The Minister approved this conservation advice and retained this species in the Vulnerable category, effective from 19/10/2021

Conservation Advice

Prototroctes maraena

Australian Grayling

Taxonomy

Conventionally accepted as *Prototroctes maraena* Günther 1864.

Common names: Cucumber Herring, Cucumber Mullet, Cucumber Fish, Yarra Herring (Berra et al. 1982; Backhouse et al. 2008b; NSW DPI 2015a; Gomon & Bray 2017; VFA 2018).

Summary of assessment

Conservation status

Vulnerable: Criterion 2 B2 (a) (b) (ii), (iii), (iv)

The highest category for which *Prototroctes maraena* is eligible to be listed is Vulnerable and the category it is eligible for listing is Criterion 2 B2 (a) (b)(ii), (iii), (iv).

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

The Australian Grayling was listed as Vulnerable under the predecessor to the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) the *Endangered Species Protection Act 1992* and was transferred to the EPBC Act in July 2000.

This advice follows assessment of new information provided by the New South Wales Government as part of the process to systematically review species that are inconsistently listed under the EPBC Act and relevant New South Wales legislations/lists.

Public consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 44 business days between 7 May and 7 July 2020. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

The Minister approved this conservation advice and retained this species in the Vulnerable category, effective from 19/10/2021

Species information

Description

Prototroctes maraena (Australian Grayling) is a small to medium sized slender fish with soft clear fins (Backhouse et al. 2008b). Reaching a maximum length of about 330 mm (more commonly between 170–190 mm) and 0.5 kg, the Australian Grayling is generally greyish-bronze to olive in colour on its back with a silvery belly—the scales are extremely thin and deciduous (McDowall 1980a; Berra & Cadwallader 1983; Allen et al. 2002; Backhouse et al. 2008b). It has a small cone-like head, large eyes and its lower jaw is shorter than its upper jaw (i.e., a sub terminal mouth typically indicative of a benthic feeder) (McDowall 1980a; Allen et al. 2002; Backhouse et al. 2008b). The Australian Grayling does not possess a lateral line or scales on its head. The species' most distinguishable feature is that it extrudes a "cucumber-like" odour from its skin when freshly caught, hence commonly called "Cucumber Herring" or "Cucumber Mullet" (McDowall 1976; Berra et al. 1982; Allen et al. 2002; Backhouse et al. 2008b; NSW DPI 2015a; VFA 2018).

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 is known in Australia as "whitebait runs" (McDowall 1980a; Allen et al. 2002; Gomon & Bray 2017).

Distribution

The Australian Grayling was historically known to occur in coastal catchments greater than 200 m above sea level (ASL), generally in the freshwater, estuarine and marine reaches of waterways in south-eastern Australia along New South Wales (NSW), Victoria, Tasmania (including on King Island in the Bass Strait) and South Australia (SA) (Backhouse et al. 2008b; Jenkins et al. 2009; NSW FSC 2015; DoEE 2019). Nationally, there are no reliable population estimates for the Australian Grayling (NSW DPI 2015a; DoEE 2019). Due to their high fecundity, it has been suggested that the Australian Grayling population undergoes large fluctuations and that following a decline in population, the Australian Grayling could exhibit an increase in abundance over a period of 14–17 years (Berra 1982).

New South Wales

The historical distribution of the Australian Grayling in NSW is from the Hunter River catchment southwards to the Victorian border (Miles 2005, 2007; NSW FSC 2015). While most observations have been from the NSW south coast, from the Shoalhaven River to the Victorian border, the species historical distribution has contracted by 65 percent from observations recorded between 1994–2014 (Bishop & Bell 1978; Bell et al. 1980; Miles 2005; NSW DPI 2015a; NSW FSC 2015; DoEE 2019; Walsh pers comm in NSW Fisheries 2020). The Faragher (1995) threatened fish species survey (cited in Miles 2005) has the most comprehensive report on the status of Australian Grayling in NSW and all other reports have only limited documentation of the species (Miles 2005).

Victoria

The Australian Grayling was incorrectly considered extinct in Victoria in the years leading up to the 1970s (VFA 2018). However, surveys post-1970, recorded Australian Grayling present in almost all coastal rivers east of, and including the Hopkins River catchment near Warrnambool (Backhouse et al. 2008b; VFA 2018; DoEE 2019; SWIFFT 2019). Historically, the strongest abundances of Australian Grayling were found in the Tambo, Mitchell, Tarwin and Yarra catchments in central and eastern Victoria (Berra 1982; DoEE 2019; VFA 2018; SWIFTT 2019).

Australian Grayling occurs within the *Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria* threatened ecological community. The Conservation Advice lists priority research and conservation actions to mitigate the risk of extinction of assemblages of species associated with this ecological community.

Tasmania

The Australian Grayling has been recorded in catchments draining to the north, west and east coasts of Tasmania, but has not yet been recorded in the southwest catchments—potentially due to a lack of surveys (McDowall 1976; Backhouse et al. 2008b; TSS 2019). Historically, Australian Grayling have been found on King Island in the Bass Strait (Backhouse et al. 2008b; DoEE 2019). Within the northwest and northeast rivers, Australian Grayling have been found to be 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 (unpublished data, TSPLC Tasmania pers comm 2020; IFS Tasmania pers comm 2020).

South Australia

Whilst considered rare, Australian Grayling may still be found in SA, with a historical verified report at Ewens Ponds in 1982 and an unverified report at Piccaninnie Ponds (Hammer 2002; Backhouse et al. 2008b; Hammer et al. 2009; NSW DPI 2015a; DoEE 2019). Other recordings of the species remain unverified (Hammer et al. 2009). It is suggested that SA never held established local populations and individuals recorded were likely vagrant fish which travelled to South Australian catchments from resident local populations based in Victoria (Hammer 2002; Hammer et al. 2009).

Cultural significance

The Australian Grayling is a native fish species which may hold significant values to Indigenous people as a valued food resource (Humphries & Walker 2013). In NSW where the species occurs on Indigenous land, Indigenous work crews along with Local Land Services coordinate ongoing habitat rehabilitation efforts (Daly pers comm in NSW DPI Fisheries 2020).

Australian Grayling were once a popular target sport fish for recreational fishers, especially with fly fishers, given the species readily "takes to" a fly (the specialised, lightweight, artificial fly lure used in this method) (Bishop & Bell 1978; Bakehouse et al. 2008a).

Relevant biology/ecology

The Australian Grayling is a diadromous species that spends its larval stages in marine water and its adult life mainly in freshwater (Backhouse et al. 2008b). The species' distribution during its larval marine phase is unknown, and it is suspected that varying marine conditions such as sea surface temperatures and oceanic currents affects larval distribution and recruitment (Koster et al. 2020). Berra (1982) and Berra & Cadwallader (1983) suggested that the species also exhibited an amphidromous life history, as juveniles will spend time in brackish waters, rather than immediately returning to freshwater. This suggestion was supported by a later study (Crook et al. 2006). This brackish/marine water phase could potentially be attributed to their ancestral stage whereby spending time in brackish/marine waters maximised chances of survival and growth (Berra 1987). This habitat provides ideal growing conditions for the larvae, keeping them protected from the colder river water temperatures during winter (Berra 1987).

The Australian Grayling has a maximum life expectancy of up to five years, but many rarely live past an age of three years (Bishop & Bell 1978; Berra 1982; 1984; NSW DPI 2015a). Males are sexually mature at one year of age, and females at two years of age, but spawning typically occurs after two years of age. The age-length ratio for the species varies with location and water temperatures, as fish from the same year class collected in rivers with warmer water temperatures are on average larger than fish collected in rivers with colder water temperatures (Berra & Cadwallader 1983). For instance, fish collected in the Tambo River (Victoria) were similar in size to fish collected in the Shoalhaven River (NSW), however, fish from the

Shoalhaven River had larger maximum size values (Bishop & Bell 1978; Berra & Cadwallader 1983). The higher maximum values in the Shoalhaven River could be attributed to warmer water, thus extending the growing season (Berra & Cadwallader 1983).

Australian Grayling generally migrates downstream to the lower freshwater reaches of rivers to spawn, however, this is dependent on specific hydrological cues such as water velocity and temperature as the species have been observed in small fast-moving shoals within fast stream currents (Koster et al. 2013; Amtstaetter et al. 2015, 2016; Kaminskas pers comm 2021). Spawning usually occurs over a two-week period, typically from late-summer to mid-winter and this period varies with location and local environmental factors such as varying water temperatures, water flow events and other variables (McDowall 1976; Backhouse et al. 2008b; Koster et al. 2013). However, Bacher & O'Brien (1989) demonstrated that Australian Grayling eggs would not hatch as salinity increases. Additionally, oocytes are reabsorbed in winter if suitable spawning triggers have not occurred (O'Connor & Mahoney 2004). For instance, Hall & Harrington (1989), concluded that spawning in the Barwon River, Victoria occurs in mid- to late-May coinciding with temperatures between 12–13.5°C and salinities of 1.5 ppt, and is potentially triggered by the lunar phase. Koster et al. (2013) also observed a peak in drifting egg densities in early to mid-May in the Bunyip River, Victoria. Whereas spawning in the Tambo River occurs April to early-May coinciding with water temperatures of 13°C (Berra & Cadwallader 1983; Berra 1987). It appears that spawning is triggered by a combination of water flow events and decreases in water temperatures (Bakehouse et al. 2008b; DoEE 2019).

Fecundity of the Australian Grayling varies between 25 000 and 68 000 eggs, with an average of 47 000 eggs (Berra 1982; 1984). Eggs are less than 1 mm in diameter, demersal and non-adhesive (McDowall 1976; Jackson 1980; Berra 1984; 1987; Backhouse et al. 2008b; DoEE 2019). Spawning behaviour and site selection are currently unknown, eggs have been recorded as settling on a variety of substrates (gravel, granite, muddy and silted) (Backhouse et al. 2008b). Eggs hatch between 10 and 20 days after being laid. Larvae emerge at 6.5 mm in length, are buoyant, and while they are free swimming, they are typically swept downstream into marine habitats by river flow (Berra 1982; 1987; Backhouse et al. 2008b). The species appears to be highly *r-selected*, suggesting that they have the ability to quickly re-populate following a period(s) of poor environmental conditions, if conditions permit recovery (Berra 1987).

The Australian Grayling is an omnivorous feeder, feeding on crustaceans, aquatic insects, their own larvae, aquatic plants (including macrophytes and algae) as well as terrestrial insects that fall into the water (Jackson 1976; Berra et al. 1982; Backhouse et al. 2008b). Australian Grayling have been observed feeding on algae-covered rocks and within large still pools rising to insects (Jackson 1976; Berra et al. 1982; Berra 1987; Kaminskas pers comm 2021). Stomach content observations indicate that their diet is mainly insect larvae, suggesting that this species is at least a predatory insectivore (Jackson 1976; Berra et al. 1982; Berra 1987).

A lack of genetic diversity between Australian Grayling collected from coastal rivers in Victoria suggested that a single population occurs in Victoria, as larvae are most likely dispersed during the marine stage of their life cycle (Schmidt et al. 2011). Within the Tasmanian population there is no evidence of fragmentation with good connectivity between multiple catchments, allowing for the exchange of Australian Grayling between these catchments (IFS Tasmania pers comm 2020). However, genetic studies for populations occurring in NSW and Tasmania have not been undertaken.

Threats

The primary threats to the Australian Grayling are outlined in Table 1, below. The predominant threat to the species is the installation of fish passage barriers restricting upstream and downstream movement along rivers and streams (Crook et al. 2006; Humphries & Walker 2013; Dawson & Koster 2018). Restriction of movement hinders the species natural migratory responses to migrate to brackish waters to spawn and alternatively their migration back upstream into freshwater (Backhouse et al. 2008b). The species is susceptible to the following activities: vegetation and tree clearing (including riparian), which increases siltation, and earthworks which can damage/destroy riverine habitats (TSS 2019). The species is also vulnerable to climate-induced changes causing extreme weather events such as drought and bushfires, including the marine larval phase which can potentially be impacted by varying marine conditions. Furthermore, bushfires can have direct and indirect effects on the species including changes in water chemistry and changes in the surrounding landscape which can lead to sediment run-off into waterways post-fire events (Lyon & O'Connor 2008). Australian Grayling populations are also at risk from the following threats: introduced fish species and their associated diseases and pathogens, and currently from recreational fishing as incidental catch. Historically, the species was targeted by both recreational and commercial fishing activity, and there is likely continual incidental capture in these activities (Bishop & Bell 1978; Bakehouse et al. 2008a; IFS Tasmania 2019).

Table 1: Threats impacting the Australian Grayling in approximate order of severity of risk, based on available evidence.

Threat factor	Threat type and status	Evidence base
Habitat loss and fragmentation		
Fish passage barriers	Known past and current	The Australian Grayling relies on passages free from barriers for spawning movements up- and downstream in coastal catchments. The installation of weirs, dams, locks and barrages are known to affect fish movement by creating barriers and preventing fish access to key habitat areas. This has led to declines and localised extinctions from above and below these barriers (Crook et al. 2006; Humphries & Walker 2013; Dawson & Koster 2018). For instance, the Australian Grayling is now extinct upstream of Tallowa Dam in the Shoalhaven River (Gehrke et al. 2001). Many of the other coastal catchments in south-eastern mainland Australia and in Tasmania contain barriers which similarly restrict lineal fish movements along river and stream channels (Humphries & Walker 2013; IFS Tasmania pers comm 2020). Bice et al. (2018) suggested that low-level tidal barriers can prevent spawning movements to the sea for diadromous species. As a result, the connectivity between larvae flowing into the sea and juveniles returning into the rivers are likely prevented through these structures.
Altered hydrology	Known past and current	Australian Grayling has been observed in small shoals over sandy substrates within a fast current (Kaminskas pers comm 2021). The species will select its spawning site based on water velocity and temperature (Amtstaetter et al. 2015, 2016). The species is reliant on water flows to trigger a migratory response for spawning (Koster et al. 2013, 2018). Flow event duration is critical as it needs to be of a length of time that allows for larvae to drift to coastal waters and as a cue for juveniles to swim back into freshwater (Koster et al. 2017; Dawson & Koster 2018). O'Connor & Mahoney (2004) demonstrated that Australian Grayling will not release eggs if no, or less

		than expected, river flow occurs during their expected spawning season (Amtstaetter et al. 2015, 2016). In the absence of expected water flows due to low or altered hydrological regimes, effective management of environmental flow releases can promote migration and spawning of the species (Amtstaetter et al. 2016; Shenton et al. 2011, 2014).
Sedimentation and poor water quality	Suspected past and known current	Anthropogenic events are thought to have led to the depletion of key riparian zones required by the Australian Grayling (Miles 2007). While Australian Grayling can tolerate some minimal changes to their surrounding habitat, the species is susceptible to ongoing modifications to the following activities: vegetation and tree clearing (including riparian), which increases siltation, and earthworks (for agricultural and urban development) which can damage/destroy riverine habitats (Hall & Harrington 1989; TSS 2019). These activities lead to erosion and poor water quality by effecting levels of water temperature, eutrophication, and chemistry (Berra 1982; TSS 2019).
Changes to coastal morphology	Suspected past, present, and future	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) has indicated that closures of estuarine mouths will have a direct impact on diadromous fish migration.
Invasive species		
Introduced fish species	Suspected past and current	Introduced fish species are present in areas inhabited by Australian Grayling. These include: Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) were introduced to Australia for angling reasons (as recreation and for consumption) where they were, and continue to be, stocked into rivers and streams, many of which contain Australian Grayling populations. Both species are known to cause detrimental effects to native fish species and 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; IFS Tasmania pers comm 2020). Knott (1973) attributes the near extinction of Australian Grayling in Tasmania to the presence of trout. Redfin (*Perca fluviatilis*) was also introduced for angling reasons (Arthington & McKenzie 1997; Humphries & Walker 2013). While no direct studies have demonstrated any interaction between Redfin and the Australian Grayling (Arthington & McKenzie 1997), Redfin is a voracious predator of native fish species (McDowall 1980b; Backhouse et al. 2008a; Humphries & Walker 2013). In Tasmania, Redfin has

		been observed predating on and competing with Australian Grayling for resources (IFS Tasmania pers comm 2020). European Carp (*Cyprinus carpio*) including ornamental variant Koi Carp and Goldfish (*Carassius auratus*) are successful invaders of freshwater waterways, particularly, taking advantage of altered river systems (Koehn 2004; Koehn et al. 2018). European Carp are now the most abundant large freshwater fish in south-eastern Australia, and in some waterways, they can form up to 100% of total fish biomass (Koehn et al. 2000; Koehn 2004; Driver et al. 2005; Davies et al. 2012). Whilst no direct interaction has been observed between European Carp and Australian Grayling, the species is likely to be impacted by the presence of European Carp. European Carp's ability to degrade aquatic habitats is suspected as the main contributing factor to the declines of many native fish populations (Arthington & McKenzie 1997; Koehn 2004; Driver et al. 2005). Carp disturb native fish habitats by raising turbidity, destroying submerged macrophytes and causing riverbank erosion (Roberts et al. 1995; Roberts & Sainty 1996; Vilizzi et al. 2014; Hardaker et al. 2020). Additionally, European Carp will compete with native fishes for resources through interference or exploitation, such as physical exclusion and competition of resources (e.g., food) (Hardaker et al. 2020). It is predicted that the removal of introduced benthivorous fish such as European Carp will lead to long-term (>10 years) positive ecological recovery of key habitat features such as water quality and macrophytes utilised by native freshwater fishes (Nichols et al. 2019). Eastern Gambusia (*Gambusia holbrooki*), a small fish introduced via the aquarium industry has been implicated in the decline of more than 30 fish species worldwide, including nine from Australia (Lintermans 2007; Humphries & Walker 2013). It predates on the eggs and larvae of native fish, even fin-nipping at much larger fishes (Koehn & O'Connor 1990a; b; Arthington & McKenzie 1997; Lintermans 2007; Humphries & Walker 2013).
Climate change		
Increased disconnection between habitats	Known current and future	Lin et al. (2017) modelled the effects of climate change on the habitat of Australian Grayling and demonstrated that the biggest challenge for the species is the disconnection between habitats (barriers to movement) required to complete their life cycle. Predicated changes in annual rainfall runoff for Victorian catchments by 2030 and 2070 will result in more variable river flows (Jones & Durack 2005), potentially affecting the species migration and spawning cues. Climate change is expected to

		cause localised extinctions of Australian Grayling populations.
Extreme weather events	Known current and future	Meteorological drought desiccates local water sources for many freshwater fishes and for the Australian Grayling, periods of no or low rainfall likely hinders the species migration and spawning cues (Lennox et al. 2019). Since 1970 the majority of low rainfall over south-eastern Australia has occurred in Autumn (March–May), coinciding with the spawning period of Australian Grayling and potentially resulting in years of low recruitment (Murphy & Timbal 2008). Shenton et al. (2011) modelled climate change scenarios on Australian Grayling spawning in the Latrobe River. The modelling indicated that by 2050 or 2070 there will no longer be any sustaining populations in the Latrobe River due to reduced water flows and increasing water temperatures being too high to trigger spawning.
Changes in ocean physiology	Possible current and suspected future	The East Australian Current (EAC) been strengthening since 1944, and now extends ~350 km further south than it once did (Last et al. 2011). The current is important for the marine ecosystem off south-eastern Australia as it transports warmer tropical water and consequently facilitating tropical and sub-tropical marine species to exist further south in latitude than expected (Hobday & Lough 2011; Last et al. 2011; Gray & Kennelly 2018). Long term annual average sea surface temperatures (SST) records from 1880–2009 indicate that the EAC SST has warmed by an average of 2.28°C (Last et al. 2011). The EAC is predicted to further increase in SST of >1°C by 2030, >2°C by 2050 and up to 3°C by 2070—in addition to a 20% increase in mean flow (Hobday & Lough 2011). However, while Australian Grayling may be potentially affected by the strengthening EAC, its marine larval phase is unknown, it is therefore unknown if these varying oceanic processes will impact the species larval distribution and recruitment (Koster et al. 2020). Furthermore, the period in which Australian Grayling larvae are present in the marine environment (autumn–spring) are when SST and salinity are greatest (Ridgway 2007).
Increased intensity/frequency of wildfire/bushfire	Suspected current and future	While climate change does not directly cause bushfire, it has caused an increase in the occurrence of extreme fire weather and in the length of the fire season across large parts of Australia since the 1950s (CSIRO 2020). In 2019, the annual national mean temperature was 1.52°C above average (BoM 2020). Climate change has driven longer, more intense fire seasons and an increase in the average number of elevated fire weather days, as measured by the

		Forest Fire Danger Index (FFDI) (CSIRO 2020). The highest annual accumulated FFDI was recorded in 2019 (CSIRO 2020). Bushfires can drastically reduce the habitat quality available in aquatic ecosystems and influence the extinction risk of species within those ecosystems (Shelley et al. 2021). Direct effects from the fires include increases in water temperatures and changes to water chemistry which is compounded by the surrounding burnt vegetation increasing nutrients—in particular, nitrogen and phosphorus (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 to the aquatic ecosystem up to 80 km downstream of a fire impacted area (Lyon & O'Connor 2008). In 2019/20, catastrophic wildfire conditions culminated in fires that covered an unusually large area of eastern and southern Australia. In many places, the fires burnt with high intensity. The full impact of the 2019/20 bushfires has yet to be fully determined. The bushfires will not have impacted all areas equally, some areas burnt at very high intensity while other areas burnt at lower intensity, potentially even leaving patches unburnt within the fire footprint.
Disease		
Pathogens and parasites	Suspected, past, current, and future	The only known parasites to have directly affected the Australian Grayling are the Anchor Worm (*Lernaea cyprinacea*) and Trematodes (of the Family Opecoelidae) (Hall 1983; Berra 1987). Anchor Worm is thought to have been introduced through European Carp, Goldfish and/or Redfin (Lintermans 2007; Diggles 2011; Humphries & Walker 2013; Kaminskas 2020). While the parasite does not cause direct mortality to the host, an infestation can cause indirect mortality through poor health and growth as it affects the feeding behaviour of its host (Read et al. 2007). Fish are generally an intermediate host for parasites and while some fish can be heavily infected, many co-exists without any or only minor increases in mortality or changes in behaviour (Collyer & Stockwell 2004). Trematodes are a type of flatworm parasite that is exclusively found in fish (Bray et al. 2016). A study into the diet of Australian Grayling by

		Berra et al. (1987) found that 86% of samples collected were infested with Trematodes. Fungus can also impact Australian Grayling. In the late-1800s, mass fish kills of Australian Grayling covered in a cotton-like, woolly growth were observed in Tasmanian Rivers (Saville-Kent 1887; Examiner 1931; Kaminskas 2020). The suspected cause was the *Saprolegnia parasitica* fungus (cotton mould), coinciding with the introduction of Atlantic Salmon (*Salmo salar*) and Brown Trout (*Salmo trutta*) (known carriers of the fungus) to Tasmania (Saville-Kent 1887; Backhouse et al. 2008a; Kaminskas 2020). The widespread observations of mass Australian Grayling fish kills covered in a cotton-like woolly growth from multiple Tasmanian rivers strongly suggests that the *Saprolegnia* was the main causative agent, however, the definite cause by *Saprolegnia* was never confirmed as all accounts of the mass fish kills only observed dead fish floating down river (McDowall 1976; Berra 1982; Kaminskas 2020). *Saprolegnia* was identified as the main causative agent for widespread freshwater fish kills on mainland Australia, including Australian Grayling where mass kills were observed in populations from the south coast of NSW (Kaminskas 2020). While no studies have demonstrated the interaction between Australian Grayling and the following pathogens and parasites, they do inhabit the same areas: *Schyzocotyle acheilognathi* (Asian Fish Tapeworm). The European Carp is a known definitive Asian Fish Tapeworm host species and is thought to have introduced it to Australia (Henderson 2009). It causes reduced growth and death in fish and infection has been observed in the following native and introduced species: *Hypseleotris* spp. (native Carp Gudgeons); *Retropinna semoni* (Australian Smelt); Eastern Gambusia and Goldfish (Dove & Fletcher 2000; Henderson 2009). While not documented as present in Australian Grayling to date, the potential for infestation is present. Epizootic haematopoietic necrosis virus (EHNV) is an Australian endemic iridovirus (*Ranavirus*) affecting many native and introduced freshwater fish (OIE 2018). While the Australian Grayling have not yet been observed as naturally susceptible to EHNV (OIE 2018) and noting that the virus now appears to be endemic (i.e., permanently established in the epidemiological sense) only in the upper Murrumbidgee River catchment (Becker et al. 2019; Kaminskas 2020), it is unclear whether the species would be susceptible if the virus if it was to escape into coastal NSW and Vic catchments. However,

		EHNV has not been detected in Australia (last detected in Victoria) since 2012 (AHA 2018). Infection with *Aeromonas salmonicida* – atypical strain (goldfish ulcer disease) is a bacterium that was introduced into Australia in the 1970s via the ornamental fish trade (Humphrey & Ashburner 1993). All salmonids, as well as many non-salmonids are believed to be susceptible. Australian Grayling is not known to be naturally susceptible and to date, there have been no infectivity trials (DAFF 2012). The bacterium is capable of survival outside its host in freshwater, brackish and marine environments, and is currently known to occur in Queensland, NSW, Victoria, Tasmania, and South Australia. However, it has not been detected since 2007 (DAFF 2012; AHA 2018).
Fishing		
Recreational fishing	Known past and current	A once popular angling species, the Australian Grayling was often taken during the early period following European settlement (Bishop & Bell 1978; Backhouse et al. 2008a). Australian Grayling are now protected from all targeted fishing in NSW, Tasmania and Victoria. However, the species is being caught incidentally by recreational fishers targeting salmonids using fly-fishing methods (Backhouse et al. 2008a). Due to their thin and deciduous scales, Australian Grayling is a delicate fish that is extremely prone to handling stress (Berra & Cadwallader 1983; Koster et al. 2013; Dawson & Koster 2018).
Historic and current commercial fishing	Suspected, past, current, and future	Juvenile Australian Grayling in Tasmania are known to occur alongside *Galaxias* spp. and *Lovettia* spp. during upstream whitebait migration (Backhouse et al. 2008a). The whitebait season occurs for one month between spring and summer each year alternating between rivers (Backhouse et al. 2008a; IFS Tasmania 2019). While Australian Grayling juveniles cannot be targeted by anglers as they are a protected species under Tasmanian legislation, they are occasionally caught as bycatch, but in most cases subsequently returned to the waterway (IFS Tasmania 2019).

The Minister approved this conservation advice and retained this species in the Vulnerable category, effective from 19/10/2021

How judged by the Committee in relation to the EPBC Act criteria and regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	**Endangered Severe reduction**	**Vulnerable Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence: Not eligible

It should be noted that population size reduction has been assessed over the past 10 years between 2010 and 2019, rather than past three generations of Australian Grayling which amount to 7.5 years. The species has a maximum life expectancy of up to five years, however many do not live past an age of three years (see Relevant biology/ecology). Therefore, a plausible estimate of approximately 2.5 years for measuring one generation length is the mid-point between the species age of sexual maturity and average life expectancy. To offer context to the judgement made about the Australian Grayling's population reduction for the purpose of this Criterion, information about recent sampling of the species across its natural distribution is summarised for each jurisdiction below.

New South Wales

Australian Grayling are known to occur in coastal river catchments from Clyde River south to Bruces Creek (Wallagaraugh River catchment near the NSW/Victoria border) (NSW DPI 2015b). Between 2008 and 2012, NSW Fisheries conducted fish surveys at sites used previously in its annual surveys (NSW FSC 2015). The 2008–12 surveys only detected one individual from 113 sites, which were all less than 200 m ASL (NSW FSC 2015). In comparison, surveys undertaken in 1993–95 sampled 64 individuals from 22 sites (Harris & Gehrke 1997; NSW FSC 2015).

A 2009/10 survey interviewing recreational fishers in the Shoalhaven River region found no Australian Grayling being reported as recreational catch (Miles & West 2011). Between 2010 and 2013, fish surveys undertaken by the NSW Department of Primary Industries in the Shoalhaven River also detected no Australian Grayling (Walsh et al. 2014). Since the construction of the Tallowa Dam in 1976, only one Australian Grayling individual has been detected downstream of the dam (in 1997) and none have been detected upstream (Gehrke et al. 2001). It is highly plausible the species is extinct in this major south coast river catchment and likely in surrounding catchments where it was once abundant.

In recent years, observations of Australian Grayling in NSW catchments have been extremely limited. A single individual was also detected in 2019 in the Brogo River (Gilligan pers comm in NSW DPI Fisheries 2020). One Australian Grayling was observed and two captured by NSW DPI Fisheries in the freshwater reach of the Clyde River in February 2020 during post-bushfire recovery monitoring (Walsh pers comm in NSW DPI Fisheries 2020).

Victoria

The Australian Grayling is expected to occur in all Victorian coastal catchments from the Hopkins River eastwards to the NSW/Victoria border. The greatest number of records for the species are from the Tambo, Barwon, Mitchell and Tarwin river systems in the central and east of the state (SWIFFT 2019).

Between 2010 and 2019, 23 Australian Grayling have been sampled from the Mitchell River catchment in the East Gippsland region, including its tributaries – the Dargo and Wonnangatta rivers (ALA 2019; NFRC 2019). Other recent records of Australian Grayling from the East Gippsland region include nine individuals sampled in the Bemm River in 2011, while some juveniles (~140 mm in length) were caught and released on shallow sandflats in the Thurra River in 2013 (ALA 2019; iNaturalist 2021). Surveys in the Snowy River in 2014 only detected one Australian Grayling individual (Stoessel 2014).

Surveys between 2012–14 collected 923 Australian Grayling eggs in the Thomson River in the West Gippsland region (Amtstaetter et al. 2015). Sampling in the Thomson and Latrobe rivers upstream from the confluence of the two surveyed 38 adults in 2012/13, while 1198 Australian Grayling eggs were collected in 2013/14 (Amtstaetter et al. 2015; 2016). Other surveys of the Thomson River collected 1117 Australian Grayling eggs in 2013/14 (Koster et al. 2017), and 98 young-of-the-year (YOY) fish were sampled during between 2005–2015 (Webb et al. 2018). Abundance of these YOY fish varied annually, with the lowest record of zero in 2013 and highest of 34 in 2007 (Webb et al. 2018). For the Latrobe River, three Australian Grayling were detected at Sand Banks Reserve in 2010 (ALA 2019) and a 2015 survey following an environmental water release in the river detected eggs and larvae, the first record of a successful breeding event in the Latrobe River (VEWH 2016a). Recent Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) sampling in the Thomson River recorded 18 individuals in 2016, 11 in 2018 and in 2019 the sampling detected an unspecified number of animals between 80–220 mm, as well as six YOY fish (DELWP 2017; 2018; NFRC 2019). The Native Fish Report Card Program also recorded nine Australian Grayling in the Thompson River in 2017, five in 2018 and none in 2019 (NFRC 2019). Further to the west, a survey in 2018 in the Tarwin River detected three animals including two YOY fish, indicating breeding is occurring there (Aquatica Environmental 2018).

In the Melbourne region's Yarra River surveys between 2009 and 2019 detected 340 Australian Grayling eggs and larvae, 50 YOY and 123 individuals (Borg et al. 2014; O'Connor et al. 2015; Koster et al. 2017; NFRC 2019; ALA 2019). Abundance fluctuated annually, with no discernible pattern over time. These surveys were also able to detect Australian Grayling above and below the fishways and passages, including YOY fish indicating breeding is occurring (Borg et al. 2014; O'Connor et al. 2015). More recently, the Native Fish Report Card Program detected four individuals in 2018 and one in 2019. In the Bunyip and Tarago River catchments, surveys between 2009 and 2015 detected 11 846 eggs, 1245 larvae and 143 adults (length ranging from 160–240 mm) (Koster et al. 2013; 2017; 2018). Eggs and larvae were collected every year except 2012 where no sampling occurred. Melbourne Water also detected eggs, larvae and adults of the species in the Tarago River following water releases in 2016 (VEWH 2016b). Other detections of Australian Grayling in the Melbourne area occurred at the Lang River in 2011 and in the Maribyrnong River in 2015 (ALA 2019).

Along the Victorian coastline to the west of Port Phillip Bay, the Australian Grayling has been recently recorded in the Gellibrand, Barham and Barwon river catchments. The Native Fish Report Card Program detected the species in the Gellibrand River between 2017 and 2019 (NRFC 2019). Other recent records of the species within this catchment included an observation in 2010 and the capture of a juvenile in 2011 (The Standard 2011). In the Barwon River, 50 YOY fish were sampled in 2013 (O'Connor et al. 2015) while 93 individuals were recorded in 2013/14 (Jones & O'Connor 2017). A single Australian Grayling was detected in the Barwon River in 2013 at Reedy Lake (ALA 2019), 72 individuals were also recorded in the Barham River in 2013/14 (Jones & O'Connor 2017). Further to the west in Victoria, a single Australian Grayling was recorded in 2019 in the Glenelg River (ALA 2019; NFRC 2019). This was the first observation of the species in 122 years for the Glenelg River.

Tasmania

Recent surveys in 2013 have detected juvenile Australian Grayling in the Emu, Tamar, Pieman, and Gordon river catchments, and within the Tarkine Region. Across northern Tasmania, the species has been found recently to be locally abundant in the Frankland, Mersey, Gawler, Leven, Tamar, North Esk, South Esk, Ringarooma and Great Forester rivers (NVA TAS 2019; unpublished data, TSPLC Tasmania pers comm 2020). At times, significant numbers also occur in the lower sections of the River Derwent (unpublished data, TSPLC Tasmania pers comm 2020). However, a number of other recent targeted surveys monitoring the aquatic fauna in response to various development projects, detected no Australian Grayling in the Emu and Gordon river catchments and within the Tarkine Region (Parliament Tas 2009; Northbaker 2009; Hydro TAS 2013; Hardie 2015). Since 2012, short periods of drought on the east coast have made habitats more tenuous, potentially impacting Australian Grayling populations (IFS Tasmania pers comm 2020).

When estimates of Area of Occupancy (AOO)[1] for the Australian Grayling are analysed for the most recent full 10-year period for which the Department of Agriculture, Water and Environment has occurrence records (i.e., until 2015, therefore most recent 10-year period assessed for AOO is between 2006–2015), there is a 39 percent reduction in AOO. However, this 39 percent reduction appears to include a relatively sharp drop in AOO between 2006 and 2007, after which the reduction in AOO, while still in decline, appears to reduce annually at a slower rate (refer Figure 1 below).

The decline in AOO between 2010 until 2015 is approximately 10 percent, and if that decline was to continue at that annual rate to the end of 2019, it would equate to approximately a 17 percent reduction (i.e., a 2019 estimate of AOO 368 km^2) over the past 10 years, which is insufficient to trigger listing in the category of Vulnerable (where decline needs to be by 30 percent or more).

Conclusion

The Committee notes that there has been a historic decline in the population of the Australian Grayling nationally, particularly in the 1970s and 1980s. However, for the purposes of assessment under Criterion 1, the decline for the species has been assessed over the past 10 years (i.e., since 2010), given the species' approximate generation length. The Australian Grayling has been detected throughout its expected geographical range in NSW, Victoria and Tasmania since 2010, however the number of individuals observed each year have varied, with fluctuating numbers being observed. There are no reliable national or regional population estimates. It is estimated that AOO has declined by approximately 17 percent over the past 10 years. Available data therefore indicates that while there is likely continuing population decline, it is unlikely this decline is of at least 30 percent (as required for listing under Criterion 1).

[1] Estimates of Area of Occupancy (AOO) were calculated by using the 2x2 km (i.e., 4 km^2) grid cell method (based on the Guidelines for Using the IUCN Red List Categories and Criteria ver. 14, August 2019) and summating all grid cells for the past 20 years.

Following assessment of the data the Committee has therefore determined that the species is **not eligible** for listing under any category of this criterion.

Changes in Area of Occupancy versus time

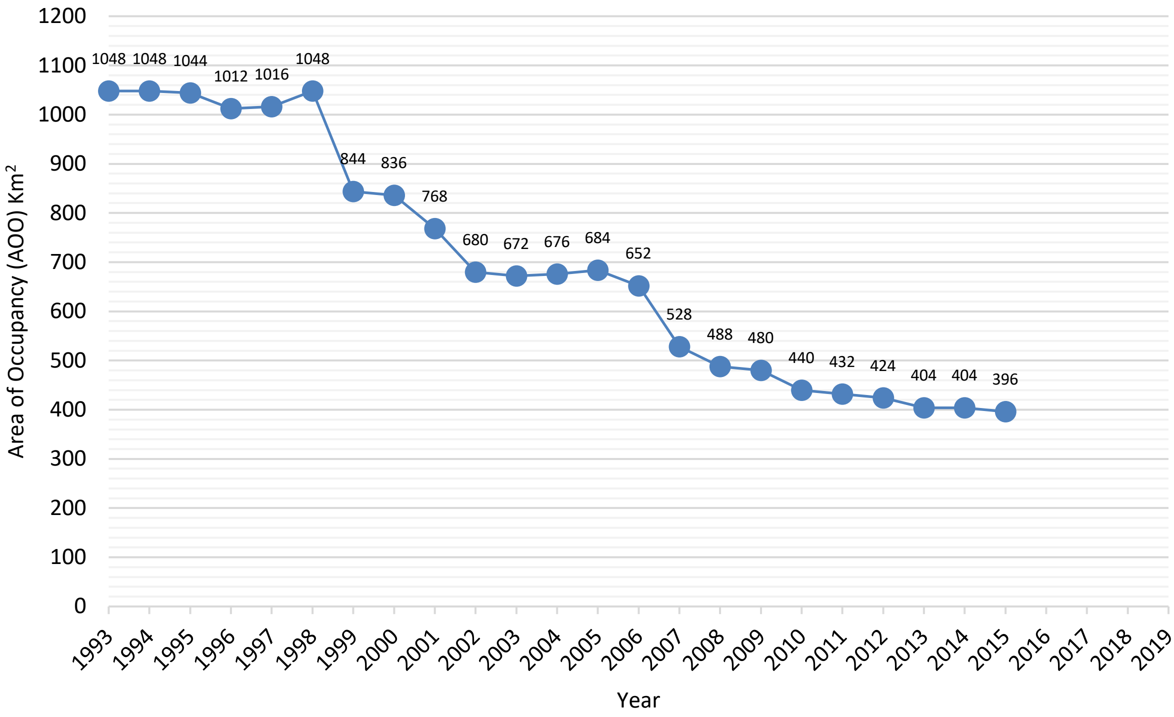

Figure 1: AOO estimates (i.e., available until 2015) versus time (Source: DAWE 2020)

Criterion 2.	Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence: Eligible under Criterion 2 B2 (a) (b)(ii), (iii), (iv) for listing as Vulnerable

The extent of occurrence (EOO) is estimated to be 266 000 km^2 and the AOO is estimated at approximately 368 km^2 (DAWE 2020). The EOO was calculated using a minimum convex hull while the AOO was based extrapolating trend information from AOO estimates between 2010 and 2015 to attain a 2019 estimate (refer Figure 1). As explained under Criterion 1, AOO estimates for the Australian Grayling could only be reliably calculated until 2015 given the availability of records held by the Department of Agriculture, Water and the Environment. The AOO estimates for between 2010 and 2015 were calculated by using the 2x2 km (i.e., 4 km^2) grid cell method (based on the Guidelines for Using the IUCN Red List Categories and Criteria ver. 14, August 2019) and summating all grid cells for the past 20 years (i.e., for 2010 summating grid cells from 1991-2010 and for 2015 summating grid cells from 1996-2015).

The analysis of AOO between 2010 and 2015 outlined under Criterion 1 indicates a declining trend in AOO, which is likely to be continuing, due to an inferred ongoing decline in quality of habitat and number of subpopulations for the species.

When assessing a species' threatened category eligibility, the term 'location' for this criterion is defined by the IUCN as "*a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present*". Consequently, the full impact of the 2019/20 bushfires affecting the south coast of NSW and eastern Victoria has yet to be fully determined but have potentially reduced known locations of the Australian Grayling. The south coast of NSW historically contains the greatest number of Australian Grayling and it is estimated that approximately 64 percent of the species NSW range was within the extent of the 2019/20 bushfires (NSW DPI 2020), and locations in NSW are suspected to be as low as one or two. In Victoria, the extent of impact includes the East and North Gippsland region, however the burnt impact on the species Victorian range is unknown (DELWP 2020). The catchments in the East Gippsland region has known Australian Grayling populations, and in the past 10 years detections of the species has occurred in the following East Gippsland rivers; Mitchell, Bemm, Thurra and Snowy. Therefore, the suspected number of locations in Victoria is between 1–3.

Additionally, it is estimated that a combined 63 percent of downstream catchments (up to 80 km) in NSW and Victoria are potentially fire impacted by sediment slugs (Legge et al. 2020). The extent of bushfire impacts overlapping in NSW and Victoria suggests that number of locations for Australian Grayling has reduced. In Tasmania, there is no evidence that the population is fragmented, with good connectivity between multiple catchments allowing for exchange of Australian Grayling between these catchments (IFS Tasmania pers comm 2020). Accounting for the Tasmanian population and the fire and non-fire affected populations in NSW and Victoria, the total number of locations for the species across its national extent is considered most likely to be between 6–10, therefore classifying as limited (≤ 10) as prescribed above for how Criterion 2 is applied.

The Committee considers that the species' AOO is restricted, and the geographic distribution is precarious for the survival of the species because its number of locations is limited and decline in AOO, quality of habitat and number of locations may be estimated, projected and/or inferred. Therefore, the species has met the relevant elements of Criterion 2 to make **it eligible for listing as Vulnerable.**

Criterion 3. Population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**

	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence: Insufficient data to determine eligibility

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence: Insufficient data to determine eligibility

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion. However, while numbers are likely to be in continuing decline for Australian Grayling, the Committee considers that it is highly likely that the number of mature individuals in the wild is greater than 1000. Therefore, it is also highly likely that the species is not eligible for listing under this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence: Insufficient data to determine eligibility

Population viability analysis has not been undertaken.

The Minister approved this conservation advice and retained this species in the Vulnerable category, effective from 19/10/2021

Conservation actions

Recovery plan

The "National Recovery Plan for the Australian Grayling *Prototroctes maraena*", published by the Victorian Government was adopted by the Australian Government under the EPBC Act in 2008. As part of the reassessment of the Australian Grayling's conservation status, consideration was given to the continued need for a national recovery plan. The continuation of a national recovery plan at this stage is not required given that this approved Conservation Advice provides sufficient direction to implement priority actions, mitigate against key threats and enable recovery. Significant management and research are already being undertaken across its range at state level.

Primary conservation actions

Primary conservation action is to mitigate extinction risk by halting decline and stabilising populations of the Australian Grayling through effective environmental flows management and the removal of fish passage barriers which helps promotes spawning and migration in the species, as well as increasing river connectivity. This aims to ensure the species become self-sustaining in the wild and to recover and rebuild populations.

Conservation and management priorities

- Species protection
    - Maintain the "no-take" status and non-targeting in fishing regulations across the species' range.
- Habitat protection and rehabilitation
    - Assess fish passage barriers (weirs, dams, locks, and barrages), targeting areas where the Australian Grayling is known to occur, or may occur, and implement management and engineering solutions (such as fishway locks) to provide fish passage to improve river connectivity.
    - Identify rivers where flow regulation or water abstraction potentially impacts on important 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 habitat areas used by the Australian Grayling from activities, such as vegetation (including tree) clearing in riparian and broader catchment zones, as well as earthworks 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 Trout (Family Salmonidae), Redfin (*Perca fluviatilis*), European Carp (*Cyprinus carpio*) and Eastern Gambusia (*Gambusia holbrooki*), in areas known to contain Australian Grayling.
    - Protect important Australian Grayling subpopulations from stocking of Trout. Current stocking programs are still occurring in areas known to contain Australian Grayling, making them highly vulnerable to predation. Trout stocking should cease where Australian Grayling occur to ensure they are not impacting the species.

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 where appropriate.
- Enhance, modify, and implement National Resource Management planning processes to minimise adverse impacts on Australian Grayling.
- Ascertain the cultural significance of the Australian Grayling to Traditional Owners.

Survey, monitoring and mapping priorities

- Implement a targeted monitoring program for Australian Grayling, using a combination of eDNA and conventional techniques, across its national distribution, to determine reliable population estimates, this includes data on size and structure of populations. Monitoring should initially target areas (including the fire affected regions from the 2019/20 bushfires in NSW and Victoria) where there are known gaps in distribution of data.
- Utilise a combination of eDNA techniques and conventional monitoring to improve knowledge of introduced fish distribution and abundance in areas where Australian Grayling occur.
- Once populations have been identified, establish ongoing monitoring 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.
- Investigate the impact of estuary/coastal morphology on the migration of Australian Grayling during the larval and juvenile phase. This will fill knowledge major gaps on larval and juvenile distribution, habitat and movement and lead into investigating the marine phase of Australian Grayling.
- Investigate the ecology of Australian Grayling during the marine phase of their life cycle.
- 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 (other than Trout (Family Salmonidae)) Redfin (*Perca fluviatilis*), European Carp (*Cyprinus carpio*) and Eastern Gambusia (*Gambusia holbrooki*), in areas known to contain the Australian Grayling.
- 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 NSW and Tasmania (noting the Victorian population has already been assessed).
- Investigate the impact of increased sedimentation on the Australian Grayling and associated habitats in catchments affected by bushfires.

- 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.

Recommendations

(i) The Committee recommends that *Prototroctes maraena* be retained its current listing status of Vulnerable in the list referred to in section 178 of the EPBC Act as there is insufficient evidence to support transferring it to a different category and inclusion of the species in that category is having a beneficial impact on the continued survival of the species.

AND

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

14 September 2021

The Minister approved this conservation advice and retained this species in the Vulnerable category, effective from 19/10/2021

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