Prototroctes maraena

Australian grayling

TASMANIAN THREATENED SPECIES LISTING STATEMENT

Prototroctes maraena
Image © Ron Mawbey

Scientific name:	***Prototroctes maraena*** Günther, 1864
Common name:	Australian grayling
Other names:	Cucumber Herring, Cucumber Mullet, Cucumber Fish
Group:	Vertebrate, Chordata, Actinopterygii, family **Retropinnidae**
Status:	*Threatened Species Protection Act 1995*: **vulnerable (1995)**
	Environment Protection and Biodiversity Conservation Act 1999: **Vulnerable (2000)**
	IUCN Red List: **Vulnerable (B2b(i,ii,iii,iv,v)c(iv) (2019))**
Distribution:	Endemic status: **Not endemic to Tasmania**
	Tasmanian NRM Region: **North, South, Cradle Coast**
	Tasmanian IBRA region, Version 7: **Northern Midlands, Northern Slopes, South East, Southern Ranges, West, Furneaux, King**

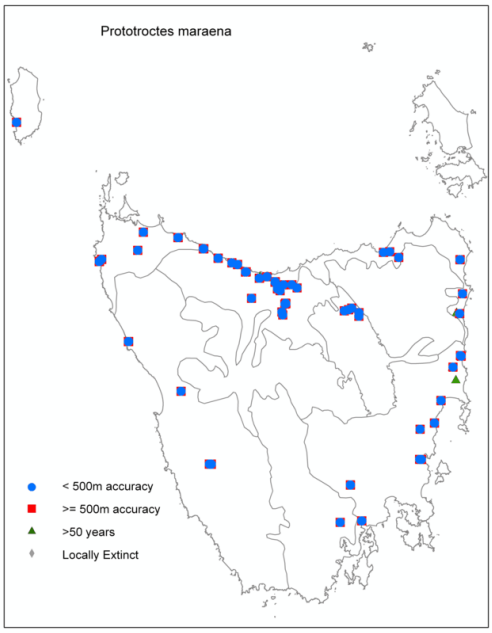

Figure 1. The distribution of *Prototroctes maraena* within Tasmania, showing IBRA regions (from Natural Values Atlas)

Plate 1. The Australian grayling
Image © Tarmo A. Raadik

Tasmania

SUMMARY: In Tasmania, the Australian grayling (*Prototroctes maraena*) is a small to medium-sized slender fish which migrates between fresh and marine waters. Adults live and breed in freshwater rivers, and their larvae are swept downstream into coastal waters. Juveniles remain in marine waters for approximately six months before migrating to freshwater habitat. Little is known of the population size of this species and its distribution in Tasmania, but it is believed the species' range has contracted substantially in recent years. Major threats to the Australian grayling include the construction of barriers that prevent migration of larvae downstream and adults upstream, declining water quality and altered river flow regimes and predation by invasive fish species.

IDENTIFICATION AND ECOLOGY

The Australian grayling (*Prototroctes maraena*) is a silvery, streamlined fish with soft clear fins (Backhouse et al. 2008a) growing to an average length of 17–18 cm, to a maximum length of 30 cm. It has a distinctive cucumber-like smell when freshly caught, hence commonly being known as the cucumber herring or cucumber mullet. The dorsal fin is positioned just behind the base of the pelvic fin, there is a small adipose fin, forked tail, thin scales, and no lateral line. The body shape is slender and compressed, with a small head, large eyes, and bluntly pointed snout. Colour may vary with age, from silvery with olive-grey back and whitish belly, to olive green-brown on the back with a darker side streak and silvery-yellow belly (McDowall 1996).

The Australian grayling is a migratory species which moves between salt water and fresh water (i.e. diadromous), spending its larval stages in marine water and its adult life primarily in freshwater (Backhouse et al. 2008b). The species is recognised as amphidromous (a distinctive form of the diadromous life cycle), characterised by freshwater spawning and movement of larvae downstream to the sea, where they develop for several months before returning upstream to live and reproduce (McDowall 2007).

Spawning occurs generally over a two-week period between late summer and mid-winter, with site-specific timing associated with environmental factors (Bishop & Bell 1978; Jackson & Koehn 1988). It appears that spawning is triggered by a combination of water flow events and decreases in water temperature (Bakehouse et al. 2008b).

Spawning behaviour and exact spawning habitat are unknown. Females produce a very large number of small, amber coloured eggs (25,000–68,000, with an average of 47,000) (Berra 1982; 1984), which are non-adhesive, and probably scatter on the riverbed. Eggs have been recorded settling on a variety of substrates, and hatch between 10 and 20 days after being laid (Backhouse et al. 2008b). After hatching, the larvae are buoyant and swim actively towards the surface and are swept to the sea (Bacher & O'Brien 1989). This downstream migration appears to be an obligatory aspect to the life cycle (Crook et al. 2006), with juveniles returning upstream after four to six months to spend the rest of their life in freshwater. Female Australian grayling spawn at two years of age although males may mature within one year (Berra 1984). The migrating juveniles are sometimes found amongst whitebait or elver runs, and adults are occasionally observed in large schools in rivers.

Australian graylings are omnivorous, feeding on a mixed diet of small aquatic insects, crustaceans, and algae (Berra et al. 1987). They may live for up to five years although most reach only two to three years of age (Bishop & Bell 1978; Berra 1982).

Prototroctes maraena is the only surviving member of the family Prototroctidae (Southern graylings). A closely related species, the New Zealand grayling (*Prototroctes oxyrhynchus*) became extinct by the 1930s, for reasons that are unclear (Bell et al. 1980).

Survey techniques

The principal method for surveying freshwater fish including the Australian grayling is electro-fishing. This technique involves the use of an electric current passed through the stream water to stun any fish present. When performed correctly, the sampled fish are largely unharmed, although Australian grayling are more susceptible to poor recovery from electrical shock than other freshwater species (TSS 2024).

Radio telemetry has also been used to improve understanding of migration cues and patterns for this species (Dawson & Koster 2018; Koster et al. 2013; Amtstaetter et al. 2016).

Drift nets have been used to successfully capture eggs when they are drifting downstream. Drift nets are more successful when set near the riverbed rather than closer to the surface and have best success in faster-flowing water courses with a gravel substrate (Amtstaetter et al. 2015).

All techniques require specialist equipment and expertise and should only be performed by trained specialists. Please seek further advice from the Inland Fisheries Service and the Threatened Species Section if you wish to sample freshwater fish. These methods require a permit 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

Juvenile Australian grayling are similar in appearance to other native fish species, including smelts, mullets and hardyheads, and these species are often found together in schools forming what are known in Australia as "whitebait runs" (McDowall 1980; Allen et al. 2002). Small Australian grayling are easily confused with the common Australian smelt but can be distinguished by longer pectoral and pelvic fins (McDowell 1976), and a dorsal fin that is positioned further forward of the anal fin in grayling, but in smelt is aligned (NSW DPI 2021).

Plate 2. The Mersey River, one of the riverine habitats of *Prototroctes maraena* in Tasmania Image © Adrian Webb

DISTRIBUTION AND HABITAT

The Australian grayling occurs in coastal streams and rivers around Tasmania (Plate 2) and in south-eastern Australia from western Victoria to southern New South Wales as far north as the Shoalhaven River (Plate 3). It may occur in any coastal stream without barriers to upstream juvenile migration.

On mainland Australia, adult grayling have been found in deep, slow-flowing pools (Bishop & Bell 1978) and in clear, gravel-bottomed streams with moderate flow and alternating pools and riffles (Berra 1982) as well as in muddy waters (Jackson & Koehn 1988). The freshwater spawning habitat is unknown, as is the marine juvenile habitat. Dispersal distances in both the marine and freshwater habitat are also unknown, although in Victoria, Australian grayling have been recorded more than 100 km upstream from the sea (Jackson & Koehn 1988).

Historically, *Prototroctes maraena* was widespread in coastal rivers from the Grose River west of Sydney throughout New South Wales, Victoria and eastern South Australia (Wager & Jackson 1993). This species occurred throughout Tasmania, including King Island.

Prototroctes maraena is considered to be in decline. Although still quite widespread (Fulton 1990), it is now patchily distributed throughout its former range and occurs in lower numbers. There is concern it may have disappeared from some rivers (Bell et al. 1980). It was once common and often taken by anglers, but is now rarely seen.

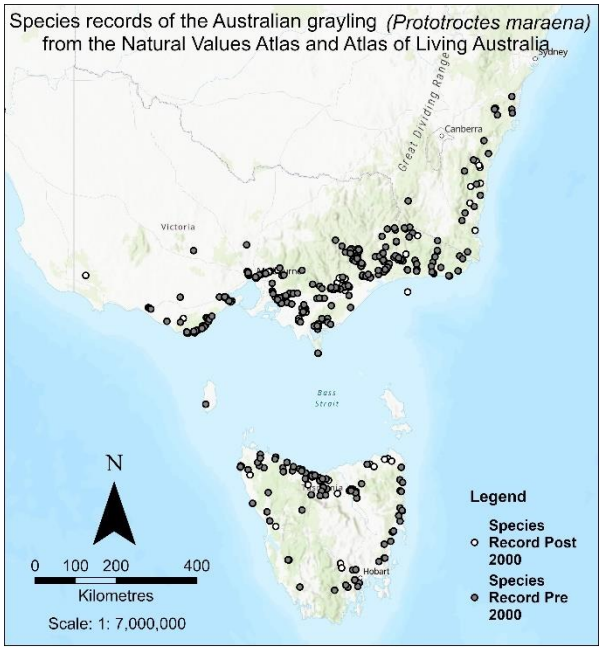

Plate 3. Species records of *Prototroctes maraena* (data points from the Natural Values Atlas and Atlas of Living Australia 2024) Map © Karen Fagg (NRE Tas)

Berra (1982) suggested that large fluctuations in grayling populations might be a natural result of variation in recruitment from year to year.

TASMANIAN POPULATION PARAMETERS

Number of subpopulations: Not quantified
Number of locations: Not quantified
Extent of occurrence: 68,726 km^2
(Australian distribution: 454,776 km^2)
Area of occupancy (as per IUCN criteria) = 376 km^2
(Australian distribution: 1,092 km^2)
Number of mature individuals: Unknown
Largest subpopulation: Unknown

Within Tasmania, the Australian grayling is found in northern, eastern, southern and western rivers. Important rivers for the species, as defined in by Backhouse et al.(2008a) as rivers at the limits of the species' range, and those known to contain large breeding populations or occur in areas with extensive spawning habitat, are provided in Table 1.

Population numbers are not well understood in Tasmania, and it is thought that the species' range has contracted considerably recently.

RESERVATION STATUS

In Tasmania, potential habitat of the Australian grayling is reserved in the south-west National Park, where some entire catchments are undisturbed. However, the only record of the species from this area is from the Gordon River downstream of the Franklin River. Other rivers around the coast are on private land, land managed by Sustainable Timber Tasmania, or have only part of the catchment reserved, for example the Douglas-Apsley National Park.

Table 1. Important Rivers for *Prototroctes maraena* within Tasmania.

River	IBRA region*
Gordon River	Tasmanian West
Pieman River	Tasmanian West
Arthur River	Tasmanian West
Ettrick River	King
Duck River	King
Detention River	King
Franklin River	Tasmanian Northern Slopes
Inglis River	Tasmanian Northern Slopes
Cam River	Tasmanian Northern Slopes
Blythe River	Tasmanian Northern Slopes
Sulphur Creek	Tasmanian Northern Slopes
Leven River	Tasmanian Northern Slopes
Forth River	Tasmanian Northern Slopes
Don River	Tasmanian Northern Slopes
Mersey River	Tasmanian Northern Slopes
Rubicon River	Tasmanian Northern Slopes
North Esk River	Ben Lomond
Great Forester River	Flinders
Ansons River	Flinders
George River	Flinders
Scamander River	Flinders
Little Swanport River	Tasmanian South East
Douglas River	Tasmanian South East
Apsley River	Tasmanian South East
Lisdillon River	Tasmanian South East
Meredith River	Tasmanian South East
Prosser River	Tasmanian South East
Derwent River	Tasmanian South East
Huon River	Tasmanian Southern Ranges
North West Bay River	Tasmanian South East

* IBRA region = Interim Biogeographic Regionalisation for Australia

CONSERVATION STATUS

Prototroctes maraena was listed as vulnerable on the initial schedules of the *Threatened Species Protection Act 1995* (TSP Act) due to population decline over much of its former range.

The Australian grayling was listed as Vulnerable under the predecessor to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and was transferred to the EPBC Act in 2000. In 2019, *Prototroctes maraena* was listed as Vulnerable on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (Koster & Gilligan 2019).

THREATS, LIMITING FACTORS AND MANAGEMENT ISSUES

The species is threatened by factors contributing to habitat degradation and alteration:

Barriers to Movement: In Tasmania, barriers such as dams and weirs prevent upstream movement of juveniles and downstream movement of adults, both of which are essential for completion of the species' life cycle. It has been suggested by Bice et al. (2018), that low-level tidal barriers prevent the passage of larvae to the sea and juveniles returning into the rivers, while Humphries & Walker (2013) suggest these barriers restrict lineal fish movements along river and stream channels.

Altered hydrology: River regulation by damming and water extraction result in reduced dry weather flows and minor flood events feeding into downstream waterways. The Australian grayling selects spawning sites based on water velocity and temperature (Amtstaetter et al 2015; 2016) and relies on increased water flow to trigger a migratory response for spawning (Koster et al. 2013; 2018). O'Connor & Mahoney (2004) found that Australian grayling will not release eggs if water flow is not sufficient during their expected spawning season.

Siltation and poor water quality: Increased siltation of rivers can result from catchment disturbance including vegetation clearing, degradation of riparian zones, agricultural activities, burning and roading, including new construction or maintenance activities. Increased siltation reduces water quality, can promote plankton blooms and smother river substrate used by Australian grayling for feeding and spawning. High turbidity from suspended sediment erodes fish gills and has been shown to affect feeding in riverine fish species (Rowe et al. 2002). Sediments can remain deep in river substrates for several years and altered flows may reduce sediment removal.

Whilst subsequent flooding would usually flush excessive siltation downstream, reduced flooding (e.g. from drought, river regulation) possibly means less effective flushing of sediment from gravel beds. Australian grayling are likely to be highly susceptible to siltation through smothering of gravel required for spawning habitat. Even though subsequent flooding may gradually mobilise sediments and shift them downstream, several missed breeding seasons in short succession can have severe consequences for population conservation.

Wildfires can drastically reduce habitat quality in aquatic ecosystems and increase the extinction risk of species. Direct effects from predicted future increases in fire frequency and intensity include increases in water temperatures and changes to water chemistry, which are compounded by likely increased nutrient levels (nitrogen and phosphorus in particular) leached from the surrounding burnt vegetation (Wilkinson et al. 2007; Lyon & O'Connor 2008). The biggest indirect impact is post-fire rainfall leading to runoff of sediment, ash, and nutrients or "sediment slugs" into waterways (Wilkinson et al. 2007; Lyon & O'Connor 2008; Alexandra & Finlayson 2020). Sediment slugs contain higher nutrient levels and may increase the chances of toxic algal blooms occurring, which lowers the water quality, leading to fish kills (Wilkinson et al. 2007; Alexandra & Finlayson 2020). Sediment slugs have been found to cause impacts on the aquatic ecosystem up to 80 km downstream of a fire-impacted area (Lyon & O'Connor 2008).

Changes to coastal morphology: It has been suggested that changes in coastal morphology (i.e., the river mouth and its connectivity with the sea) can cause disruptions to migration pathways (Crook et al. 2006). Gillanders et al. (2011) indicated that closures of estuarine mouths will have a direct impact on migratory (diadromous) fish migration.

Introduced Species: Brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and redfin perch (*Perca fluviatilis*) were introduced to Australia for angling reasons (i.e. recreational sport and consumption). Brown trout are well established, with most streams within Tasmania containing self-sustaining populations, with essentially no stocking of any rivers. Where present, redfin perch maintain self-sustaining populations where the habitat is favourable.

These species are known to predate on native fish species, negatively impacting their populations (Cadwallader 1996; Jackson et al. 2004; Humphries & Walker 2013; Jarvis et al. 2019). Trout compete with Australian grayling for resources and are known to prey on smaller Australian grayling individuals (including larvae and juveniles) (Backhouse et al. 2008a). Knott (1973) attributes the decline of Australian grayling in Tasmania to the presence of trout. Redfin perch have been observed preying on and competing with Australian grayling for resources in Tasmania (TSSC 2021). Other species such as eastern gambusia (*Gambusia holbrooki*) and European carp *(Cyprinus carpio)* have the potential to impact on the species if numbers increase or become re-established in Tasmania.

Climate change: Modelling of the effects of climate change on the habitat of Australian grayling has demonstrated that the biggest climatic challenge for the species is the decoupling of suitability between migratory habitats (freshwater and marine), such as warming marine habitats reducing suitability for larvae (Lin et al. 2017).

Disease: There is risk of infection by introduced parasites and diseases to the Australian grayling. A copepod parasite probably originating on European carp and redfin perch has been found on grayling in Victoria (Hall 1983). Mass mortalities and decline of grayling reported in the 1880s (references in Jackson & Koehn 1988) coincide with introduction of trout to Tasmania (in 1864), and may have been associated with a disease fatal to grayling (Cadwallader 1996).

Fishing: The species is caught incidentally by recreational fishers targeting salmonids using fly-fishing methods (Backhouse et al. 2008a). Due to their thin and deciduous scales, Australian grayling are delicate fish that are extremely prone to handling stress (Berra & Cadwallader 1983; Koster et al. 2013; Dawson & Koster 2018). Juvenile Australian grayling are also occasionally caught as bycatch during the whitebait season (October-November), but in most cases they can be subsequently returned to the waterway (IFS 2024).

MANAGEMENT STRATEGY

Management objectives

The main objective for the recovery of *Prototroctes maraena* is to mitigate extinction risk by halting decline and stabilising populations of the Australian grayling through effective management of environmental flow and removal of barriers to fish passage, thereby to promoting spawning and migration in the species and increase river connectivity.

What has been done?

Measures are being implemented to address habitat degradation in the long term, for example, the setting of environmental flows for regulated rivers and removing redundant weirs from coastal streams.

- **National Recovery Plan:** The first National Recovery Plan for the species was published by the Victorian Government Department of Sustainability and Environment under the provisions of the Commonwealth EPBC Act in 2008. This Recovery Plan has sunsetted under the EPBC Act and is no longer in force.
- **Conservation Advice:** A Conservation Advice document published in 2021 under the EPBC Act is considered the most contemporary management document for the species and a National Recovery Plan is not recommended as being required (TSSC 2021).
- **Management prescriptions:** The species is included in the Forest Practices Authority *Threatened Species Adviser*. Any forest practices, as defined by the *Forest Practices Act 1985*, potentially affecting the species will be identified through the threatened species notification process. Management recommendations in the *Threatened Species Adviser* provide management prescriptions to protect this species in conjunction with the Forest Practices Code (FPA 2020; 2021).

  Targeted surveys and monitoring: The Australian grayling has been recorded in catchments across Tasmania, with a scarcity of records in the southwest catchments potentially due to a lack of surveys (McDowall 1976; Backhouse et al. 2008b; TSS 2024). Historically, Australian grayling have been found on King Island in the Bass Strait (Backhouse et al. 2008b; DoEE 2024). Within the northwest and northeast rivers, Australian grayling are temporally locally abundant in the Mersey (a significant stronghold for the species), Gawler, Leven, Tamar, North Esk and Great Forester rivers. At times, significant numbers also occur in the lower sections of the River Derwent and Huon River.
- **Protection from fishing**: The Australian grayling is fully protected under the TSP Act and EPBC Act legislation and the Tasmanian *Inland Fisheries Act 1995*. It is prohibited to take or disturb the species. However, there has been little public education and enforcement to support the legislation.

What is needed?

Agencies, groups or individuals may assist with some or all of the following recovery actions (coordinated efforts may achieve the best and most efficient results):

- 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.
- **Habitat protection and rehabilitation**
  - Assess fish passage barriers (weirs and dams), targeting areas where the Australian grayling is known to occur, or may occur, and implement management and engineering solutions to provide fish passage to improve river connectivity.
  - Identify rivers where flow regulation or water abstraction potentially impacts on subpopulations and habitats of the Australian grayling and ensure life history requirements (such as promoting/triggering spawning and migration) are included in river management processes.

  Protect key habitats from activities such as vegetation (including tree) clearing in riparian and broader catchment zones, as well as earthworks and flood mitigation measures that degrade riverine and estuarine habitat.

- **Invasive species eradication and control**
  - Implement, or supplement existing programs to include a targeted control program for introduced fish species, including redfin perch (*Perca fluviatilis*), and eastern gambusia (*Gambusia holbrooki*), in areas known to contain Australian grayling. Monitor for incursions of European carp (*Cyprinus carpio*) following reported successful eradication of functional populations in Tasmania.
  - Protect important Australian grayling subpopulations from stocking of trout.
- **Community and stakeholder liaison, awareness, and education**
  - Increase recreational fisher awareness on the incidental capture of Australian grayling as the species is prone to handling stress and may recover poorly from hooking/de-hooking.
  - Ensure research findings are publicised and incorporated into catchment management and river health programs.
  - Establish and understand the cultural significance of the Australian grayling to Traditional Owners.
- **Survey, monitoring and mapping priorities**
  - Support the development and implementation of a targeted monitoring program for Australian grayling, using a combination of eDNA and conventional techniques, across its distribution, to determine reliable population estimates and size structure.
  - Utilise a combination of eDNA techniques and conventional monitoring to improve knowledge of introduced fish distribution and abundance in areas where Australian grayling occur.
  - Establish an ongoing monitoring program to gain an understanding of population distribution and changes as well as habitat quality. This will provide data for reliable estimates on the population cycle of Australian grayling and is especially important for locations where recovery actions are occurring (e.g., fishway installation, catchment rehabilitation).
- **Information and research priorities**
  - Investigate spawning cues, site selection and the influence of water flow parameters for triggering a spawning response in Australian grayling.
  - Identify rivers that are source populations for the Australian grayling and prioritise those rivers for environmental flows management.
  - Investigate the direct and indirect impact of invasive species in areas known to contain the Australian grayling.
  - Investigate the ecology of Australian grayling during the marine phase of their life cycle.
  - Investigate the Australian grayling's susceptibility to parasites and pathogens endemic to the areas where the species occurs.
  - Further understand the causes and consequences of infestations of viruses, pathogens, and parasites on Australian grayling.
  - Undertake genetic assessment of Australian grayling populations in Tasmania.
  - Investigate the impact of increased sedimentation on the Australian grayling and associated habitats in catchments affected by wildfires.
  - Investigate the impacts of changes in autumn river flows and intensification of the East Australian Current relevant to the Australian grayling, based on current knowledge and climate change scenarios.

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Permit: It is an offence under Tasmanian legislation to collect, catch, damage, injure, destroy, or kill a threatened species listed under the *Threatened Species Protection Act 1995,* without a permit.

Version history

Version	Date	Author	Purpose/Change
1.0	19/12/2006	Dr Jean Jackson and Robbie Gaffney	First version. Draft first prepared in 2006 by Dr Jean Jackson and revised by Robbie Gaffney. Endorsed by the Scientific Advisory Committee.
2.0	8/12/2024	Karen Fagg (TSS, NRE Tas)	Revised and updated in 2024 by Karen Fagg (TSS). Endorsed by the Scientific Advisory Committee following their 88th meeting on August 8th 2024.