documented via trophic niche analyses (Vidal et al. 2020) and implicated in the decline of <i>Galaxias</i> species throughout Australia, including other species of the mountain galaxias complex (Glova 1989; Crowl et al. 1992; Cadwallader 1996; McDowall 2006; Raadik et al. 2010). Salmonids (usually juveniles) can compete with <i>Galaxias</i> species (usually adults) for foraging and sheltering resources via interference (aggressive behaviour used to exclude <i>Galaxias</i> species from resources) and exploitation competition (use of similar resources) (Crowl et al. 1992; Cadwallader 1996; Raadik et al. 2010). This can lead to starvation, displacement, reduced reproductive output and mortality of <i>Galaxias</i> individuals (Crowl et al. 1992; Cadwallader 1996; Raadik et al. 2010).</p> <p>Although the impacts of this threat on the tapered galaxias are undocumented, the species is likely to be affected, given its ecological similarities to other <i>Galaxias</i> species.</p>
Altered hydrology/water quality caused by feral ungulates	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: inferred</li> <li>• Likelihood: likely</li> <li>• Consequence: moderate</li> <li>• Trend: unknown</li> <li>• Extent: across the entire range</li> </ul>	<p>Feral pigs (<i>Sus scrofa</i>) and feral deer (multiple species) are found in association with river systems in West Gippsland, Vic (Parks Victoria 2016). Feral pigs have been listed as a key threatening process under the EPBC Act (DOEE 2017) and feral deer are considered a major emerging pest problem (DSEWPaC 2011).</p> <p>By trampling, wallowing and rooting, feral pigs and deer modify stream sides and increase erosion, which alters water quality via eutrophication (enrichment of water with nutrients), and increases sedimentation, siltation and turbidity (Singer et al. 1984; McDowell 2007; Doupe et al. 2010; Davis et al. 2016; DOEE 2017). Additionally, increased sediment load (especially following high rainfall events) can suffocate fish and smother stream substrate, which reduces food availability, refuge and spawning habitat (Raadik &amp; Nicol 2012). Such changes to water quality have been implicated in the decline of other <i>Galaxias</i> species, including other species of the mountain galaxias complex (Allan &amp; Lintermans 2018; Driscoll et al. 2019).</p> <p>Although the impacts of this threat on the tapered galaxias are undocumented, the species is likely to be affected by altered hydrology and water quality if feral ungulates are present.</p>

Threat	Status <sup>a</sup>	Evidence
Habitat loss, disturbance or modification		
Inappropriate fire regimes	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: observed</li> <li>• Likelihood: likely</li> <li>• Consequence: major</li> <li>• Trend: increasing</li> <li>• Extent: across the entire range</li> </ul>	<p>Fires have been implicated in the decline of <i>Galaxias</i> species, including other species in the mountain galaxias complex, due to their fragmented distribution and limited recolonisation/dispersal abilities (Stoessel et al. 2012; Raadik &amp; Nicol 2013; Raadik &amp; Nicol 2015; NSW FSC 2016).</p> <p>Fires can degrade stream habitats by increasing water temperature and sediment load, reducing dissolved oxygen levels and altering water chemistry, which can impact aquatic ecosystems up to 80 km downstream of burnt areas (Lyon &amp; O'Connor 2008; Crowther et al. 2015; Harper et al. 2019; Alexandra &amp; Finlayson 2020; Silva et al. 2020). Physiologically, species of the mountain galaxias complex are highly susceptible to such changes in water quality, with an upper thermal tolerance of approximately 33 °C, which declines with reductions in dissolved oxygen and mild exposure to ash and sediment (Mulvey 2021). Extensive sedimentation has been observed in Stoney Creek following fires (Raadik &amp; Nicol 2013). Increased sediment load (especially following high rainfall events) can suffocate fish and smother stream substrate, which reduces food availability, refuge and spawning habitat (Lyon &amp; O'Connor 2008; Raadik et al. 2010). As the species is non-migratory, all life history stages (eggs, larvae, juveniles, adults) are susceptible to post-fire impacts.</p> <p>Although salmonids are also susceptible to the impacts of fires (Novak &amp; White 1990; Rinne 1996), they can quickly recolonise streams after fire-related disturbances (Novak &amp; White 1990; Lyon &amp; O'Connor 2008). Accordingly, fires can increase predation risk for galaxiids, by reducing shading/protective cover from predators, and drowning out instream barriers (via sedimentation) and facilitating salmonid invasion (DSE 2011a; NSW FSC 2016). Salmonids may also be introduced if fire-bombing is undertaken across streams using local water from predator-infested waterways (Raadik 2018).</p> <p>Fires may also create new instream barriers, which can increase fragmentation of the species (DSE 2011a; NSW FSC 2016). Additionally, impacts from toxic fire suppression chemicals, such as foam/fire retardants, can weaken or kill fish if introduced into waterways (Raadik et al. 2010; Raadik 2016, 2018, 2019a).</p>

Threat	Status <sup>a</sup>	Evidence
Altered hydrology/water quality caused by anthropogenic activities	<ul style="list-style-type: none"> <li>• Timing: historical/current</li> <li>• Confidence: inferred</li> <li>• Likelihood: likely</li> <li>• Consequence: major</li> <li>• Trend: unknown</li> <li>• Extent: across the entire range</li> </ul>	<p>Anthropogenic activities associated with timber harvesting, including harvesting, road/track maintenance and herbicide/pesticide application, can alter flow rates and mobilise sediment and/or toxins into streams, which alters water quality via eutrophication, increased sedimentation, siltation and turbidity (Campbell &amp; Doeg 1989; Motha et al. 2003; Bowmer 2013). Increased sediment load (especially following high rainfall events) can suffocate fish and smother stream substrate, which reduces food availability, refuge and spawning habitat (Lyon &amp; O'Connor 2008; Raadik et al. 2010).</p> <p>Over the past 50 years, timber harvesting has occurred over an extensive area of the Stoney Creek catchment, including in areas adjacent to Stoney No. 4 Track and Stoney No. 5 Track, where the tapered galaxias occurs (Raadik &amp; Nicol 2013). Forestry operations continue in parts of the range of this taxon.</p> <p>Spatial analysis of catchments occupied by the tapered galaxias across all land tenures indicates that 8% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks and reserves and special protection zones in State forest. Further areas are excluded from harvesting by prescription under the Victorian Code of Practice for Timber Production 2014 (the Code). No species-specific protections for the tapered galaxias are included in the Code. However, other more general prescriptions such as protection and buffering of waterways provide protection from forestry operations. In recent years, modified harvesting and forest regeneration practices have been implemented in native forest that are designed to further mitigate the potential threat from forestry operations to threatened species and their habitats.</p> <p>Despite these protections, unsealed roads and tracks, which intersect with Stoney Creek, can mobilise sediment into the stream (Raadik &amp; Nicol 2013). Such changes to water quality are likely to impact the species (Raadik &amp; Nicol 2013; Threatened Species Recovery Hub 2018; Raadik 2019a; Lintermans et al. 2020). Further, these tracks provide easy access to Stoney Creek and increase the risk of anthropogenic-assisted salmonid invasion (Threatened Species Recovery Hub 2018).</p>

Threat	Status <sup>a</sup>	Evidence
Climate change		
Increased temperatures, change to precipitation patterns and more extreme weather events	<ul style="list-style-type: none"> <li>• Timing: current/future</li> <li>• Confidence: inferred</li> <li>• Likelihood: almost certain</li> <li>• Consequence: major</li> <li>• Trend: increasing</li> <li>• Extent: across the entire range</li> </ul>	<p>Native freshwater fishes are known to persist in severe droughts, where they have evolved under those conditions (Smith 1982). Indeed, members of the mountain galaxias complex have historically been able to persist through droughts in small pools (Closs &amp; Lake 1996). However, the CSIRO &amp; Bureau of Meteorology (2015) predict eastern Australia will experience decreased average rainfall, and increased frequency of droughts and average temperatures. From 2017–2019, West Gippsland experienced its three driest years on record (Bureau of Meteorology 2020).</p> <p>These changes to rainfall patterns and temperatures are predicted to cause decreased surface run-off, which will impact the hydrology of small headwater streams (e.g., lower water levels and higher water temperatures) with increasing severity and frequency (DSE 2011b; CSIRO &amp; Bureau of Meteorology 2015; DELWP 2020). Severe and prolonged droughts may also create new instream barriers, which can increase fragmentation and reduce spawning and recruitment (Lennox et al. 2019).</p> <p>Additionally, the frequency and severity of bushfires is increasing due to climate change (CSIRO &amp; Bureau of Meteorology 2015), which is likely to cause long-term changes to water quality and threaten the persistence of native fish (Shu-ren 2003; Whitney et al. 2015). The increased sedimentation/siltation caused by fires (as well as feral ungulates and anthropogenic activities) is likely to smother and infill coarse substrate in the streambed (described above, e.g. Lyon &amp; O'Connor 2008). This prevents <i>Galaxias</i> species from burrowing into substrate to escape declining water level, leaving them susceptible to mortality during periods of surface water loss (unpublished data cited in Raadik et al. 2010).</p> <p>Further, the frequency of extreme rainfall events is also increasing (CSIRO &amp; Bureau of Meteorology 2015; DELWP 2020), which is likely to increase stream bank erosion and sedimentation, alter water quality and drown out instream barriers facilitating salmonid invasion (Magilligan et al. 2015; Threatened Species Recovery Hub 2018; Ross et al. 2019; DELWP 2020; Lintermans et al. 2020).</p>

Threat	Status <sup>a</sup>	Evidence
Disease		
Internal parasites	<ul style="list-style-type: none"> <li>• Timing: current</li> <li>• Confidence: observed</li> <li>• Likelihood: unknown</li> <li>• Consequence: unknown</li> <li>• Trend: unknown</li> <li>• Extent: unknown</li> </ul>	<p>A short, thin, white worm (coiled and pointed at both ends, possibly a nematode) was recorded in the fat deposits around stomach of tapered galaxias individual (Raadik 2011, 2014). The identity, prevalence and consequences of this worm are unknown.</p> <p>Additionally, metacercarial cysts, the second life stage of parasitic flatworms (flukes), have been reported in the skin and fins of other species in the mountain galaxias complex (Raadik 2011, 2014).</p> <p>Galaxiids appear to be particularly susceptible to infection with metacercarial cysts, with some fish carrying hundreds of cysts on the body and fins (VFA 2008). Heavily infected galaxiids are weak and slow-moving, making them an easy target for predators (Collyer &amp; Stockwell 2004; VFA 2008). The prevalence of metacercarial cysts in the tapered galaxias population is unknown and requires further investigation.</p>

Timing—identify the temporal nature of the threat

Confidence—identify the extent to which we have confidence about the impact of the threat on the species

Likelihood—identifies the likelihood of the threat impacting on the whole population or extent of the species

Consequence—identify the severity of the threat

Trend—identify the extent to which it will continue to operate on the species

Extent—identify its spatial content in terms of the range of the species

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed in consultation with experts and using available literature.

**Table 2 Tapered galaxias risk matrix**

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain				Increased temperatures, change to precipitation patterns and more extreme weather events	
Likely			Altered hydrology/water quality caused by feral ungulates	Inappropriate fire regimes Altered hydrology/water quality caused by anthropogenic activities Competition with introduced salmonids	Predation by introduced salmonids
Possible					
Unlikely					
Unknown					

**Risk Matrix legend/Risk rating:**

Low Risk	Moderate Risk	High Risk	Very High Risk
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**Categories for likelihood are defined as follows:**

Almost certain – expected to occur every year

Likely – expected to occur at least once every five years

Possible – might occur at some time

Unlikely – such events are known to have occurred on a worldwide bases but only a few times

Unknown – currently unknown how often the incident will occur

**Categories for consequences are defined as follows:**

Not significant – no long-term effect on individuals or populations

Minor – individuals are adversely affected but no effect at population level

Moderate – population recovery stalls or reduces

Major – population decreases

Catastrophic – population extinction/extirpation

**Note:** The threat ‘internal parasites’ has not been included in Table 2 as the consequences are unknown.

Priority actions have then been developed to manage the threat particularly where the risk was deemed to be ‘very high’ (red shading) or ‘high’ (yellow shading). For those threats with an unknown or low risk outcome (green and blue shading) it may be more appropriate to identify further research or maintain a watching brief.



## Conservation and recovery actions

### Primary conservation objective

By 2031-33, at least three geographically separated subpopulations of the tapered galaxias will be established and will have produced viable offspring. The species' probability of extinction in the wild will have declined, following the removal of introduced salmonid predators and improvement of lost or degraded habitats.

### Conservation and management priorities

#### Introduced species impacts

- Remove and control introduced salmonid predators in the catchment(s) where the tapered galaxias occurs (Raadik 2017) and catchments where the species does not occur, but translocations could be established. Prevent any further introductions of non-native fish species, including via stocking, into the catchment(s) where the species occurs and catchments where the species does not occur, but translocations could be established.
- Maintain existing instream barriers (natural or artificial) and construct new instream barriers, where appropriate, to prevent incursion of introduced salmonid predators and other non-native fish species (Raadik 2019b). This should include annual inspection and maintenance of barrier integrity to ensure the continued effectiveness.
- Continue to implement strategies to remove and control feral ungulates, including feral pigs and deer, as detailed in the relevant management (Parks Victoria 2016) or threat abatement plans (DOEE 2017).

#### Fire, climate change and extreme weather impacts

- Provide fire and land managers with maps of known and likely habitat for the species and specific advice to support decision making in fire prevention, preparedness, response and recovery.
- Develop and implement a fire management strategy that optimises the survival of the species during fires.
- Trial temporary, artificial, deep 'refuge' pools (particularly immediately downstream of groundwater inflow areas), following short-term loss of surface water and smothering of substrate with sediment, to provide temporary security from complete population loss and allow for salvage of surviving fish (Raadik et al. 2010). In some areas, artificial spawning structures may also be required to bolster natural spawning following sedimentation events.

### **Habitat loss disturbance and modifications impacts**

- Maintain vegetated protection zones (no harvesting or soil disturbance) along the entire stream drainage network (wet or dry, stream channel to headwater drainage lines), within catchment(s) where the species occurs.
- Assess the effectiveness of current forestry management practices in ameliorating disturbance to catchment(s) where the species occurs. Revise management practices and protection prescriptions if necessary.
- Review management of roads and tracks in catchment(s) where the species occurs, including stream crossings (wet/dry, channel or drainage lines), to eliminate sources of direct sediment input into the stream drainage network and prevent illegal translocation of non-native fish species.

### **Ex situ recovery actions**

- To ensure species persistence, establish a captive breeding program, informed by population genetic analysis, to augment extant or extirpated subpopulations and/or establish translocated subpopulations.
- Translocations should be conducted according to relevant state legislation, policies, protocols and guidelines, including DPI (2005, 2014), Ayres et al. (2012) and Zukowski et al. (2021), where techniques for other *Galaxias* species are presented and can be applied for the tapered galaxias. Introduced salmonids/non-native fish species must be absent or excluded from any translocation sites. Translocation sites may include new catchments with potential to be habitat (assisted colonisation), historically occupied catchments where non-native fish species have been removed (reintroduction) or currently occupied catchments (for genetic management/reinforcement).
- For subpopulations with high extirpation risk, prepare salvage/rescue plans to remove a proportion of individuals from the subpopulation and maintain them in captivity until the threat(s) abate (temporary captive maintenance). Implement strict biosecurity, disease prevention and aquarium maintenance procedures to allow the return of fish to the population following abatement of the risk.

## **Stakeholder engagement/community engagement**

- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions.
- Continue to liaise with government agencies, land managers and stakeholder groups in the catchment(s) where the species occurs and does not occur, but translocations could be established, to ensure up-to-date population data and scientific knowledge inform the implementation of conservation actions for this species, particularly regarding the removal and control of introduced salmonid predators.
- Promote community awareness of the tapered galaxias and identify opportunities for involvement in conservation actions.
- Contribute to impact assessment and planning processes on measures to protect the tapered galaxias and its habitat, including park management plans and environmental impact assessments.

## **Survey and monitoring priorities**

- Undertake targeted surveys to locate any additional subpopulations and identify suitable translocation sites.
- Implement a long-term monitoring program (e.g. abundance, length and weight, or eDNA if robust methods have been developed) to assess population size/trends across the species' range and provide early-predator detection warning (e.g. absence of first four to five age classes indicates one or more predators present) (Raadik et al. 2010).
- Undertake annual monitoring of translocated populations, including genetic analysis, undertake genetic top-ups when required, and evaluate success after three generations.
- Undertake annual monitoring of salmonid predators (e.g. presence and abundance, or eDNA if robust methods have been developed) and monitor and evaluate the efficacy of management interventions.
- Undertake annual monitoring of habitat condition and degradation, including the impacts of herbivores and weed invasion, and monitor and evaluate the efficacy of management interventions.

## Information and research priorities

- Investigate the ecological requirements of the species, including:
  - population genetic structure, levels of genetic diversity and minimum viable population size;
  - life history traits, such as time to maturity, longevity, fecundity, spawning period and number of young;
  - diet and habitat preferences;
  - desiccation, low dissolved oxygen and water temperature tolerance (adults, juveniles, larvae and eggs);
  - climbing ability, movements and dispersal patterns of adults and juveniles; and
  - predator-avoidance behaviour.
- Investigate techniques for captive maintenance, breeding, on-growing and translocation.
- Determine a target density for wild and translocated subpopulations, taking factors such as carrying capacity and the impacts of climate change into consideration.
- Investigate options to enhance the resilience of the species' current habitat to climate change and options for providing new habitat that would be suitable for the species under climate change scenarios.
- Investigate the identity, prevalence and consequences of diseases and parasites on the tapered galaxias.
- Ascertain the cultural significance of the tapered galaxias to Traditional Owners.

## Links to relevant implementation documents

This Conservation Advice is developed to be able to subsequently inform other planning instruments, such as a Bioregional Plan or a multi-entity Conservation Plan.

[Guidelines for assessing translocations of live aquatic organisms in Victoria \(2014\)](#)

[Guidelines for the translocation of barred galaxias \(\*Galaxias fuscus\*\) for conservation purposes \(2012\)](#)

[Protocols for the translocation of fish in Victorian inland public waters \(2005\)](#)

[Threat abatement guidelines for the key threatening process 'Novel biota and their impact on biodiversity' \(2013\)](#)

[Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs \(\*Sus scrofa\*\) \(2017\)](#)

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The Threatened Species Scientific Committee finalised this assessment on DD Month Year.

## Attachment A: Listing Assessment for *Galaxias lanceolatus*

### Reason for assessment

This assessment follows prioritisation of a nomination from the TSSC following the imperilled freshwater fish species expert assessment plan.

### Assessment of eligibility for listing

This assessment uses the criteria set out in the [EPBC Regulations](#). The thresholds used correspond with those in the [IUCN Red List criteria](#) except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing assessments through the Common Assessment Method (CAM).

### Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

**Table 3 Key assessment parameters**

<b>Metric</b>	<b>Estimate used in the assessment</b>	<b>Minimum plausible value</b>	<b>Maximum plausible value</b>	<b>Justification</b>
<b>Number of mature individuals</b>	<600	400	800	<p>Based on monitoring data from 2013–2021, the number of mature individuals is estimated to be approximately 400–800 (midpoint = 600; low confidence) (Raadik 2021).</p> <p>A precautionary approach has been taken in this assessment (due to likely continuing decline and low confidence of monitoring estimates), so the number of mature individuals is considered to be &lt;600 (i.e., fewer than the midpoint estimated from monitoring data).</p>
<b>Trend</b>	Declined within the last 3 generations; likely to decline following the next threatening event.			<p>The species' density declined at Stoney No. 5 Track due to sedimentation following fires (in 2007) and drought stress (Raadik &amp; Nicol 2013), and at Stoney No. 4 track due to sedimentation following fires (in 2013 and 2019) (Raadik 2021. pers comm 15 November) (see Criterion 1/2).</p> <p>As threats are ongoing, the number of mature individuals is likely to decline following the next threatening event to impact the subpopulation (e.g., salmonid incursion, sedimentation following fire, severe drought, etc.) (See Criterion 1/2).</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
<b>Generation time (years)</b>	2–4	2	4	The tapered galaxias is likely to have a generation time of approximately 2–4 years (see Criterion 1).
<b>Extent of occurrence</b>	20 km <sup>2</sup>	= AOO =20 km <sup>2</sup>	<100 km <sup>2</sup>	<p>EOO is calculated by applying the shortest continuous imaginary boundary which can be drawn to encompass record data from 2002–2021, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019).</p> <p>The minimum plausible EOO value is equal to the AOO estimate used in this assessment (IUCN 2019). The maximum plausible value is from the Threatened Species Recovery Hub (2018) rapid assessment. The estimate used in the IUCN (Raadik 2019a) and Lintermans et al. (2020) rapid assessments was 16 km<sup>2</sup>.</p> <p>The minimum plausible value has been used in this assessment, as it includes all known extant records. All values are within the range of the Critically Endangered category of Criterion 2.</p>
<b>Trend</b>	Contracted historically; stable over the last 3 generations; likely to contract following next threatening event			<p>The species is thought to have historically occupied the entire Stoney Creek system, portions of the Thomson River system (including the Deep Creek system) and possibly the lower Macalister River system (Raadik 2014). Accordingly, EOO is considered to have contracted historically.</p> <p>EOO has remained stable over the last 3 generations however, as threats are ongoing, EOO is likely to contract following the next threatening event (e.g., salmonid incursion, sedimentation following fire, severe drought, etc.) (See Criterion 2).</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
<b>Area of Occupancy</b>	20 km <sup>2</sup>	< 10 km <sup>2</sup>	20 km <sup>2</sup>	<p>The maximum plausible value has been calculated using record data from 2002–2021 and applying 2 x 2 km grid cells, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019). The maximum plausible value has been used in this assessment, as it used the 2 x 2 km grid cell method and was considered to include all known extant records.</p> <p>The minimum plausible value is from the Threatened Species Recovery Hub (2018) rapid assessment. The estimate used in the IUCN (Raadik 2019a) and Lintermans et al. (2020) rapid assessments was 16 km<sup>2</sup>.</p> <p>The minimum plausible value is within the Critically Endangered category of Criterion 2, while the other estimates fall within the range of the Endangered category.</p>
<p>AOO is a standardised spatial measure of the risk of extinction, that represents the area of suitable habitat known, inferred or projected to be currently occupied by the taxon. It is estimated using a 2 x 2 km grid to enable comparison with the criteria thresholds. The resolution (grid size) that maximizes the correlation between AOO and extinction risk is determined more by the spatial scale of threats than by the spatial scale at which AOO is estimated or shape of the taxon's distribution. It is not a fine-scale estimate of the actual area occupied. In some cases, AOO is the smallest area essential at any stage to the survival of existing subpopulations of a taxon (e.g., breeding sites for migratory species).</p>				
<b>Trend</b>	Contracted historically; stable over the last 3 generations; likely to contract following next threatening event			<p>Using the same reasoning as 'EOO' (above), AOO is considered to have contracted historically, but been stable over the last 3 generations.</p> <p>As threats are ongoing, AOO is likely to contract following the next threatening event (e.g., salmonid incursion, sedimentation following fire, severe drought, etc.) (See Criterion 2).</p>
<b>Number of subpopulations</b>	1	1	1	<p>There is a single subpopulation in a single stream with no barriers to connectivity among recorded sites (Raadik 2011; Raadik &amp; Nicol 2013; Raadik 2014).</p> <p>The brown trout is present in Stoney Creek; however, a natural instream barrier (waterfall) prevents its incursion into the area occupied by the tapered galaxias (Raadik 2011; Raadik &amp; Nicol 2013; Raadik 2014; Raadik 2021).</p> <p>The tapered galaxias has not been recorded elsewhere in the Thomson and La Trobe River catchments, nor further downstream in the Stoney Creek catchment (Raadik &amp; Nicol 2013). It was not collected from a tributary that joined Stoney Creek downstream of Stoney No. 3 Track, Glenmaggie Creek and the headwaters of Mt Useful Creek (Raadik 2011; Raadik &amp; Nicol 2013; Raadik 2014). Accordingly, the species is unlikely to occur more broadly than the headwaters of Stoney Creek.</p>

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
<b>Trend</b>	Declined historically; stable over the last 3 generations; likely to decline following next threatening event			Using the same reasoning as 'EOO' (above), the number of subpopulations is considered to have declined historically but been stable over the last 3 generations.  Incursion of introduced salmonids is a serious risk to the only remaining subpopulation, which could result in total subpopulation loss (and therefore extinction of the species).
<b>Basis of assessment of subpopulation number</b>	See justification for number of subpopulations.			
<b>No. locations</b>	1	1	1	There is a single subpopulation in a single stream with no barriers to connectivity among recorded sites (Raadik 2011; Raadik & Nicol 2013; Raadik 2014). Accordingly, all individuals could be rapidly affected by a single threatening event (e.g., incursion of introduced salmonids).  One location has been used in this assessment.
<b>Trend</b>	Stable			One location has been used in this assessment, so it is not possible for the number of locations to decline any further.
<b>Basis of assessment of location number</b>	See justification for number of locations.			
<b>Fragmentation</b>	Although the species distribution is suspected to have been fragmented by introduced salmonids (see Criterion 1), the species does not meet the requirements to be considered 'severely fragmented'. The species now only occurs within a very restricted distribution in a single stream with no barriers to connectivity among recorded sites (Raadik 2011; Raadik & Nicol 2013; Raadik 2014).			
<b>Fluctuations</b>	There are no known extreme fluctuations in EOO, AOO, number of subpopulations, locations or number of mature individuals.			



**Criterion 1 Population size reduction**

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
<b>A1</b>	≥ 90%	≥ 70%	≥ 50%
<b>A2, A3, A4</b>	≥ 80%	≥ 50%	≥ 30%
<p><b>A1</b> Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p><b>A2</b> Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p><b>A3</b> Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p><b>A4</b> An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>Based on any of the following</p> <ul style="list-style-type: none"> <li>(a) direct observation [except A3]</li> <li>(b) an index of abundance appropriate to the taxon</li> <li>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</li> <li>(d) actual or potential levels of exploitation</li> <li>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</li> </ul>			

**Criterion 1 evidence****Eligible under Criterion 1 A3ce for listing as Critically Endangered****Generation length**

The generation length of the tapered galaxias is unknown. However, it is likely to be similar to that of other species in the mountain galaxias complex, which is between two and four years (Allen et al. 2002; Raadik 2019a). This gives an estimated three-generation period of 6–12 years. However, given the minimum timeframe is 10 years, a timeframe of 10–12 years was used for this criterion.

**Historical population reduction (prior to 2009)**

Predation on *Galaxias* species by introduced salmonids has been implicated in the decline of *Galaxias* species throughout Australia, including other members of the mountain galaxias complex (Tilzey 1976; Wager & Jackson 1993; Cadwallader 1996; Lintermans 2000; McDowall 2006; Lintermans 2013; Lintermans et al. 2020). The distribution of *Galaxias* species and salmonids are usually mutually exclusive (e.g. Tilzey 1976; Lintermans 2000), suggesting that *Galaxias* species have been eliminated by salmonid predation. Indeed, the role of salmonids in the fragmentation of *Galaxias* subpopulations has been well documented in Australia (Lintermans 2000; Raadik & Kuitert 2002; Green 2008).

The tapered galaxias is likely to have been historically more widespread and may have occupied the entire Stoney Creek system, portions of the Thomson River system (including the Deep Creek system) and possibly the lower Macalister River system (Raadik 2014). Accordingly, the species is presumed to have undergone very severe population reduction and range contraction throughout the 20<sup>th</sup> century, following the incursion of introduced salmonids (Raadik 2014), but this is outside the timeframe relevant to this criterion.

### **Past population reduction (2009-11 to 2021)**

#### *Density sampled near Stoney No. 5 Track*

Density of the tapered galaxias has been sampled near Stoney No. 5 Track from 1998–2021 (Raadik 2021). Density at this site declined by approximately 80 percent from 2002–2012 (Raadik et al. 2001; Raadik & Nicol 2013). This decline was linked to sedimentation following fires in 2007 and drought stress (Millennium Drought) (Raadik 2021. pers comm 4 November). No monitoring data was collected from 2007–2011. Some decline could have occurred within the last three generations (i.e., from 2009-11 onwards); however, as decline was linked to threatening events in 2007 (Raadik & Nicol 2013), most decline at this site is likely to have occurred immediately following this threatening event (i.e., prior to 2009-11 and more than three generations ago).

Density at this site subsequently increased from 2012–2016 and fluctuated among years, while remaining substantially lower than pre-disturbance density estimates (in 1998 and 2002) (Raadik 2021). This increase in density may be linked to contraction of individuals to this upstream monitoring site, following fires further downstream in 2013 and 2019 (Raadik 2021. pers comm 15 November).

#### *Density sampled near Stoney No. 4 Track*

Density of the tapered galaxias has been sampled further downstream near Stoney No. 4 Track from 2012–2021 (Raadik 2021). Density at this site declined very severely by >80 percent (Raadik 2021), due to sedimentation following fire in 2013 and 2019, with no individuals recovered after either fire (Raadik 2021. pers comm 15 November).

Most of the decline at the Stoney No. 4 Track site is considered to be due to mortality following these disturbance events (Raadik 2021. pers comm 15 November). However, Stoney No. 5 Track (further upstream) has likely acted as a refuge for some individuals from further downstream (i.e., near Stoney Track No. 4 Track) immediately following fire, with gradual recolonisation of downstream habitat in the years following fire (Raadik 2021. pers comm 15 November).

While very severe decline has occurred at the Stoney No 4. Track site within the last three generations (2009-11 to 2021), individuals at this site represent a very small proportion of the total population (Raadik 2021). This suggests that decline within the last three generations (2009-11 to 2021) does not exceed the threshold required for the species to be eligible under A2 or A4 (past reduction).

### **Future population reduction (2021 to 2031-33)**

The tapered galaxias was not impacted by the 2019-20 bushfires. However, the species is projected to undergo further very severe decline following future threatening events (particularly incursion of introduced salmonids, sedimentation following fire and severe drought), based on:

- Inferred very severe historical reduction of the tapered galaxias throughout the 20<sup>th</sup> century, following the incursion of introduced salmonids (Raadik 2014);
- Observed/inferred very severe reduction of other *Galaxias* species, including other members of the mountain galaxias complex, following the incursion of introduced salmonids (Tilzey 1976; Wager & Jackson 1993; Cadwallader 1996; Lintermans 2000; McDowall 2006; Lintermans 2013; Lintermans et al. 2020); and
- Observed very severe reduction of the tapered galaxias at Stoney No. 5 Track due to sedimentation following fires (in 2007) and drought stress (Raadik & Nicol 2013), and at Stoney No. 4 track due to sedimentation following fires (in 2013 and 2019) (Raadik 2021. pers comm 15 November).

A threatening event of this type (i.e., incursion of introduced salmonids, sedimentation following fire or severe drought) is considered likely to occur in the catchment where the tapered galaxias occurs, within the next three generations. The brown trout is present in Stoney Creek; however, a natural instream barrier (waterfall) prevents its incursion into the area occupied by the only tapered galaxias subpopulation (Raadik 2011; Raadik & Nicol 2013; Raadik 2014; Raadik 2021). Rapid and very severe population decline (with possible extinction) is anticipated following further incursion or stocking beyond the natural barrier (Threatened Species Recovery Hub 2018; Lintermans et al. 2020). This could occur through natural drown-out in high flow events or illegal translocation/stocking (either deliberately or accidentally) by anglers (Threatened Species Recovery Hub 2018).

Additionally, increased temperatures, change to precipitation patterns and more extreme weather events (driven by climate change) are likely to cause decline in the species. Changes to rainfall patterns and temperatures are predicted to cause decreased surface run-off, which will impact the hydrology of small headwater streams (e.g., lower water levels and higher water temperatures) with increasing severity and frequency (Döll & Zhang 2010; DSE 2011b; Arnell & Gosling 2013; CSIRO & Bureau of Meteorology 2015; DELWP 2020). The increased frequency and severity of bushfires is likely to cause long-term changes to water quality and threaten the persistence of native fish (Shu-ren 2003; Whitney et al. 2015), e.g. via increased sedimentation, which can smother and infill coarse substrate in the streambed (described above, e.g. Lyon & O'Connor 2008). Further, the increasing frequency of extreme rainfall events is likely to increase stream bank erosion and sedimentation, alter water quality and drown out instream barriers facilitating salmonid incursion (Magilligan et al. 2015; Threatened Species Recovery Hub 2018; Ross et al. 2019; DELWP 2020; Lintermans et al. 2020). Further information about these threats is available in Table 1.

One or more of these events is projected to occur within the next three generations and is projected to result in very severe population reduction (>80 percent) of the tapered galaxias. This is supported by the expert elicitation conducted by Lintermans et al. (2020), which predicted that the tapered galaxias had  $\geq 70$  percent probability of extinction by 2040 without additional conservation actions.

As such, the species appears to meet the requirements for listing as Critically Endangered under A3 (future reduction).

### **Conclusion**

The species is projected to undergo very severe population reduction within the next three generations, which is equivalent to at least 80 percent. The cause has not ceased. The data presented above appear to demonstrate that the species is eligible for listing as **Critically Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

## Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy

	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
<b>B1.</b> Extent of occurrence (EOO)	< 100 km <sup>2</sup>	< 5,000 km <sup>2</sup>	< 20,000 km <sup>2</sup>
<b>B2.</b> Area of occupancy (AOO)	< 10 km <sup>2</sup>	< 500 km <sup>2</sup>	< 2,000 km <sup>2</sup>
<b>AND at least 2 of the following 3 conditions:</b>			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

## Criterion 2 evidence

### Eligible under Criterion 2 B1ab(i,ii,iii,iv,v) for listing as Critically Endangered

#### Extent of occurrence (EOO) and area of occupancy (AOO)

The EOO and AOO are estimated at 20 km<sup>2</sup>. These figures are based on the mapping of point records from 2002–2021, obtained from state governments, museums and CSIRO. The AOO was calculated using a 2 x 2 km grid cell method (IUCN 2019). As EOO was smaller than AOO, the AOO estimate was also used as the EOO estimate in this assessment (see Table 3) (IUCN 2019).

The species' EOO appears to meet the requirements for listing as Critically Endangered under B1 (<100 km<sup>2</sup>). The species' AOO appears to meet the requirements for listing as Endangered under B2 (<500 km<sup>2</sup>).

#### Number of locations

There is a single subpopulation in a single stream with no barriers to connectivity among recorded sites (Raadik 2011; Raadik & Nicol 2013; Raadik 2014). Accordingly, all individuals could be rapidly affected by a single threatening event (e.g., incursion of introduced salmonids) (Threatened Species Recovery Hub 2018; Lintermans et al. 2020). This could occur through natural drown-out in high flow events or illegal translocation/stocking (either deliberately or accidentally) by anglers (Threatened Species Recovery Hub 2018). The number of locations used in this assessment is one. The species' number of locations appears to meet the requirement for listing as Critically Endangered under this criterion.

### Continuing decline

As described in Criterion 1, the tapered galaxias is suspected to have been historically more widespread through the entire Stoney Creek system, portions of the Thomson River system (including the Deep Creek system) and possibly the lower Macalister River system, prior to its suspected very severe reduction throughout the 20<sup>th</sup> century (following the incursion of introduced salmonids) (Raadik 2014). Accordingly, the EOO, AOO, area, extent and/or quality of habitat, and number of subpopulations and mature individuals are likely to have declined over this time period.

Additionally, the tapered galaxias population declined at Stoney No. 5 Track due to sedimentation following fires (in 2007) and drought stress (Raadik & Nicol 2013), and at Stoney No. 4 track due to sedimentation following fires (in 2013 and 2019) (Raadik 2021. pers comm 15 November). This suggests decline in area, extent and/or quality of habitat, and number of mature individuals occurred over this time period. As there is only a single subpopulation which was not extirpated, EOO, AOO and number of subpopulations did not decline.

Although EOO, AOO, area, extent and/or quality of habitat, and number of subpopulations and mature individuals appear to be relatively stable currently (see Criterion 1), the species is projected to undergo further very severe decline should similar threatening events occur in the very restricted distribution of the single remaining subpopulation (particularly incursion of introduced salmonids, sedimentation following fire and severe drought), based on:

- Inferred very severe historical reduction of the tapered galaxias throughout the 20<sup>th</sup> century, following the incursion of introduced salmonids (Raadik 2014);
- Observed/inferred very severe reduction of other *Galaxias* species, including other members of the mountain galaxias complex, following the incursion of introduced salmonids (Tilzey 1976; Wager & Jackson 1993; Cadwallader 1996; Lintermans 2000; McDowall 2006; Lintermans 2013; Lintermans et al. 2020); and
- Observed very severe reduction of the tapered galaxias at Stoney No. 5 Track due to sedimentation following fires (in 2007) and drought stress (Raadik & Nicol 2013) and at Stoney No. 4 track due to sedimentation following fires (in 2013 and 2019) (Raadik 2021. pers comm 15 November).

A threatening event of this type (i.e., incursion of introduced salmonids, sedimentation following fire or severe drought) is considered likely to occur in the catchment where the tapered galaxias occurs, within the next three generations (see Criterion 1 – future population reduction). In particular, rapid and very severe population decline (with possible extinction) is anticipated following further incursion or stocking of introduced salmonids beyond the natural barrier (Threatened Species Recovery Hub 2018; Lintermans et al. 2020). This would result in likely extinction of the species, and therefore would constitute continuing decline in EOO, AOO, area, extent and/or quality of habitat, and number of subpopulations and mature individuals.

Additionally, the species' very restricted distribution and very small population size (impacting inbreeding, genetic drift, etc.) render it more vulnerable to reduced genetic diversity and genetic decline (Frankham et al. 2002; IUCN 2012). Genetic diversity is an important factor influencing a population's persistence (Frankham 2005; Bouzat 2010) and populations lacking genetic diversity often have higher rates of extinction (Markert et al. 2010). Lintermans et al. (2020) used expert elicitation to predict that the tapered galaxias had  $\geq 70$  percent probability of extinction by 2040 without additional conservation actions. Additionally, preliminary results from population genetic analysis also indicate that the tapered galaxias has lost most of its genetic diversity and has a high level of inbreeding, which restricts its' evolutionary potential (Raadik 2021. pers comm 4 November). This is another factor that could cause continuing decline in EOO, AOO, and number of subpopulations and mature individuals.

The species appears to be undergoing continuing decline in EOO, AOO, area, extent and/or quality of habitat, and number of subpopulations and mature individuals. Accordingly, the species appears to meet the continuing decline requirement for listing under this criterion.

### **Severe fragmentation**

Although the species distribution is suspected to have been fragmented by introduced salmonids (see Criterion 1), the species does not meet the requirements to be considered 'severely fragmented'. There is a single subpopulation which now only occurs within a very restricted distribution in a single stream with no barriers to connectivity among recorded sites (Raadik 2011; Raadik & Nicol 2013; Raadik 2014).

### **Extreme fluctuations**

The density of the tapered galaxias has fluctuated among years (Raadik 2021); however, these fluctuations do not meet the requirements to be considered 'extreme fluctuations' (IUCN 2019). There are no known extreme fluctuations in EOO, AOO, number of subpopulations, locations or mature individuals. The species does not appear to meet the extreme fluctuations requirement for listing under this criterion.

### **Conclusion**

The species' EOO and number of locations appear to be very restricted; and EOO, AOO, area, extent and/or quality of habitat, number of subpopulations and mature individuals appear to be undergoing continuing decline.

The data presented above appear to demonstrate that the species is eligible for listing as **Critically Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

**Criterion 3 Population size and decline**

	<b>Critically Endangered Very low</b>	<b>Endangered Low</b>	<b>Vulnerable Limited</b>
Estimated number of mature individuals	< 250	< 2500	< 10,000
AND either (C1) or (C2) is true			
<b>C1.</b> An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	<b>Very high rate 25% in 3 years or 1 generation (whichever is longer)</b>	<b>High rate 20% in 5 years or 2 generation (whichever is longer)</b>	<b>Substantial rate 10% in 10 years or 3 generations (whichever is longer)</b>
<b>C2.</b> An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

**Criterion 3 evidence****Eligible under Criterion 3 C2a(ii) for listing as Endangered****Number of mature individuals**

Based on monitoring data from 2013–2021, the number of mature individuals is estimated to be approximately 400–800 (midpoint = 600) (Raadik 2021). This estimate is low confidence, as it has been derived from density estimates for the total population (i.e., including juveniles, sampled near Stoney Track No. 4 and Stoney Track No. 5) from 2013–2021. Density estimates fluctuate among years (Raadik 2021), introducing some error into the mature individuals estimate. Additionally, it is difficult to determine maturity in the field, as juveniles and adults appear superficially similar and length at maturity can vary among individuals. This introduces further error into the mature individuals estimate (above).

Given that continuing decline is likely to be occurring and the monitoring estimates are low confidence, a precautionary approach has been taken in this assessment and the number of mature individuals is considered to be <600 (i.e., fewer than the midpoint estimated from monitoring data). The entire estimated range for the number of mature individuals falls within the Endangered category (<2500). The number of mature individuals appears to meet the requirements for listing as Endangered (<2500).



### **Continuing decline**

As discussed in Criterion 2 (see above), the species appears to be undergoing continuing decline in the number of mature individuals. The species appears to meet the C2 continuing decline requirement for listing as Endangered under this criterion.

### **Percentage of mature individuals in a single subpopulation**

The tapered galaxias is known from a single subpopulation in Stoney Creek (Raadik 2011; Raadik & Nicol 2013; Raadik 2014). Accordingly, 100 percent of individuals occur in one subpopulation. The species appears to meet the requirements for listing as Endangered under this criterion.

### **Number of mature individuals in each subpopulation**

As all mature individuals occur within the same subpopulation, the number of mature individuals in each subpopulation is also considered to be <600 (Raadik 2021). The species appears to meet the requirements for listing as Vulnerable under this criterion.

### **Extreme fluctuations**

There are no known extreme fluctuations in the number of mature individuals (see Criterion 2). The species does not appear to meet the extreme fluctuations requirement for listing under this criterion.

### **Conclusion**

The number of mature individuals is < 2500, with continuing decline and 100 percent of mature individuals occurring in a single subpopulation. The data presented above appear to demonstrate that the species is eligible for listing as **Endangered** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

**Criterion 4 Number of mature individuals**

	<b>Critically Endangered Extremely low</b>	<b>Endangered Very Low</b>	<b>Vulnerable Low</b>
<b>D. Number of mature individuals</b>	< 50	< 250	< 1000
<b>D2.<sup>1</sup> Only applies to the Vulnerable category</b> Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km <sup>2</sup> or number of locations ≤ 5

<sup>1</sup> The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

**Criterion 4 evidence****Eligible under Criterion 4 D for listing as Vulnerable****Number of mature individuals**

As explained under Criterion 3, the number of mature individuals is considered to be <1000. The species appears to meet the requirements for listing as Vulnerable under this criterion.

**Conclusion**

The number of mature individuals is likely to be fewer than 1000. The data presented above appear to demonstrate that the species is eligible for listing as **Vulnerable** under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

## Criterion 5 Quantitative analysis

	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

## Criterion 5 evidence

### Insufficient data to determine eligibility

#### Population viability analysis

Population viability analysis has not been undertaken for the tapered galaxias.

#### Conclusion

There are insufficient data to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

### Adequacy of survey

The survey effort has been considered adequate and there is sufficient scientific evidence to support the assessment.

### Listing and Recovery Plan Recommendations

A decision about whether there should be a Recovery Plan for this species has not yet been made. The purpose of this consultation document is to elicit additional information to help inform the decision.

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Department of Agriculture, Water and the Environment  
GPO Box 858, Canberra ACT 2601  
Telephone 1800 900 090  
Web [awe.gov.au](http://awe.gov.au)

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