National Recovery Plan
for the
Mallee Emu-Wren *Stipiturus mallee*, **Red-lored Whistler** *Pachycephala rufogularis*, **Western Whipbird** *Psophodes nigrogularis leucogaster*

Department of Environment, Land, Water and Planning

Australian Government

Department of Environment, Land, Water & Planning

State Government Victoria

Government of South Australia
Department of Environment, Water and Natural Resources

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Contents

Summary

In Australia, more than 80% of threatened birds are affected by a combination of habitat loss, fragmentation and/or degradation, with nearly half affected by altered fire regimes. In particular, fire-prone mallee habitats (semi-arid eucalypt woodlands <10m tall, in which individual trees are multi-stemmed) support a suite of threatened or near-threatened bird species (Brown *et al*. 2009, Woinarski and Recher 1997, Garnett and Crowley 2000). So while this Recovery Plan focuses on three songbirds occurring in inland south-eastern Australia: the Mallee Emu-wren (*Stipiturus mallee*), Red-lored Whistler (*Pachycephala rufogularis*), and eastern subspecies of the Western Whipbird (*Psophodes nigrogularis leucogaster*), recovery strategies identified in this plan are applicable to other mallee birds.

The Mallee Emu-wren occurs in north-western Victoria and eastern South Australia south of the Murray River, in the heart of an area known as the 'Murray Mallee'. The Western Whipbird occurs in the same region, with other populations on the southern tips of Yorke and Eyre Peninsulas. The Red-lored Whistler occurs in the Murray Mallee both north and south of the Murray River, with isolated populations in central-western New South Wales and the northern Eyre Peninsula.

Widespread clearing of the mallee landscape, and especially the selective clearing of mallee on fertile soils, was the initial leading cause of the decline of these species. Inappropriate fire regimes, particularly large-scale, frequent fire, currently pose the most significant threat to these threatened bird species. Grazing by mammalian herbivores, including domestic stock and native and feral animals, is further degrading remaining habitat. The Mallee Emu-wren is listed as Endangered, while the Red-lored Whistler and Western Whipbird are listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In New South Wales, the Red-lored Whistler is listed as Critically Endangered under the *Threatened Species Conservation Act 1995*. In Victoria all three birds are listed as Threatened under the *Flora and Fauna Guarantee Act 1988*. Victoria's threatened species advisory lists (DSE 2013) provide further detail on the conservation status of each species, with the Red-lored Whistler and Mallee Emu-wren classified as Endangered, and the Western Whipbird classified as Critically Endangered. In South Australia, the Mallee Emu-wren and the Western Whipbird are listed as Endangered and Red-lored Whistler is listed as Vulnerable under the *National Parks and Wildlife Act 1972*.

This Recovery Plan contains actions that will address these threats and should, within five years, reduce the rate of recent population declines, and initiate longer-term measures designed to ensure the persistence of viable breeding populations in south-eastern Australia. This will be achieved by addressing issues affecting habitat quality and connectivity, especially the extent and frequency of fires and total grazing pressure.

Species Information

Mallee Emu-wren

Description

The Mallee Emu-wren is a tiny bird, growing to about 14 cm in length (including the long filamentous tail) and 4-6 g in weight. The male has dark-streaked grey-brown upper parts and wings, a rufous crown, sky-blue face, brow, throat and breast, tawny buff underparts and a long brown tail. The female is duller in colouration and lacks the blue on the head and breast. The Mallee Emu-wren has an inconspicuous weak, high-pitched call (description from Higgins *et al.* 2001).

The species is insectivorous, but does not eat ants (Brown 2011). Birds mostly forage within large mature Spinifex Grass (*Triodia scariosa*) hummocks (Brown 2011), and occasionally on the ground or in low shrubs, to 50 cm above ground (Wilson 1912; Howe 1933; Schodde 1982; Rowley & Russell 1997). Little is known of breeding biology. Nesting has been recorded from September to November (Rowley & Russell 1997; Higgins *et al*. 2001). The nest is placed in a clump of Spinifex Grass, usually in the centre, and typically 15–45 cm above the ground (Schodde 1982; Rowley & Russell 1997). Two or three eggs are laid and incubated by the female (Howe 1933), with both parents probably feeding the young (Rowley & Russell 1997; Higgins *et al*. 2001). Usually one brood is raised per season, but a second brood may be raised in good seasons (Howe 1933; Schodde 1982), and birds can re-lay if the first clutch fails (Howe 1933).

Mallee Emu-wrens occur in groups of 1–5 birds (Brown *et al.* 2009), and breeding pairs have territories of about 5 ha (Brown 2011). The Mallee Emu-wren is a cryptic bird, spending most of the time close to the ground in dense cover. They are weak fliers and are probably largely sedentary (Schodde 1982; Emison *et al*. 1987), even though they are able to colonise new habitats up to six km away (Emison *et al*. 1987). Mallee Emu-wrens generally avoid small open patches and are unable or unwilling to traverse large open areas such as fire scars (Brown 2011). This severely limits their ability to disperse and recolonise nearby habitat. After breeding, territories probably break down and birds can form foraging groups through autumn and winter (Schodde 1982; Emison *et al*. 1987). For information on the biology of the Mallee Emu-wren, see Higgins *et al*. (2001).

Distribution

The Mallee Emu-wren is restricted to north-western Victoria and eastern South Australia, and does not occur in New South Wales (Schodde 1982; Menkhorst & Bennett 1990; Higgins *et al*. 2001; Brown *et al.* 2009) (Figure 1). In Victoria, it occurs in the Sunset Country south of a line from Berrook to Nangiloc to the Big Desert north of 36°S (Higgins *et al.* 2001) and east to a line linking Nangiloc to the north of Lake Hindmarsh, including Annuello Flora and Fauna Reserve (Cooper 1972; Schodde 1982; Emison *et al.* 1987; Higgins *et al*. 2001). Within this broad area its distribution is extremely patchy, and large areas of apparently suitable habitat appear to be unoccupied.

In South Australia, the Mallee Emu-wren occurred from Peebinga south to Comet Bore and west to Billiatt Conservation Park (north of Lameroo) and Carcuma Conservation Park (near Coonalpyn) (Eckert 1977; Hatch 1977; Close 1982; Carpenter & Matthew 1986; 1992; Higgins *et al*. 2001). The species was last recorded in Billiatt Conservation Park in 1987, though a small number persisted in a heritage agreement block contiguous with the park's edge until 2014 when the area burnt (Clarke 2005a, Allan and Hedger unpublished data).

The species is scattered very patchily within the Ninety-Mile Desert (Close 1982; Schodde 1982; Carpenter & Matthew 1992).

Population numbers

Since the last population estimate was made (Garnett and Crowley 2000), the Mallee Emu-wren has contracted in distribution with populations detected in only five of the seven reserves which they had occupied in 2000 (Brown *et al.* 2009). In Victoria, the Murray-Sunset National Park and adjacent State forests contain the vast majority of the Mallee Emu-wren population, with an estimated 15,709 individuals (range 7939–35,702) or 92% of the global population (Brown *et al.* 2009). Hattah-Kulkyne National Park supports a moderate population (526, range 238–1776) (Brown *et al*. 2009). Despite extensive surveys, just one pair was located in Wyperfeld National Park by Brown *et al.* (2009). However, a further four individuals were detected in Wyperfeld National Park in September 2014. Given that only six additional records have been obtained for this region since 1999 (Barrett *et al.* 2003), the Mallee Emu-wren is likely to be extremely rare in Wyperfeld National Park (Brown *et al*. 2009). Although the Mallee Emu-wren occurred in Bronzewing, Wathe and Annuello Flora and Fauna Reserves (Silveira 1999, P. Murdoch pers. comm.), Brown *et al.* (2009) and Watson (2001) concluded from their and others' surveys that the species is now extinct within these reserves.

From South Australia, Paton (2000) estimated that 4,000–7,000 birds occurred in Ngarkat Conservation Park, but subsequently reported a population decline of >90% in recent years due to extensive bushfires and droughts (D. Paton *pers. comm.*, 2005), resulting in a small population of fewer than 100 birds (Paton and Rogers 2007). An extensive fire (53,000 ha) in 2014 burnt through this population with surveys following the fire so far failing to locate any surviving birds (Allan and Hedger unpublished data). In 1988 a fire (60,000 ha) is thought to have brought about the extinction of the Mallee Emu-wren from Billiat Conservation Park in South Australia (Gates 2003). The small population persisting in a heritage agreement block on the northern boundary of the park was lost during a 2014 fire (73,000 ha) (Allan and Hedger unpublished data). Due to these 2014 fires the current situation for the Mallee emu-wren in South Australia is dire, with the species now likely extinct from both Billiatt and Ngarkat Conservation Parks (D. Paton pers. comm., 2014).

Habitat

The Mallee Emu-wren occurs mostly in areas of Spinifex Grass on low dunes, sometimes with an overstorey of low woodland including *Eucalyptus incrassata*, *E. dumosa*, *E. leptophylla*, *Callitris verrucosa* and low shrubs from the genera *Melaleuca*, *Leptospermum*, *Acacia*, *Hakea*, *Baeckia* and *Allocasuarina* (Howe 1933; Schodde 1982; Carpenter & Matthew 1986; Rowley & Russell 1997; Higgins *et al*. 2001). In the northern part of its range the species occurs mostly in Woorinen Sands Mallee and Loamy Sands Mallee vegetation types (Clarke 2005b; Brown 2011). In more southerly parts of its range the Mallee Emu-wren occurs in tall open heath and low mallee-heath (Clarke 2005b) dominated by *Leptospermum*, *Banksia* and *Allocasuarina* species, with Silver Broom (*Baeckia behrii*), Common Fringe-myrtle (*Calytrix tetragona*) and Grass-trees (*Xanthorrhoea semiplana*), and where areas of Spinifex Grass may be small or large (Hatch 1977; Carpenter & Matthew 1992; Rowley and Russell 1997). Nearly all remaining habitat occurs in conservation reserves on public land.

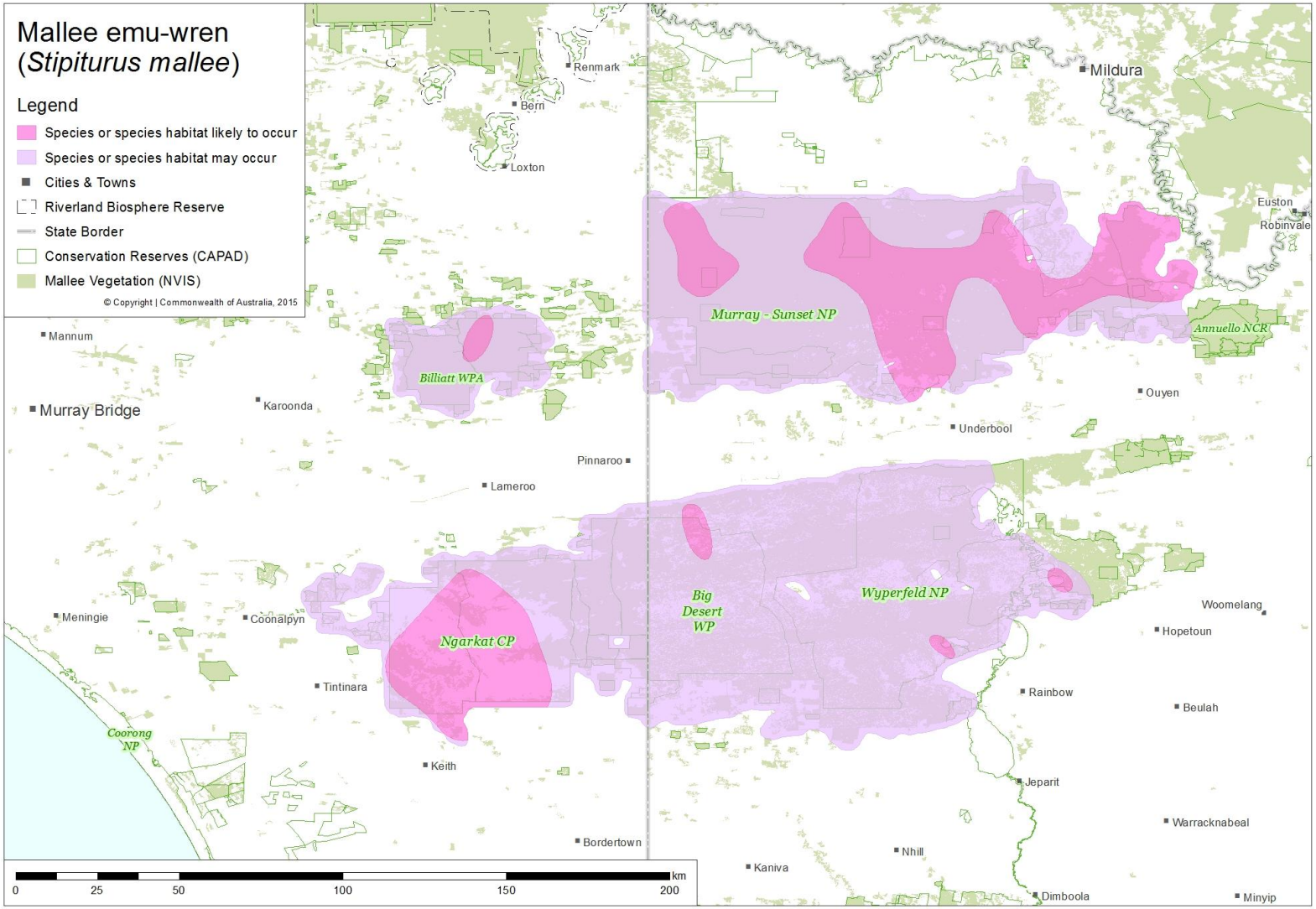

Figure 1. Potential distribution of the Mallee Emu-wren and its habitat. Detailed distribution information is available from the Department for Environment, Water and Natural Resources (DEWNR) South Australia) and the Department of Environment, Land, Water and Planning (DELWP) Victoria**.**

It has been suggested that the Mallee Emu-wren prefers dense stands of long-unburnt Spinifex Grass (Howe 1911, 1933, Howe and Tregellas 1914, Wilson 1912, Schodde 1982). However, the species has been recorded in an array of post-fire age-classes (Silveira 1993), including five years after fire (Garnett 1992). In other areas, habitat has not been recolonised until the Spinifex Grass formed large hummocks at least nine years after fire, reaching high densities after 19 years (Silveira 1993). Brown (2011) conducted a detailed assessment of habitat preferences and found that in Victoria, the Mallee Emu-wren exhibits a mixed response to fire age-classes and has a strong preference for mid to late successional stage vegetation, with highest densities in those areas that have not been burnt for 21-30 years. In the heath-dominated areas there appears to be a preference for habitats that have not been burnt for 10–29 years (Clarke (2005b; Connell *et al. in press*). Recent analysis of post-fire habitat (Connell *et al. in press*) indicate that Mallee Emu-wren is a Spinifex Grass specialist with preference for intermediate post fire vegetation growth stages of 21-30 years. Following bushfire events at Ngarkat Conservation Park and Bronzewing Flora and Fauna Reserve in January 2014, there have been recent population losses of the Mallee Emu-wren in Victoria.

Red-lored Whistler

Description

The Red-lored Whistler grows to 20 cm length and up to 37 g in weight. The male has dark grey upper-parts, orange-rufous throat and lores, orange-rufous under-parts except for a mid-grey band across the upper breast. The female is similar but paler above and below (Higgins & Peter 2002). Immature birds are brownish-grey with a rufous eyebrow and a pale throat. The species has a conspicuous song.

Red-lored Whistlers feed on arthropods, mainly insects, and very occasionally on seeds and fruit (Higgins & Peter 2002). The observation that birds mostly forage on or near the ground (Woinarski 1987), was not confirmed by Moise (2008) who found that Red-lored Whistlers in both Spinifex Grass (*Triodia*) mallee and mallee heath foraged mostly in the canopy by snatching and gleaning. The species breeds from August to October (Parsons & McGilp 1935; Higgins & Peter 2002), in areas where mallee eucalypts are 5–8 m tall and form an open canopy over a fairly dense shrub layer (Woinarski 1987; Matthew *et al*. 1996). Nests are built in mallee eucalypts, shrubs or on the top of a clump of Spinifex Grass, often <1 m above ground, and 2–3 eggs are laid which hatch in about 15 days.

The Red-lored Whistler has a very large territory of around 100 ha in Spinifex Grass mallee and 20 ha in mallee heath with about 30% overlap with neighbouring territories (Moise 2008). The species is generally solitary and its population density is low; about one bird per 50 ha (Woinarski 1987). Red-lored Whistlers are largely sedentary (Woinarski 1987; Higgins & Peter 2002, Moise 2008), although some autumn and winter movements may occur (Parker 1984). For information on the biology and ecology of the Red-lored Whistler, see Higgins and Peter (2002).

Distribution

The Red-lored Whistler is distributed from the northern Eyre Peninsula in South Australia to central-western New South Wales (Figure 2). However, within this area its distribution is very patchy, and large areas are not utilised because the habitat is apparently unsuitable (Woinarski 1987). Grazing impacts can render habitat unsuitable for >6 km around dams (Harrington 2002), exacerbating an already patchy distribution. In Victoria the species occurs in an area from around Broken Bucket Tank north-west of Yanac, north to Settlement Road

on the north edge of Murray-Sunset National Park and from the South Australia-Victoria border east to 143°E, which includes Annuello Flora and Fauna Reserve and occasional records in Hattah-Kulkyne National Park and near Lake Brambruk in Wyperfeld National Park (Higgins & Peter 2002; Watson 2011). Red-lored Whistlers are probably now locally extinct at Hattah-Kulkyne National Park and Bronzewing and Wathe Flora and Fauna Reserves (Clarke 2007a; Garnett *et al.* 2011).

In South Australia the species occurs from Mt Shaugh, Ngarkat and Mt Rescue Conservation Parks (Ninety-Mile Desert), west to Mount Boothby and Carcuma Conservation Parks, near Coonalpyn (Higgins & Peter 2002). There were many records in Billiatt Conservation Park (Carpenter and Matthew 1986; Matthew *et al*. 1996; Gates 2003) and they are widespread in and around the Riverland Biosphere Reserve in an area bounded by lines joining Calperum, Sandleton and Canegrass Stations (Eckert 1972; Pedler 1982; Matthew *et al*. 1996; Sluiter & O'Neill 1996; Higgins & Peter 2002). However, landscape-scale fires have reduced numbers substantially in recent years in Billiatt and Ngarkat Conservation Parks and the Riverland Biosphere Reserve (Clarke 2004a; Moise 2008; Allan, Hedger and Paton 2014 unpublished data). Farther west, they have been occasionally recorded near the lower reaches of the Murray River around Mannum, Murray Bridge, Ferries-McDonald Conservation Park and Lake Alexandrina (Matthew *et al*. 1996; Higgins & Peter 2002). The species is probably now locally extinct at Ferries-McDonald and Mt Boothby Conservation Parks (Garnett *et al.* 2011). A small isolated population in Pinkawillinie Conservation Park on the northern Eyre Peninsula (Matthew *et al*. 1995, 1996), which was partially burnt in 2005, has not been located again despite searching (Way 2007).

In New South Wales, Red-lored Whistlers chiefly occur in the central-western NSW mallee centred on Round Hill and Nombinnie Nature Reserves (Chapman 1990; Cooper & McAllan 1995; Higgins & Peter 2002). It is thought to have become locally extinct at Pulletop Nature Reserve in central New South Wales where it was last seen in 1982 (Garnett *et al.* 2011). There were also records during the 1980s from the Scotia Mallee west of the Darling River, at Scotia Sanctuary, Tarawi Nature Reserve and Springwood Station north of Wentworth (Blakers *et al*. 1984; Cooper & McAllan 1995; Barrett *et al* 2003), but targeted searches have failed to find Red-lored Whistlers in this region since 1996 (Mazzer *et al.* 1998; Clarke 2004b).

In summary, there have been numerous local extinctions of smaller populations across the Red-lored Whistler's range, coupled with periodic major reductions in larger populations due to landscape-scale fires. For example, both of Moise's (2008) study populations were largely eliminated by fires in Ngarkat Conservation Park and the Riverland Biosphere Reserve in 2006, with the latter fire covering 118,000 ha. Numerous fires in 2014 further reduced the larger populations, with Billiatt (73,000 ha), Ngarkat (53,000 ha) and the Riverland Biosphere Reserve (53,000 ha) all experiencing landscape-scale fires.

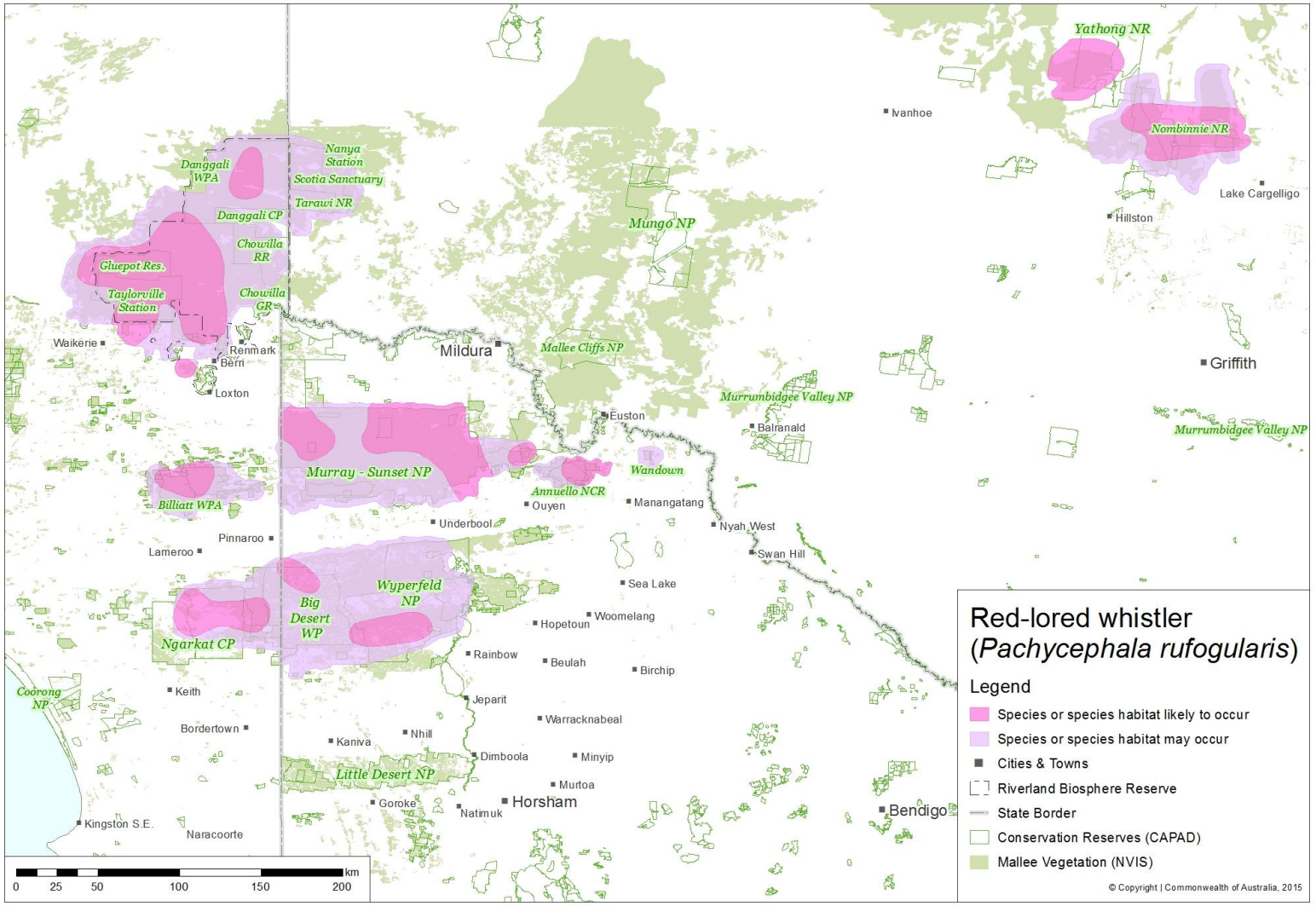

Figure 2. Potential distribution of the Red-lored Whistler and its habitat. Detailed distribution information is available from the Department of Environment, Water and Natural Resources (DEWNR) South Australia, the Department of Environment, Land, Water and Planning (DELWP) Victoria and the Office of Environment & Heritage (OEH), New South Wales.

Population numbers

Garnett *et al.* (2011) estimated the total breeding population to be no greater than 2,000 birds in six subpopulations, a marked reduction from the previous estimate by Garnett & Crowley (2000) of 10,000 birds in eight subpopulations. This reduction is largely due to numerous landscape-scale fires and drought conditions over the last decade.

The largest population of about 1,000 birds is probably north of the Murray River in South Australia's Riverland Biosphere Reserve (Garnett *et al.* 2011). There are now about 100–200 pairs in the Ngarkat/Big Desert/Wyperfeld complex and 100+ pairs in the Murray-Sunset/Hattah complex (Garnett *et al.* 2011). Population declines have been recorded at Billiatt, Mount Rescue and Ngarkat Conservation Parks, probably since the 1980s, and only the largest long unburnt tracts of mallee at these three locations remain occupied (Clarke 2004a). Given that there are only likely to be small numbers in central New South Wales, Garnett *et al.* (2011) revised the total population down to no more than 2,000 mature individuals. The South Australian fires in 2014 have likely reduced numbers in this state, with the species now probably eliminated from at least Billiatt Conservation Park, with few in Ngargkat Conservation Park.

Habitat

The Red-lored Whistler occurs in Spinifex Grass (*Triodia*) mallee, shrubland or mallee heath, mostly 2–5m tall and usually where the canopy is sparse, and with a sparse to moderately dense but patchy shrub layer (Carpenter & Matthew 1986; Woinarski 1987; Matthew *et al*. 1996; Sluiter & O'Neill 1996). Like the Mallee Emu-wren, the Red-lored Whistler prefers the Woorinen Sands Mallee ecological vegetation class in Victoria (Clarke 2007a). Moise (2008) showed that the Red-lored Whistler has strict habitat requirements with its distribution in both mallee and mallee heath limited by the presence of Spinifex Grass (*Triodia scariosa*). Red-lored Whistlers often nest on Spinifex Grass hummocks (Higgins and Peter 2002, Moise 2008). Dominant Eucalypt species include *Eucalyptus incrassata*, *E. dumosa* and *E. socialis*, with understorey shrubs including *Acacia* species, *Callitris verrucosa*, *Leptospermum coriaceum*, *Calytrix tetragona*, *Hakea muelleriana*, *Baeckea behrii*, *B. crassifolia*, *Phebalium bullatum*, *Leucopogon cordifolius*, *Banksia ornata* and Broombush (*Melaleuca uncinata*), and a ground cover of *Triodia scariosa* and species such as *Westringia rigida*, *Ptilotus* species and *Stipa* species (Matthew *et al*. 1995; 1996; Sluiter & O'Neill 1996). Birds are very occasionally recorded in tall mallee, eucalypt woodland and *Banksia* species scrub (Hackett & Hackett 1986; Cooper & McAllan 1995). The Red-lored Whistler appears to have one of the most specialised habitat requirements of all of the threatened mallee birds, and because their habitat is patchily distributed and the birds have very large home ranges, this specialisation results in low population densities (Clarke 2005b, Moise 2008). Much of the remaining habitat is in conservation reserves.

Red-lored Whistlers apparently do not recolonise areas until at least five years after a fire (Matthew *et al*. 1996). In the Big Desert mallee-heath, 63% of Red-lored Whistler records were in vegetation 21–40 years post-fire, with other records in long-unburnt habitat (Cheal *et al*. 1979), while studies in heath habitat indicated a preference for Broombush 3–30 years of age (Woinarski 1987, 1989). In the Sunset Country, the Red-lored Whistler was recorded from a range of early post-fire to long-unburnt vegetation (Cheal *et al*. 1979; Silveira 1993; Sluiter & O'Neill 1996), with areas that have remained unburnt for 21–44 years most important (Clarke 2005b; Connell *et al. in press*). In the Riverland Biosphere Reserve, the Red-lored Whistler has been recorded predominantly in long-unburnt mallee (Moise 2008), with habitats that have remained unburnt for 46–52 years most important, with some ability to utilise habitats last burnt 20–23 years ago. In heath-dominated mallee the species

appears to occupy more recently burnt habitats, with a preference for areas burnt 10–24 years ago (Clarke 2005b, Moise 2008).

In the Riverland Biosphere Reserve Red-lored Whistlers occur >6 km from water points and their associated grazing impacts (Harrington 2002). Moise (2008) also recorded this species only in areas that had experienced low grazing impacts.

Western Whipbird

Taxonomy

The taxonomy of the Western Whipbird is complicated and has been controversial (see Christidis & Norman 1999; Schodde & Mason 1999). As currently accepted, the species comprises four subspecies: nominate subspecies *nigrogularis*, occurring in the interior of southern Western Australia; subspecies *oberon*, occurring along the south coast of Western Australia; subspecies *lashmari*, confined to Kangaroo Island, South Australia; and subspecies *leucogaster*, occurring in South Australia (excluding Kangaroo Island) and Victoria. It is subspecies *leucogaster*, the eastern subspecies of the Western Whipbird, which is the subject of this Recovery Plan. For brevity, the common name Western Whipbird will be used from here on, but all comments apply only to the subspecies *leucogaster*.

Description

The Western Whipbird is a stoutly built bird growing to about 25 cm in length and 45 g in weight. It has a long graduated tail, short rounded wings and a short triangular erectile crest. Colouration is pale greyish olive above and pale grey below, with a white belly and olive-brown flanks, black throat bordered by white streaks and the outer tail feathers tipped with white (Pizzey & Knight; Higgins & Peter 2002).

The Western Whipbird is a shy and elusive bird that dwells mainly on the ground in dense, low shrubbery and is usually only detected by its call. It is probably sedentary (Condon 1966; Higgins & Peter 2002), a weak flier (Smith 1991), and has restricted dispersal ability across areas cleared of vegetation (Woinarski *et al*. 1988). Near Malinong in South Australia territories were estimated at less than 20 ha (Woinarski *et al*. 1988). In north-western Victoria three pairs occupied an area of about eight km², with several hundred metres between nests (Howe & Ross 1933). One male at Pinnaroo moved within a circular area of about 12 ha (McGilp & Parsons 1937).

The Western Whipbird feeds on arthropods including spiders and insects (McGilp & Parsons 1939; Condon 1966). Most food is obtained by foraging on the ground, although they will also forage in low shrubs (Condon 1966). Nesting has been recorded in September and October (Howe & Ross 1933; Bryant 1938; Howe & Burgess 1942; Woinarski *et al*. 1988), with nests usually built within 50 cm of the ground, in dense shrubs, Spinifex Grass (*Triodia*), sedge (*Lepidosperma* species) clumps or the crowns of the grass-tree (*Xanthorrhoea semiplana*) (Howe & Ross 1933; Woinarski *et al*. 1988, Higgins & Peter 2002). Two eggs are laid that hatch in about 21 days, and the nestling period is about 12 days (Higgins & Peter 2002). There is no information about life-span or fecundity. For information on the biology and ecology of the Western Whipbird, see Higgins and Peter (2002).

Distribution

The eastern subspecies of the Western Whipbird occurs in South Australia and Victoria, in three widely separated areas – the Murray Mallee region of Victoria and South Australia, and on the Eyre and Yorke Peninsulas of South Australia (Figure 3). In Victoria it was confined to the Big Desert and Sunset Country, but there have been no confirmed records since 1974 (Hunt & Kenyon 1970; Hunt 1976; Higgins & Peter 2002), although there were unconfirmed reports from 1979–1985 (Woinarski *et al*. 1988). It may now be extinct in Victoria (Garnett *et al* 2011), following fires since 2000 in remaining suitable habitat, and targeted searches that have failed to find it (Clarke 2007a). In the South Australian Murray Mallee, the Western Whipbird occurs in an area from Billiatt Conservation Park south to the Ninety-Mile Plain, Ngarkat Conservation Park, and other nearby conservation parks including Mt Rescue. They are occasionally recorded farther west in an area bounded by Coomandook, Coonalpyn and Meningie, and farther north-west around Malinong (Hatch 1977; Carpenter & Matthew 1986; Woinarski *et al*. 1988; Higgins & Peter 2002; Clarke 2004a). On the Yorke Peninsula, the Western Whipbird is confined to the southern tip, in Innes National Park and Warrenben Conservation Park (Condon 1966; Mack 1967; Higgins & Peter 2002). On the Eyre Peninsula, it occurs in Lincoln and Coffin Bay National Parks in the south (McNamara 1966; Higgins & Peter 2002).

Population numbers

The total population has been estimated at about 6,000 mature birds. The largest subpopulation of about 5,000 birds is on southern Eyre Peninsula, with most of the remainder on southern Yorke Peninsula (Garnett *et al.* 2011; Johnson 2011). There are possibly <100 birds in South Australia's Murray Mallee, with large fires in Ngarkat and Billiat Conservation Parks having reduced the already small populations (Gates 2003; Clarke 2004a; Garnett *et al*. 2011). Again, these populations have likely been reduced further after the 2014 landscape-scale fires in Ngarkat and Billiat Conservation Parks (Hedger and Paton 2014 pers. comm.).

Habitat

The Western Whipbird occurs in mallee scrub on sandy flats, dunes or limestone, with an overstorey of mallee eucalypts including *Eucalyptus incrassata, E. socialis, E. leptophylla* and *E. diversifolia*, and a dense species-rich understorey comprising shrubs such as *Melaleuca lanceolata, M. uncinata* and *Baeckia behrii, Callitris verrucosa, Allocasuarina* spp., *Hakea muelleriana, Leptospermum coriaceum*, and *Triodia irritans*, and also in *Acacia* species thickets (Carpenter & Matthew 1986; Woinarski *et al*. 1988; Higgins & Peter 2002). Most of the remaining habitat occurs in conservation reserves.

Habitat structure rather than floristics appears to be the most important factor determining habitat preference (Smith 1991). Preferred habitat consists of a dense shrubby understorey 1.5–2 m tall below an open mallee eucalypt layer 2–5 m tall (Woinarski *et al.* 1988; Higgins & Peter 2002). Age post-fire is also important. Western Whipbirds have been recorded in vegetation of 2–40+ years post-fire age, but are most often recorded in vegetation 10–25 post-fire (Woinarski *et al*. 1988). At Billiatt Conservation Park birds were recorded in mallee vegetation burnt six years previously, but not recorded at the same site in the first five years post-fire (Matthew, J.S. *pers. comm*., 2005). In Mt Rescue Conservation Park, four of the seven individuals detected between 1999 and 2003 were in long-unburnt (>40 years) mallee (Clarke 2005a).

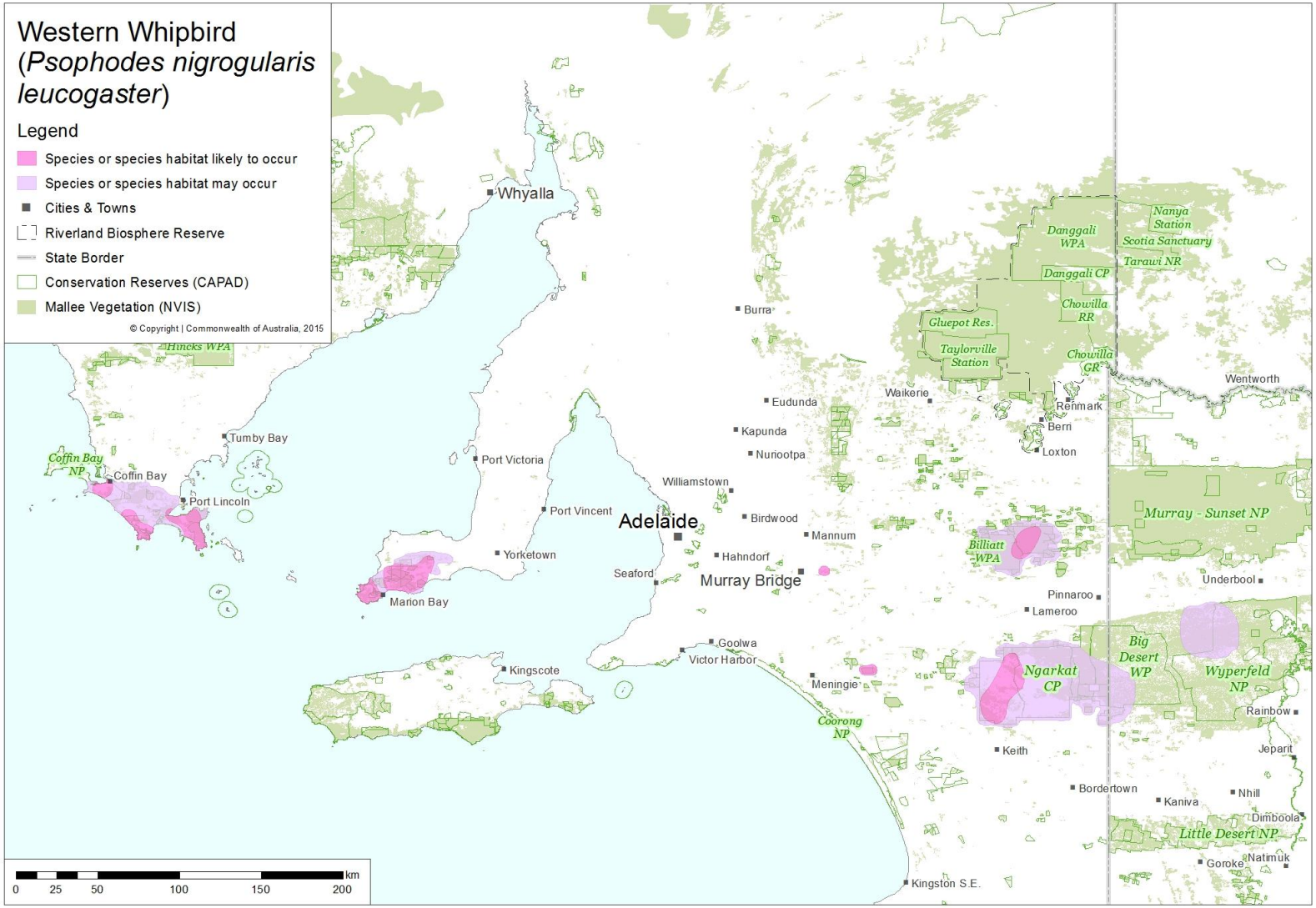

Figure 3. Potential distribution of the Red-lored Whistler and its habitat. Detailed distribution information is available from DEWNR (for South Australia) and DELWP (for Victoria).

Decline and Threats

The Mallee Emu-wren, Red-lored Whistler and Western Whipbird have all suffered substantial declines in range and abundance, and this decline is continuing.

Mallee Emu-wren: In Victoria this species has disappeared from substantial portions of its former range. There have been no records from Yanac or east of Hopetoun since the early 1900s (Howe 1911; Chisholm 1946; Emison *et al*. 1987), none from Wathe Flora and Fauna Reserve since the 1960s, none from Bronzewing Flora and Fauna Reserve since the 1970s, and only six records from Wyperfeld National Park since 1999 (Brown *et al.* 2009). A major decline in distribution and abundance has also occurred in South Australia. The large population in Ngarkat Conservation Park has significantly declined to just 20-60 territories (Brown *et al.* 2009) with the 2014 fire likely removing all these birds, and the species has disappeared from Pinnaroo and Nadda (Eckert 1977). Searches of previously known locations and elsewhere in Billiatt Conservation Park failed to locate any birds (Gates 2003; Clarke 2004a) with the small population on the park's boundary eliminated during the 2014 fire.

Red-lored Whistler: Numbers of Red-lored Whistlers have more than halved (Garnett & Crowley 2000). The species has not been recorded at Pulletop Nature Reserve in New South Wales since 1982 (Garnett *et al.* 2011), and was not recorded in surveys in south-western New South Wales (Mazzer *et al.* 1998; Barrett *et al*. 2003). Landscape-scale fires have caused a substantial decline in numbers in Billiatt, Mt Rescue and Ngarkat Conservation Parks in South Australia (Clarke 2004a, Paton and Hedger pers. comm.), with a few birds occurring in only the largest unburnt tracts of intact mallee. In 2006, a 118,000 ha fire reduced numbers substantially in the Riverland Biosphere Reserve (Moise 2008).

Western Whipbird: There has been a substantial contraction and fragmentation of the range of the Western Whipbird (Garnett & Crowley 2000). In Victoria there are historical records from near Manya and Murrayville (Howe 1928; Howe & Ross 1933; Bryant 1938; Howe & Burgess 1942; Chisholm 1946; Woinarski *et al*. 1988), but there have been no confirmed records anywhere in the State since 1974. In South Australia, on the Eyre Peninsula, birds formerly occurred as far north as Cockaleechie, but have disappeared from there (Condon 1966). In the Murray mallee, they have not been recorded from around Peebinga since 1940 (Condon 1966). There are just four records from the Billiatt region, with several areas formerly occupied now apparently abandoned (Gates 2003; Clarke 2004a).

Major threats

Major threats to the Mallee Emu-wren, Red-lored Whistler and Western Whipbird include clearing, frequent and extensive fires, habitat fragmentation and isolation, declining habitat quality, introduced predators and climate change.

Clearing

Widespread clearing and fragmentation of mallee habitats, especially the selective clearing of mallee on fertile soils, was the major cause of the initial declines of the Mallee Emu-wren, Red-lored Whistler, Western Whipbird and other threatened mallee birds (Schodde 1982; Parker 1984; Woinarski 1987; Blakers & MacMillan 1988; Woinarski *et al.* 1988; Cooper & McAllan 1995; Rowley & Russell 1997; Silveira 1993; Garnett *et al.* 2011). Although much of the clearing occurred decades ago, substantial clearing has occurred in more recent times, especially in New South Wales, where over 19,000 ha was cleared in the three years to December 2002 (DLWC 2001, 2002). The Red-lored Whistler has apparently disappeared

from Pulletop Nature Reserve in New South Wales since 1982 (Chapman 1990), due to continued clearing around the reserve.

The Yellow-throated Miner (*Manorina flavigula*) is an aggressive species that has expanded its range in response to the clearing of native vegetation in the landscape (Mac Nally *et al*. 2014). It may be responsible for the displacement of some mallee birds (Grey 1996), particularly smaller-bodied species in the same way that the Noisy Miner (*Manorina melanocephala*) excludes other birds (Grey *et al*. 1997, 1998, Mac Nally *et al*. 2014).

Inappropriate Fire Regimes

The greatest current threat to existing populations of mallee birds is inappropriate fire regimes that lead to loss, fragmentation or degradation of suitable habitat either immediately or over time. While periodic fire in mallee habitats is an ecological necessity (Gill *et al.* 1999), large fires also pose a significant risk to threatened birds (Garnett *et al.* 2011). Mallee is one of the most fire-prone environments in Australia and may be capable of supporting a bushfire every 10–20 years (Noble 1984). Single bushfires can burn hundreds of thousands of hectares (Noble 1984; Clarke & Clarke 1999), and these landscape-scale fires can effectively remove, at least temporarily, vast areas of habitat. Regeneration is slow and it can be decades before the habitat becomes suitable for certain species once again (Benshemesh 1990; McLaughlin 1992; Silveira 1993). Large, hollow-bearing mallee stems are in short supply or absent from most areas because such stems are likely to have been growing for over 100 years since the last fire (Gibbons & Lindenmayer 2002).

The threat posed by bushfire relates to the extent and frequency of fires. Avitabile *et al.* (2013) used satellite imagery to map fires in the Murray Mallee over 35 years from 1972–2007. In total, 1,060 separate fires were identified, but the bulk of the areas burned during this period (84%) occurred during 16 fires that were each >10,000 ha. Three of these fires burned over 100,000 ha. These large, infrequent fires shape the age distribution of the vegetation's fire age classes across the region (Avitabile *et al.* 2013). Very little mallee vegetation (<3% of the area) was burnt more than once between 1972–2007. Thus, at a landscape-scale, fire is relatively common but it is infrequent at any particular location. Some areas remain unburnt for >100 years (Avitabile *et al.* 2013). The area of suitable mallee habitat available for Mallee Emu-wrens, Red-lored Whistlers and Western Whipbirds has been greatly reduced and fragmented by historical clearing, and while fragmentation may afford some protection against extensive fires by containing fires, it also reduces total population sizes and exacerbates the negative impacts of large fires through isolating populations, particularly of Mallee Emu-wren and Western Whipbird.

Nowadays, extensive bushfires leading to further population fragmentation is the greatest risk the three species face, and all three species have declined markedly in recent decades due to the effects of large bushfires on habitat availability (Silveira 1993; Brown *et al*. 2009; Garnett *et al.* 2011). The low dispersal abilities of Mallee Emu-wrens and Western Whipbirds may limit their ability to recolonise isolated patches of habitat after fire (Woinarski *et al.* 1988; Garnett & Crowley 2002, Brown *et al.* 2009).

The time between fires is also a key issue for the conservation of threatened mallee birds. None of the 28 mallee species studied by Taylor *et al*. (2013) were positively associated with landscapes with extensive recently burned (<10 years) vegetation. Habitats of 1–15 years post-fire age are not central to the needs of any threatened mallee bird (Clarke 2005b), and numbers of Mallee Emu-wrens, Red-lored Whistlers and Western Whipbirds increase in habitats >15 years post-fire (Carpenter & Matthew 1986; Woinarski 1987, 1989, Moise 2008, Brown *et al.* 2009). More broadly, of the threatened birds in Australia whose relationships

with fire have been comparatively well-documented, almost all show a clear preference for less frequent fires (Woinarski & Recher 1997).

The key to reducing risks from fire to threatened birds centres on preventing the loss of known populations and available habitat as a result of extensive bushfires and focusing on the requirements of species that are known to be sensitive to fire, rather than managing for overall species richness (Bennett *et al.* 2010). Maintaining threatened birds that are vulnerable to habitat fragmentation and fire needs to involve landscape-scale management (Woinarski & Recher 1997). Ensuring a continuous provision of mid-age vegetation in the landscape, while also maintaining extensive areas of older vegetation appears to be an appropriate management strategy, benefiting most mallee bird species (Watson *et al*. 2012b, Taylor *et al*. 2013). Employing planned fires that maintain unburnt patches will further benefit mallee birds, with the unburnt patches providing important refuges and sources of recolonisation (Watson *et al*. 2012a).

Habitat fragmentation and isolation

Isolation of small populations exposes them to a high risk of extinction, with successive regional extinctions leading to declines over wide areas, as demonstrated by many threatened mallee birds (Saunders & Ingram 1995; Luck *et al.* 1999a, b; Garnett *et al.* 2010). Many of these birds are sedentary, with relatively poor dispersal abilities (Garnett & Crowley 2000; Higgins *et al.* 2001; Higgins & Peter 2002; Brown *et al.* 2009). Where blocks of mallee are largely surrounded by cleared land, numbers of Mallee Emu-wrens (Possingham & Possingham 1997; Gates 2003; Brown *et al.* 2008), Red-lored Whistlers (Chapman 1990; Clarke 2004) and Western Whipbirds (Condon 1966; Woinarski *et al*. 1988; Possingham & Possingham 1997) have declined to extinction. Clarke (2004a) found that Red-lored Whistlers and Western Whipbirds still occurred in Billiatt Conservation Park (59,000 ha), but no longer occurred in 13 nearby remnants (180–1,500 ha) with suitable habitat. The Mallee Emu-wren had been previously extirpated from Billiatt by a large bushfire (Brown *et al.* 2009). The Red-lored Whistler has disappeared from the 145 ha Pulletop Nature Reserve (Boles 1988; Chapman 1990). At the landscape scale, remnants need to be linked so that dispersing birds have a greater chance of recolonising suitable habitat.

Declining habitat quality

Grazing

Grazing by mammalian herbivores, including domestic stock, native species, and feral animals, is a primary cause of habitat degradation in Australia, and ground-dwelling fauna are particularly at risk from grazing impacts (Reid & Fleming 1992; Smith & Smith 1994; Smith *et al.* 1995). Grazing removes understorey plants, prevents tree regeneration, modifies vegetation structure and leads to soil disturbance and erosion, decreased leaf litter cover, and a reduction in invertebrate diversity and abundance (Ford *et al.* 2001). Grazing of mallee, often in the remnant patches, is widespread on public and private land. About 90% of mallee in New South Wales and 20% in South Australia is public land under pastoral lease (Choate 1990). In areas grazed by Sheep (*Ovis aries*), Malleefowl (*Leipoa ocellata*) densities were reduced by 85–90% compared to similar ungrazed habitats (Frith 1962). Grazing also has a negative impact on Mallee Emu-wrens (Schodde 1982), and is an important cause of decline in the Striated Grasswren (*Amytornis striatus*), Southern Scrub-robin (*Drymodes brunneopygia*), Shy Heathwren (*Hylacola cauta*) and Chestnut Quail-thrush (*Cinclosoma castanea*) (Boehm 1955; Mack 1970; Schodde 1982; McAllan 1987; Saunders & Ingram 1995; Smith *et al.* 1995; Harrington 2002).

Artificial water points

The greatest influence on grazing intensity in the arid and semi-arid rangelands, and hence the level of degradation, is the availability of water (Landsberg *et al.* 1997). Grazing intensity is high 0–4 km from water, moderate 4–8 km away, and barely discernible beyond 10 km from a water point (James *et al.* 1999). Before the introduction of artificial watering points, most mammalian herbivores were restricted to areas with a permanent natural water source, occasionally expanding their range by using temporary water points following heavy rain (Fisher *et al.* 1972). Nowadays, as little as 3–8% of the rangelands is more than 10 km from a water point (Landsberg & Gillieson 1996). The optimal habitat for birds that are negatively affected by artificial water points could have been reduced to as little as 3% of their former extent (Harrington 2002). Red-lored Whistlers were only found >6 km from artificial water points (Harrington 2002).

The introduction of artificial water points in mallee habitats has also increased the area available for more water-dependent birds that may pose a risk to threatened mallee birds through predation or competition for food and habitat. Water-dependent birds, that is species that require daily access to drinking water, made up only 25% of the species composition, but comprised 75% of the total number of individuals recorded in Riverland Biosphere Reserve and Murray-Sunset National Park (Harrington 2002). Some of the more numerous water-dependent birds are predators such as corvids and raptors (Harrington 2002) that may increase predator pressures on threatened species and their nests (Luck *et al.* 1999b). Competitive or aggressive displacement can contribute to the decline of birds (Dow 1977; James *et al.* 1999).

Mallee tree harvesting

Several tree harvesting operations exist within mallee, particularly in New South Wales. Some mallee eucalypts are harvested to produce eucalyptus oil, charcoal and didgeridoos, whilst Broombush (*Melaleuca uncinata*) is harvested for brush fencing. Harvesting mallee poses several threats, with frequent harvesting leading to the removal of the mid-late growth stage mallee vegetation preferred by many threatened mallee birds. The need to construct temporary tracks to facilitate harvesting allows easier access by introduced predators and herbivores, and increases the likelihood of introducing weeds and pathogens such as Cinnamon Fungus (*Phytophthora*).

Predators

Many threatened mallee birds forage on the ground, and introduced predators such as the feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) have had a marked impact on species such as the Malleefowl (Priddel & Wheeler 1995; Smith *et al.* 1995; Garnett & Crowley 2000). Foraging on or near the ground may make Red-lored Whistlers, Mallee Emu-wrens and Western Whipbirds vulnerable to introduced predators. Native predators such as currawongs (*Strepera* spp.) and ravens (*Corvus* spp.) may be exerting increased pressure on threatened birds in remnants with high edge to area ratios (Gardner 1998; Major *et al*. 1996; Luck *et al.* 1999b) and with artificial water points.

Climate Change

Projections for the future climate of the Mallee include increased frequency of hot days, higher annual mean temperature, reduced average rainfall and stream flows, and fewer and heavier rainfall days (DECCW 2010; DSE 2012; Siebentritt *et al.* 2014).

These projections suggest an increased risk of bushfires, heatwaves, floods and drought (DSE 2012). As a result, the availability of food resources may decline, reducing the area of habitat suitable for mallee birds and further increasing the risk of isolation. Habitat specialists such as the Mallee Emu-wren, or species with geographically isolated distributions or disjunct populations such as the Red-lored Whistler and Western Whipbird, may be particularly susceptible to climate change and are predicted to experience severe contractions in geographical range (Brereton *et al.* 1995).

Recovery Information

Current Conservation Actions

The decline of and threats to mallee birds have been the impetus for the following work during the last two decades:

- The area of mallee reserved in New South Wales has more than doubled to c.450,000 ha, with most of the increase due to Nombinnie and Tarawi Nature Reserves and the privately-owned Scotia Sanctuary.
- The purchase of Calperum, Gluepot and Taylorville Stations during 1994–99 by non-government organisations and the Commonwealth Government has reserved a substantial (>400,000 ha) area of mallee in South Australia that has a large population of Red-lored Whistlers, contains the core of the Black-eared Miner's (*Manorina melanotis*) range (Baker-Gabb 2001, 2007), and significant populations of other threatened birds.
- About 164,000 ha of mallee has been added to the reserve system in South Australia.
- Victoria's mallee reserves increased from 313,000 ha to over 1.1 million hectares.
- Fire management plans are in place and regularly reviewed for all government reserves across the three Murray Mallee states, as well as for large non-government reserves in the Riverland biosphere Reserve and Scotia Sanctuary. A strategic bushfire management plan is currently being developed for the Mallee and Murray Goulburn Bushfire Risk Landscape, in accordance with objectives outlined under the Code of Practice for Bushfire Management on Public Land (DSE 2012b).
- Surveys of mallee biodiversity with management recommendations in New South Wales (e.g. Mazzer *et al.* 1998; Val *et al.* 2001), Victoria (e.g. Robertson *et al.* 1989), and South Australia (e.g. Forward & Robinson 1996).
- Surveys of threatened mallee birds in South Australia (Gates 2003; Clarke 2004a), Victoria (Clarke 2007b, b; Brown *et al.* 2009; Watson 2011), and New South Wales (Clarke 2002; Clarke 2004b).
- Landscape-scale habitat suitability modelling for a suite of threatened mallee birds in South Australia, New South Wales and Victoria (Clarke 2005b).
- Research on habitat including post-fire age preferences of threatened mallee birds (Woinarski 1987; Woinarski *et al.* 1988; Silveira 1993).
- Research on flora and fauna of Ngarkat Conservation Park, with emphasis on responses to fire, by Adelaide University (e.g. Moseby 1993; Stewart 1995; Paton 2000; Ward & Paton 2004).
- During 2004-2009, La Trobe and Deakin Universities co-ordinated a major investigation, the ‘Mallee Fire and Biodiversity Project’, into the effects of fire on wildlife in a 104,000

km² study area spanning the three Murray Mallee States, involving seven PhD students, senior researchers, a coordinator, and >100 volunteers (Bennett *et al.* 2010). Subsequently, the then-Department of Environment and Primary Industries funded a continuation of this project in Victoria as 'Mallee HawkEye' 2011-2014. Much of this work is now published, with major implications for the management of fire and fauna in the Murray Mallee. The results within Haslem *et al*. 2010a, 2010b, Taylor *et al*. 2012, Watson *et al*. 2012a, 2012b, Taylor *et al*. 2013 and Avitabile *et al*. 2013 have implications relevant to Mallee Emu-wren, Red-lored Whistler and Western Whipbird. For a full listing of publications from this work see: http://www.latrobe.edu.au/zoology/research/specialisations/fire-ecology/projects/mallee-fire-and-biodiversity/publications

- NSW OEH has assigned the red-lored whistler to the site-managed species management stream under the *Saving our Species* program. Two sites have been identified for recovery action; the first comprises the Nombinnie Nature Reserve and State Conservation Area and Round Hill Nature Reserve, and the second site comprises Scotia Sanctuary, Tarawi Nature Reserve, Nanya Station and some private property. Proposed actions at the first site include to reduce and maintain a low density of feral goats, reduce the risk of adverse fire, and monitor species abundance and condition. These actions align with those within this recovery plan. The proposed action at the second site is to determine the area of occupancy of the species using targeted surveys.

Other actions such as native vegetation clearance controls may also be of benefit to the Mallee Emu-wren, Red-lored Whistler and Western Whipbird. This has been particularly important for the retention of large blocks of mallee and the corridors between isolated patches (e.g. action to reserve and enhance the link between Hattah and Annuello blocks, and between Hattah and the Sunset Country in north-west Victoria). A range of other measures such as improved fire management regimes and decommissioning of artificial water points in reserves have benefited these mallee birds, though often not specifically targeted at them. A number of reserves and national parks have been established to provide biodiversity and community benefits within the range of the Mallee Emu-wren, Red-lored Whistler and Western Whipbird.

Strategy for Recovery

Despite now having over 2.5 million hectares of the Murray Mallee in reserves, populations of almost all threatened mallee birds are still declining (Garnett *et al.* 2011). Therefore, addressing issues affecting habitat quality, especially the extent of fires and the number of years between consecutive fires, and total grazing pressure, are the priorities for attention in this Recovery Plan. Ensuring that land managers attain and implement the most appropriate fire regimes for threatened birds (i.e. those that provide an array of post-fire age classes, with an emphasis on maintaining large areas of mid to late successional stage (at least >15 years) mallee and heath), and reduce the impact of grazing on habitat, are important outcomes of this Plan. Restricting access to or closing artificial water points is the best way of reducing grazing pressure and enhancing biodiversity conservation (Landsberg *et al.* 1997), and will greatly assist conservation of threatened mallee birds. Control of predators to protect key habitat areas, particularly cats, is also important.

Further studies are needed to determine the reserve area and size of subpopulations that must be actively managed to retain genetic diversity of threatened mallee birds, and what constitutes a functional corridor between remnants. Studies such as those of Freudenberger *et al.* (1997) on the south-west mallee of New South Wales provide sound information on what needs to be considered during reserve acquisition. Vegetated corridors are required to facilitate movements between isolated remnants of those birds with poor dispersal ability.

Reversing the effects of habitat fragmentation through identification and revegetation of strategic links is an important aim, but is a costly, long-term process. Translocations to replenish depleted or extirpated populations following habitat recovery may be a useful short-term management tool. Incentives will be required for landholders to manage the best remnants and facilitate corridor improvement or establishment for the conservation of threatened mallee birds.

This Recovery Plan takes account of existing national Recovery Plans for the other nationally threatened mallee birds including the Black-eared Miner (Baker-Gabb 2001), Malleefowl (Benshemesh 2007) and Regent Parrot (*Polytelis anthopeplus monarchoides*) (Baker-Gabb and Hurley 2010). Actions described in this plan will benefit other threatened or declining birds occurring in the Murray Mallee (Table 1).

Recovery Objectives

The Long-term Objective of recovery is to improve the conservation status of the Mallee Emu-wren, Red-lored Whistler and eastern subspecies of the Western Whipbird. Within the five-year life span of this Recovery Plan, the aim is to:

- retain all existing subpopulations,
- reduce the rate of decline for these species,
- expand their core populations in larger (>30,000 ha) remnants, and
- initiate longer-term measures designed to ensure their persistence in south-eastern Australia.

Strategies to achieve the recovery objectives include**:**

- Establish a recovery team to coordinate implementation of the recovery plan.
- Incorporate threatened mallee bird fire scale and frequency requirements into all fire management plans and annual works plans.
- Enhance habitat connectivity and quality.
- Manage total grazing pressure from all herbivores by decommissioning artificial water points and controlling introduced herbivores.
- Undertake introduced predator control programs.
- Monitor trends in subpopulations in response to management actions, particularly rates of recovery from fire.
- Investigate the need for translocations, including the degree of genetic isolation of geographically separate subpopulations, and develop translocation programs where necessary.
- Enhance community involvement and awareness.

Program Implementation

The Recovery Plan will run for five years from the date of its adoption under the EBPC Act, and will be managed by the relevant nature conservation agency for each State. Implementation will be coordinated through a Recovery Team to ensure collaboration across affected states and sharing of technical and scientific knowledge, and habitat management expertise.

Program Evaluation

This Recovery Plan will be independently reviewed within five years of the date of its adoption under the EPBC Act.

Summary of Recovery Strategies, Performance Criteria and Actions

For further information regarding the implementation of recovery actions in this plan, see the minutes from the Threatened Mallee Bird Conservation Action Plan Workshop, hosted by BirdLife Australia in August 2014 (Boulton and Lau 2015). This document and associated documents are updated periodically by BirdLife Australia, and should be given due regard when implementing actions in this plan.

Note: Detailed implementation information is contained in Appendix 1.

Strategies	Performance Criteria	Recovery Actions
1: Establish a recovery team to coordinate implementation of the recovery plan.	Successful implementation of the recovery plan over five years.	1.1 Convene a meeting of stakeholders to determine the feasibility of combining this Recovery Plan's recovery efforts for threatened birds of the Murray Mallee with the Black-eared Miner recovery program, and separating this from the recovery program for the Western Whipbird on Yorke and Eyre Peninsula. 1.2 Coordinate implementation of the recovery plan. 1.3 Report regularly on progress against objectives and performance criteria. 1.4 Review the recovery program after five years of operation.
2: Incorporate threatened mallee bird fire scale and frequency requirements into all fire management plans and annual works plans.	Fire management plans and annual works plans acknowledge the need to maintain or increase the area of long-unburnt mallee to support the recovery of these species .	2.1 Use Deakin/La Trobe university fire history mapping and recent data on mallee birds' fire scale and timing requirements to develop multi-species fire management strategies for different areas and types of mallee. 2.2 Assess existing and proposed fire plans and liaise with agency, fire authority, and landowner representatives to discuss any potential amendments to their fire management strategies. 2.3 Ensure that relevant resource managers in Government agencies are aware of threatened mallee birds' habitat within or near their region, and its fire management requirements.
3: Enhance habitat connectivity and quality.	Establishment of functional corridors and adequate reserve systems.	3.1 Determine fragmentation impacts due to clearing and fire, the limitations of patch size, and what constitutes functional corridors. 3.2 Advocate planting native species in critical areas such as wide breaks in key corridors, but only where fencing and natural regeneration cannot take place. 3.3 Assess the existing reserve system, particularly in NSW where much mallee on public land is leased for grazing. 3.4 Review existing mallee tree harvesting operations to determine their overall impact on subpopulations of threatened birds and have licensing prescriptions amended where necessary.

4: Manage total grazing pressure from all herbivores by decommissioning artificial water points and controlling introduced herbivores.	Feral herbivore impacts on mallee vegetation are markedly reduced in areas containing threatened mallee birds.	4.1 Undertake site-based cost-benefit analysis to avoid perverse outcomes of decommissioning water points (i.e. may be important for bushfire control, grazing may reduce fuel etc) 4.2 Based on outcomes of 4.1, decommission or fence artificial water points to exclude mammalian herbivores on reserves, after ascertaining and catering for the regional water requirements of threatened birds such as the Regent Parrot and Major Mitchell Cockatoo. 4.3 Improve control of goats and rabbits in mallee woodlands on public lands, and provide incentives for private landholders with Sheep to do likewise. 4.4 Promote the use of sealed tanks as a more reliable source of water for fighting fires.
5: Undertake introduced predator control programs.	Fox and feral cat populations controlled in key areas with threatened mallee birds.	5.1 Support fox and feral cat control programs for Malleefowl and other ground-dwelling threatened mallee birds, particularly in areas where subpopulations are recovering from fire or where on-ground works are occurring.
6: Monitor trends in subpopulations in response to management actions, particularly rates of recovery from fire.	Population changes are quantified with sufficient precision to determine subpopulation trends and the effectiveness of management work.	6.1 Develop monitoring protocols and undertake targeted monitoring at sites recovering from fire and where on-ground works are occurring. 6.2 Work with the ongoing *Atlas of Australian Birds* national monitoring program to promote long-term monitoring of other subpopulations by volunteers.
7: Investigate the need for translocations, including the degree of genetic isolation of geographically separate subpopulations, and develop trigger points and translocation programs where necessary.	Genetic relationships between widely separated subpopulations determined and requirement for translocations or other strategies to reduce isolation clarified.	7.1 Determine genetic relationships between widely separated subpopulations of the Western Whipbird. 7.2 Determine translocation needs and develop translocation strategy if necessary, particularly for Mallee Emu-wrens and Western Whipbirds in the Murray Mallee.
8: Enhance community involvement and awareness.	High levels of community involvement in monitoring and programs to enhance habitat for threatened mallee birds.	8.1 Collate and provide information to Landcare groups and landholders on the value of mallee woodlands, how to manage them (e.g. fire regimes, tactical grazing), where to obtain further information, and how to receive incentive funding and other assistance. 8.2 Secure the management of high priority lands through voluntary cooperative agreements under the relevant legislation.

Cost of the Recovery Plan

The estimated cost of the recovery program is $1,035,000 over five years.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Totals	$300,000	$240,000	$295,000	$280,000	$135,000	$1,350,000

Biodiversity Benefits

The implementation of this Recovery Plan will have benefits for a wide range of mallee species and habitats. Within the range of the Mallee Emu-wren, Red-lored Whistler and Western Whipbird there are a large number of nationally threatened and declining mallee birds (Garnett & Crowley 2000) that also require large areas of intact habitat. In particular, there are eight other species of declining birds that occur throughout much of the Murray Mallee (Table 1). Actions proposed in this Recovery Plan such as decommissioning artificial water points, implementing fire management strategies, and involving the community in surveys and monitoring are all likely to benefit these and other native species. Moreover, this Recovery Plan augments the biodiversity benefits of existing national Recovery Plans for the Murray Mallee's endangered Black-eared Miner (Baker-Gabb 2001) and the vulnerable Malleefowl (Benshemesh 2007) and Regent Parrot (Baker-Gabb and Hurley 2011).

Table 1. Nationally threatened and declining birds *regularly* found within the range of the Mallee Emu-wren, Red-lored Whistler and Western Whipbird.

Common name	**Scientific name**	**Status**	
		A/Plan	**EPBC**
Malleefowl	*Leipoa ocellata*	V	V
Major Mitchell Cockatoo	*Cacatua leadbeateri leadbeateri*	NT	
Regent Parrot	*Polytelis anthopeplus monarchoides*	E	V
Striated Grasswren	*Amytornis striatus striatus*	NT	
Black-eared Miner	*Manorina melanotis*	E	E
Slender-billed Thornbill	*Acanthiza iredalei hedleyi*	LC	
Hooded Robin	*Melanodryas cucullata cucullata*	NT	

A/Plan = *The Action Plan for Australian Birds 2010* (Garnett *et al.* 2011).
EPBC = *Environment Protection and Biodiversity Conservation Act 1999*
E = Endangered, V = Vulnerable, NT = Near Threatened, and LC = Least Concern)

Affected Interests

Government and non-government organisations with an interest in the recovery program for the three mallee birds include:

- Office of Environment & Heritage, NSW
- Department of Primary Industries, NSW
- Rural Lands Protection Board, NSW
- Department of Environment, Land, Water and Planning, Vic
- Parks Victoria
- Department of Environment, Water and Natural Resources, SA
- Catchment Management Authorities
- Regional Vegetation Committees
- Local Governments
- Private landholders, leaseholders and Landcare Groups with blocks of mallee
- Non-government organisations such as BirdLife Australia
- Research organisations such as universities

This list of stakeholders should not be considered exhaustive.

Role and Interests of Indigenous people

Indigenous communities on whose traditional lands these threatened mallee birds occur have been advised, through the relevant regional Indigenous facilitator, of this Recovery Plan and invited to comment and be involved in the implementation of the Recovery Plan. No concerns were expressed.

Social and Economic Impacts

The social and economic impacts of this national Recovery Plan for threatened mallee birds will have positive and minor negative social and economic impacts. The majority of the threatened mallee birds' habitat is in public reserves. The main potential impacts on private landholders are covered by existing legislation for native vegetation retention in all range States, or concern the offering of incentives to landholders for fencing and restoration of corridors and remnants. Protection of mallee habitat by government authorities when considering clearing applications could result in economic impacts on individuals by restricting the development of areas for cropping or other uses. However, the benefits gained by such decisions will in the long-term far outweigh any short term imposts given the large proportion of mallee that has been cleared already.

Tighter restrictions on harvesting mallee and heath (e.g. charcoal, Broombush) should have localised economic impacts because these industries generate modest profits. Any restriction of harvesting in reserves will cause agencies to lose monies gained from licences, but require less staff time for supervision. The exclusion of grazing from mallee in State Forests will possibly result in a loss of minor revenue for agencies and affect a small number of farmers. Fencing areas on private land to exclude grazing may also result in some small economic impact.

Management Practices

Activities likely to benefit conservation of threatened mallee birds include:

- actions that reduce the extent of bushfires and increase the length of time between consecutive fires at any given site
- decommissioning artificial water points in mallee to reduce grazing pressure
- incentives for landholders to undertake works to protect threatened mallee birds and their habitat such as fencing remnant mallee vegetation on private land, especially in NSW where much of the foraging habitat is on land leased by graziers and cereal growers
- community involvement in the recovery program, especially in activities such as long-term monitoring
- promotion of conservation activities such as regular press articles in regional newspapers and other suitable media, and field days to provide information for remnant protection to assist landholders in their efforts to protect threatened birds.

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Priority, Feasibility and Estimated Costs of Recovery Actions

Action	Description	Priority	Feasibility	Responsibility	Cost estimate					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	**Recovery team**									
1.1	Meet with stakeholders	1	100%	VicGov, DEWNR, OEH	**$5,000**	**$0**	**$0**	**$0**	**$0**	**$5,000**
1.2	Coordinate recovery program	1	100%	VicGov, DEWNR, OEH	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$4,000**	**$20,000**
1.3	Report recovery program results	2	100%	VicGov, DEWNR, OEH	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$1,000**	**$5,000**
1.4	Review after five years	2	100%	VicGov, DEWNR, OEH	**$0**	**$0**	**$0**	**$0**	**$5,000**	**$5,000**
2	**Fire management**									
2.1	Develop fire management strategies	1	95%	VicGov, DEWNR, ALT, BA, OEH	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
2.2	Amend existing fire plans	1	95%	VicGov, DEWNR, OEH	**$10,000**	**$0**	**$0**	**$0**	**$0**	**$10,000**
2.3	Inform resource managers of requirements	1	100%	VicGov, DEWNR, OEH	**$0**	**$10,000**	**$0**	**$0**	**$0**	**$10,000**
3	**Enhance habitat connectivity and quality**									
3.1	Fragmentation impacts & corridors	1	75%	VicGov, DEWNR, OEH, Unis	**$0**	**$20,000**	**$20,000**	**$20,000**	**$0**	**$60,000**
3.2	Regenerate corridors	2	75%	VicGov, DEWNR, OEH	**$0**	**$0**	**$0**	**$15,000**	**$15,000**	**$30,000**
3.3	Assess reserve system	2	90%	OEH	**$0**	**$5,000**	**$0**	**$0**	**$0**	**$5,000**
3.4	Review mallee harvesting licences	3	90%	VicGov, DEWNR, OEH	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
4	**Manage total grazing pressure**									
4.1	Site-based cost benefit analysis	1	95%	VicGov, DEWNR, OEH	**$10,000**	**$0**	**$0**	**$0**	**$0**	**$10,000**
4.2	Decommission artificial water points	1	90%	VicGov, DEWNR, OEH	**$20,000**	**$20,000**	**$20,000**	**$20,000**	**$20,000**	**$100,000**
4.3	Control feral herbivores	1	60%	VicGov, DEWNR, OEH	**$50,000**	**$50,000**	**$50,000**	**$50,000**	**$50,000**	**$250,000**
4.4	Use sealed tanks	2	90%	VicGov, DEWNR, OEH	**$60,000**	**$0**	**$0**	**$0**	**$0**	**$60,000**
5	**Introduced predator control**									
5.1	Fox and cat control	3	90%	VicGov, DEWNR, OEH	**$15,000**	**$15,000**	**$15,000**	**$15,000**	**$15,000**	**$75,000**

6	**Population trends**									
6.1	Monitoring sub-populations	1	90%	VicGov, DEWNR, OEH	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**	**$500,000**
6.2	Assist volunteers' long-term monitoring	1	90%	VicGov, DEWNR, OEH, BA	**$15,000**	**$5,000**	**$5,000**	**$5,000**	**$5,000**	**$35,000**
7	**Translocation**									
7.1	Determine genetics	1	95%	VicGov, DEWNR, OEH, Unis	**$0**	**$0**	**$40,000**	**$40,000**	**$0**	**$80,000**
7.2	Determine translocation needs	1	90%	VicGov, DEWNR, OEH, Unis	**$0**	**$0**	**$30,000**	**$0**	**$0**	**$30,000**
8	**Community participation**									
8.1	Provide extension programs	2	100%	DEWNR, OEH	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$10,000**	**$50,000**
8.2	Cooperative management agreements	2	50%	VicGov, DEWNR, OEH	**$0**	**$0**	**$0**	**$0**	**$10,000**	**$10,000**
	Totals				**$300,000**	**$240,000**	**$295,000**	**$280,000**	**$235,000**	**$1,350,000**

Abbreviations: VicGov = the Department of Environment, Land, Water and Planning with primary responsibility, other relevant departments and priority stakeholder Parks Victoria, who have a key delivery role, DEWNR = Department of Environment, Water and Natural Resources (SA), ALT = Australian Landscape Trust (SA), BA = BirdLife Australia (SA), OEH = Office of Environment & Heritage (NSW), Unis = Universities and research institutions.

Appendix 1. Detail of Recovery Actions

Strategy 1: Establish a recovery team to coordinate implementation of the recovery plan.

Performance criterion: Successful implementation of the recovery program over five years.

Action 1.1: Convene a meeting of stakeholders to determine the feasibility of combining most of this Recovery Plan's recovery efforts for threatened birds of the Murray Mallee with the Black-eared Miner recovery program, and separating this from the recovery program for the Western Whipbird on Yorke and Eyre Peninsula.

The Black-eared Miner Recovery Team has successfully worked in the Murray Mallee for over a decade and has surmounted many of the challenges posed in this Recovery Plan such as developing monitoring protocols, genetic research, translocating and monitoring >100 birds, applying the results of fire research, and involving hundreds of volunteers (Baker-Gabb 2007).

Responsibility: Victorian Government[1], Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 1.2: Coordinate implementation of the recovery plan.

Coordination to implement the recovery plan (either through the establishment of a recovery team or the development of partnerships with existing recovery networks operating in the same region) is required as part of standard project governance.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 1.3: Report regularly on progress against objectives and performance criteria.

Regular reporting is required to determine progress against objectives, allow adaptive management and maintain the involvement and support of stakeholders.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 1.4: Review the recovery program after five years of operation.

An independent review after five years is a standard requirement for national Recovery Plans.

[1] Victorian Government includes the Department of Environment, Land, Water and Planning with primary responsibility, other relevant departments and priority stakeholder Parks Victoria, who have a key delivery role.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Strategy 2: Incorporate threatened mallee bird fire scale and frequency requirements into all fire management plans and annual works plans.

Performance criterion: Fire management plans and annual works plans acknowledge the need to maintain or increase the area of long-unburnt mallee to support the recovery of these species.

Action 2.1: Use Deakin/La Trobe university fire history mapping and recent data on mallee birds' fire scale and timing requirements to develop multi-species fire management strategies for different areas and types of mallee.

Nowadays, extensive bushfires leading to further population reduction and fragmentation is the greatest risk the three species face, and all three species have declined markedly in recent decades due to bushfires (Silveira 1993; Brown *et al*. 2009; Garnett *et al.* 2011). The time between fires is also a key issue for the conservation of threatened mallee birds. Numbers of Mallee Emu-wrens, Red-lored Whistlers and Western Whipbirds increase in habitats >15 years post-fire (Carpenter & Matthew 1986; Woinarski 1987, 1989, Moise 2008, Brown *et al.* 2009).

The fire history mapping by La Trobe and Deakin universities was in part funded by the agencies from the three Murray Mallee states and it is being incorporated into fire planning. While there is general acceptance of research on the vegetation age since fire requirements of threatened mallee birds, these requirements may not always be consistent with bushfire management objectives such as prevention of bushfire risk to human life and property.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Australian Landscape Trust (SA), BirdLife Australia (SA), Office of Environment & Heritage (NSW).

Action 2.2: Assess existing and proposed fire plans and liaise with agency, fire authority, and landowner representatives to discuss any potential amendments to their fire management strategies.

This action is a natural progression from the work to be undertaken in Action 1.1.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 2.3: Ensure that relevant resource managers in Government agencies are aware of threatened mallee birds' habitat within or near their region, and its fire management requirements.

This action is a natural progression from work in Action 1.1 and should be undertaken to ensure that organisations such as Catchment Management Authorities and local government authorities are made aware of the results.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Strategy 3: Enhance habitat connectivity and quality.

Performance criterion: Establishment of functional corridors and adequate reserves.

Action 3.1: Determine fragmentation impacts due to clearing and fire, the limitations of patch size, and what constitutes functional corridors.

Small, isolated reserves may never be able to support sufficient birds, or it may not be possible to prevent reserve-wide fires without fuel reducing too large a proportion of the reserve. It may not be a wise use of resources to attempt to bolster remnant populations on such reserves. Alternatively, if functional corridors can be determined for threatened mallee birds and such corridors restored, this would be a medium-term solution for maintaining viable populations in some small reserves. Support PhD research on this subject.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW), Universities.

Action 3.2: Advocate planting native species in critical areas such as wide breaks in key corridors, but only where fencing and natural regeneration cannot take place.

This action is a natural consequence of Action 3.2. Note that natural regeneration protected from stock by fences is cheaper than mechanical or hand planting.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 3.3: Assess the existing reserve system, particularly in NSW where much mallee on public land is leased for grazing.

Determine where shortfalls exist and where additional protection of areas of high conservation value outside reserves will bolster the long-term viability of the mallee birds.

Responsibility: Office of Environment & Heritage (NSW).

Action 3.4: Review existing mallee tree harvesting operations to determine their overall impact on subpopulations of threatened birds and have licensing prescriptions amended where necessary.

Several harvesting operations exist within mallee, particularly in New South Wales. Some mallee eucalypts are harvested to produce eucalyptus oil, charcoal and didgeridoos, whilst Broombush *Melaleuca uncinata* is harvested for brush fencing. Harvesting mallee poses several threats, with frequent harvesting leading to the removal of the older-age mallee habitats preferred by many threatened mallee birds.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Strategy 4: Manage total grazing pressure from all herbivores by decommissioning artificial water points and controlling introduced herbivores.

Performance criterion: Feral herbivore impacts on mallee vegetation are markedly reduced in areas containing threatened mallee birds.

Action 4.1. Undertake site-based cost benefit analysis to avoid perverse outcomes to the species of decommissioning water points (i.e. may be important for bushfire control, grazing may reduce fuel etc.).

The presence of artificial watering points in the mallee maintains high numbers of introduced herbivores and unnaturally high densities of native herbivores, both of which have negative impacts on the native vegetation. The decommissioning of these artificial watering points has successfully been used to reduce herbivore numbers and allow regeneration of native plant communities subject to over grazing. In Victoria, more than 85% of artificial water points on Parks Victoria land have already been closed or decommissioned.

By undertaking a cost benefit analysis and a full inventory of remaining watering points, actions can be directed to decommissioning watering points in areas with the greatest benefits to the species. After completing the cost-benefit analysis for the species, the consequences of decommissioning and the options available to mitigate these consequences will need to be considered. For example, fencing dams to exclude herbivores facilitates goat control and capped above-ground tanks offer a more reliable source of water for fire suppression purposes.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 4.2: Based on outcomes of 4.1, decommission or fence artificial water points to exclude mammalian herbivores on reserves, after ascertaining and catering for the regional water requirements of threatened birds such as the Regent Parrot and Major Mitchell Cockatoo.

The greatest influence on grazing intensity in the arid and semi-arid rangelands, and hence the level of degradation, is the availability of water (Landsberg *et al.* 1997). Grazing intensity is high 0–4 km from water, moderate 4–8 km away, and barely discernible beyond 10 km from a water point (James *et al.* 1999). Nowadays, as little as 3–8% of the rangelands is more than 10 km from a water point (Landsberg & Gillieson 1996). The optimal habitat for birds that are negatively affected by artificial water points could have been reduced to as little as 3% of their former extent (Harrington 2002). Red-lored Whistlers were only found >6 km from artificial water points (Harrington 2002). Considerable progress has been made in the strategic decommissioning of artificial water points in Victoria's mallee reserves and in the Riverland Biosphere Reserve, but more closures of dams are needed.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 4.3: Improve control of Goats and Rabbits in mallee woodlands on public lands, and provide incentives for private landholders with Sheep to do likewise.

Grazing by mammalian herbivores, including domestic stock, native species, and feral animals, is a primary cause of habitat degradation in Australia, and ground-dwelling fauna are particularly at risk from grazing (Reid & Fleming 1992; Smith *et al.* 1995). Grazing of mallee, often in the remnant patches, is widespread on public and private land. About 90% of mallee in New South Wales and 20% in South Australia is public land under pastoral lease (Choate 1990). In areas grazed by Sheep, Malleefowl densities were reduced by 85–90% compared to similar ungrazed habitats (Frith 1962). Grazing by Goats is likely to have similar impacts (Benshemesh 2007. Grazing also has a negative impact on Mallee Emu-wrens (Schodde 1982). Fencing of water points can facilitate Goat trapping and control, particularly if coupled with an ongoing culling program. Rabbit control can be achieved in the mallee without the need to remove trees by a combination of poisoning, warren ripping and fumigation (Cooke 1981).

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 4.4: Promote the use of sealed tanks as a more reliable source of water for fighting fires.

Artificial water points such as dams are a very unreliable source of water in the mallee during droughts when major fires often occur. Sealed tanks at strategic locations provide a much more reliable source of water.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Strategy 5: Undertake introduced predator control programs.

Performance criterion: Fox and feral cat populations controlled in key areas with threatened mallee birds.

Action 5.1: Support fox and feral cat control programs for Malleefowl and other ground-dwelling threatened mallee birds, particularly in areas where subpopulations are recovering from fire or where on-ground works are occurring.

Introduced predators such as the Red Fox and feral Cat have had a marked impact on species such as the Malleefowl, and foraging on or near the ground may make Red-lored Whistlers, Mallee Emu-wrens and Western Whipbirds vulnerable to introduced predators. Each State has threat abatement plans that focus on Fox control and Malleefowl protection in the mallee. South Australia's 'Operation Bounceback' provides a very good example of an integrated feral predator and herbivore control program that should be supported and emulated.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Strategy 6: Monitor trends in subpopulations in response to management actions, particularly rates of recovery from fire.

Performance criterion: Population changes are quantified with sufficient precision to determine subpopulation trends and the effectiveness of management work.

Action 6.1: Develop monitoring protocols and undertake targeted monitoring at sites recovering from fire and where on-ground works are occurring.

Recent surveys (e.g. Brown *et al.* 2009) have identified the location of several subpopulations that have been markedly reduced by large fires and are now in the recovery phase. The low dispersal abilities of Mallee Emu-wrens and Western Whipbirds may limit their ability to recolonise isolated patches of habitat after fire (Woinarski *et al.* 1988; Brown *et al.* 2009). Whether these populations will recover without management assistance such as population supplementation, or will continue to decline is not known. Regular, targeted monitoring is needed to determine the timing and type of management interventions required and whether management activities are producing the desired results.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 6.2: Work with the ongoing *Atlas of Australian Birds* national monitoring program to promote long-term monitoring of subpopulations by volunteers.

BirdLife Australia and other community organisations have the potential to provide structured long-term monitoring of subpopulations of threatened mallee birds that is beyond the current resource capacities of most agencies.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW), BirdLife Australia.

Strategy 7: Investigate the need for translocations, including the degree of genetic isolation of geographically separate subpopulations, and develop trigger points and translocation programs where necessary.

Performance criterion: Genetic relationships between widely separated subpopulations determined and requirement for translocations or other strategies to reduce isolation clarified.

Action 7.1: Determine genetic relationships between widely separated subpopulations of the Western Whipbird. Several subpopulations of threatened mallee birds are both small and

geographically isolated. Concern has been expressed (e.g. Brown *et al.* 2009, Garnett *et al.* 2011) that such isolated populations may be experiencing a range of demographic and genetic challenges that could potentially be overcome by translocating birds from larger subpopulations. A recent genetic study of the Mallee Emu-wren found they exhibited a low to moderate level of genetic diversity, evidence of bottlenecks, genetic drift and weak population genetic structure (Brown et al. 2013). The implications of these findings are the Mallee Emu-wren can be considered for management purposes as a single genetic unit, but individuals separated by <2 km are more related which would require founding individuals for translocations to be sourced from several patches (Brown and BirdLife Australia 2014).

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW), Research institutions.

Action 7.2: Determine translocation needs and develop a protocol, particularly for Mallee Emu-wrens and Western Whipbirds in the Murray Mallee.

Translocations have been identified as a strategy to supplement subpopulations depleted and isolated by fragmentation and large fires, especially for Mallee Emu-wrens and Western Whipbirds which have limited dispersal abilities (Brown *et al.* 2009; Garnett *et al.* 2011). The first steps to developing a translocation proposal have been undertake for the Mallee Emu-wren, with a preliminary assessment of the risk and feasibility of translocating Mallee Emu-wrens (Brown and BirdLife Australia 2014). The overall assessment after evaluation of the biological and ecological feasibility for translocation was moderately favourable. The Black-eared Miner Recovery Team has previously developed protocols and undertaken successful translocations of >100 birds from the Riverland Biosphere Reserve to Murray-Sunset National Park (Clarke & Clarke 1999; Baker-Gabb 2007).

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Universities and Research institutions.

Strategy 8: Enhance community involvement and awareness.

Performance criterion: High levels of community involvement in monitoring (Action 2.2) and programs to enhance habitat for threatened mallee birds.

Action 8.1: Collate and provide information to Landcare groups and landholders on the value of mallee woodlands, how to manage them (e.g. fire regimes, tactical grazing), where to obtain further information, and how to receive incentive funding and other assistance.

Given that about 90% of mallee in New South Wales and 20% in South Australia is public land under pastoral lease (Choate 1990), significant biodiversity conservation gains could be made if these mallee habitats were managed more sustainably by leaseholders.

Responsibility: Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).

Action 8.2: Secure the management of high priority lands through voluntary cooperative agreements under the relevant legislation.

This action flows from Action 3.4.

Responsibility: Victorian Government, Department of Environment, Water and Natural Resources (SA), Office of Environment & Heritage (NSW).