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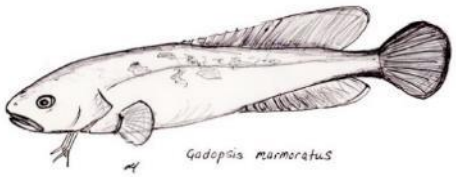

Ecology, Monitoring, Conservation

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A 2021 update on the status of key small-bodied threatened freshwater fishes in the southern Murray-Darling Basin

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A report to the Tri-State Murray NRM Regional Alliance

Tri-State Murray NRM Regional Alliance

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Section 1 BACKGROUND

Native small-bodied freshwater fishes – those obtaining a maximum total length (TL) of less than 150 mm – are under threat across the Murray-Darling Basin (MDB). These small fishes possess traits, such as limited dispersal, short longevity and small ranges, that make them inherently at risk (Kopf et al. 2017; Liu et al. 2017; Olden et al. 2007). Thus threats such as habitat loss and degradation, invasive species, over-exploitation, water abstraction and flow alteration have led to historical declines in range and abundance for these species (Dudgeon *et al.* 2006; Arthington *et al.* 2016). Furthermore, small fishes are particularly vulnerable to drought impacts (Chessman 2013; Crook et al. 2010) and historical declines were further compounded by the prolonged and extreme Millennium Drought. Indeed, local and regional extinctions of some species are now being realised throughout the southern MDB and regional concerted actions are critically important to prevent species loss.

Building on the 2019 status report provided by Whiterod et al. (2019b), the present report provides an update (current up until 15 April 2021) on the status of six small fishes historically found throughout the southern section of the MDB, which are now under threat and require urgent conservation actions. These are Flathead Galaxias *Galaxias rostratus,* Murray Hardyhead *Craterocephalus fluviatilis*, Olive Perchlet *Ambassis agassizii*, Southern Purple-spotted Gudgeon *Mogurnda adspersa*, Southern Pygmy Perch *Nannoperca australis* and Yarra Pygmy Perch *Nannoperca obscura*. This report provides a summary of the present status of each species in terms of:

- Conservation status;
- Background information (i.e. pre-drought status);
- Status following millennium drought (up until 2019);
- The last two years;
- Genetic management;
- Known threats and knowledge gaps; and
- Overall summary.

The report considers both wild and backup populations, which can be both captive facilities and surrogate refuges. Some of the information provided here is expanded on within translocation strategies developed for SA and NSW (Whiterod 2019; Zukowski et al. 2021) and it is hoped that both reports will guide future conservation efforts directed toward these threatened species.

Section 2 SUMMARY OF SPECIES

2.1 Flathead Galaxias *Galaxias rostratus*

(NSW DPI Fisheries)

2.1.1 Snapshot since 2019 summary

Since 2019, the status of the species has continued to decline with no new populations discovered, the status of known populations remaining unknown and not improvement in management except for escalation of its international conservation status:

- IUCN conservation status escalated to Critically Endangered.

2.1.2 Conservation status

International: *Critically Endangered*
National: *Critically Endangered*
NSW: *Critically Endangered*
SA: *Extinct in Wild*
Victoria: *Threatened (Vulnerable)*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management Act 1994*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 *and Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.1.3 Identification guide

Given its rarity and similarity with other species, the identification of Flathead Galaxias can be problematic. It has olive-green back and sides, a silver undercarriage and can grow up to 146 mm in length but are more often found at or below 100 mm (Lintermans 2007; McDowall and Frankenberg 1981). It has a forked tail, flattened top part of the head and large mouth in

which the gape extends to below the eye. The origin of the anal and dorsal fins aligns but the anal fin extends slightly further back towards the tail than the dorsal fin (Lintermans 2007). It can be confused with Common Galaxias (*Galaxias maculatus*) and Obscure Galaxias (*Galaxias oliros*) but there are several identification differences, including its flattened head, and larger mouth and eyes.

2.1.4 Background

Flathead Galaxias was historically widely but patchily recorded across the southern MDB (Lintermans 2007). In NSW, it was once common from Murray and Murrumbidgee catchments and there were single records from the upper-Macquarie and mid-Lachlan catchments (Llewellyn 2005). In Victoria, it is known from Kerang Lakes as well as mid-to upper-catchments, including the Broken, Goulburn, Ovens, Kiewa and upper-Murray catchments and as far west as Avoca River (Lintermans 2007; Tarmo Raadik, ARI, unpublished data). In South Australia, there are only a handful of historical (1800s) records as far as Murray Bridge (Hammer et al. 2009). Whilst there is no quantitative information on population trends in the species, it is evident that it has experience substantial declines in distribution and abundance, much of which occurred prior to the Millennium Drought. It is presumed locally extinct from Lachlan and Murrumbidgee catchments as well as the lower- to mid-Murray Catchment. The status in other regions was unclear.

The ecology of the species is poorly known but is it believed to prefer still to low flow habitats, including wetlands, swamps, lakes and rivers (Lintermans 2007). It spawns at water temperatures over 10.5°C generally in August to September and is believed to become sexually mature at one year and live for ~3 years.

2.1.5 Status following millennium drought (up until 2019)

Whilst there has not been any greater insight provided on the status of Flathead Galaxias since the Millennium Drought, it is suspected that it continues to decline. Indeed, there have been four records in New South Wales since 2003, with only one being post-2012. In Victoria, there are post-drought records in the Goulburn River Catchment, in Cornella Creek (Dion Iervasi, Austral Consulting unpublished data), and a farm dam in the Spring Creek Catchment near Mitchellstown (Raymond et al. 2019). It is acknowledged that it may persist in patchy

and isolated habitats across the southern MDB but limited focus (e.g. surveys) and problematic identification hamper the ability to gain an updated assessment of its status.

Targeted surveys for Flathead Galaxias were undertaken at all sites they had recently been detected within the NSW Murray. These surveys included intensive techniques known to successfully capture the species in the past at 12 locations. Despite this intensive targeted sampling no Flathead Galaxias were detected. Given these surveys and other general fish surveys that have been carried out within the region it appears quite likely that Flathead Galaxias may be locally extinct within the NSW Murray region or at the very least persisting in very low abundances (Pearce et al. 2018b). There have not been any backup populations established for the species.

2.1.6 The past two years

In the past two years since the 2019 summary (Whiterod et al. 2019b), there has not been any increased focus on the species, and its continued decline is presumed.

2.1.7 Genetic management

There has not been a genetic assessment for Flathead Galaxias, so the species is managed as a single conservation unit.

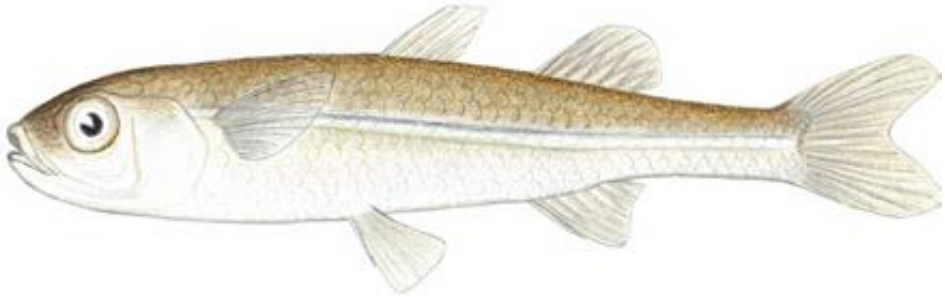
2.1.8 Known threats and knowledge gaps

Due to limited information about this species, the exact threats that have contributed to its decline are poorly known. However, competition with and predation by alien species such as Trout, Eastern Gambusia and Redfin Perch, competition and habitat alteration by Common Carp, effects of river regulation (altered river regime) and cold water pollution on reproduction success, loss of habitat connectivity between streams and loss and degradation of habitat especially loss of aquatic vegetation through agricultural practices all may have been associated with their demise (Lintermans 2007). Knowledge gaps about the biology and ecology of Flathead Galaxias, causes for decline, factors preventing recovery, movement patterns and habitat requirements exist.

2.1.9 Overall summary

Flathead Galaxias presumably continues to decline whilst out of sight; and is now assumed extinct across much of its former range and only irregularly recorded in extremely low numbers in other areas. Despite escalation of its international conservation status, has not resulted in increased focus on the species. This is a critical need to undertake target surveys of its present status, improve ecological knowledge and identify and mitigate threats to its long-term viability. Equally important is the establishment of backup populations. Without this increased effort, it is anticipated to continue to decline and become extinct from the southern MDB.

2.2 Murray Hardyhead *Craterocephalus fluviatilis*



(NSW DPI Fisheries)

2.2.1 Snapshot since 2019 summary

Since 2019, the status of the species has improved slightly due in part to the integration of new knowledge into management. Specifically, the following has occurred:

- IUCN conservation status escalated to Critically Endangered;
- All known subpopulations of the species have persisted;
- The reintroduced NSW subpopulation appears secure, as does the rediscovered Lyrup Lagoon subpopulation in the SA riverland;
- The species has been detected (March 2021) in Lake Albert for the first time since 2009 following reintroductions;
- Tailored environmental watering regimes for isolated subpopulations have been adopted at key sites; and
- A recent genetic study has guided reintroductions of the species.

2.2.2 Conservation status

International: *Critically Endangered*
National: *Endangered*
NSW: *Critically Endangered*
SA: *Critically Endangered*
Victoria: *Threatened*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management Act 1994*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 *and Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.2.3 Identification guide

Murray Hardyhead grow up to 100 mm TL, have a small protruding mouth, large silvery eyes, moderately rounded snout, two small and short-based dorsal fins, a forked tail, with pectoral fins positioned high on the body (Lintermans 2007).

- Murray Hardyhead frequently co-occur with Unspecked Hardyhead *Craterocephalus fulvus* but is distinguished primarily by possessing more transverse scale rows compared (Murray Hardyhead: 10 or 11 scale rows with 3 rows above the lateral line; Unspecked Hardyhead: 7 or 8 rows). Furthermore, Murray Hardyhead scales are generally roundish with pigment around the margin, while Unspecked Hardyhead scales appear diamond shaped and are arranged in uniform rows, with pigment through the scale as well as around the margin (Ellis and Kavanagh 2014);
- In the Lower lakes region where it co-occurs with Smallmouthed Hardyhead *Atherinosoma microstoma*, Murray Hardyhead have a deeper body and shorter gill rakers (Hammer and Wedderburn 2008);
- Unlikely to co-exist with Darling River Hardyhead *Craterocephalus amniculus* given known ranges, it has fewer mid-lateral scales than the Darling River Hardyhead (Murray Hardyhead: 31−35 scales; Darling River Hardyhead: >38 scales); and
- Its range does not overlap with Lake Eyre Hardyhead *Craterocephalus eyresii*.

2.2.4 Background

The Murray Hardyhead is a short-lived (<2 years) salt-tolerant species endemic to the lowland floodplains of the Murray and Murrumbidgee river systems, where is was likely to have been common historically (Ellis et al. 2013; Lintermans 2007; Stoessel 2010). The species prefers saline vegetated (namely submerged *Myriophyllum* and *Ruppia*) wetland habitats although submerged terrestrial vegetarian/structure may also serve as suitable habitat in shallow saline wetlands (Ellis et al. 2013). Salinity tolerance varies with life history stage with juveniles and adults are capable of surviving salinities in excess of 100,000 μScm^{-1} electrical conductivity (hereby referred to as 'EC') whereas egg hatch rates (40,000 EC) and larvae survival is impacted at much lower salinities (Stoessel et al. 2020).

The species experienced significant declines as a consequence of river regulation and the associated alteration and loss of well vegetated shallow saline, wetland habitats (DELWP 2017; Ellis et al. 2013; Hammer et al. 2013). These impacts were exacerbated by critical water shortages during the Millennium Drought. During the drought (or shortly after), populations were lost from some sites (e.g. Lake Albert, Lake Elizabeth, Woorinen North Lake, Lake Hawthorn), while others experienced dramatic declines in abundance (DELWP 2017). A

number of key sites were maintained through the drought via environmental watering, including the Cardross Lakes, Berri Evaporation Basin and Disher Creek (mid-Murray) and Boggy Creek (Lower Murray); and Round Lake and Woorinen North Lakes (Kerang Lakes) (Bice et al. 2014; Ellis et al. 2013; Wedderburn et al. 2014). In addition, fish rescues were undertaken during this period for wild-to-wild reintroductions as well as establishing backup populations (Ellis et al. 2013; Hammer et al. 2013).

2.2.5 Status following millennium drought (up until 2019)

The post-drought conservation of Murray Hardyhead has benefited from the establishment of backup populations. This included the Murray-Darling Freshwater Research Centre (MDFRC) captive facility, which housed and bred fish sourced from nine sites across four of the regional populations before closing in 2011 (Ellis et al. 2013; Hammer et al. 2013). Additionally, in 2011, a total of 300 fish from Boggy Creek (Lower Murray population) were used to establish a captive facility at Flinders University; these fish were bred over one season and utilised for wild release (to Hindmarsh and Mundoo islands) before closure of the facility. These fish were maintained in a refuge site off Boggy Creek in the latter stages of the Millennium Drought using environmental water allocations over 2009–10 (Wedderburn et al. 2013). In 2015, the Lake Elizabeth subpopulation was reestablished using fish from Lake Kelly. More recently in 2017, captive maintenance and breeding occurred at Arthur Rylah Institute, which demonstrated out of season production of fish and allowed for salinity tolerance testing (Dan Stoessel, ARI, unpublished data). These fish were subsequently used to reinforce Round Lake and Lake Elizabeth subpopulations (Dan Stoessel, ARI, unpublished data). During 2010 and 2011, a surrogate refuge (Munday Dam) was successfully established using fish sourced from various sites across the Lower Murray with another established in 2017.

Since the end of the drought, there has been some fragmented recovery of wild populations in part due to active management (environmental watering and reintroductions) (Bice et al. 2014; Ellis et al. 2013; Wedderburn et al. 2014). In the South Australian Lower Lakes region, the species has seen limited recovery attributed to the persistence of the Boggy Creek site with environmental water and reintroduction of 7520 fish (Bice et al. 2014; Wedderburn et al. 2013). Reintroductions helped the species persist in the Rocky Gully wetland (Whiterod et al. 2019a).

Over the latter part of the 2010s, subpopulations in the South Australian Riverland mid-Murray (including Berri Evaporation Basin and Disher Creek) were maintained, whilst the species was rediscovered in Lyrup Lagoon within the Gurra Gurra Wetland Complex (Whiterod and Gannon 2019b).The species was also translocated to Koorlong Lake (fish sourced from the MDFRC captive maintenance facility) and Brickworks Billabong (wild-wild transfers from Koorlong Lake, Berri Evaporation Basin and Disher Creek (Dan Stoessel, ARI, unpublished data; Whiterod and Wood 2019). Murray Hardyhead were also released into Little Frenchman's Creek in NSW in late 2018 representing the first record of the species in NSW for more than 13 years (Ellis et al. 2018). Attempted reintroductions to Lake Hawthorn appear unsuccessful (Dan Stoessel, ARI, unpublished data; Whiterod and Wood 2019). In the Kerang Lakes region, the species was been maintained in Round Lake and, following reintroduction, in Lake Elizabeth, however it was lost to Woorinen North and Lake Kelly.

2.2.6 The past two years

In the past two years since the 2019 summary (Whiterod et al. 2019b), all known subpopulations of the species have persisted. In Lake Alexandrina, the species persists at multiple locations. Significantly, for the first time in 12 years, it was recently detected at one site in Lake Albert (Scotte Wedderburn, The University of Adelaide, unpublished data) which follows the reintroduction of more than 17,000 fish over five years (Nick Whiterod, Aquasave–NGT, unpublished data). These reintroductions have been possible due to the two Lower Lakes surrogate refuges continuing to be maintained. In the South Australian lower Murray section, the reintroduced subpopulation of the species at Rocky Gully Wetland remains present (Whiterod and Gannon 2020) and it is likely that it may occur at other floodplain wetlands. Across the Riverland region, the Berri Evaporation Basin and Disher Creek subpopulations persist although abundance is variable (Murraylands and Riverland Landscape Board, unpublished data). Since its rediscovery in 2019, the Lyrup Lagoon subpopulation has demonstrated strong numbers and recruitment (Murraylands and Riverland Landscape

Board, unpublished data; Whiterod and Gannon 2019b; Whiterod et al. 2021). The inundation and salinity regime of this site has been carefully managed, predominately through environmental watering (including 307 ML over 2019–20), but over 2020-21, inflows from Lock 4 weir pool raising (supplemented with 23 ML of environmental water) have helped maintain suitable habitat for the species. A fourth Riverland subpopulation has been discovered in the isolated saline groundwater disposal basin (Noora Basin), with its ongoing conservation requiring careful consideration in light of the particular management challenges and needs of the site (Whiterod and Gannon 2019a; Whiterod and Gannon 2021; Whiterod et al. 2020).

In NSW, the reintroduced population at Little Frenchman's Creek has demonstrated successful recruitment over three consecutive breeding seasons (2018–19, 2029–20 and 2020–21) and appears secure so long as a managed environmental watering regime is adhered to (Ellis et al. 2020). In the Victoria Mallee region, translocated subpopulations persist in Koorlong Lake but the species was not detected in Brickworks Billabong or Lake Hawthorn during April 2021 surveys (Nick Whiterod, Aquasave–NGT, unpublished data). In north central Victoria (Kerang Lakes region), a well-managed remnant subpopulation persists in Round Lake, and a reintroduced population survives in Lake Elizabeth. Subpopulations may also remain in the Reedy Lakes and Tutchewop Drain system.

2.2.7 Genetic management

The remnant subpopulations of the species have been managed as five conservation units on the basis of genetic distinction, these being the (1) lower Murray River and Lower Lakes; (2) Riverland and Victorian Mallee regions; but with separate units for the (3) Kerang Lakes: Round Lake and Lake Kelly; and (4) Woorinen North Lake (believed to be extinct); and (5) Lake Elizabeth (Adams et al. 2011). Recent population genetic analyses effectively consolidates these units into two meta-populations for which there are nine partially isolated subpopulations (Thiele et al. 2020). The meta-populations being the (1) lower Murray River and Lower Lakes, (2) the Riverland and Victorian Mallee regions and, although they did not form part of the analyses of Thiele et al. (2020), NSW subpopulations (e.g. the reintroduced subpopulation as well as any future subpopulations). It is increasingly recognised that

separate management of subpopulations may be reinforcing genetic isolation, thus managing more broadly (e.g. meta-population level) is now recommended (Thiele et al. 2020).

2.2.8 Known threats and knowledge gaps

The threats to the species include the impacts of river regulation and water abstraction that have contributed to the deterioration and loss of the floodplain wetlands and changing of salinity regime, as well as the impact of alien species (Ellis et al. 2013; Hammer et al. 2013; Wedderburn et al. 2017). Many of these threats relate to the deterioration and loss of shallow vegetated saline wetland habitats preferred by Murray Hardyhead (Wedderburn et al. 2007). Knowledge regarding the biology and behavior of the species gained via captive management has informed in-situ management of wild of re-introduced populations (Ellis et al. 2013). Furthermore, research determining the salinity tolerance of various life stages has informed environmental watering of known (and reintroduction) sites that support the species (Stoessel et al. 2020). Building on the summary of Koehn et al. (2017), Koehn et al. (2020) summarises the amount of available knowledge that exists for the species (Table 1), indicating that, typically, less than 59% of knowledge that is needed is presently available.

Table 1. Status of available knowledge for life stages of Murray Hardyhead (available knowledge was scored as follows: 1: 0–19% of knowledge needed is available; 2: 20–39% of knowledge needed is available; 3: 40–59% of knowledge needed is available; 4: 60–79% of knowledge needed is available; 5: 80% of knowledge needed is available): adapted from Koehn et al. (2020).

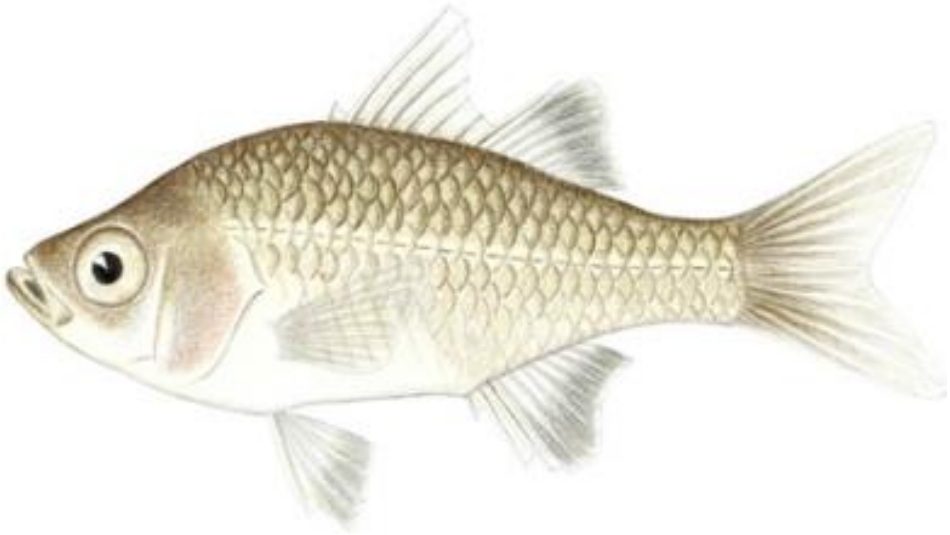
Spawning	Eggs	Larvae	Juveniles	Adults
Spawning	2.5			3.0
Spawning conditions				3.0
Survival (recruitment)	2.0	2.0	2.0	2.0
Growth and condition		2.0	2.0	3.0
Movements		2.0	2.0	2.0
Physical habitat requirements	3.0	3.0	3.5	4.0
Water quality tolerances	2.0	2.0	3.0	3.5
Flows requirements	2.5	2.5	2.5	2.5

2.2.9 Overall summary

As of 2021, Murray Hardyhead persist across a number of locations, often supported by strategic environmental water delivery. The persistence of recently rediscovered and reintroduced populations has improved the outlook for the species. Improved knowledge of the breeding ecology and salinity tolerance and genetic status has informed conservation management of the species.

The challenges ahead include ongoing commitment to this conservation management, and a shift in focus towards 'recovery' whereby additional translocated populations are established in locations that serve as nodes for dispersal during future flood events (i.e. flow mitigated dispersal and genetic mixing between populations) (Ellis et al. 2013). Continued active management and reintroductions are required as well as mitigation of pest species and other prevailing threats to ensure persistence and meaningful recovery of this (and other) species.

2.3 Olive Perchlet *Ambassis agassizii*



(NSW DPI Fisheries)

2.3.1 Snapshot since 2019 summary

Since 2019, the single known southern MDB subpopulation has persisted (and although no targeted management of the species in the southern MDB has taken place, captive maintenance and breeding has occurred for northern MDB populations):

- Surveys indicate that in the Lachlan River, the subpopulation is self-sustaining, with juveniles and adults present (Adam Kerezsy, unpublished data).

2.3.2 Conservation status

International: *Least Concern*
National: not listed
NSW: *Endangered population* (MDB population)
SA: *Critically Endangered* & *Protected*
Victoria: *Regionally Extinct*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management Act 1994*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 *and Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.3.3 Identification guide

Olive Perchlet are small bodied (up to 76 mm TL but more often to 50 mm TL), oval, laterally compressed, olive to semitransparent, with brown margins on the scales (Lintermans 2007). Individuals have a proportionately large mouth and eyes, a single prominent dorsal fin and a forked tail.

2.3.4 Background

Olive Perchlet was historically widespread throughout the MDB in NSW, Queensland, South Australia and Victoria, and in coastal streams of north eastern NSW and south eastern Queensland (Allen and Burgess 1990). In the MDB, it was found broadly from both the northern (Darling River, Border Rivers, Bogan River, Clarence River and Condamine-Balonne, Nebine and Warrego River) and southern catchments (Lachlan River, Murrumbidgee River and Murray River downstream to the Lower Lakes) (Lintermans 2007). Although the species remains common within the rivers of coastal Queensland and NSW, the MDB population has declined and is now patchily distributed or absent. In the southern MDB, it was found in the Darling, mid-Murray and Lower Murray as far downstream as Lake Alexandrina (Hammer et al. 2009). The species has experienced widespread historical decline and is now considered extinct in Victoria (last record 1922) and South Australia (last record in 1983). It was considered absent from the NSW section of the southern MDB, before it was rediscovered (after 47 year absence) in large numbers (almost 5000 fish) from several locations (Mountain Creek and Lake Brewster) in the Lachlan River Catchment (McNeil et al. 2008). The rediscovered population in the Lachlan Catchment is restricted to the weirpool upstream of Brewster Weir and a short distance downstream of Brewster Weir, as well as reaches within the lower end of Mountain Creek (the outlet channel for Lake Brewster). It has been reintroduced to the Cargelligo weirpool (upstream of Brewster in the Lachlan) as well as the Thegoa Lagoon near Wentworth (700 captive bred fish in May 2011) but neither population has established (Dean Gilligan, NSW DPI Fisheries, personal communication). In the 1990s, attempts were made to establish a backup population in SA, using fish sourced from Queensland, but it was unsuccessful as subsequent monitoring failed to detect the species (Hammer 2008a).

2.3.5 Status following millennium drought (up until 2019)

The majority of the decline of Olive Perchlet in the southern MDB occurred prior to the Millennium Drought. The rediscovered population in the Lachlan River Catchment appears to be persisting and is of conservation priority as the only known southern MDB population. The species still occurs in the coastal streams and the northern MDB.

2.3.6 The past two years

In the past two years since the 2019 summary (Whiterod et al. 2019b), surveys have confirmed that the single known southern MDB subpopulation has been maintained although its distribution remains restricted.

2.3.7 Genetic management

Significant genetic differentiation is evident across the present range of the species, indicating four main groupings: southern coastal QLD, northern coastal NSW, southern MDB (Lachlan catchment) and northern MDB (Burnett, Warrego, Condamine, Macintyre, Gwydir and Bogan; Peter Unmack, unpublished data). At this stage, managing the species separately across the distinct groupings is recommended but, consistent with other target species, evaluation of the validity of assisted gene flow is required.

2.3.8 Known threats and knowledge gaps

Although no individual threat has been attributed to the ongoing decline of the species, potential threats include impacts from alien fish (including predation by Redfin Perch *Perca fluviatilis*, egg predation and resource competition with Eastern Gambusia *Gambusia holbrooki* and competition and habitat alteration by Common Carp *Cyprinus carpio*), spawning and recruitment restrictions and habitat loss and degradation caused by cold water pollution and river regulation (Lintermans 2007). There are records of migration through tidal barrage fishways in coastal streams but there is limited knowledge of movement patterns of the MDB populations of the species (Lintermans 2007). Building on the summary of Koehn et al. (2017), Koehn et al. (2020) summarises the amount of available knowledge that exists for the species (Table 2), indicating that typically less than 39% of knowledge that is needed is presently available (and in many cases <19%).

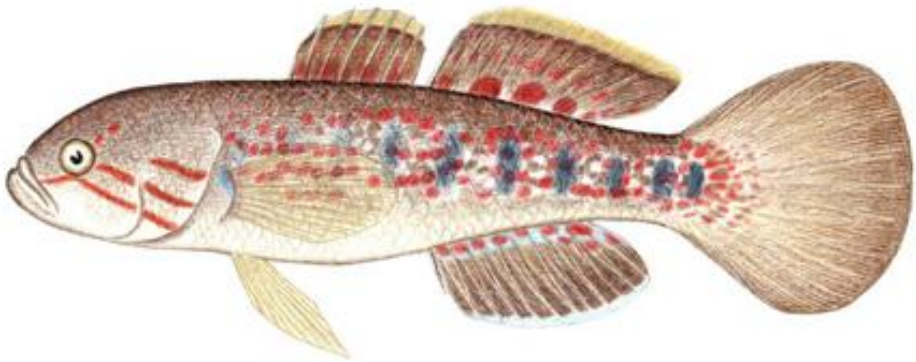
Table 2. Status of available knowledge for life stages of Olive Perchlet (available knowledge was scored as follows: 1: 0–19% of knowledge needed is available; 2: 20–39% of knowledge needed is available; 3: 40–59% of knowledge needed is available; 4: 60–79% of knowledge needed is available; 5: 80% of knowledge needed is available): adapted from Koehn et al. (2020).

Spawning	Eggs	Larvae	Juveniles	Adults
Spawning	2.0			2.0
Spawning conditions				2.0
Survival (recruitment)	1.0	1.0	1.0	1.5
Growth and condition		1.0	1.0	1.0
Movements		1.0	1.0	1.0
Physical habitat requirements	3.0	1.0	2.0	3.0
Water quality tolerances	1.0	1.0	1.0	1.0
Flows requirements	2.0	1.0	2.0	2.0

2.3.9 Overall summary

Olive Perchlet is now considered extirpated from the southern MDB other than one remnant population within the Lachlan River Catchment. There are large knowledge gaps about this species relating to basic ecology and the threats that contributed to population declines. The status of the species in the southern MDB has not changed since the 2019 status summary and the urgent need to act remains to conserve the known population and recover the species across areas where it has been lost.

2.4 Southern Purple-spotted Gudgeon *Mogurnda adspersa*



(NSW DPI Fisheries)

2.4.1 Snapshot since 2019 summary

Since 2019, there has been the rediscovery of remnant subpopulations in the Kerang Lakes region but the Lower Murray subpopulation persists only in very low numbers. Adding to long-term backup populations for the Lower Murray subpopulation, two captive facilities have been established for the Kerang subpopulation:

- Rediscovery of the species at multiple sites in the Kerang Lakes region;
- Persistence (in low numbers) of Lower Murray subpopulation; and
- Strong backup populations of Lower Murray subpopulations and establishment of captive facilities for the Kerang subpopulation.

2.4.2 Conservation status

International: *Least Concern* -
National: *not listed*
NSW: *Endangered*
SA: *Critically Endangered & Protected*
Victoria: *Threatened*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management Act 1994*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 *and Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.4.3 Identification guide

Southern Purple-spotted Gudgeon reach a maximum of 150 mm TL, but more typically attain between 60 and 120 mm TL. It has a rounded head, small mouth, rounded tail and two dorsal fins (Lintermans 2007). The species has several distinguishing markings; a row of darkish blotches present on the sides from the start of the second dorsal fin to the start of the caudal fin, surrounded by numerous red and white spots and, at times, a series of iridescent blue blotches toward the tail and brown to purple facial strips (3–4 in males; two in females).

2.4.4 Background

Historically, Southern Purple-spotted Gudgeon was broadly distributed across coastal areas of Queensland and New South Wales as well as patchily occurring in the MDB. In the southern MDB, it was once widespread and common in wetland and fringing river habitats. Specifically, it was known from Lachlan, Murrumbidgee and Murray catchments, including the Lower Murray (Cardross Lakes and SA section). Whilst still common in coastal QLD, it has experienced substantial declines across the MDB. In the southern MDB, it is now considered extinct from Cardross Lakes (last records in 1990s) and was declared extinct in South Australia in the early 1990s; following the last verified record of them in 1973 (Hammer et al. 2009). However, in 2002, the species was recorded from a single wetland, Jury Swamp near Murray Bridge, signaling its rediscovery after 30 years (Hammer et al. 2015). Just as the species was rediscovered, flows and water availability began to decline associated with the Millennium Drought. As conditions deteriorated, fish were rescued into three captive breeding facilities, with the view of establishing surrogate populations to help safeguard the species (Hammer 2007b). By spring 2009, Jury Swamp had completely dried, with presumed local, and regional extinction of the species (Hammer et al. 2015). At this stage, fish rescued at the height of the Millennium Drought were used to establish captive populations in private breeding facilities (Hammer et al. 2013). This species is most likely locally extinct from the NSW section of the southern MDB, with the last record from 1996.

2.4.5 Status following millennium drought (up until 2019)

Fish rescued at the height of the Millennium Drought were used to establish backup populations (Hammer et al. 2013). Three captive maintenance and breeding facilities were established and have continued to produce moderate numbers (100s) of fish annually. Additionally, the establishment of a surrogate refuge for the species has been successful with high numbers (population estimated at >10,000 fish) and regular spawning and recruitment observed. These backup populations enabled the reintroduction of fish to occur in the attempt to reestablish the species. Initially, over 2011 and 2012, 1120 fish were reintroduced into a historical site with several recaptures (n=15) before the site unexpectedly dried (Bice et al. 2014). Considerably more fish (5043 fish) were reintroduced to the rediscovery site (Jury Swamp) over 2014 to 2019. The species has been regularly detected at the site in low numbers, but the reestablishment of self-sustaining populations has not occurred (Whiterod 2019). In NSW, active captive maintenance and breeding for this species occurred at the NFC in the early 2000s with fish produced from this program stocked into several locations. The only location where the species was reintroduced within the Southern MDB was Adjungbilly Creek near Gundagai; this population does not appear to have established as subsequent sampling has not detected the species at the release site or elsewhere in the system.

2.4.6 The past two years

The MDB In the past two years since the 2019 summary (Whiterod et al. 2019b), the status of the species in the southern MDB has been enhanced with its rediscovery in the Kerang Lakes region in late 2019 (Iervasi 2019). Subsequent surveys have indicated the range of the species extends into several hydrologically connected lakes in the region (Dion Iervasi, Austral Consulting, unpublished data; Stoessel 2020). Additionally, eDNA samples collected from waterways and wetlands in the Kerang region, in 2019, are presently being analysed to further determine the species range in the region (Dan Stoessel, ARI, personal communication). In

2021, broodstock were collected to establish a captive breeding program, which ultimately aims to produce off-spring for introduction into off-stream surrogate sites, thereby acting as insurance to the species persistence in the region (Stoessel pers. comm. 2021). The Lower Murray subpopulation continues to persist with regular reintroductions taking place and strong backup populations are being maintained.

2.4.7 Genetic management

The MDB population is one of three genetic lineages of the species (Sasaki et al. 2016). Further, the southern MDB sub-population is considered genetically distinct from those of the northern MDB (Hammer et al. 2015; Sasaki et al. 2016). As such, the southern MDB sub-population of the species is considered a separate conservation unit. Genetic analyses are underway to assess the newly discovered Kerang Lakes subpopulation, which will guide future management of the species in the southern MDB.

2.4.8 Known threats and knowledge gaps

The species has declined due to intensive flow regulation and diversions resulting in habitat alteration and loss, as well as predation and competition with alien species. Recently, the species has been significantly threatened by the 2018–19 drought and 2019–20 bushfires. Knowledge gaps exist regarding both biology and ecology (see Table 3 which provides a summary of knowledge status of this species in the MDB (Koehn et al. 2017).

Table 3. Status of knowledge of the biology and ecology for life stages of Southern Purple-spotted Gudgeon (low (1–3); moderate (4–7), and high (7–10) knowledge: adapted from Koehn et al. (2017)).

Spawning	Eggs	Larvae	Juveniles	Adults
Moderate	Moderate	Low	Low	Moderate

2.4.9 Overall summary

The future of the species remains precarious in the southern MDB. It is only known from few locations, which have resulted from reintroductions. In the Lower Murray, it does persist but has yet to reestablish a self-sustaining population. In NSW, reintroductions have not been successful with the southern MDB, however there has been the successful establishment of an additional population within the Castlereagh River in the northern MDB. Encouragingly, healthy backup populations are maintained for the species. Identification of priority sites for

the species, which considered localised threats, environmental water and reintroductions are required to reestablish a network of sites across the southern MDB.

2.5 Southern Pygmy Perch *Nannoperca australis*

(NSW DPI Fisheries)

2.5.1 Snapshot since 2019 summary

Since 2019, the overall status of the species has improved slightly due to natural recovery and reintroductions although declines are still evident in parts of its range (including the Lachlan River Catchment). Importantly, the MDB lineage of the species has been listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*, which will hopefully translate to increased management attention (but see Yarra Pygmy Perch). Specifically, the following has occurred:

- National conservation status of MDB lineage listed as Vulnerable; and
- Mixed status of wild subpopulations, with some decline, some recovering and reintroductions aiming to establish others.

2.8.1 Conservation status

International: *Near Threatened*
National: *Vulnerable* (*MDB lineage*)
NSW: *Endangered*
SA: *Critically Endangered & Protected*
Victoria: *Threatened*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management*

Act 1994; QLD: *Nature Conservation Act 1992*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 and *Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.5.2 Identification guide

Southern Pygmy Perch are a small freshwater perch attaining a maximum size of ~85 mm TL. The species has a slightly rounded head, a small mouth that extends to just in front of eye and a rounded tail (Lintermans 2007). The body colour is cream to gold to greenish-brown. These features, along with a round pupil, distinguish the species from the Yarra Pygmy Perch, with which it is often confused. Additionally, male Southern Pygmy Perch develop bright red fins during spawning, whereas the fins of a breeding male Yarra Pygmy Perch are black.

2.5.3 Background

Historically, Southern Pygmy perch occurred in the coastal catchments of south-east South Australia and southern Victoria, the South Australian Gulf, the north of Tasmania, and King and Flinders Islands and the southern MDB. In the southern MDB, it was formally found in the lower Murrumbidgee and Murray catchments, including tributaries (Broken, Ovens, Goulburn, Kiewa, Mitta Mitta) and the lower reaches (Lower Lakes and Mt Lofty tributaries). The species has experienced significant range reductions since European settlement associated with the degradation and loss of wetland habitat and impact of alien species (Lintermans 2007). At this stage, the species remained widely distributed but persisted as fragmented subpopulations. These subpopulations were further impacted by the Millennium Drought, with local extirpation occurring from mid- and upland Murray Catchment sites (including Barmah-Millewa, Normans Lagoon, Happy Valley Creek, Tallangatta Creek, Khancoban Lagoon, Oolong Creek and likely the lower Ovens River floodplain) as well as sites in Mount Lofty Ranges and Lake Alexandrina (and Hindmarsh Island). At this time, fish from Lake Alexandrina and surrounds areas (Turvey's Drain and

Mundoo Island) were rescued to establish backup populations (initially captive maintenance and breeding facility) (Cole et al. 2016; Hammer 2008b).

2.5.4 Status following millennium drought (up until 2019)

Since the Millennium Drought, the species has continued to decline across the southern MDB. In eastern Mt Lofty Ranges tributaries, some recovery has occurred, and locally strong subpopulations exist, including in the Tookayerta, Finniss and Angas catchments and Mt Lofty Ranges tributaries (Wedderburn and Barnes 2012; Wedderburn and Barnes 2013; Wedderburn and Barnes 2014; Whiterod and Hammer 2014). In Lake Alexandrina, the species was not detected in autumn 2011 indicating local extirpation occurred as a consequence of the drought (Wedderburn and Barnes 2017; Wedderburn and Barnes 2018; Wedderburn et al. 2019a). Subsequent reintroductions of the species over 2011-12 occurred at three sites around Lake Alexandrina (Turvey's Drain, Hindmarsh Island and Mundoo Island) (Bice et al. 2014). Since the releases the species has been detected at all three sites, but only the Hindmarsh Island site has demonstrated persistence and recruitment in subsequent years (Whiterod 2018). Recent genome analyses confirmed these reintroductions led to the recovery of the Lake Alexandrina population (Beheregaray et al. 2021; Marshall 2020). In Victorian and NSW, subpopulations in Middle Creek, Mountain Creek (Victoria), Mountain Creek (New South Wales), Coppabella Creek, Blakney Creek and Spring Creek have severely reduced the area of occupancy (Pearce 2015). It is still known from Avoca River and Campapse River catchments as well as upper Goulburn River (upper Hughes Creek, upper Seven Creeks, and the Granite Creeks -Castle, Creighton, Nine Mile and Pranjip); tributaries of the upper Campaspe and Avoca rivers; the Broken River, Ovens River, Mitta Mitta and Kiewa River catchments (Rose 2018)(Raymond et al. 2019). Other sites have been lost since the Millennium Drought (Brauer et al. 2016) with some occurring as habitats dried over the summer of 2018−19.

The Lower Lakes captive maintenance and breeding facility (Attard et al. 2016a; Attard et al. 2016b) was used to establish a surrogate refuge in 2014, which has persisted with low numbers over time (Whiterod 2019). In NSW, multiple backup populations were established over time (Table 4); two for the Lachlan River subpopulation and one for each of the Murrumbidgee River (and Murray River subpopulations). An emergency drought rescue of

fish from Coppabella Creek was used to establish two surrogate refuges (Table 4). In Victoria, captive maintenance and breeding was been established for two Campapse and one Avoca subpopulations (Rose 2018). There are 10 surrogate refuges supporting individuals from 4 subpopulations (King River, Hughes, Castle and Sevens Creeks) in the NECMA and GBCMA region.

2.5.5 The past two years

In the past two years since the 2019 summary (Whiterod et al. 2019b), the overall status of the species has remained stable. In NSW, current populations include: the Blakney Creek subpopulation, although it has experienced recent range retraction; Billabong Creek headwaters (e.g. Mountain Creek sub-catchment - experienced large recent range retraction), Coppabella Creek (stable population) and a reintroduced population in Pudman Creek (established, but only just persisting) (Pearce 2015; Pearce et al. 2018a; Rose 2018). In SA, despite declines, there are locally strong subpopulations in the tributary streams of the Mount Lofty Ranges (Whiterod et al. 2019b) and in Lake Alexandrina (including Mundoo Island and Black Swamp), with the latter most likely due managed water regimes (Wedderburn et al. 2019b). In the Victorian MDB, it persists in Middle Creek and Mountain Creek as well as the Avoca River and Campapse River catchments. The species occurs in the Hughes Creek in the Goulburn River Catchment (Dylan McWhinney, Goulburn-Broken CMA, personal communication). Reintroductions of the species have occurred in the Deniliquin Lagoons (1200 fish: Josh Campbell, Murray LLS, personal communication) and Sheepwash Creek and an increasing number of backup populations in the GBCMA and NECMA regions are maintained.

2.5.6 Genetics management

Although once considered to form one contiguous meta-population across the southern MDB (particularly Murray Catchment), the species has now contracted to 14 genetically distinct subpopulations (Cole et al. 2016; Hammer 2008b). These are (1) Angas River; (2) Finniss River; (3) Lake Alexandrina and surrounds: lower reaches of Tookayerta Creek, Turvey's Drain and Mundoo and Hindmarsh islands; (4) mid- to upper-reaches of Tookayerta Creek; (5) Avoca River; (6) Goulburn and Broken rivers; (7) upper Broken River; (8) Campapse River; (9) Upper

Murray (Norman Lagoon); (10) Coppabella Creek; (11) Kiewa River; (12) Ovens River; (13) Mitta Mitta River; and (14) Lachlan River. These genetic distinctions have been used to define conservation units, but in recognition of the negative impacts of fragmentation, a strategy of translocation (including genetic rescue) is recommended to enhance genetic diversity (Brauer and Beheregaray 2020; Brauer et al. 2016).

2.5.7 Known threats and knowledge gaps

River regulation, cold water pollution and associated habitat deterioration including loss of aquatic vegetation, floodplain alienation and flow changes as well as predation and competition with alien species (including Redfin Perch, Trout species, and possibly Eastern Gambusia, and competition with/habitat alteration by Common Carp) have contributed to population declines in Southern Pygmy Perch. The Urumwalla Creek population was severely reduced by drought in 2019 (Mark Lintermans, University of Canberra, personal communication). Knowledge gaps exist regarding the biology and ecology of this species (Lintermans 2007). Building on the summary of Koehn et al. (2017), Koehn et al. (2020) summarises the amount of available knowledge that exists for the species (Table 4), indicating that, typically, less than 59% of knowledge that is needed (majority is presently available).

Table 4. Status of available knowledge for life stages of Southern Pygmy Perch (available knowledge was scored as follows: 1: 0–19% of knowledge needed is available; 2: 20–39% of knowledge needed is available; 3: 40–59% of knowledge needed is available; 4: 60–79% of knowledge needed is available; 5: 80% of knowledge needed is available): adapted from Koehn et al. (2020).

Spawning	Eggs	Larvae	Juveniles	Adults
Spawning	2.5			3.0
Spawning conditions				3.0
Survival (recruitment)	2.0	2.0	2.0	2.0
Growth and condition		2.0	2.0	2.5
Movements		2.0	2.0	2.0
Physical habitat requirements	2.0	2.0	3.0	3.0
Water quality tolerances	2.0	2.0	2.5	3.0
Flow requirements	2.0	2.0	2.0	2.0

2.5.8 Overall summary

Although occurring broadly and despite some post-drought recovery, the species continues to decline across the southern MDB. Water level management of Lake Alexandrina for the enhancement of Southern Pygmy Perch populations is now factored into water planning in the Lower Lakes (Wedderburn et al. 2019b). Backup populations are limited, with previous

efforts hampered by numerous conservation units (requiring separate consideration) identified for the species.

2.6 Yarra Pygmy Perch *Nannoperca obscura*

(NCCMA)

2.6.1 Snapshot since 2019 summary

Since 2019, the status of the species has continued to decline in the southern MDB. It remains undetected in the wild and, whilst new captive facilities and surrogate refuges have been established, backup populations remain at low capacity. There has not been any substantial improvement in management of the species with only its international conservation status being escalated:

- IUCN conservation status escalated to Endangered; and
- The species remains locally extirpated from the MDB.

2.6.2 Conservation status

International: *Endangered*
National: *Vulnerable*
NSW: *Critically Endangered*
SA: *Critically Endangered*
Victoria: *Threatened*

The conservation status assessed under the following legislation: International: Union for Conservation of Nature (IUCN) Red List of Threatened Species; National: *Environment Protection and Biodiversity Conservation Act 1999*; New South Wales: *Fisheries Management Act 1994*; South Australia: Action Plan for South Australian Freshwater Fishes 2009 *and Fisheries Management Act 2007*; Victoria: *Flora and Fauna Guarantee Act 1988*.

2.6.3 Identification guide

Yarra Pygmy Perch is small (~75mm), has a pointed head, small mouth (not reaching below the eye), slightly rounded tail and single deeply notched dorsal fin (Lintermans 2007). The body colour is gold to dusky brown with a pale belly and dark spots in a row along the midline. These features, along with an irregular shaped (imperfect circle) black pupil, distinguish the species from the Southern Pygmy Perch, which it is often confused with. Additionally, the fins of breeding males are black whereas male Southern Pygmy Perch develop bright red fins during spawning.

2.6.4 Background

Yarra Pygmy Perch is known from coastal areas from Western Victoria through to South Eastern SA to lower reaches of the southern MDB, where the only MDB population is found. Throughout its range, the species occurs in patchily and fragmented lower flow habitats within drainage channels and wetlands, usually with an abundance of submerged aquatic vegetation. In the southern MDB – where it was only formally recognised within the MDB in 2001 (Brauer et al. 2013; Hammer et al. 2010) – it is restricted to fringing habitats of Lake Alexandrina, the lower reaches of the Mount Lofty Ranges tributary streams and waterways of Hindmarsh Island (Hammer 2004; Hammer et al. 2002; Wedderburn and Hammer 2003). During the Millennium Drought, there were dramatic declines in the availability and condition of these habitats and the species experienced declines in range and abundance (Hammer 2007a; Hammer 2008c; Wedderburn et al. 2012). The species was last detected in February 2008 (Holmes Creek at Estick Creek mouth: Hammer 2008c), after which time it is considered to have become regionally extinct. At this stage, a total of 200 wild Yarra Pygmy Perch were rescued from drying habitats at three sites for temporary captive maintenance and breeding, which has enabled the establishment of several backup populations in captive and surrogate settings (Hammer et al. 2013; Whiterod 2019).

2.6.5 Status following millennium drought (up until 2019)

Over 2010–2011, the return of post-drought flows to the lower reaches of the southern MDB prompted reintroductions in an attempt to re-establish wild populations. This relied on backup populations, which have achieve varying levels of productivity (Bice et al. 2014; Whiterod 2019). Importantly, self-sustaining populations in high abundance were maintained in the Flinders University captive maintenance and breeding facility and the Crouch Dam surrogate refuge , both of which were utilised as the source of reintroductions with 5850 fish reintroduced at five former sites over 2011–2014 (Bice et al. 2014). Short-term survival (i.e. recapture) and wild recruitment was observed over 2013 to 2014 (Bice et al. 2014). Yet, in autumn 2014, only one individual was detected across the region (during targeted monitoring of the reintroduction sites) despite broader monitoring across its former range (Bice et al. 2014; Wedderburn 2014; Wedderburn and Barnes 2014). At this time, the main surrogate refuge (Crouch Dam) collapsed, and this backup population was lost. During spring 2015, 900 Yarra Pygmy Perch were reintroduced into three sites on Hindmarsh Island with survival observed for up to one month (Wedderburn et al. 2016), these were the last records of the species in the southern MDB despite regular monitoring across its entire MDB range. Most recently, an occupancy study across the lower Murray conducted in November to December 2018 failed to detect the species (Wedderburn et al. 2019a). The study involved triplicate surveys, to account for probability of detection, at 32 sites where Yarra Pygmy Perch has been recorded historically (Bice et al. 2008; Higham et al. 2005; Wedderburn and Hammer 2003), at sites where the species was reintroduced (Bice et al. 2014; Wedderburn et al. 2016) and several other sites in the region that have suitable habitat. As such, the species now only persists as five backup populations, all of which maintain low abundances and have concern over their viability. The genetic status of backup populations is currently being assessed. Of some encouragement, a new surrogate refuge (Price Dam) created in September 2018, has shown signs of recruitment and appears to be establishing.

2.6.6 The past two years

In the past two years since the 2019 summary (Whiterod et al. 2019b), the species has gone undetected in its former habitats of the MDB (Nick Whiterod, Aquasave-NGT, unpublished data; Wedderburn and Barnes 2020). Despite this, its plight as the first freshwater fish

extinction from the MDB has received minimal attention. Small scale backup populations persist, and genetic rescue is being trialed, but the situation remains dire without intervention commensurate with the scale of the problem.

2.6.7 Genetic management

The MDB population of Yarra Pygmy Perch represents a single genetic conservation unit as it is a distinct genetic lineage (i.e. evolutionary significant units, ESU) from other populations across the range of the species (Brauer et al. 2013; Hammer et al. 2010). Previously when present, there was some gene flow amongst locations in the southern MDB but genetic diversity is extremely low implying limited fitness (Brauer et al. 2013). In addition to assessing the genetic status of backup populations a genetic rescue is currently being trialed.

2.6.8 Known threats and knowledge gaps

Threats are heightened by the extreme localisation of this species in the southern MDB. These threats relate to river regulation (and water level stability), habitat alteration, including the loss of aquatic vegetation, predation, and competition with introduced species namely Redfin Perch and Eastern Gambusia. Table 5 indicates the limited knowledge that exists on the ecology of the species (Koehn et al. 2017).

Table 5. Status of knowledge of the biology and ecology for life stages of Yarra Pygmy Perch (low (1–3); moderate (4–7), and high (7–10) knowledge: adapted from Koehn et al. (2017)).

Spawning	Eggs	Larvae	Juveniles	Adults
Low	Moderate	Low	Low	Moderate

2.6.9 Overall summary

As of 2021, Yarra Pygmy Perch has not been detected in the MDB for six years and there is little urgency by government agencies to reverse the first freshwater fish extinction from the MDB. The backup populations continue to be in peril with potentially <1000 individuals in total remaining across the captive facilities and surrogate refuges. Exploration of genetic rescue is underway, but concerted effort and hard decisions remain necessary to increase production of the species to allow for the capacity to undertake translocations back into the MDB in the future.

Section 3 GENERAL SUMMARY

This report represents the second summary of the status of key threatened small-bodied freshwater fishes – Flathead Galaxias, Murray Hardyhead, Olive Perchlet Southern Pygmy Perch, Southern Purple-spotted Gudgeon and Yarra Pygmy Perch – from the southern MDB. Each of the target species, except for Yarra Pygmy Perch, historically occurred more broadly across the southern MDB. Having experienced historical declines, these species were profoundly impacted by the Millennium Drought, which led to declines in known range and abundance, and threatened regional persistence. Since the Millennium Drought, some recovery is evident and there has been improved knowledge and refined management, particularly, over the past two years, that offers some hope for the future. Encouragingly, several subpopulations have been rediscovered and reintroductions have been successfully implemented. The role of translocations is emphasised; the recovery of the Lower Lakes subpopulation of Southern Pygmy Perch and five of the known Murray Hardyhead subpopulations are a direct consequence of reintroduction efforts. However, as it stands in 2021, each species remains under extreme threat and is only known from a limited number of wild and backup populations (Table 6).

Table 6 Summary of the known wild and backup populations for each threatened small-bodied freshwater fish species. Changes from 2019 are indicated by green highlight with the 2019 value shown in brackets.

Species	Conservation unit	Known populations		
			Backup	
		Wild	Captive facility	Surrogate refuge
Flathead Galaxias	MDB	Few	0	0
Murray Hardyhead	Lower Lakes & Lower Murray	Numerous	0	2
	Mid-Murray	7 (6)	0	0
	Kerang Lakes (Round and Lake Kelly)	1	0	0
	Woorinen North Lake	0	0	0
	Lake Elizabeth	1	0	0
Olive Perchlet	MDB	1	0	0
Southern Purple-spotted Gudgeon	Lower Murray	1	6 (3)	2 (1)
	Kerang Lakes	2 (0)	2 (0)	0
Southern Pygmy Perch	Angas River	Numerous	0	0
	Finniss River	Numerous		0
	Lake Alexandrina & surrounds	Numerous		1
	Tookayerta	Numerous		0
	Avoca River	1	0	2 (1)
	Goulburn and Broken rivers	Several	0	10
	Upper Broken River	Few	0	0
	Campapse River	3	0	4 (2)
	Upper Murray (Albury)	0	0	0
	Coppabella Creek	Few	0	1
	Kiewa River	Few	0	0
	Ovens River	Few	0	0
	Mitta Mitta River	Few	0	0
	Lachlan River	Few	0	2
Yarra Pygmy Perch	MDB	0	3* (2)	4*

**including one location with genetic rescue (South East SA x MDB fish)*

This updated status report provides background information for six small-bodied freshwater species to assist with managing the long-term survival of each target species in the Southern MDB. In summary, the present report highlights the intensity of the situation at hand. Without appreciation of this risk, and a long-term commitment by a range of stakeholders, the loss of species will be inevitable.

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