

THREATENED SPECIES SCIENTIFIC COMMITTEE

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

The Minister's delegate approved this Conservation Advice on 16/12/2016.

Conservation Advice

Galaxias auratus

golden galaxias

Conservation Status

Galaxias auratus (golden galaxias) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) effective from 7 June 2005.

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 <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.

The main factors that are the cause of the species being eligible for listing in the Endangered category are that the golden galaxias has a restricted distribution, occurring at only two sites in central Tasmania, with an extent of occurrence (EOO) of less than 100 km² and the two natural populations are fragmented (TSSC 2005). The species is threatened by diminishing habitat availability and degradation (TSSC 2005). The decline in quality of golden galaxias habitat is caused by fluctuating water levels due to extraction for irrigation, evaporation and low rainfall, which combined with the species' very restricted EOO, makes its geographic distribution precarious for its survival (TSSC 2005).

Description

The golden galaxias, family Galaxiidae, is a small to medium, stout freshwater fish, reaching a maximum length of approximately 240 mm (Allen et al., 2002; TSS 2006). Adults are golden to olive in colour with dark elliptical or ovoid spots on the back and sides, tending to silvery-grey on the underside (Allen et al., 2002; TSS 2006). Fins are amber to light orange with a black posterior edge on the dorsal, anal and pelvic fins (Fulton 1990) and the tail is forked (TSS 2006). Juveniles have dark bands on the back and sides which gradually fragment into the characteristic pattern of adults (Allen et al., 2002).

Distribution

The golden galaxias is endemic to Tasmania, and distribution is restricted to two lakes (Lake Crescent and Lake Sorell) and associated streams and wetlands on the Central Plateau (TSS 2006). Lake Crescent and Lake Sorell are shallow lakes, separated by a narrow strip of flat land though interconnected via a man-made channel, at approximately 800 m above m.s.l and have been individually regulated since the early 1800s (Twelvetrees 1902; Tas DPIWE 2005; Hardie 2013). The species is much more abundant in Lake Crescent, at approximately ten times the density found in Lake Sorell (Hardie 2003). Even though the type locality for the species, collected in the early 1880s, was recorded as the Great Lake, it was widely considered by reviewers that the type location is Lake Sorell based on describer's field notes (Andrews 1976).

The golden galaxias occurs within the Tasmanian Central Highlands Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion and the South Natural Resource Management Region.

The distribution of the golden galaxias is not known to overlap with any EPBC Act-listed threatened ecological community.

The Department of the Environment has prepared survey guidelines for the golden galaxias. The survey guidelines are intended to provide guidance for stakeholders on the effort and methods considered appropriate when conducting a presence/absence survey for species listed as threatened under the EPBC Act.

<http://www.environment.gov.au/epbc/publications/threatened-fish.html>

Relevant Biology/Ecology

The golden galaxias is restricted to freshwater habitats, and is primarily a lacustrine (lake-dwelling) species that lives in still or gently flowing waters. Adults appear to prefer rocky habitats, especially around the shore line in Lake Crescent and throughout the rocky substrate which dominates Lake Sorell (Hardie 2003). Juvenile fish live in open water until between 4 and 5 months old (40 mm in length) and then move to the inshore seeking shelter and larger prey items (Hardie 2003). It is suspected that adjacent wetlands to Lake Crescent and Lake Sorell are important habitats when inundated for the species' feeding, shelter and possibly spawning (Hardie 2003).

As larvae, the golden galaxias feeds on zooplankton and small insect larvae in the water column (Hardie 2003). Once juvenile fish reach sizes between 60 and 70 mm long they move inshore and feed on larger benthic prey. Juveniles and adults feed on a variety of aquatic and terrestrial insects, small crustaceans and molluscs (Allen et al., 2002; Hardie 2003). Terrestrial invertebrates falling into the water account for a significant proportion of the species' diet during summer and autumn (Hardie 2003).

The golden galaxias spawns in late autumn to winter (Hardie 2003), which is in contrast to almost all other non-diadromous (life cycle is spent entirely in freshwater) galaxias species (Humphries 1989; Fulton 1990). Mature females produce between 1000 and 15 000 small eggs (~1.5 mm diameter), depending on the size of the female (Hardie 2003). Spawning eggs adhere to rocky substrate or aquatic vegetation in shallow water between 300 and 600 mm deep (Hardie 2003). Eggs incubate for between 30 and 45 days. Newly hatched larvae are approximately 5 - 6 mm long (Hardie 2003).

Threats

Low lake levels, caused by dry conditions and water extraction, is the primary threat to the golden galaxias (TSSC 2005; TSS 2006). Other likely threats include competition and predation by alien fish species and the presence of fish containment screens, which are aimed at stopping movement of European carp (*Cyprinus carpio*) between Lake Sorell and Lake Crescent, but are likely inadvertently stopping genetic transfer of golden galaxias between the two lakes (TSS 2006).

Table 1 – Threats impacting the golden galaxias in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Habitat loss, disturbance and modifications		
Low lake levels caused by water extraction and drought	known current	<p>Lake Crescent and Lake Sorell have been impounded to supply water to municipalities and agricultural water users in the Clyde River valley (Hardie 2013).</p> <p>Golden galaxias rely on littoral habitats, consisting of submerged and emergent aquatic vegetation and shorelines of rocky and sandy substrata, to spawn (Hardie 2013). The available spawning habitat area is limited when water levels are low (Hardie 2013).</p> <p>A prolonged drought in central Tasmania between the late 1990s and early 2009, and the extraction of water for municipal users and agricultural irrigation, led to a deterioration of important habitat for golden galaxias (TSSC 2005; TSS 2006; Hardie 2013). Recruitment was poor during several breeding seasons and the abundance of the species declined, particularly in Lake Crescent (Hardie 2013). Water quality had declined and there had been a decrease in the abundance of aquatic macrophytes (TSS 2006). Shallow lakeside marshes have dried out and rocky shores have been exposed as a result (TSS 2006).</p> <p>The prolonged drought and increased abstraction for irrigation is thought to have increased turbidity in Lake Crescent and Lake Sorell (Stuart-Smith et al., 2007). Laboratory feeding trials indicate that turbidity does not appear to directly negatively impacting feeding, though the absence of structure, as may be the case when water levels are reduced, increases the species reliance on planktonic prey which may affect the lower trophic levels in the lakes (Stuart-Smith et al., 2007)</p> <p>Water levels in Lake Crescent and Lake Sorell were manipulated to assist spawning of golden galaxias during 2007 until 2009 (Hardie 2013). Seasonal water-level rises between May and September have been found to be important to spawning and recruitment in Lake Crescent, and should be implemented for the ongoing management of the species (Hardie 2013).</p>

Invasive species		
Competition and predation by alien and fish species not-native to the area	suspected current	<p>Brown trout (<i>Salmo trutta</i>) that are present in both Lake Crescent and Lake Sorrell, and feed almost exclusively on golden galaxias (IFS unpublished data, cited in TSS 2006). The species was once considered the preferred bait for trout fisherman in Lake Crescent (Fulton 1990). Laboratory trials found that brown trout also significantly alter the habitat use pattern of golden galaxias, with potential indirect impacts on feeding, growth and reproduction (Stuart-Smith et al., 2008). Indications are that behavioural changes by golden galaxias to avoid predation may also be having sub-lethal impacts, given that before the introduction of brown trout, the species had evolved in isolation from larger predatory fishes (Stuart Smith et al., 2008).</p> <p>European carp (<i>Cyprinus carpio</i>) were present in both Lake Crescent and Lake Sorell since the 1990s (TSS 2006). The Tasmanian Carp Management Program appears to have managed to eradicate carp from Lake Crescent given that the last carp was caught there in 2007, and eight years of annual monitoring since has not detected the species (IFS 2015). European carp are still present in Lake Sorell but the objective of the program is to eradicate the species from this lake as well (IFS 2015).</p> <p><i>Galaxias maculatus</i> (common galaxias), a diadromous South Pacific species not native to Lake Crescent and Lake Sorell is thought to have been accidentally introduced (Hardie 2003).</p>
Fragmentation		
Fish containment screens	suspected current	<p>Containment screens have been installed in the canal which connects the two lakes to stop European carp moving from Lake Sorell to Lake Crescent. These screens use 5 mm mesh which also prevent the movement of golden galaxias (except the very smallest of individuals) between the lakes (TSS 2006). It had been considered likely that these fish containment screens have fragmented the two populations of golden galaxias, allowing little genetic transfer between them (TSSC 2006). The implications for the species' genetic structure are not known (TSS 2006). As stated above, the Tasmanian Government is currently working to eradicate European carp in Lake Sorell (IFS 2015). Ideally, the containment screen should be removed once European carp are eradicated from Lake Sorell to allow interchange of golden galaxias between the two lakes.</p>

Conservation Actions

Conservation and management priorities

Habitat loss, disturbance and modifications

- Create refuge habitat sites, especially in Lake Crescent, using rocks or artificial substrates to create structure to support feeding, refuge and spawning requirements for the golden galaxias.
- Manage water levels in both lakes to provide sufficient water for spawning habitats, especially between May and September, for example by increasing water levels in spawning season. Environmental water releases into Lake Crescent from Lake Sorell between 2007 and 2009 have benefited the Lake Crescent population while having no adverse impacts on the Lake Sorell population (Hardie 2013). These water releases should be implemented permanently to protect habitat diversity and ensure good water quality.
- Maintain water levels in both lakes above the Critical Minimum Level as per the *Lakes Sorell and Crescent Water Management Plan*, of which an objective is to “maintain the health and population” of the golden galaxias.
- Manage any other changes to hydrology, so that any increases in sedimentation and/or pollution are avoided.

Invasive species

- Continue the implementation of the *Carp Management Plan* to eradicate European carp completely from Lake Sorell and avoid reintroduction into Lake Crescent.
- Do not stock alien salmonids (such as brown trout) in Lake Crescent and Lake Sorell.

Stakeholder Engagement

- Raise awareness of the species within the local community and with visitors, possibly as part of a broader Tasmanian threatened galaxiid communication strategy (TSS 2006), highlighting the importance of not introducing alien or non-native species to Lake Crescent and Lake Sorell.
- Engage with recreational fishers about the importance of not-moving or translocating trout, and other alien fish species, around inland waters.
- Increase compliance effort to ensure that the use of golden galaxias as live or dead bait for trout is strictly prohibited, noting that historically there was a strong preference of trout fishers for using the species as bait.
- Engage with private landholders and land managers responsible for areas adjacent to waterways in which remaining populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.

Survey and monitoring priorities

- Continue to monitor of the species' population annually for the progress of recovery in both Lake Crescent and Lake Sorell, and any other sites the species is found to occur, and assess the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Further examine the impact of all alien species, present in Lake Sorell and Lake Crescent, on the golden galaxias.
- Undertake genetic studies to act as a baseline to monitor genetic diversity between the Lake Crescent and Lake Sorell populations, given that the two populations are now fragmented as a European carp containment screen is installed between the two.

References cited in the advice

- Allen, G.R., Midgley, S.H., & Allen, M. (2002). *Field Guide to the Freshwater Fishes of Australia*. Western Australian Museum, Perth.
- Andrews, A.P. (1976). A revision of the family Galaxiidae (Pisces) in Tasmania. *Australian Journal of Marine and Freshwater Research* 27, 297 – 349.
- Fulton, W. (1990). *Tasmanian Freshwater Fishes*. Fauna of Tasmania handbook no. 7, University of Tasmania, Hobart.
- Hardie, S.A. (2003). *Current Status and Ecology of the Golden Galaxias (Galaxias auratus)*. Inland Fisheries Service, Hobart.
- Hardie, S.A. (2013). Hydrological manipulation to assist spawning of a threatened galaxiid fish in a highland lake system. *Marine and Freshwater Research* 64, 887 – 899.
- Humphries, P. (1989). Variation in the life history of diadromous and landlocked populations of the spotted galaxias, *Galaxias truttaceus* Valenciennes, in Tasmania. *Australian Journal of Marine and Freshwater Research* 40, 501 – 518.
- Inland Fisheries Service (IFS) (2015). *Carp Management Program Annual Report 2014-15*. Inland Fisheries Service, Tasmanian Government, New Norfolk, Tasmania.
- Stuart-Smith, R.D., Stuart-Smith, J.F., White, R.W.G., & Barmuta, L.A. (2007). The effects of turbidity and complex habitats on the feeding of a galaxiid fish are clear and simple. *Marine and Freshwater Research* 58, 429 – 435.
- Stuart-Smith, R.D., White, R.W.G., & Barmuta, L.A. (2008). A shift in the habitat use pattern of a lentic galaxiid fish: an acute behavioural response to an introduced predator. *Environmental Biology of Fishes* 82, 93 – 100.
- Tasmania Department of Primary Industries, Water and the Environment (Tas DPIWE) (2005). *Lakes Sorell and Crescent Water Management Plan*. Department of Primary Industries, Water and the Environment, Hobart. 31 pp.
- Threatened Species Section (TSS) (2006). *Recovery Plan: Tasmanian Galaxiidae 2006–2010*. Tasmanian Department of Primary Industries and Water, Hobart, Tasmania.

Twelvetrees, W. H. (1902). *Report on country on the east shore of Lake Sorell, and on a discovery of coal near Oatlands*. Report to W.H. Wallace, Secretary for Mines Hobart. Government Geologist's Office, Launceston. Government Printer, Tasmania.

Other sources cited in the advice

Threatened Species Scientific Committee (TSSC) (2005). *Commonwealth Listing Advice on Galaxias auratus*. Australian Government Department of Environment and Heritage, Canberra, Australian Capital Territory.

Available on the Internet at:

http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=77038