



Consultation on Species Listing Eligibility and Conservation Actions

Galaxias aequipinnis (East Gippsland galaxias)

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

- 1) the eligibility of *Galaxias aequipinnis* (East Gippsland 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

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 aequipinnis* (East Gippsland 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 km² ☐ 100 – 200 km² ☐ 200 – 500 km² ☐ >500 km²

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 km² ☐ 10 – 100 km² ☐ 100 – 500 km² ☐ >500 km²

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 km² ☐ 100 – 200 km² ☐ 200 – 500 km² ☐ >500 km²

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 km² ☐ 10 – 100 km² ☐ 100 – 500 km² ☐ >500 km²

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 aequipinnis* (East Gippsland 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 aequipinnis (East Gippsland galaxias) © Copyright Tarmo. A Raadik

Conservation status

Galaxias aequipinnis (East Gippsland 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 aequipinnis 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+4bce: Critically Endangered
- Criterion 2: B1ab(i,ii,iii,iv,v): Critically Endangered
- Criterion 3: C1: Vulnerable
- Criterion 4: D: Ineligible
- 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, severe fragmentation and continuing decline due to multiple threats: introduced species, fire, climate change, and other habitat loss, disturbance and modification impacts. The species also has a 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 aequipinnis* Raadik (2014). *Galaxias aequipinnis* (East Gippsland 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, East Gippsland galaxias, was formally described (Raadik 2014).

Description

The East Gippsland galaxias (family Galaxiidae) is a small, native freshwater fish, which has an elongate, tubular and scaleless body with a lateral line. The species commonly grows to 70–80 mm length to caudal fin (LCF) but can reach a maximum of 110 mm LCF and 12.9 g in weight. The body is predominantly brown on the back and upper sides above lateral line, becoming light brown to cream ventrally, with the belly almost silvery white; juveniles are relatively plainly coloured. The body has dark brown to black irregular blotches and vertical bands, and a broad indistinct pale coppery mid-lateral band. The head and snout are short, with a large mouth and small coppery-gold eyes. The fins are soft-rayed, translucent and slightly pale yellow to dusky. The gill cover is translucent with a small golden patch. This description is drawn from Raadik (2011), Raadik (2014) and Bray (2020).

The species can be distinguished from other species in the mountain galaxias complex by its stouter body, long pelvic fins, lack of black bars along the lateral line and longer lower jaw relative to the upper jaw (Raadik 2011, 2014).

Distribution

Current distribution

The East Gippsland galaxias is a non-migratory, freshwater resident, which is endemic to Victoria (Vic) (Map 1). It is only known from the Arte River system (Arte River and Little Arte River) at approximately 250–390 m above sea level (ASL), which is a tributary of the Goolengook River in the Bemm River catchment in East Gippsland (East Gippsland Basin (River Basins of Victoria); East Gippsland River Region (Australian Hydrological Geospatial Fabric River Regions)) (Map 1) (Raadik 2011, 2014).

The East Gippsland galaxias is the only species in the mountain galaxias complex known from the Arte River/Bemm River system, however, other *Galaxias* species, *Galaxias brevipinnis* (climbing galaxias) and *Galaxias maculatus* (common galaxias) are also known from the Bemm River catchment (Raadik 2011, 2014).

The species is known from two subpopulations in the Arte River (ranging from a large waterfall in the headwaters, through headwater tributaries, to an instream barrier further downstream) and from the mid reaches of the Little Arte River (Map 1) (Raadik 2011, 2014) on public land or within timber harvesting areas (Raadik 2019a). All intervening waters (main stem and side tributaries) have been sampled between the Arte River subpopulation and the Little Arte River subpopulation, and no individuals have been found (Raadik 2021. pers comm 19 October), while the presence of the brown trout (*Salmo trutta*) has been confirmed in the Goolengook River, the lower Arte River and the Little Arte River (Raadik 2011, 2014), indicating that East Gippsland galaxias subpopulations are isolated from each other due to salmonid predation (Raadik 2021. pers comm 19 October).

Instream barriers (waterfalls) prevent the incursion of the brown trout into the areas occupied by the East Gippsland galaxias (Threatened Species Recovery Hub 2018). 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). Accordingly, the East Gippsland galaxias is likely to be restricted to the two known subpopulations: in the headwater section of the Arte River and a section of the Little Arte River (Raadik 2011, 2014).

Past distribution and decline

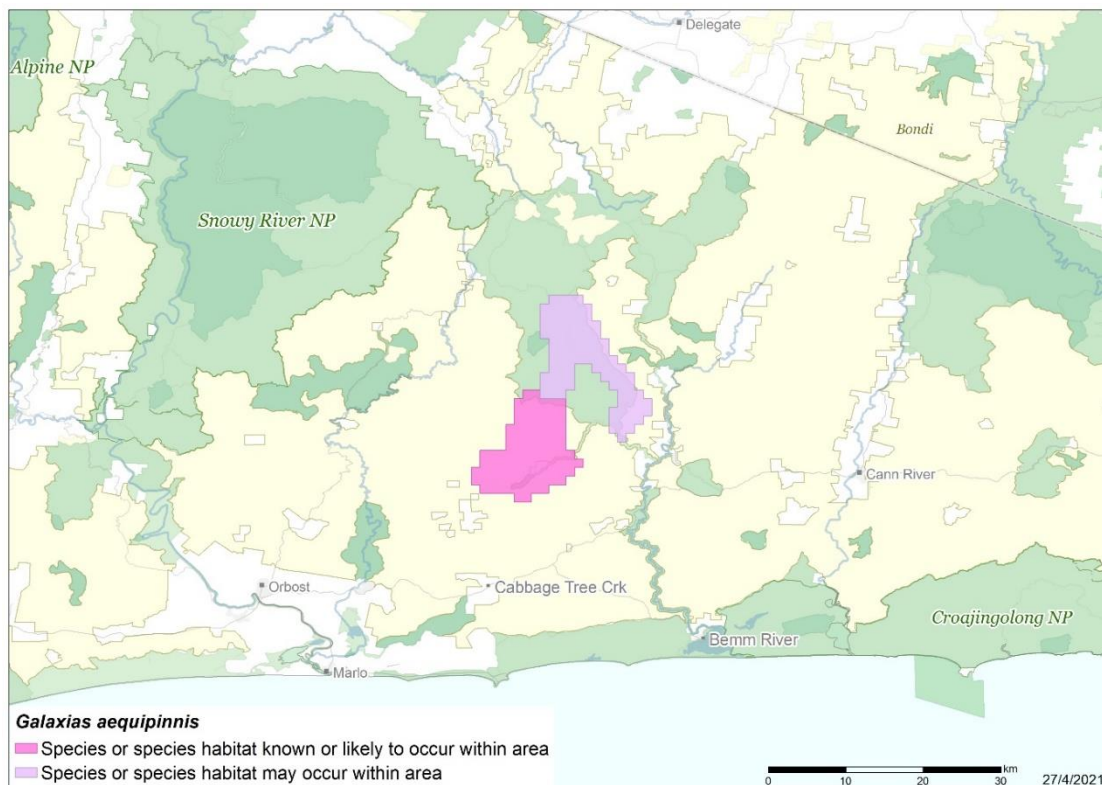
The species is likely to have been historically more widespread and may have occupied the majority of the Goolengook River system prior to the introduction of the brown trout (Raadik 2014).

Density of the East Gippsland galaxias declined by >50 percent following fires (and associated sedimentation) in early 2014 (Raadik 2021). Additionally, the East Gippsland galaxias was impacted by the 2019-20 bushfires and is projected to decline by >50 percent within three generations of the 2019-20 bushfires (see Appendix A) (Legge et al. 2021).

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). One translocation has been conducted from the Arte River to a small tributary of the Goolengook River (Threatened Species Recovery Hub 2018), although monitoring has indicated no sign of successful breeding and no individuals were recovered following the 2019-20 bushfires (Raadik 2021. pers comm 19 October). Additionally, following the 2019-20 bushfires, 100 individuals were captured in February 2020, held in temporary housing and released back to the capture site in September 2020 (DELWP 2020a; Shelley et al. 2021).

Map 1 Modelled distribution of the East Gippsland 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.

No Registered Aboriginal Parties (i.e., Traditional Owner groups, legally recognised under the Aboriginal Heritage Act with responsibilities for managing and protecting Aboriginal Cultural Heritage on Country) have been appointed east of the Snowy River (VAHC 2021). However, the area has significant cultural heritage for Indigenous peoples. Indigenous organisations in this area include the Bidwell-Maap Nation Aboriginal Corporation, Nindi Ngujarn Ngarigo Aboriginal Corporation and Snowy Cann South Monero Aboriginal Corporation.

The name of the Goolengook River system (in which the East Gippsland galaxias occurs), is derived from Bidawal language (DELWP 2021b). The cultural significance of the East Gippsland galaxias to Indigenous peoples 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.

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

The East Gippsland galaxias has been recorded in the Arte River system from small to moderately large (average width: 1.5–6.0 m; average depth: 0.15–0.40 m), clear to slightly tannin-stained, well-shaded and cool streams, flowing through densely forested catchments (Raadik 2011, 2014). These streams consist of pools, glides and riffles, with smaller amounts of rapids and backwater areas (Raadik 2011, 2014). The species microhabitat preferences are unknown. However, the substrate in streams occupied by the species consists predominantly of bedrock with boulder and cobble, with smaller amounts of gravel and coarse sand, and relatively large areas of silt deposits (Raadik 2011, 2014). Additionally, instream cover is provided predominantly by rock, vegetation overhang and timber debris, with smaller areas of aquatic vegetation (Raadik 2011, 2014). Average depth of pools is 0.6–0.8 m (Raadik 2011, 2014). *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 species has been collected with *Anguilla australis* (southern shortfin eel), climbing galaxias, *Euastacus bidawalus* (Bidawal crayfish), *Euastacus kershawi* (Gippsland spiny crayfish), *Paratya australiensis* (Australian glass shrimp) (Raadik 2011, 2014). The brown trout is present further downstream in the Arte River, lower reaches of the Little Arte River, and in the Goolengook River system (Raadik 2011, 2014).

Diet

The diet of the East Gippsland 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 East Gippsland 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 East Gippsland galaxias is largely unknown. The spawning period is thought to be from winter to spring but may vary (Raadik 2011, 2014). Individuals collected in late-February (late summer) were at an early stage of gonad development, while individuals collected in late-May (end of autumn) were at an advanced stage, with males running ripe and female gonads well developed and ripe (Raadik 2011, 2014). The majority of individuals recorded in late-May were larger than 54 mm LCF, with the smallest sexually developing individual 54.8 mm LCF (Raadik 2011, 2014). However, three individuals were juveniles (37.0, 39.5 and 41.4 mm LCF respectively) considered of 0+ age, possibly indicating a late spawning with hatching in November and December (Raadik 2011, 2014).

Other species in 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 East Gippsland galaxias is only known from the Arte River system in East Gippsland, approximately 250–390 m ASL (Map 1) (Raadik 2011, 2014). Although the microhabitat preferences of this species are unknown, it has been recorded from small to moderately large, clear to slightly tannin-stained, well-shaded and cool streams, flowing through densely forested catchments (Raadik 2011, 2014). These streams consist of pools, glides and riffles, with smaller amounts of rapids and backwater areas (Raadik 2011, 2014). 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 East Gippsland 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 East Gippsland galaxias are important for the long-term recovery and survival of this species.

Threats

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

The East Gippsland 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, 2014). The species' restricted distribution and 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 East Gippsland galaxias had 50–69 percent probability of extinction by 2040 without additional conservation actions. Preliminary results from population genetic analysis indicate that East Gippsland galaxias has lost most of its genetic diversity and has a high level of inbreeding (Raadik 2021. pers comm 19 October).

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

Table 1 Threats impacting the East Gippsland galaxias

Threat	Status ^a	Evidence
Introduced species		
Predation by introduced salmonids	<ul style="list-style-type: none"> • Timing: current/future • Confidence: inferred • Likelihood: likely • Consequence: catastrophic • Trend: unknown • Extent: across the entire range 	<p>Predation by introduced salmonids, including the brown trout and the rainbow trout, has been implicated in the decline of <i>Galaxias</i> 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 <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 & Kuitert 2002; Green 2008b). <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, wild salmonids now successfully breed in many Victorian waterways and have formed self-sustaining populations (DSEWPaC 2013), including in the Goolengook River system (Raadik 2011, 2014).</p> <p>The East Gippsland galaxias is thought to have historically occupied the majority of the Goolengook River system, prior to the introduction of the brown trout (Raadik 2014). However, the species is now fragmented and only occurs in two small sections of streams where salmonids are absent and their invasion is prevented by natural barriers (waterfalls) (Raadik 2011, 2014). Consequently, the presence of salmonids is likely preventing dispersal and gene flow among subpopulations, causing low genetic variation (Lintermans 2000).</p> <p>As most size classes of the East Gippsland galaxias are within the optimal prey size range for the brown trout (3–97 mm) (Bannon & Ringler 1986; Sánchez-Hernández & 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 ^a	Evidence
Competition with introduced salmonids	<ul style="list-style-type: none"> • Timing: current/future • Confidence: inferred • Likelihood: likely • Consequence: major • Trend: unknown • Extent: across the entire range 	<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 East Gippsland 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"> • Timing: current • Confidence: inferred • Likelihood: likely • Consequence: moderate • Trend: unknown • Extent: across the entire range 	<p>Feral pigs (<i>Sus scrofa</i>) and feral deer (multiple species) are found in association with river systems in East 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 & 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 & Lintermans 2018; Driscoll et al. 2019).</p> <p>Although the impacts of this threat on the East Gippsland galaxias are undocumented, the species is likely to be affected by altered hydrology and water quality if feral ungulates are present. Additionally, following the 2019-20 bushfires, feral ungulates may be putting additional pressure on habitat recovery (Parks Victoria 2021). However, both feral pigs and deer are being actively managed in East Gippsland to control this threat, especially following the 2019-20 bushfires (Parks Victoria 2016, 2021).</p>

Threat	Status ^a	Evidence
Habitat loss, disturbance or modification		
Inappropriate fire regimes	<ul style="list-style-type: none"> • Timing: current • Confidence: observed • Likelihood: likely • Consequence: major • Trend: increasing • Extent: across the entire range 	<p>Fires have been implicated in the decline of <i>Galaxias</i> species, including the East Gippsland galaxias (Raadik 2021), as well as other species in the mountain galaxias complex, due to their fragmented distribution and limited recolonisation/dispersal abilities (Stoessel et al. 2012; Raadik & Nicol 2013; Raadik & 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 & O'Connor 2008; Crowther et al. 2015; Harper et al. 2019; Alexandra & 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). Additionally, increased sediment load (especially following high rainfall events) can suffocate fish and smother stream substrate, which reduces food availability, refuge and spawning habitat (Lyon & 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 & White 1990; Rinne 1996), they can quickly recolonise streams after fire-related disturbances (Novak & White 1990; Lyon & O'Connor 2008). Accordingly, fires can also 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 ^a	Evidence
Altered hydrology/water quality caused by anthropogenic activities	<ul style="list-style-type: none"> • Timing: historical/current • Confidence: inferred • Likelihood: likely • Consequence: major • Trend: unknown • Extent: across the entire range 	<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 & Doeg 1989; Motha et al. 2003; Bowmer 2013).</p> <p>Historically, land surrounding the Arte River system was used for timber harvesting (DELWP 2021a). Forestry operations continue in parts of the range of this taxon. Consequently, many areas within the catchment have potential to be major sources of soil disturbance and sediment input into streams (Raadik 2021. pers comm 19 October).</p> <p>Spatial analysis of catchments occupied by the East Gippsland galaxias (on all land tenures) indicates that 29% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks, reserves and special protection zones within State forest. A further 47% is excluded from timber harvesting as it falls within the Immediate Protection Areas set aside for the protection of the Greater Glider and other threatened species. There are no species-specific protections for the East Gippsland galaxias in the Victorian Code of Practice for Timber Production 2014 however other more general prescriptions such as protection and buffering of rainforest, old growth and waterways provide protection from timber harvesting. 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>Such changes to water quality are likely to impact the East Gippsland galaxias (Raadik 2016; Threatened Species Recovery Hub 2018; Raadik 2019a; Lintermans et al. 2020). Further, these tracks provide easy access to the Arte River and increase the risk of anthropogenic-assisted salmonid invasion (Threatened Species Recovery Hub 2018).</p>

Threat	Status ^a	Evidence
Climate change		
Increased temperatures, change to precipitation patterns and more extreme weather events	<ul style="list-style-type: none"> • Timing: current/future • Confidence: observed • Likelihood: almost certain • Consequence: major • Trend: increasing • Extent: across the entire range 	<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 & Lake 1996). However, the CSIRO & Bureau of Meteorology (2015) predict eastern Australia will experience decreased average rainfall, and increased frequency of droughts and average temperatures. From 2017–2019, East 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 & Bureau of Meteorology 2015; DELWP 2020b). 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 & 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 & 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). The 2019-20 bushfires (including the associated sedimentation risk) are predicted to cause a 57% decline (80% confidence limits: 38–95%) in the East Gippsland galaxias' population size after 3 generations (DELWP 2020a; Legge et al. 2021).</p> <p>Further, the frequency of extreme rainfall events is also increasing (CSIRO & Bureau of Meteorology 2015; DELWP 2020b), 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 2020b; Lintermans et al. 2020).</p>

Threat	Status ^a	Evidence
Disease		
Internal parasites	<ul style="list-style-type: none"> • Timing: current • Confidence: observed • Likelihood: unknown • Consequence: unknown • Trend: unknown • Extent: unknown 	<p>A short, thin, white worm (coiled and pointed at both ends) was recorded in the fat deposits around stomach of East Gippsland 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 & Stockwell 2004; VFA 2008). The prevalence of metacercarial cysts in the East Gippsland 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 Risk matrix for the East Gippsland galaxias

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 salmonoids	Predation by introduced salmonoids
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

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 East Gippsland 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 East Gippsland 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.
- Identify and conserve habitat characteristics that facilitate movement between subpopulations.

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 East Gippsland 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. Ensure up-to-date population data and scientific knowledge inform the implementation of conservation actions, particularly regarding the removal and control of introduced salmonid predators.
- Promote community awareness of the East Gippsland galaxias and identify opportunities for involvement in conservation actions.
- Contribute to impact assessment and planning processes on measures to protect the East Gippsland 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 East Gippsland galaxias.
- Ascertain the cultural significance of the East Gippsland galaxias to Indigenous Australians.

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 \(*Sus scrofa*\) \(2017\)](#)

Conservation Advice and Listing Assessment references

- Alexandra J & Finlayson M (2020) Floods after bushfires: rapid responses for reducing impacts of sediment, ash, and nutrient slugs. *Australasian Journal of Water Resources* 24, 9-11.
- Allan H & Lintermans M (2018) The threat from feral horses to a critically endangered fish. In: Worboys GL, DA Driscoll, P Crabb (eds) *Feral horse impacts: The Kosciuszko science conference*. Australian Academy of Science; The Australian National University; Fenner School of Environment and Society; and Deakin University, Canberra. pp 88-89.
- Allen GR, Midgley SH & Allen M (2002) Galaxiids family Galaxiidae. In: Allen GR, SH Midgley, M Allen (eds) *Field guide to the freshwater fishes of Australia*. Western Australian Museum, Perth. pp 94-116.
- Arnell NW & Gosling SN (2013) The impacts of climate change on river flow regimes at the global scale. *Journal of Hydrology* 486, 351-364.
- Ayres R, Nicol M & Raadik T (2012) *Guidelines for the translocation of barred galaxias (Galaxias fuscus) for conservation purposes*. Black Saturday Victoria 2009 – Natural values fire recovery program. Department of Sustainability and Environment (Vic), Victoria.
- Bannon E & Ringler NH (1986) Optimal prey size for stream resident brown trout (*Salmo trutta*): tests of predictive models. *Canadian Journal of Zoology* 64, 704-713.
- Bouzat JL (2010) Conservation genetics of population bottlenecks: the role of chance, selection, and history. *Conservation Genetics* 11, 463-478.
- Bowmer KH (2013) Ecosystem effects from nutrient and pesticide pollutants: catchment care as a solution. *Resources* 2, 439-456.
- Bray DJ (2020) *Galaxias aequipinnis* in Fishes of Australia. Accessed: 26 April 2021 Available at: <http://136.154.202.208/home/species/5122>
- Bureau of Meteorology (2020) *Special Climate Statement 70 update—drought conditions in Australia and impact on water resources in the Murray–Darling Basin*. Bureau of Meteorology (Commonwealth).
- Cadwallader PL (1996) *Overview of the impacts of introduced salmonids on Australian native fauna*. Report prepared for the Australian Nature Conservation Agency, Canberra.
- Cadwallader PL, Eden AK & Hook RA (1980) Role of streamside vegetation as a food source for *Galaxias olidus* Gunther (Pisces: Galaxiidae). *Marine and Freshwater Research* 31, 257-262.
- Campbell IC & Doeg TJ (1989) Impact of timber harvesting and production on streams: a review. *Australian Journal of Marine and Freshwater Research* 40, 519-539.
- Closs GE & Lake PS (1996) Drought, differential mortality and the coexistence of a native and an introduced fish species in a south east Australian intermittent stream. *Environmental Biology of Fishes* 47, 17-26.
- Closs GP (1994) Feeding of *Galaxias olidus* (Guenther) (Pisces: Galaxiidae) in an intermittent Australian stream. *Marine and Freshwater Research* 45, 227-232.

- Collyer ML & Stockwell CA (2004) Experimental evidence for costs of parasitism for a threatened species, White Sands pupfish (*Cyprinodon tularosa*). *Journal of Animal Ecology* 73, 821-830.
- Cowden KLB (1988) Aspects of biology of the mountain galaxiid, *Galaxias olidus* Gunther (Pisces: Galaxiidae) in Pierce's Creek, ACT. Thesis. Australian National University.
- Crowl T, Townsend C & McIntosh A (1992) The impact of introduced brown and rainbow trout on native fish: the case of Australasia. *Reviews in Fish Biology and Fisheries* 2, 217-241.
- Crowther D, O'Connor J, Moloney P & Papas P (2015) *Detecting the effect of fire on macroinvertebrates and fish in central and eastern Victoria*. Unpublished client report for Fire and Emergency Management Division, Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- CSIRO (Commonwealth Scientific and Industrial Research Organisation) & Bureau of Meteorology (2015) *Climate change in Australia information for Australia's natural resource management regions: technical report*. CSIRO and Bureau of Meteorology, Australia.
- Davis NE, Bennett A, Forsyth DM, Bowman DMJS, Lefroy EC, Wood SW, Woolnough AP, West P, Hampton JO & Johnson CN (2016) A systematic review of the impacts and management of introduced deer (family Cervidae) in Australia. *Wildlife Research* 43, 515-532.
- DELWP (Department of Environment, Land, Water and Planning) (2020a) *Victoria's bushfire emergency: biodiversity response and recovery. Version 2. August 2020*. Department of Environment, Land, Water and Planning (Vic), Victoria.
- DELWP (Department of Environment, Land, Water and Planning) (2020b) *Victoria's water in a changing climate: Insights from the Victorian Water and Climate Initiative. Amended February 2021*. Department of Environment, Land, Water and Planning (Vic), Melbourne.
- DELWP (Department of Environment, Land, Water and Planning) (2021a) NatureKit 2.0 Logging History. Accessed: 18 May 2021 Available at: <https://maps2.biodiversity.vic.gov.au/Html5viewer/index.html?viewer=NatureKit>
- DELWP (Department of Environment, Land, Water and Planning) (2021b) VICNAMES - the register of geographic names. Accessed: 29 September 2021 Available at: <https://maps.land.vic.gov.au/lassi/VicnamesUI.jsp>
- DOEE (Department of the Environment and Energy) (2017) *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*. Department of the Environment and Energy (Commonwealth), Canberra.
- Döll P & Zhang J (2010) Impact of climate change on freshwater ecosystems: a global-scale analysis of ecologically relevant river flow alterations. *Hydrology and Earth System Sciences* 14, 783-799.
- Doupé RG, Mitchell J, Knott MJ, Davis AM & Lymbery AJ (2010) Efficacy of exclusion fencing to protect ephemeral floodplain lagoon habitats from feral pigs (*Sus scrofa*). *Wetlands Ecology and Management* 18, 69-78.
- DPI (Department of Primary Industries) (2005) *Protocols for the translocation of fish in Victorian inland public waters. Fisheries Victoria Management Report Series No. 24*. Department of Primary Industries (Vic), Victoria.

- DPI (Department of Primary Industries) (2014) *Guidelines for assessing translocations of live aquatic organisms in Victoria, version 4. Fisheries Management Report Series No. 65*. Department of Primary Industries (Vic), Victoria.
- Driscoll DA, Worboys GL, Allan H, Banks SC, Beeton NJ, Cherubin RC, Doherty TS, Finlayson CM, Green K, Hartley R, Hope G, Johnson CN, Lintermans M, Mackey B, Paull DJ, Pittock J, Porfirio LL, Ritchie EG, Sato CF, Scheele BC, Slattery DA, Venn S, Watson D, Watson M & Williams RM (2019) Impacts of feral horses in the Australian Alps and evidence-based solutions. *Ecological Management & Restoration* 20, 63-72.
- DSE (Department of Sustainability and Environment) (2011a) *Barred galaxias: fire recovery actions*. Department of Sustainability and Environment (Vic), East Melbourne.
- DSE (Department of Sustainability and Environment) (2011b) *Gippsland region sustainable water strategy*. Department of Sustainability and Environment (Vic), Melbourne.
- DSEWPac (Department of Sustainability, Environment, Water, Population and Communities) (2011) *Feral deer*. Department of Sustainability, Environment, Water, Population and Communities (Commonwealth), Canberra.
- DSEWPac (Department of Sustainability, Environment, Water, Population and Communities) (2013) *Advice to the Minister for Sustainability, Environment, Water, Population and Communities from the Threatened Species Scientific Committee (the Committee) on Amendments to the List of Key Threatening Processes under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Department of Sustainability, Environment, Water, Population and Communities (Commonwealth), Canberra.
- Frankham R (2005) Genetics and extinction. *Biological Conservation* 126, 131-140.
- Frankham R, Ballou SEJD, Briscoe DA & Ballou JD (2002) *Introduction to conservation genetics*. Cambridge University Press.
- Glova G (1989) Native and salmonid fishes: are they compatible. *Freshwater Catch* 40, 12-13.
- Green K (2008) Fragmented distribution of a rock climbing fish, the mountain galaxias *Galaxias olidus*, in the snowy mountains. *Proceedings of the Linnean Society of New South Wales* 129, 175-182.
- Harper AR, Santin C, Doerr SH, Froyd CA, Albini D, Otero XL, Viñas L & Pérez-Fernández B (2019) Chemical composition of wildfire ash produced in contrasting ecosystems and its toxicity to *Daphnia magna*. *International Journal of Wildland Fire* 28, 726-737.
- IUCN (International Union for Conservation of Nature) (2012) *IUCN Red List categories and criteria: Version 3.1*. 2nd edn. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN (International Union for Conservation of Nature) (2019) *Guidelines for using the IUCN red list categories and criteria. Version 14*. Prepared by the IUCN Standards and Petitions Committee.
- Legge S, Woinarski JCZ, Garnett ST, Geyle H, Lintermans M, Nimmo DG, Rumpff L, Scheele BC, Southwell DG, Ward M, Whiterod NS *et al.* (2021) *Estimates of the impacts of the 2019-2020 fires on populations of native animal species*. Report by the NESP Threatened Species Recovery Hub, Queensland.

- Lennox RJ, Crook DA, Moyle PB, Struthers DP & Cooke SJ (2019) Toward a better understanding of freshwater fish responses to an increasingly drought-stricken world. *Reviews in Fish Biology and Fisheries* 29, 71-92.
- Lintermans M (2000) Recolonization by the Mountain Galaxias *Galaxias olidus* of a montane stream after the eradication of Rainbow Trout *Oncorhynchus mykiss*. *Marine and Freshwater Research* 51, 799-804.
- Lintermans M (2007) *Fishes of the Murray-Darling Basin: an introductory guide*. Murray Darling Basin Commission, Canberra.
- Lintermans M (2013) Conservation and management. In: Humphries P, K Walker (eds) *The ecology of Australian freshwater fishes*. CSIRO Publishing, Collingwood. pp 283-316.
- Lintermans M, Geyle HM, Beatty S, Brown C, Ebner BC, Freeman R, Hammer MP, Humphreys WF, Kennard MJ, Kern P, Martin K, Morgan DL, Raadik TA, Unmack PJ, Wager R, Woinarski JCZ & Garnett ST (2020) Big trouble for little fish: identifying Australian freshwater fishes in imminent risk of extinction. *Pacific Conservation Biology* 26, 365-377.
- Lyon JP & O'Connor JP (2008) Smoke on the water: can riverine fish populations recover following a catastrophic fire-related sediment slug? *Austral Ecology* 33, 794-806.
- Magilligan FJ, Buraas EM & Renshaw CE (2015) The efficacy of stream power and flow duration on geomorphic responses to catastrophic flooding. *Geomorphology* 228, 175-188.
- Markert JA, Champlin DM, Gutjahr-Gobell R, Grear JS, Kuhn A, McGreevy TJ, Jr., Roth A, Bagley MJ & Nacci DE (2010) Population genetic diversity and fitness in multiple environments. *BMC Evolutionary Biology* 10, 205.
- McDowall RM (2006) Crying wolf, crying foul, or crying shame: alien salmonids and a biodiversity crisis in the southern cool-temperate galaxiid fishes? *Reviews in Fish Biology and Fisheries* 16, 233-422.
- McDowell R (2007) Water quality in headwater catchments with Deer wallows. *Journal of Environmental Quality* 36, 1377-1382.
- McLean F, Barbee NC & Swearer SE (2007) Avoidance of native versus non-native predator odours by migrating Whitebait and juveniles of the common galaxiid, *Galaxias maculatus*. *New Zealand Journal of Marine and Freshwater Research* 41, 175-184.
- Motha JA, Wallbrink PJ, Hairsine PB & Grayson RB (2003) Determining the sources of suspended sediment in a forested catchment in southeastern Australia. *Water Resources Research* 39, 1056.
- Mulvey C (2021) Impacts of bushfire-associated stressors for threatened freshwater fishes. Thesis. University of Queensland.
- Native Fish Australia (2021) Mountain galaxias. Accessed: 24 May 2021 Available at: <https://www.nativefish.asn.au/home/page/Mountain-Galaxias>
- Novak MA & White RG (1990) Impact of a fire and flood on the trout population of Beaver creek, Upper Missouri basin, Montana. In: Richardson F, RH Hamre (eds) *Wild Trout IV: Proceedings of the symposium*. Trout Unlimited, Arlington.

- NSW FSC (New South Wales Fisheries Scientific Committee) (2016) *Final determination: Galaxias tantangara – stocky galaxias as a Critically Endangered species*. NSW Fisheries Scientific Committee. Part 7A of The NSW Fisheries Management Act 1994. Department of Primary Industries (NSW), Crows Nest.
- O'Connor W & Koehn J (1991) Spawning of the mountain galaxias, *Galaxias olidus* Gunther, in Bruces Creek, Victoria. *Proceedings of the Royal Society of Victoria* 103, 113-123.
- Parks Victoria (2016) *Greater Alpine National Parks management plan*. Parks Victoria (Vic), Melbourne.
- Parks Victoria (2021) Deer and feral animal control in response to bushfire. Accessed: 14 May 2021 Available at: <https://www.parks.vic.gov.au/projects/deer-and-feral-animal-control-in-response-to-bushfire>
- Raadik TA (2011) Systematic revision of the mountain galaxias, *Galaxias olidus* Günther, 1866 species complex (Teleostei: Galaxiidae) in eastern Australia. Thesis. University of Canberra.
- Raadik TA (2014) Fifteen from one: a revision of the *Galaxias olidus* Günther, 1866 complex (Teleostei, Galaxiidae) in south-eastern Australia recognises three previously described taxa and describes 12 new species. *Zootaxa* 1, 1-198.
- Raadik TA (2016) *Galaxias species complex in eastern Victoria (east of the Hume Highway) - information and advice to the Forest Industry Taskforce*. Unpublished client report. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- Raadik TA (2017) *Predator control options for threatened galaxiids in small, upland Victorian streams: a discussion paper*. Unpublished Client report for Biodiversity Branch, EECC Division, DELWP. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- Raadik TA (2018) *Tamboritha-Dingo Hill Track Fire natural values protection: Aquatic values in Shaw's Creek catchment*. Unpublished Client Report for Parks Victoria. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- Raadik TA (2019a) *Galaxias aequipinnis*. The IUCN Red List of Threatened Species 2019: e.T122902229A123382096. Accessed: 24 May 2021 Available at: <https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T122902229A123382096.en>
- Raadik TA (2019b) *Tantangara Creek fish barrier design criteria – Snowy 2.0 project*. Unpublished Client Report for EMM Consulting. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- Raadik TA (2021) Personal communication by email, 19 October 2021. Expert in Australian Galaxiidae taxonomy, Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic).
- Raadik TA (2021) In posession of author. Expert in Australian Galaxiidae taxonomy, Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic).

- Raadik TA, Fairbrother PS & Smith SJ (2010) *National recovery plan for the barred galaxias (Galaxias fuscus)*. Department of Sustainability and Environment, Victoria.
- Raadik TA & Kuitert R (2002) Kosciuszko galaxias: a story of confusion and imminent peril. *Fishes of Sahul* 16, 830-835.
- Raadik TA & Nicol MD (2012) *Assessment of the post-fire status and distribution of the Dargo galaxias (Galaxias sp. 6), affected by the White Timber Spur fire, upper Dargo River system. Black Saturday Victoria 2009 - Natural values fire recovery program*. Department of Sustainability and Environment (Vic), Heidelberg.
- Raadik TA & Nicol MD (2013) *Searching for threatened upland galaxiids in the Thomson and La Trobe river catchments, West Gippsland. Arthur Rylah Institute for Environmental Research technical report series No: 248*. Department of Environment and Primary Industries (Vic), Heidelberg.
- Raadik TA & Nicol MD (2015) *Post-fire recovery of McDowall's galaxias, and additional aquatic fauna, in East Gippsland 2014–2015*. Unpublished client report for Gippsland Region, Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning (Vic), Heidelberg.
- Rinne JN (1996) Management briefs: Short-term effects of wildfire on fishes and aquatic macroinvertebrates in the southwestern United States. *North American Journal of Fisheries Management* 16, 653-658.
- Ross DS, Wemple BC, Willson LJ, Balling CM, Underwood KL & Hamshaw SD (2019) Impact of an extreme storm event on river corridor bank erosion and Phosphorus mobilization in a mountainous watershed in the northeastern United States. *Journal of Geophysical Research: Biogeosciences* 124, 18-32.
- Sánchez-Hernández J & Cobo F (2015) Adaptive flexibility in the feeding behaviour of brown trout: optimal prey size. *Zoological Studies* 54, 26.
- Shelley JJ, Raadik TA & Lintermans M (2021) *Draft 2019/20 bushfire impacts on freshwater fish and emergency conservation responses. NESP TSR Hub Project 8.3.6. Arthur Rylah Institute for Environmental Research Technical Report Series No. TBC*. Arthur Rylah Institute for Environmental Research, Department of Land, Water and Planning (Vic), Heidelberg.
- Shu-ren Y (2003) Effects of fire disturbance on forest hydrology. *Journal of Forestry Research* 14, 331-334.
- Silva LGM, Doyle KE, Duffy D, Humphries P, Horta A & Baumgartner LJ (2020) Mortality events resulting from Australia's catastrophic fires threaten aquatic biota. *Global Change Biology* 26, 5345-5350.
- Singer FJ, Swank WT & Edward ECC (1984) Effects of wild pig rooting in a deciduous forest. *The Journal of Wildlife Management* 48, 464-473.
- Smith JJ (1982) Fishes of the Pajaro River Basin. In: Moyle PB (ed) *Distribution and ecology of stream fishes other Sacramento-San Joaquin Drainage system California*. vol 115. University of California Publications in Zoology. pp 3-117.
- Stoessel D, Ayres R & Raadik T (2012) *Improving spawning success for barred galaxias (Galaxias fuscus) in streams affected by bushfire – an aid to recovery*. Black Saturday Victoria 2009

– Natural values fire recovery program. Department of Sustainability and Environment (Vic), Victoria.

Threatened Species Recovery Hub (2018) *Species expert assessment plan - Imperilled freshwater fish*. Unpublished report by Threatened Species Recovery Hub, Queensland.

Tilzey RDJ (1976) Observations on interactions between indigenous Galaxiidae and introduced Salmonidae in the Lake Eucumbene catchment, New South Wales. *Marine and Freshwater Research* 27, 551-564.

VAHC (Victorian Aboriginal Heritage Council) (2021) Victoria's current Registered Aboriginal Parties. Accessed: 30 September 2021 Available at: <https://www.aboriginalheritagecouncil.vic.gov.au/victorias-current-registered-aboriginal-parties>

VFA (Victorian Fisheries Authority) (2008) Some parasites of freshwater fish. Accessed: 20 September 2021 Available at: <https://vfa.vic.gov.au/operational-policy/pests-and-diseases/some-parasites-of-freshwater-fish>

VFA (Victorian Fisheries Authority) (2021) Managing recreational trout fisheries. Accessed: 13 May 2021 Available at: <https://vfa.vic.gov.au/recreational-fishing/fish-stocking/managing-recreational-trout-fisheries>

Vidal N, Trochine C, Amsinck SL, Barmuta LA, Christoffersen KS, Ventura M, Buchaca T, Landkildehus F, Hardie SA, Meerhoff M & Jeppesen E (2020) Interaction between non-native predatory fishes and native galaxiids (Pisces: Galaxiidae) shapes food web structure in Tasmanian lakes. *Inland Waters* 10, 212-226.

Wager R & Jackson PD (1993) *The action plan for Australian freshwater fishes*. Australian Nature Conservation Agency, Canberra.

Whitney JE, Gido KB, Pilger TJ, Propst DL & Turner TF (2015) Consecutive wildfires affect stream biota in cold- and warmwater dryland river networks. *Freshwater Science* 34, 1510-1526.

Zukowski S, Whiterod N, Ellis I, Gilligan D, Kerezszy A, Lamin C, Lintermans M, Mueller S, Raadik TA & Stoessel D (2021) *Conservation translocation handbook for New South Wales threatened small-bodied freshwater fishes*. A report to the New South Wales Department of Primary Industries Fisheries. Aquasave–Nature Glenelg Trust, Victor Harbor.

THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

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

Attachment A: Listing Assessment for *Galaxias aequipinnis*

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

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	4750	1300	7400	<p>Based on monitoring data (collected annually from 2014–2019), the number of mature individuals was estimated to be approximately 8000–10,600 (midpoint = 9300) prior to the 2019-20 bushfires (Raadik 2021).</p> <p>However, the overall population is expected to have declined by approximately 49%, 1 year after the 2019-20 bushfires (80% confidence limits: 30–84% decline) (see Criterion 1) (Legge et al. 2021). This suggests that the number of mature individuals is approximately 4750 (with 9300 mature individuals initially and 49% decline), but could range from approximately 1300 (worst-case estimate, with 8000 mature individuals initially and 84% decline) to approximately 7400 (best-case estimate, with 10,600 mature individuals initially and 30% decline).</p>
Trend	Declining			<p>As discussed above, the overall population is expected to have declined by approximately 49% following the 2019-20 bushfires (80% confidence limits: 30–84% decline) (see Criterion 1) (Legge et al. 2021). This decline is projected to increase over the next 3 generations (Legge et al. 2021).</p> <p>Additionally, 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
Generation time (years)	2–4	2	4	The East Gippsland galaxias is likely to have a generation time of approximately 2–4 years (see Criterion 1).
Extent of occurrence	96 km ²	38 km ²	96 km ²	<p>The estimate used in this assessment is the maximum plausible estimate and has been 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 value is the estimate used by IUCN (Raadik 2019a) rapid assessment.</p> <p>All values are within the range of the Critically Endangered category of Criterion 2.</p>
Trend	Contracted historically; possibly contracted following 2019-20 bushfires; likely to contract following next threatening event			<p>The species' distribution is thought to have been historically more widespread throughout the Goolengook River system, suggesting range contraction occurred during the late 20th century, following the incursion of introduced salmonids (Raadik 2014). Accordingly, EOO is considered to have contracted historically.</p> <p>Following the 2019-20 bushfires, no individuals have been found in the Little Arte River subpopulation (Raadik 2021), suggesting possible extirpation of this subpopulation and therefore possible contraction of EOO.</p> <p>As threats are ongoing, EOO is likely to undergo decline following the next threatening event (e.g., salmonid incursion, sedimentation following fire, severe drought, etc.) (See Criterion 2).</p>
Area of Occupancy	20 km ²	12 km ²	44 km ²	<p>The estimate used in this assessment has been calculated using record data from 1992–2021 for known subpopulations and applying 2 x 2 km grid cells, as outlined in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2019).</p> <p>The minimum plausible value is the estimate used by IUCN (Raadik 2019a) and Lintermans et al. (2020) rapid assessments. The maximum plausible value is the estimate used in the Threatened Species Recovery Hub (2018) rapid assessment.</p> <p>All values are within the range of the Endangered category of Criterion 2.</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>				
Trend	Contracted historically; possibly contracted following 2019-20 bushfires; likely to contract following next threatening event			Using the same reasoning as 'EOO' (above), AOO is considered to have contracted historically, possibly contracted following 2019-20 bushfires, and be likely to contract following next threatening event.

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of subpopulations	2	1	2	<p>There are 2 wild subpopulations in two streams with no connectivity due to the presence of introduced salmonids (Raadik 2021. pers comm 19 October). The Little Arte River subpopulation has been surveyed following the 2019-20 bushfires and no individuals have been found (Raadik 2021), suggesting this subpopulation is possibly extinct.</p> <p>The translocated subpopulation has not been included in this assessment, as monitoring has indicated no sign of successful breeding and no individuals were recovered following the 2019-20 bushfires (Raadik 2021. pers comm 19 October) (see Criterion 1).</p>
Trend	Declined historically; possibly declined following 2019-20 bushfires; likely to decline following next threatening event			Using the same reasoning as 'E00' (above), the number of subpopulations is considered to have contracted historically, possibly contracted following 2019-20 bushfires, and be likely to contract following next threatening event.
Basis of assessment of subpopulation number	See justification for number of subpopulations.			
No. locations	1	1	1	<p>Threatened Species Recovery Hub (2021) estimate that the 2019-20 bushfires (and associated sedimentation) overlapped with 100% of the East Gippsland galaxias' distribution (i.e., both subpopulations).</p> <p>Following the 2019-20 bushfires, no individuals have been found in the Little Arte River subpopulation (suggesting possible extirpation) and abundance in the Arte River subpopulation has dramatically declined (Raadik 2021). Further evidence demonstrating the severe/rapid impact of fire on this species is available in Table 1.</p> <p>Accordingly, it is feasible for all individuals to be rapidly affected by a single threatening event (e.g., fire).</p> <p>One location has been used in this assessment.</p>
Trend	Stable			One location has been used in this assessment, so it is not possible for the number of locations to decline any further.
Basis of assessment of location number	See justification for number of locations.			
Fragmentation	<p>All intervening waters (main stem and side tributaries) between the two subpopulations have been sampled and no individuals have been found (Raadik 2021. pers comm 19 October), while the presence of the brown trout has been confirmed (Raadik 2011, 2014). This indicates that subpopulations are completely isolated from each other and no dispersal between subpopulations is possible (Raadik 2021. pers comm 19 October).</p> <p>The Little Arte River subpopulation has been surveyed following the 2019-20 bushfires and no individuals have been found (Raadik 2021), suggesting this subpopulation is possibly extinct and/or not viable. Accordingly, the species is considered severely fragmented.</p>			
Fluctuations	There are no known extreme fluctuations in E00, A00, 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
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 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>A2 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>A3 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>A4 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"> (a) direct observation [except A3] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites 			

Criterion 1 evidence**Eligible under Criterion 1 A3ce+4bce for listing as Critically Endangered****Generation length**

The generation length of the East Gippsland 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.

Exclusion of translocated subpopulation from listing assessment

The IUCN criteria should be applied to wild subpopulations, as well as self-sustaining translocations, if the latter have produced viable offspring and at least five years have passed since translocation (IUCN 2019). Although one translocation has been conducted (Threatened Species Recovery Hub 2018), monitoring has indicated no sign of successful breeding and no individuals were recovered following the 2019-20 bushfires (Raadik 2021. pers comm 19 October). Accordingly, the translocated subpopulation has not been included in the assessment of the East Gippsland galaxias against the listing criteria.

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) and the role of salmonids in the fragmentation of *Galaxias* subpopulations has been well documented in Australia (Lintermans 2000; Raadik & Kuiter 2002; Green 2008).

The species is likely to have been historically more widespread and may have occupied the majority of the Goolengook River system (where it is now absent) prior to the introduction of the brown trout (Raadik 2014). Accordingly, the species is presumed to have undergone very severe population reduction and range contraction throughout the 20th 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)

Following this historical decline, the species is now only known from two isolated subpopulations in the Arte River and Little Arte River (Raadik 2011, 2014). Density of the East Gippsland galaxias declined by >50 percent following fires (and associated sedimentation) in early 2014 (Raadik 2021).

Additionally, the East Gippsland galaxias was impacted by the 2019-20 bushfires. The Threatened Species Recovery Hub (2021) estimate that the 2019-20 bushfires (and associated sedimentation) overlapped with 100 percent of the East Gippsland galaxias' distribution (i.e., both subpopulations). Following the 2019-20 bushfires, no individuals have been located in the Little Arte River subpopulation (suggesting possible extirpation) and abundance in the Arte River subpopulation has dramatically declined (Raadik 2021).

The Threatened Species Recovery Hub (2021) produced preliminary estimates of population change following the 2019-20 bushfires, using the proportion of the species' modelled distribution in areas at risk from fire and sedimentation, intersected with expert estimates of population change following fires. These preliminary estimates suggest that the overall population declined by 49 percent one year after the 2019-20 bushfires, but may have declined by as much as 84 percent (80 percent confidence limits: 30–84 percent decline) (Legge et al. 2021). Three generations after the 2019-20 bushfires, the overall population is predicted to decline by approximately 57 percent, but may decline by as much as 95 percent (80 percent confidence limits: 38–95 percent decline) assuming no further extensive fire events (Legge et al. 2021), suggesting further severe population reduction.

Future population reduction (2021 to 2031-33)

In addition to the impacts from the 2019-20 bushfires, 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 East Gippsland galaxias throughout the 20th 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/projected severe reduction of the East Gippsland galaxias following the 2014 and 2019-20 bushfires (Legge et al. 2021; Raadik 2021).

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 East Gippsland galaxias occurs, within the next three generations. The brown trout occurs in the Goolengook River, the lower Arte River and the Little Arte River (Raadik 2011, 2014), however, instream barriers (waterfalls) prevent their incursion into the areas occupied by the East Gippsland galaxias (Threatened Species Recovery Hub 2018). 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 2020b). 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 potentially drown out instream barriers facilitating salmonid incursion (Magilligan et al. 2015; Threatened Species Recovery Hub 2018; Ross et al. 2019; DELWP 2020b; 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 East Gippsland galaxias (adding to the severe population reduction (>50 percent) observed following the 2014 and 2019-20 bushfires). This is supported by the expert elicitation conducted by Lintermans et al. (2020), which predicted that the East Gippsland galaxias had a 50–69 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) and A4 (past and future reduction).

Conclusion

The species has undergone/is projected to undergo very severe population reduction within the last/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
B1. Extent of occurrence (EOO)	< 100 km²	< 5000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2000 km²
AND at least 2 of the following 3 conditions:			
(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

Exclusion of translocated subpopulation from listing assessment

As indicated under Criterion 1, the translocated subpopulation has not been included in the assessment of the East Gippsland galaxias against the listing criteria.

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

The EOO is estimated at 96 km² and AOO is estimated at 20 km². These figures are based on the mapping of point records from 1992–2021, obtained from state governments, museums and CSIRO. The AOO was calculated using a 2 x 2 km grid cell method (IUCN 2019).

The species' EOO appears to meet the requirements for listing as Critically Endangered under B1 (<100 km²). The species' AOO appears to meet the requirements for listing as Endangered under B2 (<500 km²).

Number of locations

In 2019-20, following years of drought (Bureau of Meteorology 2020), catastrophic bushfire conditions resulted in unprecedented, extensive bushfires across Australia. The Threatened Species Recovery Hub (2021) estimate that the 2019-20 bushfires (and associated sedimentation) overlapped with 100 percent of the East Gippsland galaxias' distribution (i.e., both subpopulations).

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 & O'Connor 2008; Crowther et al. 2015; Harper et al. 2019; Alexandra & 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) (Mulvey 2021). Additionally, increased sediment load (especially following high rainfall events) can suffocate fish and smother stream substrate, which reduces food availability, refuge and spawning habitat (Lyon & 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. Further evidence demonstrating the severe and rapid impact of fire on this species is available in Table 1.

Following the 2019-20 bushfires, no individuals have been found in the Little Arte River subpopulation (suggesting possible extirpation) and abundance in the Arte River subpopulation has dramatically declined (Raadik 2021). This evidence suggests the species occurs in one location over which a single fire could rapidly affect all individuals.

The species' number of locations appears to meet the requirement for listing as Critically Endangered under this criterion.

Severe fragmentation

The species is known from two subpopulations in the Arte River and the Little Arte River (Map 1) (Raadik 2011, 2014). All intervening waters (main stem and side tributaries) between the two subpopulations have been sampled and no individuals have been found (Raadik 2021. pers comm 19 October), while the presence of the brown trout has been confirmed (Raadik 2011, 2014). The distribution of *Galaxias* species and salmonids are usually mutually exclusive (e.g. Tilzey 1976; Lintermans 2000) and the role of salmonids in the fragmentation of *Galaxias* subpopulations has been well documented in Australia (Lintermans 2000; Raadik & Kuitert 2002; Green 2008). This indicates that subpopulations are completely isolated from each other and no dispersal between subpopulations is possible (Raadik 2021. pers comm 19 October).

The Little Arte River subpopulation has been surveyed following the 2019-20 bushfires and no individuals have been found (Raadik 2021), suggesting this subpopulation is possibly extinct and/or not viable.

Accordingly, the species is considered severely fragmented and appears to meet this requirement for listing under this criterion.

Continuing decline

As described in Criterion 1, the East Gippsland galaxias' distribution is likely to have been historically more widespread throughout the Goolengook River system, prior to the inferred range contraction during the late 20th 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.

The East Gippsland galaxias population underwent severe reduction following fires (and associated sedimentation) in early 2014 (Raadik 2021). The East Gippsland galaxias population is projected to undergo further severe reduction over the next three generations, following the 2019-20 bushfires (and associated sedimentation) (Legge et al. 2021). This suggests decline in area, extent and/or quality of habitat, and number of mature individuals following these two fire events. Additionally, no individuals have been found in the Little Arte River subpopulation (Raadik 2021), suggesting possible extirpation of this subpopulation and therefore possible decline in EOO, AOO and number of subpopulations.

Further, 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 East Gippsland galaxias throughout the 20th 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/projected severe reduction of the East Gippsland galaxias following the 2014 and 2019-20 bushfires (Legge et al. 2021; Raadik 2021).

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 East Gippsland 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 barriers (Threatened Species Recovery Hub 2018; Lintermans et al. 2020). This would result in likely extirpation of subpopulations, 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 East Gippsland galaxias had 50–69 percent probability of extinction by 2040 without additional conservation actions. Additionally, preliminary results from population genetic analysis indicate that the East Gippsland galaxias has lost most of its genetic diversity and has a high level of inbreeding, which restricts its' evolutionary potential (Raadik 2021. pers comm 19 October). This is another factor that could cause continuing decline in EOO, AOO, area, 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.

Extreme fluctuations

The density of the East Gippsland 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; subpopulations are severely fragmented; 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

	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2500	< 10,000
AND either (C1) or (C2) is true			
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2. 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 C1 for listing as Vulnerable****Exclusion of translocated subpopulation from listing assessment**

As indicated under Criterion 1, the translocated subpopulation has not been included in the assessment of the East Gippsland galaxias against the listing criteria.

Number of mature individuals

Based on monitoring data from 2014–2019, the number of mature individuals was estimated to be approximately 8000–10,600 (midpoint = 9300) prior to the 2019-20 bushfires (Raadik 2021).

However, the overall population is expected to have declined by approximately 49 percent, one year following the 2019-20 bushfires (80 percent confidence limits: 30–84 percent decline) (see Criterion 1) (Legge et al. 2021). This suggests that the number of mature individuals is approximately 4750 (with 9300 mature individuals initially and 49 percent decline), but could range from approximately 1300 (worst-case estimate, with 8000 mature individuals initially and 84 percent decline) to approximately 7400 (best-case estimate, with 10,600 mature individuals initially and 30 percent decline).

Field observations anecdotally support decline similar to the mid-range estimate (~50 percent) following the 2019-20 bushfires (Raadik 2021. pers comm 18 October), suggesting that the mid-range estimate of approximately 4750 mature individuals is appropriate for this species following the 2019-20 bushfires. Although the worst-case estimate falls within the Endangered category (<2500), the mid-range and best-case estimates fall within the Vulnerable category (2500-10,000). Accordingly, the number of mature individuals appears to meet the requirements for listing as Vulnerable (<10,000).

Continuing decline

As discussed in Criterion 1 (above), the species is projected to undergo continuing decline of approximately 57 percent (80 percent confidence limits: 38–95 percent decline) within three generations of the 2019-20 bushfires (Legge et al. 2021). Given that this projected decline exceeds 10 percent within three generations, the species appears to meet the C1 continuing decline requirement for listing under this criterion.

Number/proportion of mature individuals

The East Gippsland galaxias is known from two subpopulations, so it not possible for 100 percent of mature individuals to occur in a single subpopulation (noting that the Little Arte River subpopulation may be extirpated, pending further surveys). The number of mature individuals in the Arte River subpopulation is likely to exceed 1000 (Raadik 2021. pers comm 19 October). The species does not appear to meet these requirements for listing 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 <10,000 with >10 percent continuing decline projected over the next three generations. 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 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1000
D2.¹ Only applies to the Vulnerable category 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 ² or number of locations ≤ 5

¹ 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

Not eligible under Criterion 4 D

Exclusion of translocated subpopulation from listing assessment

As indicated under Criterion 1, the translocated subpopulation has not been included in the assessment of the East Gippsland galaxias against the listing criteria.

Number of mature individuals

As per the evidence presented above for Criterion 3, the number of mature individuals exceeds 1000.

Species cannot be listed under Criterion D2 under the EPBC Act (see ¹).

Conclusion

The data presented above appear to demonstrate the species is not eligible for listing under Criterion 4 under the EPBC Act. 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

Exclusion of translocated subpopulation from listing assessment

As indicated under Criterion 1, the translocated subpopulation has not been included in the assessment of the East Gippsland galaxias against the listing criteria.

Population viability analysis

Population viability analysis has not been undertaken for the East Gippsland 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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