Conservation Advice

Bidyanus bidyanus

(silver perch)

1. Name

Bidyanus bidyanus

The species is commonly known as silver perch. In the past it has been known by a number of colloquial names, notably ‘bream’, ‘black bream’ and ‘grunter’. It is in the Family Terapontidae.

2. Reason for Conservation Assessment by the Committee

This species is a Committee nomination. The Committee provides the following assessment of the species’ eligibility for inclusion in the EPBC Act list of threatened species.

3. Summary of Conclusion

The Committee judges that the species has been demonstrated to have met sufficient elements of Criterion 1 to make it **eligible** for listing as **critically endangered**.

The Committee judges that the species has been demonstrated to have met sufficient elements of Criterion 2 to make it **eligible** for listing as **endangered**.

The highest category for which the species is eligible to be listed is **critically endangered**.

4. Taxonomy

The species is conventionally accepted as *Bidyanus bidyanus* (Mitchell, 1838).

5. Description

Silver perch are an elongate fish with a laterally compressed, oval-shaped body. They have a pointed head and snout and a relatively small mouth with equal jaws and narrow bands of very fine villiform (needle-like) teeth. The spiny dorsal fin is moderately high and strong and merges with the soft dorsal fin without a distinct notch or break. The tail is slightly forked. Very large specimens assume a slightly disproportionate appearance with a strongly humped forehead, strong lateral compression and a more distinctly pointed, almost beak-like head and snout. Silver perch colouration varies based on water clarity (darker colouration is associated with clearer water) but specimens are generally a dusky bronze or green colour on the back, with silvery-grey flanks and a white belly. On some specimens dark edges to the scales create a subtle cross-hatched or checkered appearance on the flanks.

6. National Context

Silver perch are currently not listed under the EPBC Act. Silver perch are:

- protected from take in the Paroo and Warrego rivers under regulation under the Queensland *Fisheries Act 1994*; elsewhere in Queensland (including stocked impoundments) regulated take is permitted
- listed as vulnerable under the New South Wales *Fisheries Management Act 1994*; protected from take in NSW sections of Murray-Darling rivers; in listed stocked impoundments regulated take is permitted
- listed as endangered under the ACT *Nature Conservation Act 1980* and protected from take

- listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*; ranked as critically endangered for management purposes (VIC DSE, 2007); protected from take
- protected from take under regulation under the South Australian *Fisheries Act 1982*. Also listed as critically endangered under draft threatened species schedules for the South Australian *National Parks and Wildlife Act 1972* (Hammer et al., 2009).

Silver perch are also the subject of an aquaculture industry, based mainly in NSW (Rowland, 2009). While significant numbers of silver perch are bred and grown in aquaculture facilities for human consumption in Australia and Asia, these aquacultured fish are not considered meaningful to the long-term survival of silver perch in the wild, as they are highly domesticated both in the behavioural and the genetic sense (Rowland, 2009). Similarly, large numbers of hatchery-bred silver perch are stocked, usually in impoundments, but these stocked silver perch appear to make little improvement to the conservation situation of wild silver perch (Davies et al., 2008; Rowland, 2009; Davies et al., 2012).

7. Relevant Biology/Ecology

Range and habitat

Silver perch are endemic to the Murray-Darling system (including all states and sub-basins) (Allen et al., 2002; Lintermans, 2007). Hatchery-bred silver perch are also stocked out of their range in a number of impoundments on east coast river systems, where they seemingly fail to reproduce. However, a self-sustaining population of silver perch occurs in Cataract Dam in the Hawkesbury-Nepean system (NSW DPI, 2006).

Silver perch formerly utilised a diversity of habitats within the Murray-Darling system. Silver perch are commonly described as a lowland species that are not found in the cooler upper reaches of rivers. However, numerous reliable accounts exist of silver perch penetrating to Cooma (~ 800 metres ASL) on the Murrumbidgee River in large-scale upstream migrations in summer in the early and mid 1900s (NSW DPI, 2006; Trueman, 2007; Trueman, unpubl. data, 2008). Similar accounts exist of silver perch either residing or seasonally migrating into upland river habitats such as:

- the Goodradigbee River (Anderson, 1931)
- the upper Yass River (Pratt, 1979)
- the upper reaches of the Lachlan River system (Trueman, 2007; Trueman, unpubl. data, 2008)
- the upper reaches of the Macquarie River system (Fish, Campbell and Duckmaloi Rivers) (Stewart, 1966[1]; Trueman, 2007; Trueman, unpubl. data, 2008)

Silver perch are consistently reported by anglers and researchers to show a general preference for faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin (Clunie and Koehn, 2001). In the upper Murrumbidgee River during the 1960s and 1970s, the species was renowned for migrating into clear fast-flowing rapids in summer, in which anglers observed and targeted them (Pratt, 1979).

Growth, Size and Sexual Maturity

Mallen-Cooper and Stuart (2003) provide detailed information on age, growth and sexual maturation on 167 wild silver perch caught over several years from the middle reaches of the Murray River. Silver perch display sexual dimorphism, with females growing to a larger size. Growth varies between individual fish and is affected by the productivity of environments. Male fish reach sexual maturity at three years of age, and female fish reach sexual maturity at four to five years of age, although high Gonadosomatic Index values[2] are only recorded in female fish older

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[1] Stewart's descriptions clearly refer to silver perch, however he mis-names these fish as bass, an east coast native fish that does not occur in the Murray-Darling Basin.

[2] A Gonadosomatic Index (GSI) is based on the destructive sampling and dissection of numerous specimens of a fish species, across all months of the year. It is a ratio of the weight of the reproductive organs including spermatozoa or oocytes (unfertilised 'eggs') to whole body weight, and is typically applied to temperate species with an annual spawning cycle. A GSI reveals the reproductive cycle of such species including their peak spawning period.

than five years of age. Growth slows dramatically in both sexes after sexual maturity. Mallen-Cooper and Stuart (2003) estimated a mean maximum size for Murray River silver perch of 422 mm for female fish and 377 mm for male fish. However, silver perch in impoundments may significantly exceed these sizes, as recorded by Mallen-Cooper and Stuart. Larger silver perch were also recorded from the Murray River and other Murray-Darling streams in past decades. Trueman (2007) and Clunie and Koehn (2001) provide a number of records of large riverine silver perch up to approximately 4.5 kg, and at least one report of a 7 kg+ specimen. Similarly, Major Thomas Mitchell recorded a 7.7 kg silver perch from a tributary of the lower Lachlan River in 1836 (Mitchell, 1838).

Age

Mallen-Cooper and Stuart (2003) aged 167 silver perch from the Murray River, and estimated the oldest specimen to be 17 years of age, based on growth rings in transverse-sectioned otoliths[3]. However, a 27 year old specimen was recorded from Cataract Dam, a pristine, low-nutrient water-supply reservoir with unusually slow fish growth-rates (Mallen-Cooper and Stuart, 2003). For the purposes of this assessment, generation length of wild silver perch is estimated at 14 years. This was estimated based on a conservative theoretical maximum age of 22 years for Murray-Darling Basin river specimens (in turn based on the average of the maximum recorded age for Murray River fish (17 years) and Cataract Dam fish (27 years)) and an age of five years for full female sexual maturity (Mallen-Cooper and Stuart, 2003) (i.e., [22+5] / 2 = 13.5).

Diet

Adult silver perch are omnivorous, taking a variety of small prey including zooplankton, aquatic insects, molluscs, small crustaceans and worms as well as algae (Clunie and Koehn, 2001; NSW DPI, 2006). The extent of herbivory in adult silver perch has been extensively debated. Clunie and Koehn (2001) reviewed a number of references that reported increases in filamentous algae in the diet of adult silver perch as they increase in size. Conversely, Lintermans (2000) reported little change in the diet of stocked adult silver perch from Googong Reservoir (southern NSW). Davis et al. (2011) found that a degree of herbivory and ontogenetic dietary shifts to increased herbivory are both common traits in the Terapontidae family, which suggests that these traits may exist in silver perch as well. However, silver perch are likely to be highly flexible both in their diets and the extent to which herbivory and ontogenetic shifts to herbivory express in their diets, depending on their habitats. Clunie and Koehn (2001) also raise the possibility that algae are ingested for the fauna found on them [also, possibly, the nutritious bacterial-fungal biofilms found with the algae].

Reproduction

Silver perch spawn in spring or summer. Spawning is preceded by courtship behaviours, and occurs in late afternoon, dusk or shortly after nightfall. Spawning occurs in shoals at or near the surface, involves simultaneous release of milt (sperm) and eggs by male and female fish respectively, and is often accompanied by thrashing at the surface (Lake, 1967a; Merrick and Schmida, 1984; Clunie and Koehn, 2001). Merrick and Schmida (1984) reported that spawning occurs where water flows over a gravel or rock rubble substrate. Silver perch are moderately fecund; Merrick and Schmida (1984) record a 1.8 kg female producing ~500,000 eggs, and Langtry (unpubl. data cited in Clunie and Koehn, 2001) estimated a fecundity of 718,416 eggs for a 2.4 kg female. Rowland (2009) has recorded a maximum fecundity of 170,000 eggs per kilo of body weight in female fish in an aquaculture environment.

Lake (1967b) found that fertilised, water-hardened eggs were 2.7–2.8 mm in diameter, and hatched in 30–31 hours at temperatures of 26–27°C. Silver perch eggs spawned at cooler temperatures had longer hatching times. Importantly, Lake (1967b) noted that silver perch eggs are semi-pelagic and will sink to the bottom in the absence of current; he also noted the propensity for the chorion (‘outer covering’) of silver perch eggs to adsorb very fine suspended sediment.

Larvae are 3.1–3.4 mm upon hatching, positively phototactic (swim towards light) and start feeding on their fifth or sixth day (Lake, 1967b; Gerhke, 1990; Rowland, 2009). No data are available on the diet of larval silver perch in the wild. However, Rowland (2009) reported that silver perch larvae

[3] Otoliths are essentially the ear-bones of fish.

in earthen 'grow-out' ponds[4] initially ate zooplankton including rotifers, copepods, and cladocerans, followed by chironomid larvae and the adults and larvae of other aquatic insects. Rowland (2009) also reported that rotifers were the most important dietary item for silver perch larvae at the Grafton Aquaculture Centre (northern NSW). The taking of rotifers by larval silver perch is in contrast to the larvae of other large Murray-Darling fish species, which consistently avoid rotifers in favour of cladocerans and chironomid larvae (Arumugam and Geddes, 1992; Rowland, 1992, 1996; Ingram et al., 1997; King, 2005; Ingram and De Silva, 2007; Kaminskas and Humphries, 2009).

The first detailed studies of factors that induce breeding in Murray-Darling native fish were carried out at the Inland Fisheries Research Station, Narrandera, (southern NSW) using fish mostly sourced from the nearby Murrumbidgee River. In these studies Dr John Lake observed an apparent dependence by large Murray-Darling native fish on flooding (simulated by raising water levels in earthen ponds) and relatively high water temperature thresholds for spawning (Lake, 1967a). Based on Lake's results, silver perch are typically described as warm-water spawners with a threshold water temperature of 23.3°C for spawning. However, various researchers have consistently collected wild silver perch eggs and larvae in the Murray River below Lake Mulwala and in the Barmah/Millewa area at temperatures above 20°C, with many spawning events calculated to have occurred at temperatures below 20°C (Gilligan and Schiller, 2003; Koehn and Harrington, 2005; Tonkin et al., 2007). In a hatchery setting, Rowland (pers. comm. cited in Clunie and Koehn, 2001) reported successful hormone-induction spawning of captive silver perch at 17°C, although temperatures of 20–21°C were required for high survival of larvae.

Similarly, in the same reaches of the Murray River, a number of studies have recorded wild silver perch spawning either in stable irrigation flows or small within-channel freshes[5] (Gilligan and Schiller, 2003; Mallen-Cooper and Stuart, 2003; King et al., 2005). Mallen-Cooper and Stuart (2003) confirmed Lake's (1967a) finding that compared to other large native perch studied (i.e. golden perch *Macquaria ambigua*), silver perch needed only a very slight rise in water to trigger spawning. However, King et al. (2008) demonstrated that silver perch spawning in the Murray River in the Barmah-Millewa area, as measured by drifting eggs and larvae, increased significantly compared to the two preceding years during a prolonged, sizeable spring/summer flood event that was substantially enhanced with environmental water allocations.

The cumulative evidence indicates that silver perch reproduction is flexible in terms of flow conditions and temperature; reproduction can occur in both within-channel flows and floods[6] and at relatively cool water temperatures. Spawning is not flood dependent but does appear to be dependent on suitable flows and suitable flood events do appear to maximise spawning efforts and presumably recruitment. The former occurrence of silver perch in some cooler upper reach habitats with gravel and rock substrates suggest silver perch are also flexible in the type of river environments in which they can reproduce.

Movement

Silver perch are a highly migratory freshwater fish. The extensive migration of adults, particularly during flooding, has long been recognised and is considered to be part of their spawning behaviour, likely a strategy to offset the downstream drift of eggs and larvae (Cadwallader, 1977; Reynolds, 1983; Mallen-Cooper et al., 1995). Reynolds (1983) tagged and then recovered a small number of tagged adult silver perch in the lower Murray River; most moved about 40 km upstream, while one fish moved 110 km and another 570 km upstream in 19 months.

Mallen-Cooper et al. (1995) provided extensive data on the migration of silver perch in the middle reaches of the Murray River, including juveniles. Silver perch of a wide range of ages moved

[4] Earthen 'grow-out' ponds are managed to provide high densities of zooplankton when native fish larvae are introduced. Typically ponds are seeded with river water containing zooplankton and gradually allowed to dry. The ponds are subsequently flooded to induce hatching of desiccation-resistant zooplankton eggs, and enriched with fertilisers to increase the productivity of the zooplankton bloom.

[5] A 'fresh' is an Australian term for a small to moderate, temporary increase in river flow. Freshes are typically of relatively short duration, and remain within the river channel.

[6] Multiple year classes of silver perch have been recorded from Cataract Dam (Clunie and Koehn, 2003), indicating repeated successful spawnings in some stillwater impoundment environments is also possible.

upstream. Juveniles moved upstream from October to April, while mature fish moved over a briefer time period from November to February. The movement of sexually mature adult silver perch recorded by Mallen-Cooper et al. (1995) coincides with the times of year when drifting, fertilised eggs have been reported by other researchers, supporting the view that migration of adult silver perch is generally spawning-related. The movement of juvenile fish would provide them with opportunities to colonise or repopulate new habitats.

Large spawning migrations of adult silver perch from Lake Burrinjuck into the upper Murrumbidgee River were often recorded in recreational fishing literature and some scientific literature (Pratt, 1979; Lintermans, 2000, 2002). Over the course of the 1900s the size of these migrations, and the distance they penetrated upstream, slowly decreased until collapsing in the 1980s (Lintermans, 2000, 2002).

8. Threats

Silver perch face a number of threats:

<u>River regulation</u>
River regulation and water diversion have had a number of impacts on silver perch.

It is estimated there are 4000 barriers to fish movement in the Murray-Darling Basin in the form of dams, weirs and other structures (Lintermans, 2007), the vast majority of which do not have fishways. These severely curtail or prevent the movement of juvenile and adult silver perch, in turn preventing dispersal and recolonisation of extensive stretches of river, and increasing the risk of localised extinctions and fragmentation of silver perch stocks over time.

Between 2001 and 2013, the Sea to Hume Dam Fish Passage Program provided purpose-built fishways to give native fish passage past 15 weirs and barrages on the Murray River between the river’s mouth and Hume Dam at Albury (Lintermans, in prep., 2013), thereby ameliorating the impacts of weirs on the movement of juvenile and adult native fish, including silver perch in the middle and lower Murray River (but not necessarily native fish eggs and larvae). Monitoring has shown the fishways are used by large numbers of juvenile and adult native fish species, including silver perch, and that abundances are increasing upstream of previously generally-impassable weirs (Barrett, 2008; Stuart et al., 2008; Barrett and Mallen-Cooper, 2009; Koehn and Lintermans, 2012).

Silver perch eggs, with their marginal buoyancy, may also rely on long stretches of river uninterrupted by weirs to maintain a successful drift until hatching, and to subsequently deliver larvae into suitable habitats for first-feeding and recruitment (Clunie and Koehn, 2001; Mallen-Cooper and Stuart, 2003). Conversely, weirs may trap drifting silver perch eggs and recently hatched larvae, possibly leading to them settling in the anoxic silt of weir pools and dying (Clunie and Koehn, 2001). Undershot weirs kill the majority (>90%) of silver perch larvae passing through them (Boys et al., 2010); the same has been recorded for Murray cod (*Maccullochella peelii*) larvae (>50%) and golden perch (*Macquaria ambigua*) larvae (>90%) (Baumgartner et al., 2006). Further, there is the potential for irrigation off-takes to divert large numbers of eggs and larvae (as well as juveniles and adults) to almost certain death (Gilligan and Schiller, 2003; Koehn and Harrington, 2005; King and O’Connor, 2007), and floodplain regulation structures can similarly strand many juvenile and adult fish (Jones and Stuart, 2008). Suitably long stretches of unblocked river between Mulwala Weir and Torrumbarry Weir[7] and Torrumbarry Weir and Euston Weir, combined with particularly amenable habitat, may allow silver perch eggs to successfully complete their drifting and hatching and thus partially explain why this area of the Murray River supports the last significant population of silver perch.

In the upper Murray system, large dams release cold water from their base, below the lower thermal limits for hatching and growth of native fish eggs and larvae, and disrupting cues for

[7] The middle Murray population of silver perch extends well below Torrumbarry Weir, and subsequently, below Euston Weir. Both structures now have effective fishways, so in terms of juvenile and adult fish, populations above and below these structures are connected.

movement by juvenile and adult fish (e.g. Astles et al., 2003). Thermal pollution typically takes several hundred kilometres for water temperatures to be restored to normal (summarised in Clunie and Koehn, 2001). Similarly, river regulation in the southern Murray-Darling system has led to sustained high within-channel flows in summer and autumn and very low flows in winter and spring, in accord with irrigation demand. This is essentially a reversal of the natural flow pattern (Maheshwari et al., 1995), with obvious implications for native fish spawning and movements.

Dams, weirs and water extraction have eliminated many of the smaller floods and freshes that provide spawning, migratory, dispersal and colonisation opportunities for silver perch. In the middle reaches of the Murray River, for instance, Close (1990) estimated the frequency of flows 5000–10,000 ml/d has declined by 50 percent, relative to natural flows, while Maheshwari et al. (1995) concluded that the frequency of flows in the 5000–10,000 ml/d range has declined by over 50 percent. Meanwhile, weir construction in South Australia has turned the lower Murray River into a series of lentic pools under most conditions (Walker and Thoms, 1993; Maheshwari et al., 1995) and water extraction has reduced annual average flows (1895–2006) at the Murray Mouth by 61 percent (CSIRO, 2008).

King et al. (2008) demonstrated increased spawning of silver perch and other native fish can be achieved by environmental flows that aim to mimic components of natural flood events. Improvements to river regulation and environmental flows to address environmental needs such as fish breeding events in the Murray Darling Basin are currently underway. For example, in 2009–2010, 154 gigalitres of Commonwealth environmental water was delivered to environmental assets in the Murray-Darling Basin, while in 2010–2011 more than 387 gigalitres of delivered water aimed to capitalise on the ecological benefits of high rainfall and increased river flows experienced across the Basin and support the ecological recovery of riverine and wetland communities following years of extended drought (Australian Government, 2010; 2011).

<u>Blackwater events</u>

Blackwater is water containing high levels of dissolved organic carbon which gives it a characteristic dark colour. Blackwater results from flood waters inundating floodplains or dry river channels, in the process leaching carbon compounds from inundated plant material. The dissolved organic carbon in blackwater encourages rapid bacterial growth which consumes dissolved oxygen and can reduce dissolved oxygen levels to very low levels that are fatal to fish and other aquatic organisms. While the extraction of dissolved organic carbon by floodwaters is a natural phenomenon, severe blackwater events are at least partially a result of river regulation, which has reduced the frequency and extent of floodplain inundation, and thus increased stores of dissolved organic carbon yielding plant material (Gerkhe et al., 1993; King et al., 2012). In the course of 2010–2011 a severe plume of deoxygenated blackwater occurred throughout the core silver perch habitat in the middle reaches of the Murray River (MDBA, 2010). Many large Murray cod were reported to have been killed by anglers and landowners. However, no statistically significant change has been observed in the catch-per-unit-effort of silver perch in sampling in the Murray River between the Murrumbidgee junction and SA border since this blackwater event (Gilligan, in prep., 2012), suggesting that silver perch have survived this event relatively well.

<u>Habitat Degradation</u>

It is widely recognised that Murray-Darling habitats have been degraded by desnagging[8], increased turbidity and salinity, loss of submergent macrophytes (‘water weed’), and loss of riparian vegetation and associated siltation due to land clearing and a variety of poor farming practices including cattle grazing and trampling river banks (summarised in Clunie and Koehn, 2001). While all of these forms of habitat degradation have affected silver perch, key impacts are likely to be (1) loss of submergent macrophytes, which may be important nursery areas for juvenile silver perch and important sites for feeding for all life stages, and (2) siltation, which can smother silver perch eggs that sink to the substratum in the absence of current.

[8] removal of large sunken trees, known as ‘snags’

Alien pathogens

There are many pathogens and parasites present in Murray-Darling waterways capable of affecting silver perch. Almost all are introduced ('alien'), having been brought into Australia with imports of live alien fish. Diverse evidence (summarised below) suggests alien pathogens and parasites may have had greater impacts on native fish species than realised in the past, and ongoing impacts in the present. The key alien pathogens and parasites are of concern are EHNV, *Saprolegnia* and *Aphanomyces*, *Chilodonella*, *Ichthyophthirius*, *Lernaea* and Asian fish tapeworm.

Epizootic Haematopoietic Necrosis Virus (EHNV) appears to have originated from alien reptile or amphibian species, possibly imports for the pet trade (Whittington et al., 2010). EHNV causes severe necrosis of the haematopoietic or blood cell producing organs (kidney, liver and spleen) of infected fish, with subsequent haemorrhaging causing death (Langdon and Humphrey, 1987). Langdon (1989) found alien redfin perch (*Perca fluviatilis*) to be the most susceptible fish species to EHNV, and are considered to be the primary vector of the virus[9]. However, silver perch are one of several native fish species found to be highly susceptible to EHNV[10], and Langdon (1989) speculated that EHNV may have been a factor in the decline of silver perch. EHNV was first isolated in Australian waters in 1984 (Langdon et al., 1986), but unexplained spring-time kills of alien redfin perch had been noted in some Victorian waterways as early as 1972 (Langdon and Humphrey, 1987).

Whittington (2010) reported that EHNV, while sporadically found in other parts of the Murray-Darling Basin, now appears to be entrenched in the upper Murrumbidgee River. It is noteworthy that the collapse of the strong silver perch population in the upper Murrumbidgee River and Burrinjuck Reservoir in the 1980s coincides with the general establishment of alien redfin perch — the primary vector of EHNV — in the upper Murrumbidgee catchment and at least one reliable account of numerous, diseased, haemorrhaging silver perch individuals from Burrinjuck Dam (Trueman, unpubl. data, 2008).

Saprolegnia parasitica and *Aphanomyces invadans* are pathogenic oomycetes ('water moulds'). *Saprolegnia* are normally saprophytic organisms (consumers of dead/decaying organic matter) but some strains of *S. parasitica* are highly virulent and attack fish directly, generally when low water temperatures reduce the effectiveness of fish immune systems (van West, 2006; Phillips et al., 2007). In wild fish *Saprolegnia* infection is generally fatal due to the tenacious nature of the infection once established and the progressive destruction of surfaces tissues and haemodilution (van West, 2006; Read et al., 2007; Phillips et al., 2007; Rowland et al., 2007).

While sampling indicates *Saprolegnia* species have a world-wide distribution (van West, pers. comm., 2011), the world-wide pattern of sudden onset of severe, repeating *S. parasitica* epizootics in aquaculture operations and in some cases wild fish populations, suggest these virulent strains have been introduced. In Australia, this is supported by mass oomycete fish kills of Australian grayling (*Prototroctes maraena*) in Tasmanian rivers in the 1800s (Saville-Kent, 1888), intractable *S. parasitica* infections of Murray cod (*Maccullochella peelii*) eggs, larvae and adults in hatcheries since the early 1900s (Dakin and Kesteven, 1938; Rowland, 1988; Rowland and Ingram, 1991), and regular winter infections of wild bony bream (*Nematolosa erebi*) with *S. parasitica* in the lower Murray River since the 1940s (Puckridge et al., 1989).

Aphanomyces invadans (EUS or 'red-spot disease') causes severe ulcerations on the body surfaces of fish. These ulcerations are readily fatal due to destruction of surface tissues and haemodilution, however some individuals of various fish species can and do recover from EUS (Rowland, pers. comm., 2011). EUS was first recorded in Bundaberg in 1972 and first recorded in the Murray-Darling system (Darling River) in 2008. The species is known to be vulnerable to EUS (Rowland and Boys, 2010; Boys et al., 2012).

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[9] Alien rainbow trout (*Oncorhynchus mykiss*) infected with EHNV have been recorded from several fish farms; in some circumstances this species may vector the virus.

[10] Macquarie perch (*Macquaria australasica*) was found to be the native fish species most vulnerable to EHNV, with 100% mortality in experimental transmission trials.

The ecto-parasitic copepod *Lernaea cyprinacea* (anchor worm'), is now widely found in freshwater fish of south-eastern Australia having been brought into the country many decades ago with imports of infected carp (*Cyprinus carpio*) or redfin (*Perca fluviatilis*). Alien carp are considered the major vector of the parasite (Rowland and Ingram, 1991; Lintermans, 2007). *Lernaea* has low host specificity and is capable of using a very wide range of fish species (Shariff et al., 2006) causing profound negative effects on host fish (e.g. Khalifa and Post, 1976; Berry et al., 1991; Rowland and Ingram, 1991; Goodwin, 1999; Bond, 2004).

The ecto-parasitic single-celled protozoans *Chilodonella hexasticha* and *Ichthyophthirius multifiliis* ('white spot') infect the surface tissues and gills of fish and frequently cause mass mortalities of fish in aquaculture operations, including silver perch operations in Australia. Both organisms have caused a number of kills of Australian native fish in the wild (Rowland and Ingram, 1991; NSW DPI, 2006; Read et al., 2007; Rowland et al., 2007; Rowland, 2009; Fishing World, 2011). These organisms are also believed to have been brought into the country many decades ago with imports of diseased live fish.

The Asian fish tapeworm was inadvertently brought into Australia with importations of carp and is now present throughout the Murray-Darling system (Dove and Fletcher, 2000). Carp are the primary vector, and to a lesser extent gambusia (Dove and Fletcher, 2000). Asian fish tapeworm cause impaired health and growth in larger fish (Scott and Grizzle, 1979)and has already caused significant fish kills of a common small native gudgeon (*Hypseleotris* sp.) in the ACT (Lintermans, 2002, 2007) and is suspected to be an issue for the endangered Murray hardyhead (*Craterocephalus fluviatilis*) (TSSC, 2012).

<u>Alien fish</u>

Brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) were introduced to mainland Australia in 1888 and 1894 (Cadwallader, 1996). Alien trout species are restricted to the cooler upper reaches of rivers, where they dominate the biomass and impact seriously on some native fish species (Cadwallader, 1996). Alien trout species are likely involved in the loss of some upland river populations of silver perch, but are not a significant impact on silver perch overall, as the species' ranges did not overlap to a great degree; alien trout species do not occur in lowland habitats (Clunie and Koehn, 2001; Lintermans, 2007).

Alien carp (*Cyprinus carpio*) were introduced in the mid-1800s, but the strain originally introduced showed little sign of spreading (Lintermans, 2007). The Boolarra strain of carp was illegally imported into Victoria from Germany in the 1950s, and illegally introduced to the Murray-Darling Basin in the early 1960s (Rhodes, 1999). This strain of carp spread rapidly and is now extremely abundant in lowland Murray-Darling habitats and increasingly, some higher altitude habitats. Carp account for 58 percent of the total fish biomass across the Murray-Darling Basin, and in some rivers more than 90 percent of the total fish biomass (Harris and Gerkhe, 1997; Native Fish Strategy, 2003; Davies et al., 2008; Davies et al., 2012). Given this biomass alone, silver perch are likely to have been negatively affected. Carp are also vectors for parasites that affect native fish such as *Lernaea* and Asian fish tapeworm, and are increasingly recognised as raising turbidity and destroying submergent macrophytes (e.g. Roberts et al., 1995; Roberts and Sainty, 1996) which may be important nursery habitats for juvenile silver perch and important sites for feeding at all life stages. Carp may also compete with all life stages of silver perch for food. Tonkin et al. (2006) found similar prey item preferences between carp larvae and larvae of two native fish species (Murray cod *Maccullochella peelii* and golden perch *Macquaria ambigua*) in experimental conditions. Such an overlap may exist for silver perch larvae as well, and if so, is likely to be significant given the extremely high fecundity of carp and the number of larvae they produce. Tonkin et al. (2006) also recorded significant physiological and developmental advantages in carp larvae compared to the native fish larvae.

Alien redfin perch (*Perca fluviatilis*) are a fast-breeding, voracious predatory fish introduced to mainland Australia from England in 1864 (Lintermans, 2007). Redfin perch were abundant in lowland river and billabong habitats of the southern Murray-Darling Basin between the 1930s and the 1960s (Cadwallader, 1977; Clunie and Koehn, 2001) when invading alien carp effectively displaced them (Rhodes, 1999; Rowland, 2005). Redfin perch are generally not common in lowland river habitats of the southern Murray-Darling Basin today, but still occur in the middle reaches of some rivers and abound in many southern Murray-Darling impoundments where their predation and competition impacts continue to some degree. Redfin perch are noted as being the primary vector of EHNV, to which silver perch are highly susceptible (Langdon, 1989).

Alien gambusia (*Gambusia holbrooki*) are a very small aggressive fish species introduced to mainland Australia from southern USA in 1925 (Lintermans, 2007) to control mosquito larvae (although in fact small native fish species were already providing maximal mosquito larvae control e.g. Willems et al., 2005). Gambusia are now found in vast numbers in most lowland Murray-Darling habitats and indeed most waterways in south-eastern Australia. Gambusia have been documented seriously affecting native fish species as diverse as Pacific blue-eyes (*Pseudomugil signifer*) (Howe et al., 1997), ornate rainbowfish (*Rhadinocentrus ornatus*) (Keller and Brown, 2008), redfin blue-eyes (*Scaturiginichthys vermeilipinnis*) (Unmack and Brumley, 1991; Wager, 1994; Fairfax et al., 2007; Kerezsy, 2009) and Murray hardyhead (*Craterocephalus fluviatilis*) (Rehwinkel, 2011) through competitive exclusion and harassment including chasing and fin-nipping. Gambusia have also been recorded preying on native fish larvae (Ivantsoff and Arn, 1999). Emerging research is now indicating gambusia impacts are far worse than initially thought in terms of harassment and near-complete destruction of native fishes' fins through fin-nipping (Tonkin, 2011). Gambusia may have similar negative effects on larval and juvenile silver perch. Gambusia are also a vector for Asian fish tapeworm (Dove and Fletcher, 2000) and, it is suspected, *Lernaea*.

9. Decline

Historical evidence from European explorers, early settlers and travellers indicate silver perch were originally abundant in diverse geographic areas and habitats of the Murray-Darling system (Bland, 1831; Sturt, 1833; Bennett, 1834; Scott, 2005; Humphries, 2009). Diverse evidence suggests silver perch remained relatively abundant in the late 1800s and early 1900s, despite increasing environmental degradation and fishing pressure. In 1949–1950 the ecologist J.O. Langtry carried out an investigation of the Victorian reaches of the Murray River and some NSW and Victorian tributaries, and recorded generally very small catches of silver perch in commercial fishermen's catches and sample nettings (Table 1). He noted that silver perch were a mobile, unpredictable target for commercial fishermen, caught in large numbers only when migrating (Cadwallader, 1977).

Table 1. Selected catch figures for silver perch in experimental nettings arranged by J.O. Langtry in 1949–1950 (Cadwallader, 1977).

Location	Date/s	Total number of fish (native fish & alien redfin perch)	Percentage of catch comprised by silver perch
Lake Victoria	Sept–Nov 1949	1356 (all species)	0.2%
Rufus River	Sept–Nov 1949	263 (all species)	1.9%
Murray River Locks 7, 8, 9	Sept–Nov 1949	332 (all species)	40%
Lindsay Creek anabranch	1949	–	4.7%
Walpolla Creek anabranch	1949	–	3.5%
Murrumbidgee River Bringagee Anabranch/ billabong system	Oct 1949	447 (all species)	30.6%
Murray River Boundary Bend (waters closed to nets)	Oct–Nov 1949	769	14.3%

Langtry also states that between 28 May 1938 and 7 November 1942, 11 530 silver perch passed through the Euston-Robinvale fish ladder, then the only fish ladder in use in the Murray system (Cadwallader, 1977).

Further commercial catch records and other evidence indicates that silver perch numbers declined severely over the broader Murray-Darling Basin from the 1950s to the 1980s. However, recreational fishermen and various researchers still considered silver perch to be locally abundant in patches of the middle Murray River and some tributaries up until the 1980s (summarised in Clunie and Koehn, 2001; Trueman, 2007), and commercial fishers in these areas still made sizeable (multi-tonne) annual catches. Since the 1980s the decline of silver perch appears to have accelerated, with only the middle Murray River population now appearing to persist in significant numbers (e.g. Harris and Gerkhe, 1997; Mallen-Cooper and Stuart, 2003).

Silver perch were taken in the state inland commercial fisheries of NSW, Victoria and South Australia (now all closed), sometimes in significant quantities (Cadwallader, 1977; Clunie and Koehn, 2001; NSW DPI, 2006; Hammer et al., 2009). Significant catches (e.g., Table 1) occurred only during migrations of adult fish, which were believed to be spawning related (Cadwallader, 1977).

Commercial catches for the NSW inland fishery from 1947/1948 to 1995/1996 (marking the close of the fishery) show fluctuations in silver perch catch but an overall decline to very low levels by the mid 1980s, and to nil by the mid 1990s (NSW DPI, 2006) (Figure 1).

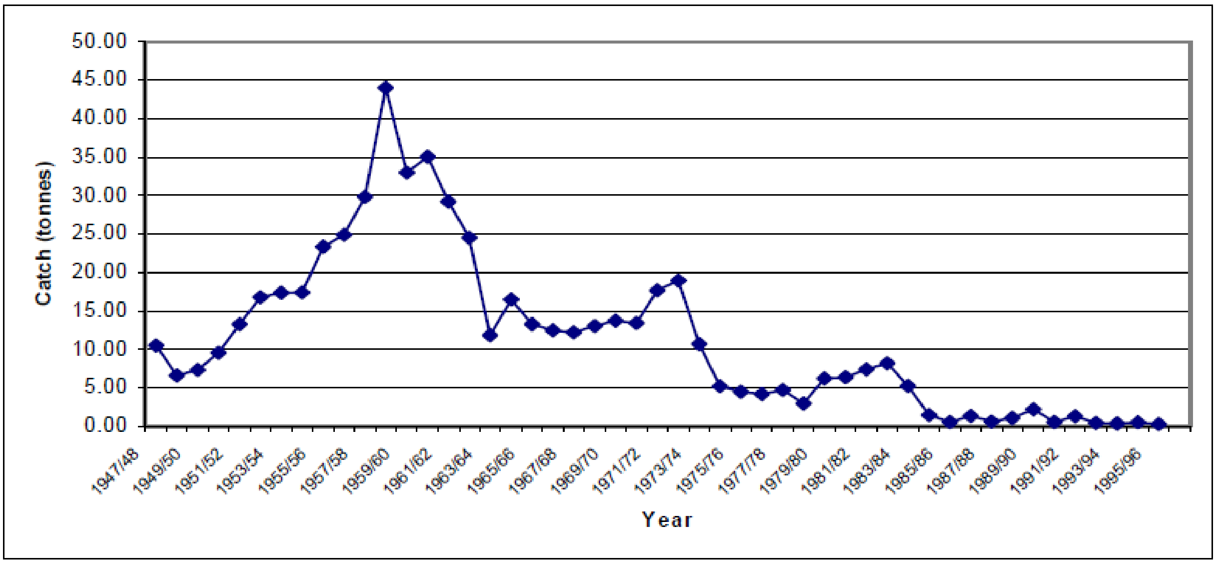

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Figure 1. Commercial catch of silver perch in NSW between 1947/1948 and 1995/1996 (NSW DPI, 2006).

Commercial catches for the South Australian inland fishery (i.e. South Australian reaches of the Murray River) from 1976/1977 to 1995/1996 show low levels of silver perch catch in the 1970s, followed by a brief, strong increase in silver perch catch in early 1980s, followed by a sharp decline in 1984/1985 and 1985/1986 to extremely low levels from which they have not recovered (Hammer et al., 2009) (Figure 2).

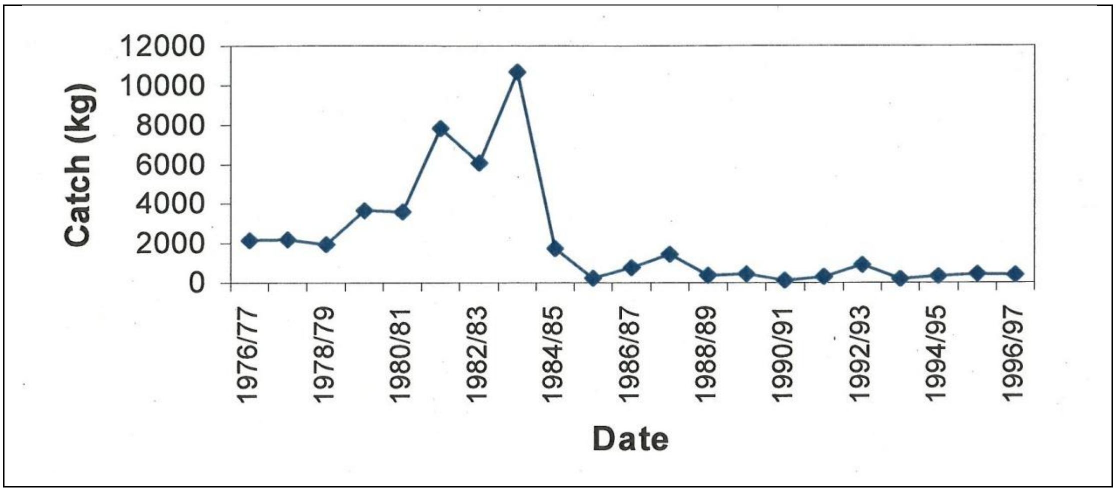

Figure 2. Commercial catch of silver perch in South Australia between 1976/1977 and 1995/1996 (Hammer et al., 2009).

Commercial fishing appears to have had a major impact up until the 1970s (Stuart, pers. comm., 2012). The interception and removal of large numbers of adult silver perch on their spawning runs by commercial fishers are likely to have impacted on silver perch stocks and contributed to their decline. However, the state inland commercial fisheries (that targeted native fish) were progressively closed in the 1990s and early 2000s.

The NSW Rivers Survey sampled 80 sites four times in two years (1995–1996) and recorded only seven silver perch in the Darling River system and only two silver perch (possibly stocked fish) in the Murray River system (Harris and Gerkhe, 1997). Records from NSW Fisheries' freshwater sampling database (1995–2003) show that silver perch account for less than 0.5 percent of fish records obtained by NSW Fisheries in all river systems except the middle Murray (NSW DPI, 2006).

The collapse of the strong silver perch population in Burrinjuck Reservoir of the ACT and the concomitant collapse of that population's annual summer migrations into the ACT reaches of the Murrumbidgee River is noteworthy. This collapse was captured in data from a fish-monitoring trap on the ACT reaches of the Murrumbidgee River at Casuarina Sands, in which silver perch captures declined from 252 specimens in 1984 to four in 1988 and zero in 1989 (Lintermans, 2000, 2002). (Severe drought impeded fish movement in the first three years of the trap's operation.) Since 1990, no silver perch have been recorded in the ACT reaches of the Murrumbidgee River in fish surveys and monitoring (ACT Government, 2012). Similarly, monitoring at two sites in Burrinjuck Reservoir in 2004 failed to locate any specimens (Gilligan, 2005).

Table 2. Captures of silver perch in fish trap at Casuarina Sands, ACT reaches of Murrumbidgee River (Lintermans, 2000, 2002).

Year	1981	1982	1983	1984	1986	1987	1988	1989	1990	1991
No. of silver perch	*severe drought*	*severe drought*	*severe drought*	252	10	42	4	0	0	0

Gilligan (2005) also sampled the length of Murrumbidgee River at sites based on previous NSW sampling records for silver perch. He recorded a single sub-adult silver perch at a single location (Willow Isles), and stated that this *'… corresponds to 10 percent of the sample of locations where they formerly existed'.*

Only one sizeable, self-sustaining population of silver perch is now found in the Murray-Darling Basin, in the middle reaches of the Murray River (including the Edwards/Wakool anabranches) from the base of Mulwala Weir to Torrumbarry Weir, and then to Euston Weir and downstream

(Mallen-Cooper and Stuart, 2003). Recent monitoring indicates this population now extends down to the South Australian border and up the lower Darling River (Gilligan, in prep., 2012).

Mallen-Cooper and Brand (1992) compared numbers of silver perch moving through the Euston Weir fishway from 1987–1992 (effectively measuring this middle Murray population) to J. O. Langtry's numbers from 1938–1942 and concluded there had been a 93 percent decline over 50 years. However, catch-per-unit-effort with electrofishing since 1994, at a single site near Euston fishway, suggests that in 2011 the population was 22 times more abundant than it was in 1994. This is considered to be 150 percent greater than in 1950 (Gilligan, in prep., 2012). Thus this middle Murray population appears to have undergone recovery.

Increased numbers of silver perch, particularly juveniles, are also reported in the Edward-Wakool anabranch system (Stuart, pers. comm., 2012) and recent records from the lower Goulburn and Ovens Rivers (VIC SAC, 2012), from which the species has long been absent. Preliminary catch-per-unit-effort data from sampling at 15 sites on the Murray River (from the base of Yarrawonga weir to the South Australian border) and the lower Darling River (base of Menindee Lakes to Murray River junction), between 1994 and 2001 indicate a statistically significant recovery in silver perch numbers (Gilligan, in prep., 2012) at these locations. These increases can be attributed to increased connectivity, as the majority of weirs and locks in the Murray River are now modified to allow effective fish passages, recent recruitment events (particularly the environment watering event in October–December 2005) and the large floods between 2010 and early 2012, allowing large-scale dispersal and recolonisation.

The same data, however, shows silver perch across other regions of NSW are at only eight percent of their 1950 abundance (Gilligan, in prep., 2012). No silver perch have been sampled by Fisheries NSW in the Bogan, Macquarie, Castlereagh, Gwydir, Culgoa-Narran, Warrego, Paroo or mid-Darling Rivers since 2002. Further, silver perch have only been sampled in a stocked impoundment in the Border Rivers catchment, and silver perch populations in the Namoi and Lachlan catchments are also largely only in stocked impoundments, with only small numbers or individuals collected from a small number of sites in the lower reaches of these catchments (Gilligan, in prep., 2012).

In South Australia the decline is to the point that the species is rarely seen and its distribution is now patchy (Hammer et al., 2009). PIRSA (2012) however note that a South Australian Inland Waters Recreational Fishery Survey (primarily based on telephone surveys of self-identified anglers) estimated that catch had increased from 3913 individuals in 2000–2001 to 22 662 in 2007–2008 across all regions of South Australia, but PIRSA (2012) also note that other sampling indicate individuals are at limited locations and uncommon below Lock 1 (i.e., Blanchetown, SA).

Lintermans (2007) reports that the first two sampling rounds of the Sustainable Rivers Audit (2004–2007) recorded only 20 silver perch from 351 randomly selected survey sites covering 16 river valleys across the Murray–Darling Basin. Davies et al. (2012) reports that fish sampling for the 2008–2010 audit across all 28 valleys of the Murray–Darling Basin (510 sites) found only 38 individuals in only eight valleys, and noted that this species was the only native species showing no evidence of recruitment.

In summary, the middle Murray population, now including the lower reaches of the Darling River, is the only population for which there is strong evidence of good numbers and indication of recovery. The cumulative evidence demonstrates that in all other reaches and catchments, wild silver perch have undergone severe declines, are rare or absent, and have not displayed measurable signs of recovery.

10. Public Consultation

The information used in this assessment was made available for public exhibition and comment for more than 30 business days (mid May to mid July 2012). No comments were received.

11. How judged by the Committee in relation to the criteria of the EPBC Act and Regulations

The Committee judges that the species is **eligible** for listing as **critically endangered** under the EPBC Act. The assessment against the criteria is as follows:

Criterion 1: It has undergone, is suspected to have undergone or is likely to undergo in the immediate future a very severe, severe or substantial reduction in numbers

For this criterion to be met, the population size of this species must have been observed, estimated, inferred or suspected to have declined by at least 30 percent over the last 41 years (three generations of the species), with this threshold value linked specifically in the Act to threats that may not have ceased or may not be reversible.

While silver perch was once a target fishery species, at the time there were no stock assessments undertaken to estimate the abundance of the species and the state of the stock. Wild silver perch are not currently a target species in any fishery and there are no current stock assessments. There are therefore limited data available to accurately estimate the total number of mature individuals during the 1970s, their current abundance and therefore the extent of their decline. However, several lines of evidence document a decline in wild silver perch of over 80 percent since 1972 (over the last 41 years and three generations of the species).

As summarised by NSW DPI (2006), silver perch was present throughout the Murray-Darling Basin including all states and sub-basins in numbers significant enough to be a commercial species in NSW, Victoria and South Australia. Between 1961 and 1975, for example, they were the fourth most important commercially exploited inland freshwater species (Pollard et al., 1980). During this period NSW accounted for the largest proportion of commercial catches of silver perch (68 percent), followed by South Australia (28 percent) and Victoria (4 percent) (Pollard et al., 1980).

Available commercial catch figures for silver perch show a relatively consistent decline from the early 1960s onwards in NSW (see Figure 1) and from the early 1980s onwards in South Australia (Clunie & Koehn, 2001). These include reductions in South Australia in catch from approximately 2 tonnes in 1976 to nil by 1986 (Hammer et al., 2009), and in New South Wales catches of approximately 14 tonnes in 1971 to nil by 1995. These reductions represent greater than 80 percent declines in states in which the species was most highly abundant.

Cumulative evidence demonstrates that in all other reaches and catchments except the middle Murray, wild silver perch have undergone very severe declines, and have either lapsed into localised extinction, or are rare and are not displaying measurable signs of recovery. Silver perch across other regions of NSW are at only eight percent of their 1950 abundance and no silver perch have been sampled in the Bogan, Macquarie, Castlereagh, Gwydir, Culgoa-Narran, Warrego, Paroo or mid-Darling Rivers since 2002 (Gilligan, in prep., 2012). In areas of NSW other than the middle Murray, this represents a decline of over 92 percent. In NSW, silver perch have only been sampled in stocked impoundments in the Border Rivers, and populations in the Namoi and Lachlan catchments are largely from stocked impoundments, with only small numbers or individuals collected from a small number of sites in the lower reaches of these two catchments (Gilligan, in prep., 2012). In South Australia the decline is to the point that the species is rarely seen and its distribution is now patchy (Hammer et al., 2009)

The middle Murray now represents the current core habitat for silver perch and its last sizeable, self-sustaining population in the wild (natural range). While this population appears to have rebuilt in numbers and, in some areas, may be at densities of up to 150 percent higher than estimated at 1950s, these areas are patchy (Lintermans, 2007) and not consistent across this middle Murray region. The middle Murray population represents a remnant population relative to the species' former functioning range (estimated in terms of catchment area at approximately 11.3 percent of its former Murray-Darling Basin range (DSEWPAC, 2013)). Recent surveys found that silver perch across the Murray-Darling Basin have failed to recruit during 2008–2010 drought conditions and that its current low densities may heighten the risk from extended recruitment failure in the future (Davies et al., 2012).

The Committee considers that while the threat of fishing has ceased, the threat to the species of river regulation, habitat degradation and resulting recruitment failure, disease, alien pathogens and competition with alien fish species is likely to continue to prevent recovery of the species in areas of its former range beyond the middle Murray. The Committee concludes that the species' population size has undergone an observed, estimated, inferred or suspected population reduction of greater than 80 percent. This is considered to be a very severe reduction in numbers, making the species eligible for listing in the critically endangered category under Criterion A2. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it **eligible** for listing as **critically endangered**.

Criterion 2: Its geographic distribution is precarious for the survival of the species and is very restricted, restricted or limited

For this Criterion to be met, the current extent of occurrence of the species is expected to be limited to less than 20,000 km^2, and/or the area of occupancy limited to less than 2000 km^2 ***and****: its geographic distribution must be precarious for its survival based on any* ***two*** *of the following: (a) severe fragmentation or occurrence at limited locations, (b) continuing decline observed, inferred or projected based on the degree of threat operating on the species (c) extreme fluctuation in extent of occurrence, area of occupancy, number of locations or subpopulations, number of mature individuals.*

Current core habitat for the last sizeable, self-sustaining silver perch population is defined as the Murray River, from the base of Mulwala Weir through to Torrumbarry Weir, through to Euston Weir, and then through to the South Australian border; the lower reaches of the Darling River, from the base of the Menindee Lake weirs through to its junction with the Murray River; and the Edwards/Wakool anabranch system. The waterways of the core habitat have a linear length of 1094.3 km (DSEWPAC, 2013). If average stream width of 50 m is assumed, this gives an area of occupancy estimate of 54.7 km^2, which is considered restricted under A2 of Criterion 2. Within this middle Murray area, the species is only patchily abundant (Lintermans, 2007).

Silver perch occurrences outside of this core habitat in the Border Rivers and in the Namoi and Lachlan catchments are in wholly and mostly stocked impoundments which do not recruit. The species' habitat has been fragmented with over 4000 barriers to fish movement in the Murray-Darling Basin in the form of dams and weirs and other structures (Lintermans, 2007). Occasional individuals of silver perch have recently been collected from a small number of sites outside of this region (lower reaches of the Lachlan and lower Namoi catchments below stocked impoundments) are extremely low in number, and of doubtful viability. Small numbers of individuals have been recently collected from a small number of sites in the lower reaches of these catchments (Gilligan, in prep., 2012) the lower Goulburn and lower Ovens Rivers of Victoria, but are absent from all other Victorian tributaries of the Murray (VIC SAC, 2012) and it is not known if these are self sustaining (VIC SAC, 2012). Individuals occur in South Australian reaches of the Murray River, but are at limited locations, and are described as '*uncommon below Lock 1*' [i.e., Blanchetown] (PIRSA, 2012) and '*rarely seen and its distribution is patchy*' (Hammer et al., 2009). It is doubtful that these individuals form a viable subpopulation in the South Australian reaches of Murray River.

Of all native fish, silver perch was considered to be the most notable failure to recruit in the recent 2008–2010 Murray-Darling Basin 'Sustainable Rivers Audit 2' (Davies et al., 2012). A total of 39 individuals were captured at 17 sites spread among eight valleys; but none were considered to be wild fish (i.e. they were considered to have originated from stockings). This was considered to potentially reflect the lack of appropriate flow signals during the drought conditions that prevailed during and immediately prior to 2008–2010. However, the species' low densities across its current range were considered by Davies et al. (2012) to heighten the risk from extended recruitment failure in the future.

While there are reports of the silver perch population rebuilding within areas of the middle Murray (Gilligan, in prep., 2012) — likely because of weirs in this area being made passable to the species again through the Hume to Sea fishway project and the 2005–2006 environmental watering event (King et al., 2008) — the species has demonstrated continued decline in numbers of individuals and number of locations across the Murray-Darling Basin, including in recent reports of number of individuals as evidenced in the 'Sustainable Rivers Audit 2' (Davies et al., 2012). This decline is projected to continue as a result of continual decline of habitats and altered water flows significantly impacting on spawning, larval survivorship and recruitment (PIRSA, 2012) and, the species' low densities across its current range heightens the risk of further decline from extended recruitment failure in the future (Davies et al., 2012). These severely fragmented populations, continued decline and projected further decline indicate the species' geographic distribution is precarious for the survival of the species.

Further, the middle Murray population has undergone an extreme fluctuation, with Mallen-Cooper and Brand (1992) concluding a 93 percent decline in the area of the Euston Weir Fishway over 50 years (1938–1942 vs. 1987–1992) and Gilligan (in prep., 2012) noting a 22-fold increase in this population over 17 years between 1994 to 2011.

The Committee considers geographic distribution of the silver perch's apparent remaining functioning populations to be restricted to the middle Murray region of its former range. Its geographic distribution is precarious for the survival of the species based on this limited location and continual and projected decline in number of individuals as a result of multiple threats including alien fish species, alien pathogens and habitat degradation. The Committee notes the silver perch population in the remaining core habitat has undergone an extreme fluctuation in number. The Committee is concerned about the long-term viability of populations surviving outside of the current core habitat because of continued threat of alien fish species, alien pathogens, river regulation, barriers that impede movement and interfere with drift of eggs and larvae, and habitat degradation and notes the risk of further decline from extended recruitment failure in the future. Therefore, the species meets the required elements of Criterion 2 and is **eligible** for listing in the **endangered** category under this Criterion.

Criterion 3: The estimated total number of mature individuals is limited to a particular degree; and either

(a) evidence suggests that the number will continue to decline at a particular rate; or

(b) the number is likely to continue to decline and its geographic distribution is precarious for its survival

For this criterion to be met, the estimated number of mature individuals of this species must be less than 10,000, and its rate of continuing decline is at least 10 percent in three generations, or there is a continued decline and its geographic distribution is precarious, having regard to the degree of threat operating on the species.

The Committee considers the silver perch's geographic range is precarious for its survival due to multiple threats including alien fish species, alien pathogens, river regulation, barriers that impede movement and interfere with drift of eggs and larvae, and habitat degradation.

While there is evidence the middle Murray population has recovered, and has increased in range recently, the evidence suggest that the limited number of other surviving silver perch populations are small and fragmented, and may not persist long term. Thus the species' extent of occurrence, and possibly total numbers, are likely to continue to decline.

However, as the middle Murray population has recovered to 150 percent of 1950 levels in some areas, and that between 1938 and 1942, J.O. Langtry recorded over 11,000 silver perch moving through the Euston Weir fishway, it is likely the total number of mature individuals in this population exceeds the highest threshold for this criterion of 10,000.

Therefore, while the silver perch's extent of occurrence, and possibly total numbers, are likely to continue to decline, and the species' distribution is precarious for its survival, the total numbers of mature individuals are likely to exceed 10,000. Therefore the species does not meet all of the required elements of Criterion 3 and is **not eligible** for listing in any category under this Criterion.

Criterion 4: The estimated total number of mature individuals is extremely low, very low or low

For this criterion to be met, the estimated total number of mature individuals of this species must be less than 1000.

No estimates are available for the total number of mature wild silver perch now present in the Murray-Darling system. Although cumulative evidence indicates wild silver perch have undergone a severe widespread decline in the Murray-Darling system, numbers of mature wild silver perch are certain to be greater than 1000, which is the highest threshold for this Criterion. Therefore, the species does not meet the required elements of Criterion 4 and is **not eligible** for listing in any category under this Criterion.

Criterion 5: Probability of extinction in the wild that is at least

(a) 50% in the immediate future; or

(b) 20% in the near future; or

(c) 10% in the medium-term future

For this criterion to be met, the probability of extinction of this species in the wild must be at least 10 percent in the medium-term future (within 100 years).

There are no data available to estimate a probability of extinction of the species in the wild over a relevant timeframe. Therefore, the species does not meet the required elements of Criterion 5 and is **not eligible** for listing in any category under this Criterion.

11. Conservation Status Conclusion

Bidyanus bidyanus (silver perch) was nominated by the Committee for inclusion in the list of threatened species referred to in section 178 of the EPBC Act. The Committee provides the following assessment of the species' eligibility.

The Committee considers that silver perch have undergone very severe declines (≥ 80 percent) over the majority of their range within the relevant time frame of 41 years. Therefore, the species is **eligible** for listing in the **critically endangered** category under Criterion 1.

The Committee considers the silver perch's estimated area of occupancy (core habitat) of 55 km^2 to be restricted. The Committee also considers the silver perch's geographic range is precarious for its survival due to multiple threats including alien fish species, alien pathogens, river regulation, barriers that impede movement and interfere with drift of eggs and larvae, and habitat degradation. Therefore, the species is **eligible** for listing in the **endangered** category under Criterion 2. (may need modification here)

The highest category for which the species is **eligible** to be listed is **critically endangered**.

12. Recovery Plan

There should be a recovery plan for this species. Only a National Recovery Plan can effectively coordinate attempts to re-establish lost, formerly significant populations through conservation stocking and translocation using broodfish sourced from the middle Murray region population, which may now have greater resistance to alien pathogens likely involved in the loss of original populations. Re-establishing formerly significant populations is a priority, because currently there is only one strong, viable natural population in the middle Murray region, which leaves the species vulnerable to extinction or further severe decline from catastrophic events. Coordination between the states, as facilitated by a National Recovery Plan, will also be important in fostering recovery actions generally. A National Recovery Plan will also more easily facilitate relevant monitoring, research and management of the current middle Murray region population.

13. Priority Conservation Actions

Research Priorities

Research priorities that would inform future regional priority actions include:

- Support and enhance existing native fish monitoring programs
    - Start a basin-wide monitoring program specifically for silver perch
- Further research into the recruitment ecology of silver perch, and the potential for managed flow events (both flood and within-channel) to facilitate silver perch spawning and recruitment
- Further research into how to avoid or minimise blackwater events during both natural and artificial flooding events
- Further research into alien pathogens, some possibly unidentified, that may be involved in past silver perch decline, including collection and examination of specimens from silver perch kills
- Investigate options to reduce the impacts of thermal pollution (i.e. un-naturally cold water released from the base of dams).

Regional Priority Actions

<u>Habitat Loss, Disturbance and Modification</u>

- Modify structures currently blocking migration of silver perch wherever possible (e.g. fishways on weirs)
- Avoid installing new structures that impede migration of all life stages of silver perch
- Avoid installing undershot weirs that kill drifting native fish larvae, and consider modifying current undershot weirs to an 'overshot' design
- Install screens at irrigation offtake/diversion points to reduce entrainment of silver perch eggs, larvae, juveniles and adults
- Manage any changes to hydrology that may result increased salinity, algal blooms, sedimentation or pollution.

<u>Flow Management</u>

- Return small daily variations to river flows, e.g. 0.15 m rises and falls, in standard river management instead of highly regulated flows to encourage spawning events.
- Initiate spring river rises for spawning.
- Explore the use of larger environmental flow events, particularly the use of environmental water to "top-up" natural flood events, to improve silver perch spawning (e.g. King et al., 2008).
- Avoid river management and environmental watering practices that may create or exacerbate blackwater events, including in terms of seasonality (i.e. late spring or summer flood events are more likely to create blackwater).

<u>Trampling, Browsing or Grazing</u>

- Develop and implement a stock management plan for important silver perch habitats to limit degradation by cattle trampling.

<u>Animal Predation or Competition</u>

- Develop and implement a management plan for alien fish species that affect silver perch, particularly carp (*Cyprinus carpio*) and gambusia (*Gambusia holbrooki*)
- Carefully consider potential impacts of fish stockings, including disease introduction, in any sites known to support wild silver perch.

Diseases, Fungi and Parasites

- Develop and implement suitable hygiene protocols to protect known sites from further outbreaks of EHN virus, Epizootic Ulcerative Syndrome (aka 'red spot disease') and parasitic protozoans such as *Chilodonella*, including from contaminated fish stockings
- Investigate control measures for *Lernaea* (aka 'anchor worm') and Asian fish tapeworm.

Conservation Information

- Raise awareness of silver perch within the community
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.

Local Priority Actions

Re-establish lost populations

- Attempt to re-establish lost, formerly significant populations (e.g. ACT reaches of Murrumbidgee River) through conservation stocking and translocation using broodfish sourced from the middle Murray region population, which may now have greater resistance to alien pathogens likely involved in the loss of original populations.

This list does not necessarily encompass all actions that may be of benefit to silver perch, but highlights those that are considered to be of highest priority at the time of preparing this advice.

Existing Plans/Management Prescriptions that are Relevant to the Species

NSW Recovery Plan for Silver Perch (2006)

Framework for Determining Commonwealth Environmental Water Use (2009)

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated versions.

14. Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the **critically endangered** category:

Bidyanus bidyanus

(ii) The Committee recommends that there should be a recovery plan for this species.

Threatened Species Scientific Committee

5 March 2013

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