Paragalaxias mesotes

Arthurs paragalaxias

TASMANIAN THREATENED SPECIES LISTING STATEMENT

Paragalaxias mesotes
Image © Robert M. McDowall

Scientific name:	*Paragalaxias mesotes* McDowall & Fulton 1978
Common name:	Arthurs paragalaxias
Group:	Vertebrate, Chordata, Actinopterygii, family **Galaxiidae**
Status:	*Threatened Species Protection Act 1995:* **endangered (2000)**
	Environment Protection and Biodiversity Conservation Act 1999: **Endangered (2005)**
	IUCN Red List: **Endangered (B1ab(v)+2ab(v) (2019))**
Distribution:	Endemic status: **Endemic to Tasmania**
	Tasmanian NRM Region: **South**
	Tasmanian IBRA region: **Central Highlands**

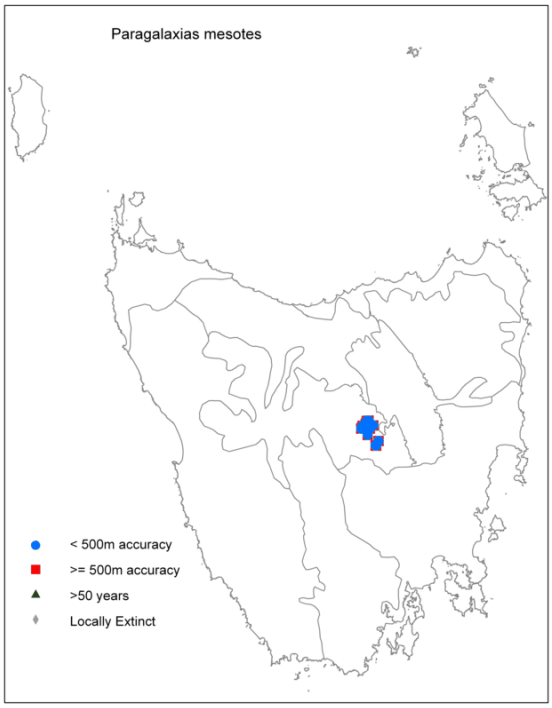

Figure 1. The distribution of *Paragalaxias mesotes*, showing IBRA regions (from the Natural Values Atlas)

Plate 1. The - Arthurs paragalaxias
Image © J. Patil (Inland Fisheries Service)

SUMMARY: Arthurs paragalaxias (*Paragalaxias mesotes*) is a small, stout galaxiid fish growing to around 80 mm in length. The species is only found in Arthurs Lake and Woods Lake, although its presence within Woods Lake is highly episodic and may be reliant on on-going conservation actions, such as periodic translocation. Both lakes have brown trout (*Salmo trutta*) populations and trout are known to prey on the Arthurs paragalaxias.

The Arthurs paragalaxias has coexisted with brown trout for over 150 years; however, the long-term impacts of this predator-prey dynamic on population numbers are unclear. The other main threat is deterioration in water quality and habitat availability through nutrient input and significant variations in lake level related to management of hydroelectric operations and irrigation demands.

Additional potential threats to the species include unsanctioned introduction of other exotic fish especially redfin perch (*Perca fluviatilis*), and drier, warmer and more variable environmental conditions resulting from climate change. The principal management objectives for the species are to monitor and protect the two subpopulations, maintain water and habitat quality and assess the potential for translocations where feasible.

IDENTIFICATION AND ECOLOGY

Arthurs paragalaxias (*Paragalaxias mesotes*) is a member of the family Galaxiidae, one of the largest freshwater fish families in Australia and the southern hemisphere, equivalent of the Salmonidae (McDowall & Frankenburg 1981). Tasmanian freshwater galaxiid fauna is particularly rich, with 16 species recognised in five genera (Hardie et al. 2006). Galaxiids are generally an elongate, tubular fish, without scales or an adipose fin. Species in the genus *Paragalaxias* have a large dorsal fin originating almost above the pelvic fins (McDowall 1996).

Galaxiidae are widespread in southern cool temperate regions, with species present in southern Australia, New Zealand, Patagonian South America, South Africa, and a number of small islands (McDowall 1996; Waters & White 1997).

The family includes many species with a juvenile marine phase (diadromous), while others are non-diadromous (without a marine stage in the life cycle). The Arthurs paragalaxias is non-diadromous, being a lacustrine (lake-living) species, spending its whole life in Arthurs Lake and Woods Lake (Plate 2), on Tasmania's Central Plateau (TSS 2006).

The Arthurs paragalaxias is a small, stout galaxiid, growing to around 80 mm in length. The head slopes to a blunt long snout. Like other *Paragalaxias* species it has a large dorsal fin originating almost above the pelvic fins. The tail is slightly forked or almost straight. Coloration is bold, usually dark greenish-grey on the back, extending down the sides as irregular bands and patches with a paler yellowish background and silvery-grey belly. The fins are translucent with some amber pigmentation along the rays (Fulton 1990, McDowall 1996).

Within the lake systems, the Arthurs paragalaxias inhabits complex rocky habitat and areas containing woody debris and macrophyte beds in littoral (nearshore) areas. The diet of the species consists of a range of aquatic animals including insect larvae, molluscs, and crustaceans (Fulton 1982). Information on the ecology, biology, and life cycle of the Arthurs paragalaxias is limited (TSSC 2016, and references therein).

Gravid females (carrying eggs) have been observed in September (Inland Fisheries Service unpublished data), and spawning occurs between September and October. Eggs are deposited on the underside of rocks and interstitial spaces (Hardie et al. 2011). Eggs and milt have been stripped from ripe fish in early November and several of the eggs hatched 25 days later (Inland Fisheries Service unpublished data). Larvae were approximately 9 mm long soon after hatching and were distinctly stouter than larvae of saddled galaxias (*Galxias tanycephalus)*, which also occurs in Arthurs Lake and Woods Lake. Arthurs paragalaxias larvae have never been collected in the wild.

Most of the population is thought to spawn only once or twice in its lifetime, therefore failure of recruitment for a year is likely to severely reduce the adult population (TSS 2006).

Longevity appears to be short, with most of the population at Arthurs Lake believed to be less than two years of age, although the species is likely to live for 2-4 years (Hardie et al. 2011). The relatively short life span of Arthurs paragalaxias makes the species vulnerable to short and prolonged periods of sub-optimal environmental conditions, as an unsuccessful breeding season is likely to have a large impact on the population, and several consecutive poor breeding seasons may cause the population to collapse (Hardie et al. 2011).

Plate 2. Littoral habitat at Arthurs Lake
Image © Karen Fagg (NRE Tas)

Survey techniques

The principal methods for surveying freshwater fish including the Arthurs paragalaxias are electrofishing and fine mesh fyke netting. Electrofishing requires specialist equipment and expertise and involves the use of an electric current passed through the water to stun fish. When performed correctly, the sampled fish are largely unharmed. Only trained specialists should perform this technique.

Fyke netting is usually undertaken overnight, using fine mesh fyke net and has been the primary method for monitoring Arthurs paragalaxias populations.

Greater numbers of *Paragalaxias mesotes* have been captured using overnight fyke netting than daytime electrofishing in littoral regions with complex and non-complex habitats (using c. 20 min electrofishing effort; Hardie et al. 2011). Nets must be constructed and set according to Inland Fisheries Service permit conditions to prevent the capture of platypus (*Ornithorhynchus anatinus*) – see the Department of Sustainability, Environment, Water, Population and Communities – survey guidelines for Australia's threatened fish (DSEWPC 2011).

Please seek further advice from the Threatened Species Section or the Inland Fisheries Service if you wish to sample freshwater fish. These methods require permits to take threatened fauna for scientific purposes, issued under the *Threatened Species Protection Act 1995* and an Inland Fisheries exemption permit to use the equipment under the *Inland Fisheries Act 1995*.

Confusing species

The species of *Paragalaxias* in Tasmania, including *P. mesotes* are very similar in appearance (Plate 3) and may require specialist advice to tell them apart. If you require assistance with identification, please contact the Threatened Species Section or the Inland Fisheries Service.

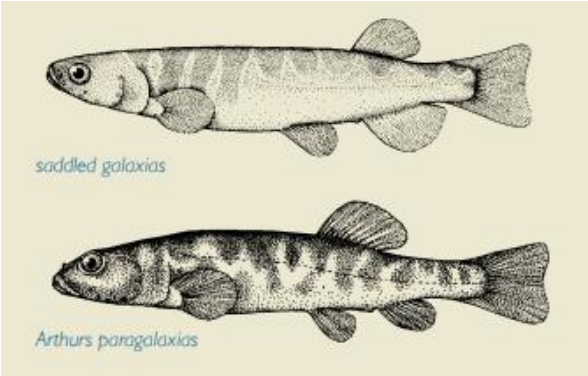

Plate 3. A visual comparison of the saddled galaxias and Arthurs paragalaxias, who share the same distribution. Image © Inland Fisheries Service

DISTRIBUTION AND HABITAT

The Arthurs paragalaxias is endemic to Tasmania, and occurs only in Arthurs Lake and Woods Lake, the headwaters of the Lake River on the Central Plateau—a distribution it shares with the saddled galaxias (Plate 3). It has also been recorded from the artificial canal that carries water from Arthurs Lake to Great Lake (Hydro Tas, unpublished data). During the 1990s population numbers of Arthurs paragalaxias declined and by 1997 the fish could no longer be found at Woods Lake.

Translocations of fish from Arthurs to Woods Lake occurred over several years, and in September 2015, 34 Arthurs paragalaxias were found in Woods Lake over two nights of monitoring, suggesting the species was becoming re-established (IFS 2016a). However, population numbers in Woods Lake have declined in recent years, with extremely low numbers caught during annual monitoring since 2018 (IFS 2023b).

The Arthurs paragalaxias is a lacustrine (lake-living) species and inhabits rocky and macrophyte-covered areas around the lake shores. While the species has been found to favour structurally complex habitats in Arthurs Lake (Hardie et al. 2011), it has also been recorded at depths of 4–5 m (Hydro Tasmania unpublished data) indicating it probably occurs throughout the lake (TSS 2006).

POPULATION PARAMETERS

Number of subpopulations: 2
Number of locations (as per IUCN definition): 2
Extent of occurrence (as per IUCN criteria): 116 km^2 (Minimum Convex Hull encompassing all points, not calculating each lake individually)
Area of occupancy (as per IUCN criteria) = 68 km^2
Number of mature individuals: Unknown
Largest subpopulation: Arthurs Lake

The populations of the Arthurs paragalaxias in Woods Lake and Arthurs Lake are the only two known subpopulations of the species (TSS 2006). As shown in Table 1, estimates of population size in the two lakes have not been undertaken.

However, the species is moderately abundant in Arthurs Lake but extremely rare in Woods Lake (IFS 2023b). The Arthurs paragalaxias population in Woods Lake experienced a decline in the 1990s, and in 1997 they were no longer found. While translocations of fish from Arthurs Lake over multiple years resulted in the documentation of 34 individuals throughout sites within Woods Lake (including mature fish and females containing large numbers of well-developed eggs) in 2015, the numbers of fish captured at Woods Lake during annual surveys continued to decline, with the last Arthurs paragalaxias documented in October 2021 (IFS 2023b; R. Freeman pers. comm. 2024).

Table 1. Population summary for *Paragalaxias mesotes*.

	Subpopulation	Tenure	NRM region*	1:25 000 mapsheet	Year last seen	Number of animals
1	Arthurs Lake	Hydro Tasmania	South	Arthurs Lake Wihareja	2023	unknown
2	Woods Lake	Hydro Tasmania, Permanent Timber Production Zone Land, Crown Land, Public Reserve and Private Freehold	South	Penny	2021	Unknown

* NRM region = Natural Resource Management region

Data from Inland Fisheries Service (Annual Reports)

Annual surveys for Arthurs paragalaxias are conducted at Arthurs and Woods Lake by the Inland Fisheries Service, via survey of overnight fyke netting using fine mesh nets. Surveys are typically conducted in spring which coincides with spawning during November and December (Hardie et al. 2011). The number of nets and trap nights utilised in annual surveys has varied in the recent years (IFS 2016a; 2021; 2022; 2023a).

CONSERVATION STATUS

The Arthurs paragalaxias was listed as rare under the Tasmanian *Threatened Species Protection Act 1995* in 1999. The species was uplisted to endangered in 2000 under Criterion B1 (extent of occurrence estimated to be less than 500 km^2) and Criterion B2b (continuing decline in area of occupancy). The reason for uplisting was due to absence of records of the species in Woods Lake since 1998 despite ongoing annual surveys.

In 2005, the Arthurs paragalaxias was listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, due to suspected severe decline in numbers due to the very severe decline in area of occupancy and extent of occurrence.

The status of Arthurs paragalaxias was most recently assessed in 2019 as Endangered on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. It was originally assessed as Rare in 1994, and then Vulnerable in 1996 and 2007, in previous IUCN Red List assessments.

RESERVATION STATUS

Arthurs Lake adjoins land managed by Hydro Tasmania. Woods Lake adjoins land on a combination of private freehold, Permanent Timber Production Zone Land, Crown Land and Conservation Reserve. Hydro Tasmania manages both lakes for a combination of values encompassing angling, conservation of native freshwater fauna, including the Arthurs paragalaxias, and supply of irrigation water for the midlands and Lake River irrigation schemes and generation of hydro-electric power.

THREATS, LIMITING FACTORS AND MANAGEMENT ISSUES

Arthurs paragalaxias faces multiple threats including predation and competition by introduced brown trout and potentially other exotic fish species, the barrier to free movement between the two lakes in which the species has been recorded as well as deterioration in water quality, habitat availability and changes to water levels. Conservation of the species is complicated by competing demands for water for generation of hydro power and irrigation, and management of the recreational trout fishery (changes in the recruitment of trout).

Water levels: Habitat quality and availability for Arthurs paragalaxias varies in Arthurs and Woods Lake with fluctuating water levels (Freeman 2019). Low water levels can impact water quality, the distribution and densities of charophyte and macrophyte beds, and the availability of refuges and potential feeding and spawning habitats (Hardie et al. 2011). Water levels in Arthurs and Woods Lake are currently impacted by hydro-electric power generation and downstream irrigation with water levels in both lakes managed in accordance with social and environmental risk thresholds (Hardie et al. 2011). Water drawdown has the potential to dewater Arthurs paragalaxias habitat and eggs in shallow lake margins (TSS 2006; TSSC 2016).

Lake level changes in Woods Lake are of particular concern for the Arthurs paragalaxias as the population appears to be in decline. Only three individuals have been captured since November 2018, the last documented in 2021 (IFS 2023b).

The cause of this population decline is not known; however, it may relate to events such as the large drawdown of water in 1995, or longer-term changes since impoundment of Woods Lake for irrigation supply in 1962. The lake is prone to periods of high turbidity and nutrient input which may degrade habitat (TSS 2006).

High turbidity is believed to increase the risk of harmful algal blooms as well as fish gill erosion which can result in high mortality rates amongst fish populations (TSSC 2016; Freeman 2019). Low water levels also dewater galaxiid habitat

and as Woods Lake has a gently sloping bed, a slight drop in water level results in exposure of a large width of shoreline. This reduces the area of rocky refuge habitat and may therefore result in increased predation by trout (Hardie et al. 2011).

However, Hydro Tasmania implemented water level management controls in 1995 to improve water quality. Subsequent revisions to these controls were implemented circa 2005 and 2009 to further reduce environmental risks to threatened galaxiids, and the current Woods Lake water level agreement was formalised between Hydro Tasmania and the Inland Fisheries Service via a Memorandum of Understanding in 2012.

Predation by brown trout: The Arthurs paragalaxias is known to be preyed on by brown trout (*Salmo trutta*), therefore limiting the abundance of Arthurs paragalaxias in both lakes, especially Woods Lake. This predation interacts with altered paragalaxiid recruitment which is primarily driven by water level management and numbers of mature adults. Contrary to the assumption that increased turbidity (as a result of altered water levels) reduces visual detection and therefore predation efficiency, studies on brown trout and Arthurs paragalaxias have found an increase in predation in turbid water (Stuart-Smith et al. 2004; Vidal et al. 2020).

Other introduced fish: The unsanctioned introduction of other introduced fish species (i.e. redfin perch (*Perca fluviatilis*), poses an ongoing threat to the Arthurs paragalaxias. This risk can be reduced through increasing public awareness about the impacts introduced fish can have on native species but cannot be fully eliminated. There is an additional risk of unwanted introductions through stocking of Woods Lake with wild-caught elvers for environmental and commercial eel fishing purposes, as these stocks have potential for being contaminated with other native or pest species (TSS 2006). IFS translocation policy and standard operating procedures for grading are presently in place (IFS 2016b).

Climate change: Drier, warmer and more variable environmental conditions resulting from climate change are predicted to have negative impacts on many native Australian fish species (Morrongiello et al. 2011), including in Tasmania (Grose et al. 2010).

Rainfall projections in Tasmania are for more seasonally and spatially variable rainfall, resulting in shifts in local hydrology (Morrongiello et al. 2011). Specifically, a decline in summer rainfall on the Central Plateau is projected (Grose et al. 2010).

Freshwater environments on Tasmania's Central Plateau are therefore predicted to experience significant declines in runoff of between 15% and 35% by 2100 (Bennett et al. 2010; Morrongiello et al. 2011). Projected hydrological changes will affect habitat quality as well as key life-history processes, with reduced water levels in lakes having the potential to reduce refuge and spawning habitats for paragalaxiids, resulting in increased predation, increased risk of poor recruitment and a reduction in abundance (Morrongiello et al. 2011).

Fragmentation of populations: Construction of the Arthurs Dam has resulted in the fragmentation of the two populations of Arthurs paragalaxias which were previously connected by flow from Arthurs Lake to Woods Lake via the Upper Lake River.

It is likely that most of the movement was in a downstream direction, and the dam, constructed in 1965, now completely blocks flow under normal conditions (TSS 2006), resulting in two discrete populations under normal conditions (TSSC 2016).

Potential reduced prey availability: Anecdotally, fishers have also reported declining fishing and concern for the general reduction in insect life in major waters including Arthurs lake (Anglers Alliance, 2024). While there is evidence suggesting national decline in insect abundance (Braby 2019, New 2022), understanding the impact of this potential decline on the freshwater ecology and its impact to Arthurs paragalaxias is still to be determined.

MANAGEMENT STRATEGY

Management objectives

A single Recovery Plan for threatened Tasmanian *Galaxias* and *Paragalaxias* species (TSS 2006) was jointly made by the Tasmanian and Federal governments in 2006. The Recovery Plan, although not updated since 2010, is still in force and serves as a guiding document for the management and conservation of the species.

The primary management objective for the Arthurs paragalaxias is to protect the two populations of the species, and to assess the potential for translocations where feasible.

What has been done?

- **Translocations:** In an attempt to re-establish the Arthurs paragalaxias population in Woods Lake, a translocation program commenced in 2002 with 173 and 467 fish translocated from Arthurs Lake to Woods Lake in 2002 and 2008 respectively (Hardie et al. 2011) and 2,470 individuals translocated between 2007 and 2012 (Freeman 2019). This resulted in the re-establishment of the species in Woods Lake with 84 individuals documented between 2014 and 2018 with multiple age classes present (Freeman 2019). However, since 2018, only one individual has been found during monitoring in each of 2019, 2020 and 2021 and none in 2022 and 2023 (IFS 2023b; R. Freeman pers. comm. 2024).
- **Habitat management (water levels):** An informal minimum lake level agreement established in 1995 between the Inland Fisheries Service and Hydro Tasmania, aims to keep Woods Lake above a minimum water level to reduce the risk of high turbidity events (Hydro Tasmania 1999). A minimum lake level agreement in place for Arthurs Lake to maintain angling amenity (Hydro Tasmania 1999) also reduces the potential for extensive habitat dewatering. Water quality including turbidity is also monitored by Hydro Tasmania during periods of concern such as low lake level events and algal bloom events.
- **Habitat management (forest industry):** The Arthurs paragalaxias is included in the *Threatened Species Adviser*, a decision-support system used by the forest industry to take account of threatened fauna in land tenures where forest practices are implemented (FPA 2021). During forest practices planning, relevant localities and catchments are identified and management prescriptions applied to minimise potential impacts of forest operations.
- **Preventing exotic species introduction:** Inland Fisheries Service has a Policy for the Translocation of Freshwater Fish in Tasmania (IFS 2016b) and implements grading procedures to minimise the risk of elvers (young eel) stocks being contaminated with exotic fish species.
- **Public education:** The Arthurs paragalaxias is included in several activities and educational products produced by the Inland Fisheries Service aimed at increasing public awareness of Tasmania's threatened freshwater fish and their conservation needs.

What is needed?

Future conservation and management strategies for Arthurs paragalaxias should include regular monitoring of populations, habitat management, management of introduced species as well as research into the life history, ecology and the genetic structure and diversity of the populations (Freeman 2019).

- Provide information and extension support to relevant Natural Resource Management committees, local councils, government agencies, the local community and development proponents on the locality, significance and management of known subpopulations and potential habitat;
- To maintain water and habitat quality – continue close liaison between the State Government, Inland Fisheries Service and Hydro Tasmania to improve and formalise lake management practices for conservation of the Arthurs paragalaxias;

- To monitor the status of the two populations – continue to conduct regular monitoring of populations of the Arthurs paragalaxias and of introduced fish present within the habitat (time of year, survey method and site selection should be considered when designing population monitoring programs). Use this monitoring to assess the effectiveness of management strategies and adapt these actions as necessary;
- To establish an additional refuge population of the species – investigate the possibility of translocations into other lakes and the feasibility for establishing populations within man-made dams;
- To reduce the risk of illegal introductions of introduced fish – increase community awareness of the potential impacts of illegal introduction of exotic fish on the Arthurs paragalaxias;
- To reduce the potential impact of introduced fish species – develop and implement a management plan to reduce brown trout breeding success in Arthurs and Woods Lakes. This could include the strategic placement of physical barriers to inhibit trout accessing streams to spawn (TSSC 2016);
- To improve understanding of predator-prey dynamics – undertake research to more fully understand the impact of brown trout predation on population numbers of Arthurs paragalaxias.
- To improve understanding of the species' genetic diversity – conduct research into the genetic structure and diversity of the species within and (if plausible with the Woods Lake population decline) between the two Arthurs paragalaxias populations;
- To improve management strategies – conduct research into the life history and habitat requirements of Arthurs paragalaxias (information which is currently limited);
- To support successful breeding – continue to manage water levels and aim to ensure structurally complex habitats are submerged throughout the year, particularly during the breeding season (early summer for Arthurs paragalaxias). The provision of additional rock piles and artificial complex substrates and structures may create additional feeding and refuge habitats (Hardie et al. 2011).

REFERENCES

Anglers Alliance (2024). AAT Minutes General Meeting 2/6/2024, Great Lake Community Centre Miena, Tasmania.

Bennett, J. C., Ling, F. L. N., Graham, B., Grose, M. R., Corney, S. P., White,C. J., Holz, G. K., Post, D. A., Gaynor, S. M., and Bindoff, N. L. (2010).*Climate futures for Tasmania: water and catchments technical report.* Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania.

Braby, M. F. (2019). Are insect and other invertebrates in decline in Australia? *Austral Entomology* 58(3): 471-477.

DSEWPC (Department of Sustainability, Environment, Water, Population and Communities) (2011). *Survey guidelines for Australia's threatened fish.* Guidelines for detecting fish listed as threatened under the *Environment Protection and Biodiversity Conservation Act* 1999. Commonwealth of Australia.

FPA (Forest Practices Authority) (2021). *Threatened Species Adviser.* Decision Support System. Forest Practices Authority, Hobart, Tasmania.

Freeman, R. (2019). *Paragalaxias mesotes. The IUCN Red List of Threatened Species* 2019: e.T16109A123378508. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T16109A123378508.en. Accessed on 06 July 2023.

Fulton, W. (1982). Observations on the ecology of four species of the genus *Paragalaxias* (Pisces: Galaxiidae) from Tasmania. *Australian Journal of Marine and Freshwater Research* 33: 999–1016.

Fulton, W. (1990). *Tasmanian Freshwater Fishes*. Fauna of Tasmania Handbook No. 7, University of Tasmania, Hobart.

Grose, M.R., Barnes-Keoghan I, Corney S.P., White, C.J., Holz, G.K., Bennet, J.B., Gaynor, S.M., Bindoff, N.L. (2010) *Climate Futures for Tasmania. General climate impacts technical report*. The Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Tasmania.

Hardie, S.A., Jackson, J.E., Barmuta, L.A. and White, R.W. (2006). Status of galaxiid fishes in Tasmania, Australia: conservation listings, threats and management issues. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 16(3), pp.235–250.

Hardie, S.A., Macfarlane, K.R. and Barmuta, L.A. (2011). *Life histories of galaxiid fishes in Arthurs Lake and Great Lake, Tasmania, and effects on water level fluctuations on their populations*. Hydro Tasmania, Hobart.

Hydro Tasmania (1999). *Environmental Review: South Esk-Great Lake Hydro catchment*. Hydro Tasmania Environmental Services.

IFS (Inland Fisheries Service) (2016a) *Annual Report 2015-2016*. Inland Fisheries Service, New Norfolk.

IFS (Inland Fisheries Service) (2016b) *Policy for the Translocation of Freshwater Fish in Tasmania: Final Version: 22 February 2017*. Inland Fisheries Service, New Norfolk.

IFS (Inland Fisheries Service) (2021) *Annual Report 2020-2021*. Inland Fisheries Service, New Norfolk.

IFS (Inland Fisheries Service) (2022) *Annual Report 2021-2022*. Inland Fisheries Service, New Norfolk.

IFS (Inland Fisheries Service) (2023a) *Annual Report 2022-2023*. Inland Fisheries Service, New Norfolk.

IFS (Inland Fisheries Service) (2023b) *Native Fish Conservation – Annual Report 2022-23*. Inland Fisheries Service, New Norfolk.

McDowall, R.M. (1996). *Freshwater Fishes of South-Eastern Australia. Second Edition*. Reed Books, Sydney.

McDowall, R.M. & Frankenberg R.S. (1981). The galaxiid fishes of Australia. *Records of the Australian Museum* 33: 443–605.

Morrongiello, J.R., Beatty, S.J., Bennett, J.C., Crook, D.A., Ikedife, D.N., Kennard, M.J., Kerezsy, A., Lintermans, M., McNeil, D.G., Pusey, B.J. and Rayner, T. (2011). Climate change and its implications for Australia's freshwater fish. *Marine and Freshwater Research*, *62*(9), pp.1082–1098.

New, T. *Insect Diversity, Declines and Conservation in Australia*. First Edition. Springer Cham. Switzerland.

Stuart-Smith, R.D., Richardson, A.M.M. and White, R.W.G. (2004), Increasing turbidity significantly alters the diet of brown trout: a multi-year longitudinal study. Journal of Fish Biology, 65: 376–388. https://doi.org/10.1111/j.0022-1112.2004.00456.x

TSS (Threatened Species Section) (2006). *Recovery Plan: Tasmanian Galaxiidae 2006-2010*. Department of Primary Industries, Water, Hobart.

TSSC (Threatened Species Scientific Committee) (2016). *Conservation Advice* Paragalaxias mesotes *Arthurs paragalaxias*. Department of the Environment and Energy, Canberra.

Vidal, N., Trochine, C., Amsinck, S.L., Barmuta, L.A., Christoffersen, K.S., Ventura, M., Buchaca, T., Landkildehus, F., Hardie, S.A., Meerhoff, M. and Jeppesen, E. (2020). Interaction between non-native predatory fishes and native galaxiids (Pisces: Galaxiidae) shapes food web structure in Tasmanian lakes. *Inland Waters*, 10(2): 212–226.

Waters, J.M. & White, R.W.G. (1997). Molecular phylogeny and biogeography of the Tasmanian and New Zealand and mudfishes (Salmoniformes: Galaxiidae). *Australian Journal of Zoology* 45:39–48.

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Version history

Version	Date	Author	Purpose/Change
1.0	February 2026	Threatened Species Section	First version. Draft first prepared in 2011 by Stephen Mallick. Revised in 2023 by Gemma Morrow (TSS), Alexia Graba-Landry (TSS), Karen Fagg (TSS), Karen Richards (TSS) and Rob Freeman (IFS). Endorsed by the Scientific Advisory Committee on 4th April 2024, and reviewed in August 2025. Approved for publication February 2026.