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PROPOSED DETERMINATION

Galaxias tantangara – Stocky Galaxias as a CRITICALLY ENDANGERED species.

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), is proposing to list *Galaxias tantangara* – Stocky Galaxias as a CRITICALLY ENDANGERED SPECIES in NSW in Part 1 of Schedule 4A of the Act.

The listing of Critically Endangered Species is provided for by Part 7A, Division 2 of the Act.

The Fisheries Scientific Committee, with reference to the criteria relevant to this species, prescribed by Part 16, Division 1 of the *Fisheries Management (General) Regulation 2010* (the Regulation) has found that:

Background

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

2) The species is a small fish in the family Galaxiidae, with a maximum recorded size of 103 mm (Length to Caudal Fork; LCF), and commonly to 75–85 mm LCF.

3) As a newly described species with few museum specimens, the historical distribution of *Galaxias 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 thought to be restricted by the presence of trout 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).

4) The reproductive ecology of *Galaxias tantangara* is unknown, but 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 unknown, though probably during winter. Fish collected in mid-March in 2002 were predominantly at an intermediate stage of gonad development (gonads filling approximately 50 % of the body cavity), though one male was almost running ripe and one female was close to ripe (gonads filling 75 % of body cavity) (Raadik 2011). No juvenile fish were sampled from a 60 m reach of stream during mid-March, with the smallest individual 74.6 mm LCF (Raadik 2014). For other species in the complex, the spawning season is predominantly in spring. Other members of 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; Lintermans 2007). The eggs of *G. olidus* are small (average 2.3 mm diameter), spherical, demersal and adhesive and hatch after 20-30 days (Cowden 1988; O'Connor and Koehn 1991). Larvae of *G. olidus* are, on average, 9.4 mm long upon hatching (O'Connor and Koehn 1991). 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).

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

6) 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 alpine 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).

7) Age at sexual maturity of *Galaxias tantangara* is unknown, but is likely to be at age-1+. Longevity of individuals is unknown, but it is likely to be moderate, as is another upland member of the *G. olidus* complex (*Galaxias fuscus*), with maximum age of 6-10 years but with most expected to live less than six years (Raadik, T.A. *pers. comm.).* The diet of *Galaxias tantangara* is unknown, but it can confidently be assumed to be a macro-invertivore, 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.*

Criteria – reduction in abundance, geographic distribution or genetic diversity (Regulation clause 271)

1) Although the historical distribution is unknown, the current global distribution of Stocky Galaxias is confined to approximately 4 km of Tantangara Creek upstream of Tantangara Reservoir, Kosciusko National Park, NSW, above a waterfall that prevents salmonid access. (Raadik 2014). This galaxiid taxon probably previously occupied all of Tantangara Creek down to the junction with the Murrumbidgee River (an additional distance of 19.38 km). This is supported by an historical record and available specimens (AMS IB.745 and BMNH 1914.80.20.75 from Tantangara Creek). The reduction to the present species' range equates to a main-stem estimated lineal loss of *Area of Occupancy* (AO) of 83%. In fact the total habitat loss would be larger than this as the stream increases in size as it progresses downstream. As this is a newly described taxon, no information is available on historical abundance and the historical collections cited above comprise only single individuals. In March 2002 the species was recorded at a density of 1.8 fish/m^2 (Raadik 2014). Based on the reasonable assumption that this species possesses the normal traits of the *Galaxias olidus* complex in terms of vulnerability to salmonid predation, the species is likely to be extirpated or at least severely reduced in population abundance in the sole stream within which it is recorded.

2) In 2014 the species was listed as 'Critically Endangered' by the Australian Society for Fish Biology under its threatened species classification (Lintermans 2014).

3) Nationally, *Galaxias tantangara* is currently not listed under the *EPBC Act 1999*, as it has only recently been described, and as it is not known to occur outside of NSW, it is not listed on other State or Territory threatened species legislation.

Criteria – threatening processes (Regulation clause 272)

1) A severe decline in distribution and abundance, or extinction of the species, is projected 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. Salmonid predation has previously been well documented as a threatening process for other galaxiids in Australia (Tilzey 1976; Lintermans 2013; McDowall 2006; Wager and Jackson 1993), and the introduction of fish to fresh waters within a river catchment outside their natural range is listed as a Key Threatening Process in NSW. *Galaxias tantangara* now only occurs in a small section of stream where salmonids are absent, and salmonid invasion is prevented by a natural barrier. 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 >80% decline in abundance and remaining distribution of *Galaxias tantangara*. Such declines have been documented for numerous other members of the *G. olidus* complex, with usually mutually exclusive distributions demonstrated for galaxiids and trout (e.g., Tilzey 1976; Lintermans 2000).

2) The species has a very small distribution and is only known to be present in a maximum of 4 km of the headwater reaches of a single, small stream (as at 16 March 2002). Such a small distribution renders the species extremely vulnerable to stochastic effects (McDowall 2006), with no alternative population or source to allow recolonisation. Access to suitable habitat is severely limited (as a result of salmonid presence), largely precluding population expansion. The fragmented nature of *Galaxias* populations in the Australian Alps and the role of salmonids in causing this fragmentation is well documented (Lintermans 2000; Raadik and Kuiter 2002; Green 2008). Should another population of the species be discovered, or re-established, there is unlikely to be connectivity between populations.

3) Loss of riparian vegetation, overgrazing and sedimentation as a result of pest animals and bushfires represent local-to-catchment-scale threatening processes, which have resulted in general declines in aquatic ecosystem health. Although there is no direct assessment of the impact of these threats to *Galaxias tantangara*, the demise of many small streams subject to such disturbances during the recent Millenium Drought (van Dijk *et al*. 2013) suggest the risk to *G. tantangara* habitat is high.

4) Climate change is likely to alter temperature and stream flow regimes in the range of *Galaxias tantangara*. 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). The relationship between these environmental parameters and the persistence or wellbeing of *G. tantangara* populations is unknown, but is of concern. This impact is suspected to occur via reduction in streamflow/loss of instream habitat, and water warming, possibly elevating water temperatures over a critical thermal maxima for the species.

5) Climate change is also predicted to result in more extreme weather events, along with an increased risk of fire. 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 *Galaxias tantangara* is projected should an instream sedimentation event occur over the occupied section of the

catchment during heavy rainfall following fire. A major fire in the Australian Alps in 2003 resulted in debris deposited in streams, that formed small dams which in turn raised water levels (Green 2008). Such an event could drown out a natural barrier, facilitating salmonid invasion of upstream habitats.

6) The alien Oriental Weatherloach *Misgurnus anguillicaudatus* is spreading throughout the upper Murrumbidgee catchment, predominantly through its illegal use as live bait (Lintermans 1993, 2004; Lintermans *et al*. 2008), and could be introduced to Tantangara Creek. The species is already established in Lake Eucumbene in the Snowy Mountains region (Lintermans and Burchmore 1996; Koster *et al*. 2002). *Misgurnus angillicaudatus* is a benthic feeder, consuming aquatic macroinvertebrates and detritus (Lintermans and Burchmore 1996; Keller and Lake 2007; Urquhart and Koetsier 2014), and feeds using a combination of chemical and tactile cues. It is a potential predator of benthic fish eggs, such as those deposited by *Galaxias* spp. Potential exclusion of *Galaxias olidus* by *M. anguillicaudatus* have been noted previously, although the mechanism is unknown and no further research has been conducted on this topic since the study of Lintermans *et al*. (1990).

Conclusion pursuant to section 220F(2) of the Act

In the opinion of the Fisheries Scientific Committee, *Galaxias tantangara*, Stocky Galaxias is facing an extremely high risk of extinction in New South Wales in the immediate future, as determined in accordance with the criteria prescribed by the regulations as discussed above.

The species is eligible to be listed as a CRITICALLY ENDANGERED species.

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