Fisheries Scientific Committee

CAM Assessment

Stocky Galaxias
Galaxias tantangara

Assessment outcome: Critically Endangered
Category: CR A3ce; B1+2ab(i,ii,iii,iv,v)

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has assessed ***Galaxias tantangara*** (**Stocky Galaxias)** under the Common Assessment Method and has determined that it is eligible to be listed as a **CRITICALLY ENDANGERED SPECIES.**

Species information and status

a) Species: *Galaxias tantangara* (Stocky Galaxias) - endemic to NSW

b) Taxonomy

Galaxias tantangara Raadik, 2014 – Stocky Galaxias (Raadik 2014) is a valid, recognised taxon and is a species as defined in the *Fisheries Management Act 1994*.

c) Current conservation status

Jurisdiction	State / Territory in which the species is listed	Date listed or assessed (or N/A)	Listing category
National (EPBC Act)	Not listed	N/A	N/A
National (Australian Society for Fish Biology)	National	2014	Critically Endangered
State / Territory	New South Wales	2016	Critically Endangered

d) Description of species

Galaxias tantangara is a small fish in the family GALAXIIDAE, with a maximum recorded size of 110 mm (Length to Caudal Fork; LCF), and commonly to 75–85 mm LCF (H. Allan unpubl. data). It is a small fish with a distinctly stocky body. The body is predominantly dark olive to brown on the back becoming lighter brown to cream underneath (Raadik 2014).

e) Distribution of species

Galaxias tantangara is only known from a small upland headwater stream where alien salmonids are absent (Raadik 2014). Recent collections (2002 & 2016-2017) of the species are from an elevation of ~1360 m above sea level in Tantangara Creek, in a catchment of approximately 4 km^2. Two historical (early 1900s) museum records from "Tantangara Creek, New South Wales" and "Tantangara Creek, Murrumbidgee River, Snowy Mountains" are likely to be this species (Raadik 2014).

As a newly described species with few museum specimens, the historical distribution of *G. tantangara* in NSW is largely unknown, but is thought to have been confined to the upper Murrumbidgee catchment near the present Tantangara Dam. Presently it is only known from the type locality, in the headwaters of Tantangara Creek, upstream of Tantangara Reservoir, NSW.

The species is considered to be restricted by the presence of Rainbow Trout (*Oncorhynchus mykiss*) and Brown Trout (*Salmo trutta*) to a small creek above a waterfall, approximately 4 km (river distance) from the source, which is at 1630 m above sea level (ASL), in a catchment of approximately 4 km^2. The species is not known from outside NSW (Raadik 2014).

f) Relevant biology/ecology of the species

The reproductive ecology of *G. tantangara* (part of the *G. olidus* (Mountain Galaxias) complex) is currently under investigation (H. Allan, University of Canberra), but until those investigations are complete can be assumed to be similar to other members of the *G. olidus* complex, which are obligate freshwater species without any marine phase. The spawning period is in late spring (H. Allan unpubl. data).

Comparably sized individuals of species in the *G. olidus* complex have low fecundity (< 400 eggs annually) with eggs generally attached to the underside of rocks in riffles (Cowden 1988; O'Connor and Koehn 1991; Shirley & Raadik 1997; Lintermans 2007; Stoessel et al. 2015). The eggs of species in the *G. olidus* complex are small (average 2.3 mm diameter), spherical, demersal and adhesive and hatch after 20-30 days (Cowden 1988; O'Connor and Koehn 1991). Hatching time for *G. tantangara* may be longer than recorded for *G. olidus* as a result of the lower water temperatures experienced at high altitude. Larvae of species in the *G. olidus* complex are, on average, 9.0—9.4 mm long upon hatching (O'Connor and Koehn 1991; Stoessel et al. 2015). The movement requirements of *Galaxias tantangara* are unknown, but based on movements of *G. olidus*, large migrations are unlikely and home-range is likely to be limited and less than 100m (see Berra 1973; Lintermans unpubl. data).

Age at sexual maturity of *G. tantangara* is unknown, but is likely to be at age 2-3 years (H. Allan unpublished data). Longevity of individuals is unknown, but it is likely to be moderate, as is another upland member of the *G. olidus* complex (*G. fuscus*), with maximum age of ~15 years but with most expected to live less than six years (Raadik et al. 2010; Raadik, T.A. pers. comm.).

The diet of *G. tantangara* is unknown, but it can confidently be assumed to be a macroinvertivore, as are other members of the *G. olidus* group (Cadwallader et al. 1980; Closs 1994; Lintermans 2007). For *G. olidus*, a substantial proportion of dietary items are derived from fringing riparian vegetation (Cadwallader et al. 1980), and this also may be the case for *G. tantangara.*

g) Habitat requirements of the species

Nothing is known of the specific environmental requirements of the species. Its present distribution and habitat is a small (~0.4 m average width and 0.1 m in average depth), cold, clear and fast flowing subalpine creek, flowing through an open forest of Eucalypts, low shrubs and tussock grass, which is often snow-covered during winter. Mesohabitats available consist predominantly of riffle and glide, with smaller areas of cascades. The substratum is composed of bedrock, boulder, and cobble, with smaller areas of pebble and gravel and sections of silt. Instream cover consists predominantly of rock, undercut banks and overhanging vegetation. Pools average 0.3 m in depth (Raadik 2014).

h) Threats and level of risk to the species

Threat	Extent	Impact
Salmonid invasion and subsequent predation is the major threat to this species. *G. tantangara* does not coexist with salmonids. The fragmented nature of Galaxias populations in the Australian Alps and the role of salmonids in causing this fragmentation is well documented (Lintermans 2000; Tilzey 1976; Raadik and Kuiter 2002; McDowall 2006; Green 2008).	The species has a very small distribution and is only known to be present in a maximum of 3 km of the headwater reaches of a single, small stream. Access to suitable downstream habitat is severely limited by the presence of alien salmonids largely precluding population expansion. Salmonids are widely distributed and abundant in all streams in the Tantangara Creek subcatchment. Translocation of salmonids past the waterfall barrier by anglers is a real risk.	If salmonids invade upstream of the waterfall on Tantangara Creek, it is projected that *G. tantangara* will become extinct. There is no evidence that *G. tantangara* and salmonids can coexist. Previous documented declines in galaxiid populations in the Snowy Mountains following salmonid invasion occurred rapidly, with complete extirpation of *G. olidus* within 3 years of salmonid invasion (Tilzey 1976).

Threat	Extent	Impact
Loss of riparian vegetation, bank and instream habitat degradation and sedimentation as a result of pest animals (feral horses) (H. Allan and M. Lintermans unpublished observations; Allan & Lintermans 2018; Driscoll et al. 2019).	Feral Horse (*Equus ferus caballus*) abundance at the sole locality where *G. tantangara* occurs is high (Allan and Lintermans 2018), and associated degradation of streams through stream widening and sediment addition is currently occurring. In 2018, *Habitat degradation and loss by Feral Horses (brumbies, wild horses)* was listed by the NSW Threatened Species Scientific Committee as a key threatening process. The determination made specific reference to potential impacts on *G. tantangara* from feral horses.	Although there is no quantitative assessment of the impact of bank and instream habitat degradation and sedimentation to *G. tantangara*, the incidence of horse crossing points on the stream within the current range of *G. tantangara* is high, and there are obvious impacts on stream morphology (width increases from a natural of ~1 m to 5 m at horse crossings (H. Allan and M. Lintermans unpubl. data)). Instream sediment loads downstream of horse crossing points are high, and likely to smother the demersal adhesive eggs of *G. tantangara* (H. Allan unpubl. data) during the reproductive season. Parental care is unknown in the Galaxiidae, so is unlikely to present any plausible mitigation to sedimentation.

Threat	Extent	Impact
Loss of riparian and catchment vegetation and instream habitat degradation and sedimentation as a result of bushfires represent local-to-catchment-scale threatening processes.	The area receives relatively high visitation rates from bushwalkers, and so the prospect of anthropogenic-origin bushfire is real. Similarly, lightning strike as an origin for bushfire ignition in the high country is relatively common.	Although there is no direct assessment of the impact of bushfire on *G. tantangara* the demise of many small streams subject to such disturbances during the recent Millennium Drought (van Dijk et al. 2013) suggest the risk to *G. tantangara* habitat is high. The species has demersal adhesive eggs subject to sediment smothering (H. Allan unpubl. data), and parental care is unknown in the Galaxiidae, so is unlikely to present any plausible mitigation. Fire in the subcatchment followed by rainfall is highly likely to result in high ash and sediment loads to the stream, smothering the stream substrate and spawning sites and filling refuge pools (e.g. see Lyon and O'Connor 2008; Carey et al. 2004).

Threat	Extent	Impact
Climate change, which is likely to: • alter temperature and stream flow regimes in the range of *Galaxias tantangara*, and. • result in more extreme weather events, along with an increased risk of fire.	Snow cover in the alpine region due to anthropogenic climate change is expected to decline by 30 - 93% (depending on the model used) by 2050 (Hennessy et al. 2003, Nicolls 2005), substantially reducing snowmelt flow volumes during spring. Snowmelt is also likely to occur earlier in the season under climate change scenarios (Hennessy et al. 2003; Green and Pickering 2009). See previous threat for likely results of increased sedimentation following fire.	The relationship between these environmental parameters and the persistence or wellbeing of *G. tantangara* populations is unknown, but is of concern. The current range of the species is at the very upstream and altitudinal limit of the inferred historic distribution. The stream is very small (av width 0.4 m, av depth 0.1 m) and so is potentially subject to desiccation and increased solar warming. Reductions in streamflow/loss of instream habitat, and water warming, possibly elevating water temperatures over a critical thermal maxima for the species is also possible (see Raadik et al. 2010; Morrongiello et al. 2011). Severe storms in burnt catchments are likely to result in extreme sedimentation of streams (see Lyon and O'Connor 2008), with major impacts on small stream habitats. A severe decline in distribution and abundance of *G. tantangara* is projected should an instream sedimentation event occur over the occupied section of the catchment during heavy rainfall following fire.

Threat	Extent	Impact
Transfer of the Climbing Galaxias (*Galaxias brevipinnis*) via inter basin water transfer.	The Snowy 2.0 proposal to develop a pumped hydro scheme utilising Talbingo and Tantangara reservoirs has potential to transfer *G. brevipinnis* from the Tumut catchment where the species is known to be present (EMM 2018). The species is not known, and considered to not occur in the Upper Murrumbidgee catchment (Lintermans 2002). The species is known to have been transferred from its native coastal catchments to the upper Murray catchment via transfer through the Snowy Mountains Hydroelectric Scheme (Waters et al. 2002), where it has expanded to occupy a broad diversity of stream types and sizes (Lintermans 2007). After transfer to Tantangara Reservoir, the species would be expected to rapidly invade upstream, and its documented climbing ability means that existing waterfall barriers would not prevent the species invading the entire current range of *G. tantangara*. Ecological impacts are largely unknown, but it is predicted that it would likely compete with other galaxiids for food, and space (Lintermans 2007). As the existing habitat of *G. tantangara* is extremely limited (only 3 km of a small (av. 1m width and 0.1 m depth) stream, there is little opportunity for habitat or niche partitioning between the two species.	The precise impacts of invading *G. brevipinnis* on *G. tantangara* are unknown, but the entire known distribution of *G. tantangara* is susceptible to such invasion. Construction of barriers to prevent invasion is not a potential mitigation measure. A severe decline or extirpation of *G. tantangara* is projected. Invasion of Lake Pedder, Tasmania by Brown Trout (*Salmo trutta*) and *G. brevipinnis*, resulted in the extirpation of native *G. pedderensis* from this waterbody (Hardie et al. 2006). Similarly in New Zealand it has been hypothesized that *G. brevipinnis* has displaced small non-migratory *G. vulgaris* in streams above impoundments (McDowall and Allibone, 1994).

i) Eligibility against criteria

Assessment against the Criteria		
A.	Population size reduction (evidence of decline)	**Critically Endangered [A3ce]** As a newly described species with few museum specimens, the historical distribution and abundance of *G. tantangara* in NSW is largely unknown, but is thought to have been confined to the upper Murrumbidgee catchment near the present Tantangara Dam. Presently it is only known from the type locality, in the headwaters of Tantangara Creek, upstream of Tantangara Reservoir, NSW. The species is restricted by the presence of alien trout to a small creek above a waterfall (approximately 5-6 m high), approximately 4 km (river distance) from the source, which is at 1630 m above sea level (asl), in a catchment of approximately 4 km^2. The species is not known from outside NSW or anywhere else within NSW (Raadik 2014). Sampling to date (2002 (Raadik 2014), 2016/17 (H. Allan & M. Lintermans unpubl. data)) has demonstrated that salmonids occupy all other streams or stream sections in the Tantangara Creek catchment. The remaining distribution of the species is confined to 3 km of a single stream. It is inferred from the response of other Galaxiid taxa to invasion by trout, and the current mutually exclusive distribution of trout and Stocky Galaxias, that if trout breach this barrier in the future, the severe decline (and likely extirpation) of the species is almost certain. If trout invade past the waterfall, it is projected that extirpation, or at least a >80% loss of current EOO and AOO will occur. Trout are continuing to expand their range in southeastern Australia (e.g. invasions past the 20+ m high waterfall on Gibraltar Creek, ACT, in the last 25 years (Lintermans unpubl. data) and continued reintroduction or upstream invasion upstream of barriers in the Goulburn River catchment, Victoria (Raadik *et al.* 2010)) and are predicted to breach the barrier on Tantangara Creek within the next 100 years. Trout are well documented as a major threat to many Galaxiid spp. (see Tilzey 1976; Cadwallader 1996; Lintermans 2000; McDowall 2006; TSS 2006; Raadik *et al.* 2010), with predation and competition considered the major mechanisms of galaxias decline both in Australia and internationally (Crowl *et al.* 1992; McDowall 2006; Raadik *et al.* 2010; TSS 2006). Even small numbers of small (<240 mm length) trout have been demonstrated to eliminate populations of threatened galaxias in small upland streams over < 2 years. First smaller galaxiid individuals were eliminated in 3-6 months and then larger individuals over 6-18 months (Raadik *et al.* 2010). Sampling immediately downstream of the barrier waterfall in 2016/17 (Allan & Lintermans unpubl. data) has captured abundant Rainbow

		Trout and Brown Trout and no galaxias, reinforcing the conclusion about the susceptibility of *G. tantangara* to salmonid predation and extirpation. Mechanisms for potential trout invasion past the waterfall barrier include illegal translocation by anglers or drown-out of the barrier during high flows (Raadik *et al.* 2010). Extreme climate events under climate change scenarios could also result in severe impacts from sedimentation following bushfires, and severe drought would also likely reduce habitat availability (dewater) in small, headwater streams. Such impacts have been noted for other galaxias spp (Raadk *et al.* 2010; Lintermans unpubl. data).
B.	Geographic range (EOO and AOO, number of locations and evidence of decline)	**Critically Endangered [B1+2ab(i,ii,iii,iv,v)]** Although the historical distribution is not definitively known, scientists working on the species strongly suspect it occurred more widely throughout the Tantangara Creek catchment before salmonid introduction and proliferation. The current global distribution of *G. tantangara* is confined to a single location comprising approximately 3 km of Tantangara Creek upstream of Tantangara Reservoir, Kosciusko National Park, NSW, above a waterfall that prevents salmonid access (Raadik 2014; H. Allan unpubl. data). This section of creek is small (~0.4 m average width and 0.1 m average depth), typical of an upland, headwater, low-order stream. Sampling to date (2002, 2016/17) has demonstrated that salmonids occupy all other streams or stream sections in the Tantangara Creek catchment (Raadik 2014; H. Allan unpubl. data). Based on knowledge of the habitat use and ecology of other upland galaxiid taxa in the *G. olidus* complex, *G. tantangara* probably previously occupied all of Tantangara Creek down to the junction with the Murrumbidgee River. Historical records of the species were recorded further downstream in Tantangara Creek, below the waterfall, where the species is now not present. The contraction to the species' present range equates to an estimated loss of EOO of at least 90.5% (from a minimum of 41.9 km^2 to 0.62 km^2 (minimum convex polygon; current EOO changed to 4 km^2 so as not to be less than AOO) with a current AOO of 4 km^2 (based on a 2 km x 2 km grid square) reduced from the inferred minimum AOO of 68 km^2 (a decline of 93.1%). If trout invade past the waterfall, it is projected that loss of all, or at least a substantial amount of, suitable habitat will occur as trout occupy available habitat.
C.	Small population size and decline (population size, distribution and evidence of decline)	**Endangered [C1+2a(ii)]** *Galaxias tantangara* is only known from a single site comprising approximately 3 km of Tantangara Creek, a small stretch of upland headwater stream where alien salmonids are currently absent (Raadik 2014; H. Allan unpubl. data). In March 2002 the species was recorded from a single site at a density of 1.8 fish/m^2 (Raadik 2014). Age at maturity is unknown, but preliminary results show that there were no indications of gravid or developing fish <57 mm TL (H. Allan

		unpubl. data). If 57 mm TL is accepted as the minimum size of a mature fish, broader sampling in 2016/17 recorded average total densities of 0.89 mature fish/linear m of stream in the lower stream section. In the upper 1 km of the species distribution (where the stream is substantially smaller), densities of 0.3 mature fish per linear metre of stream were recorded. Extrapolating an average density of mature fish of 0.89/linear m to the lower 2 km and 0.3 fish/linear m to the upper 1 km of stream generates an estimate of adult population size of ~2090 individuals. All individuals occur in a single subpopulation (C2aii). A rapid and severe decline in abundance (>25%), or extinction of the species is projected within 5-10 years if salmonid invasion past the delimiting waterfall occurs. As all age classes of *G. tantangara* are within the predation size range of salmonids, population decline following salmonid invasion is anticipated to be rapid and severe. Passage of salmonids past this waterfall (through natural drown-out in high flow events or illegal translocation by trout anglers) is projected to result in a rapid >80% decline in abundance and remaining distribution of *G. tantangara*. Previous documented declines in galaxiid populations in the Snowy Mountains following salmonid invasion occurred rapidly, with complete extirpation of *G. olidus* within 3 years of salmonid invasion (Tilzey 1976).
D.	Very small or restricted population (population size)	**Vulnerable [D2]** Criterion D1 is not met as there are an estimated 2090 mature individuals. Criterion D2 is met as the current AOO is 4 km^2 with the species occurring at only a single location. Trout are a plausible future threat that could drive the species to extinction in a very short time.
E.	Quantitative analysis (statistical probability of extinction)	**Data Deficient.** Population viability has not been undertaken for *G. tantangara*. Therefore, there are insufficient data to demonstrate if *G. tantangara* is eligible for listing in any category under this criterion.

j) Additional information

Fisheries Scientific Committee Management Recommendations for *G. tantangara*

Current and recommended management and research actions that will benefit the conservation of the species:

- Current Master of Applied Science study into the species' ecology is underway (reproduction, growth, habitat use, age, movement).

- Further survey work to locate potential trout-free sites for future translocation.
- Identification of streams suitable for trout barrier installation (or augmentation).
- Undertake predator (trout) removal, if present, from potential translocation sites.
- Broadscale fish survey work in upper Murrumbidgee catchment to locate additional populations.
- Assessment of all populations for security from trout incursion: implement annual predator detection and removal for less secure sites, and every 5 years (or following 1: 50 yr rainfall events) at other locations.
- Population genetic analysis of current and new populations, to inform translocation plan and specific population management.
- Formulation of a detailed translocation plan and undertake translocations to establish additional, viable populations to spread extinction risk.
- Management measures to reduce the abundance of feral horses within the distribution of *G. tantangara*.
- Measures to prevent the transfer of invasive *G. brevipinnis* during water transfers

Priorities Action Statement

The NSW Department of Primary Industries Priorities Action Statement (PAS) is a statutory, non-regulatory document addressing each threatened species, population, ecological community and key threatening process (KTP) listed on the schedules of the *Fisheries Management Act 1994*. The PAS provides an agreed list of strategies and actions that will assist to down-grade or de-list species, populations and ecological communities from the threatened species schedules of the *Fisheries Management Act 1994*, as well as actions that will assist to abate or eliminate the impacts of KTPs.

The draft Priorities Action Statement for the Stocky Galaxias is attached and available on the NSW DPI Website at https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what-current/critically/stocky-galaxias/priorities-action-statement-draft-actions-for-stocky-galaxias

k) Statement on the standard of scientific evidence and adequacy of survey:

This assessment has been prepared by the Fisheries Scientific Committee in good faith using the highest possible standard of scientific evidence and adequacy of survey.

As prescribed under Section 4 of the Intergovernmental MOU on the CAM, in preparing this documentation the Committee gave consideration to:

(i) the nature of the data, including adequacy of survey (occurrences) and monitoring (to detect change), including factors such as sampling design, effort applied, number of variables considered, proportion of a species' range covered, time period covered etc.;

(ii) the number of data sets relevant to the conclusion;

(iii) the range of uncertainty in the data and degree of consistency between different data sets;

(iv) the source of the data and its credibility; and

(v) the relevance of the data to the particular assessment criterion.

l) References

Allan, H. and Lintermans M. (2018). The threat from feral horses to a critically endangered fish. pp 88-89 in Worboys, G.L., Driscoll, D. and Crabb, P. (eds) Feral Horse Impacts: The Kosciuszko Science Conference — Conference Abstracts. Australian Academy of Science, The Australian National University and Deakin University, Canberra

Berra, T. M. (1973) A home range study of *Galaxias bongbong* in Australia. Copeia 4: 363-366.

Cadwallader, P. L., Eden, A. K. and Hook, R. A. (1980) Role of streamside vegetation as a food source for *Galaxias olidus* Gunther (Pisces: Galaxiidae). Australian Journal of Marine and Freshwater Research 31: 257-262.

Cadwallader, P.L. (1996) Overview of the Impacts of Introduced Salmonids on Australian Native Fauna, Australian Nature Conservation Agency, Canberra.

Carey, A., Evans, M., Hann, P., Lintermans, M., Macdonald, T., Ormay, P., Sharp, S., Shorthouse, D. & Webb, N. (2003) Wildfires in the ACT 2003: report on the impacts in natural ecosystems. Environment ACT, Canberra.

Closs, G. P. (1994) Feeding of *Galaxias olidus* (Gunther) (Pisces, Galaxiidae) in an intermittent Australian stream. Australian Journal of Marine and Freshwater Research 45 (2): 227-232.

Cowden, K.L.B. (1988) Aspects of biology of the Mountain Galaxid, *Galaxias olidus* Gunther (Pisces: Galaxiidae) in Pierce's Creek, ACT. Unpubl. BSc (Hons) thesis, Zoology Department. Australian National University, Canberra.

Driscoll, D. A., G. L. Worboys, H. Allan, S. C. Banks, N. J. Beeton, R. C. Cherubin, T. S. Doherty, C. M. Finlayson, K. Green, R. Hartley, G. Hope, C. N. Johnson, M. Lintermans, B. Mackey, D. J. Paull, J. Pittock, L. L. Porfirio, E. G. Ritchie, C. F. Sato, B. C. Scheele, D. A. Slattery, S. Venn, D. Watson, M. Watson and R. M. Williams (2019). Impacts of feral horses in the Australian Alps and evidence-based solutions. Ecological Management & Restoration 20(1): 63-72.

EMM 2018. Exploratory Works for Snowy 2.0 VOLUME 2 Environmental Impact Statement. Appendix G: Aquatic Ecology Assessment. EMM Consulting, Sydney.

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.

Green, K., and Pickering, C. M. (2009) The decline of snowpatches in the Snowy Mountains of Australia: importance of climate warming, variable snow, and wind. Arctic, Antarctic, and Alpine Research, 41 (2): 212-218. doi: 10.2307/40305825

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

Hennessy, K. J., Whetton, P. H., Bathols, J., Hutchinson, M., and Sharples, J. (2003) The Impact of Climate Change on Snow Conditions in Australia. CSIRO Atmospheric Research. Consultancy report for the Victorian Dept of Sustainability and Environment, NSW National Parks and Wildlife Service, Australian Greenhouse Office and the Australian Ski Areas Association. 47 pp.

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 (8): 799-804.

Lintermans, M. (2002). Fish in the Upper Murrumbidgee Catchment: A Review of Current Knowledge. Environment ACT, Canberra. 92 p.

Lintermans, M. (2007) Fishes of the Murray-Darling Basin: an introductory guide. Murray-Darling Basin Commission, Canberra. 166 p.

Lintermans, M. (2007). Fishes of the Murray-Darling Basin: an introductory guide. Murray-Darling Basin Commission, Canberra. 166 p.

Lyon, J. P. and O'Connor, J. P. (2008) Smoke on the water: can riverine fish populations recover following a catastrophic fire-related sediment slug? Austral Ecology 33: 794-806.

McDowall RM, Allibone RM. (1994). Possible competitive exclusion of common river galaxias (*Galaxias vulgaris*) by koaro (*G. brevipinnis*) following impoundment of the Waipori River, Otago, New Zealand. Journal of the Royal Society of New Zealand 24: 161–168.

McDowall, R. M. (2006) Crying wolf, crying foul, or crying shame: alien salmonids and a biodiversity crisis in the southern cool-temperate galaxioid fishes? Reviews in Fish Biology and Fisheries, 16 (3-4): 233-422.

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

Nicholls, N. (2005) Climate variability, climate change and the Australian snow season. Australian Meteorological Magazine, 54, 177-185

NSW Scientific Committee (2018) Habitat degradation and loss by Feral Horses (brumbies, wild horses), Equus caballus Linnaeus 1758. Final Determination to list a key threatening process under the Biodiversity Conservation Act 2016 www.environment.nsw.gov.au/news/equus-caballus-linnaeus-nsw-threatened-species-scientific-committee-final-determination (accessed 31 January 2019).

O'Connor, W. G. and Koehn, J. D. (1991) Spawning of the Mountain Galaxias, *Galaxias olidus* Günther in Bruces Creek, Victoria. Proceedings of the Royal Society of Victoria 103 (2): 113-123.

Raadik, T. (2011) Systematic revision of the Mountain Galaxias, *Galaxias olidus* Gűnther, 1866 species complex (Teleostei: Galaxiidae) in eastern Australia. (Unpubl. PhD thesis), University of Canberra, Canberra.

Raadik, T. A. (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 3898 (1): 1-198. 54: 177-185.

Raadik, T. A. and Kuiter, R. H. (2002) Kosciuszko Galaxias: a story of confusion and imminent peril. Fishes of Sahul 16: 829-835.

Raadik, T.A., Fairbrother, P.S. and Smith, S.J. (2010). National recovery plan for the Barred Galaxias (*Galaxias fuscus*). Department of Sustainability and Environment, Heidelberg, Victoria.

Shirley, M.J. and Raadik, T.A. (1997) Aspects of the ecology and breeding biology of *Galaxias fuscus* Mack, in the Goulburn River system, Victoria. Proceedings of the Royal Society of Victoria, 109, pp.157-166.

Stoessel, D.J., Raadik, T.A. and Ayres, R.M. (2015) Spawning of threatened Barred Galaxias, '*Galaxias fuscus*' (Teleostei: Galaxiidae). In Proceedings of the Linnean Society of New South Wales (Vol. 137, p. 1). Linnean Society of New South Wales.

Tilzey, R. D. J. (1976) Observations on interactions between indigenous Galaxiidae and introduced Salmonidae in Lake Eucumbene catchment, New South Wales. Australian Journal of Marine and Freshwater Research, 27 (4): 551-564.

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

van Dijk, A. I. J. M., Beck, H. E., Crosbie, R. S., de Jeu, R. A. M., Liu, Y. Y., Podger, G. M., Timbal, B. and Viney, N. R. (2013) The Millennium Drought in southeast Australia (2001–2009): Natural and human causes and implications for water resources, ecosystems, economy, and society. Water Resources Research, 49 (2): 1040-1057. doi: 10.1002/wrcr.20123.

Waters, J. M., M. Shirley and G. P. Closs (2002). Hydroelectric development and translocation of *Galaxias brevipinnis*: a cloud at the end of the tunnel? Canadian Journal of Fisheries and Aquatic Sciences 59(1): 49-56.