National Recovery Plan for Eastern Bristlebird Dasyornis brachypterus





Australian Government





Department of Sustainability Sustainability Victoria Sustainability and Environment



National Recovery Plan for Eastern Bristlebird *Dasyornis brachypterus*

Prepared by: Virginia Thomas

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EXECUTIVE SUMMARY

The Eastern Bristlebird (*Dasyornis brachypterus*) is listed as 'Endangered' in Australia under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 and under state legislation in Queensland, New South Wales (NSW) and Victoria. The species is also listed as 'Endangered' by the International Union for Conservation of Nature (IUCN). The northern population of the Eastern Bristlebird meets the criteria for 'Critically Endangered' by the IUCN.

The Eastern Bristlebird is a small, brown, well-camouflaged, ground-dwelling bird. It is generally shy and cryptic, spending most of its time in low, dense vegetation and rarely appearing in the open or flying. The species has contracted to four genetically isolated populations in three disjunct areas of south-eastern Australia: south-eastern Queensland/north-eastern NSW (northern population), the Illawarra and Jervis Bay regions of eastern NSW (central populations) and the NSW/Victorian border coastal region (southern population). Each of the geographically separate regional populations is comprised of one or more disjunct local populations or colonies.

Limited evidence suggests that Eastern Bristlebirds in the northern population are morphologically distinct from the more southerly populations. Northern birds have previously been considered a distinct sub-species, *Dasyornis brachypterus monoides*, while central and southern populations comprise the nominate subspecies *Dasyornis brachypterus brachypterus*. However, recent genetic analysis does not support sub-speciation.

The total national population of the Eastern Bristlebird is estimated at approximately 2500 birds, with two populations of around 1000 individuals. Population estimates should be recalculated with updated vegetation mapping and results of standard census techniques.

The Eastern Bristlebird inhabits a broad range of vegetation communities with a variety of plant species compositions that are generally defined by a similar structure of low, dense, ground or understorey vegetation. The species occupies fire-prone habitats and its response to fire is highly variable, however, the Eastern Bristlebird is particularly vulnerable to large-scale, intense fires. The extent, intensity and frequency of fires are all important in determining habitat suitability, along with the presence of unburnt refuges.

The main threat to the Eastern Bristlebird is the loss or fragmentation of suitable habitat, which can be caused by inappropriate fire regimes and clearing for urban or agricultural development. Habitat loss is recognised as the main process that has reduced the distribution and abundance of the Eastern Bristlebird in the last 150 years. Predation is a potential threat to the species, particularly by feral predators and particularly after fire. Other threats include habitat degradation from feral animals and livestock and invasion of weeds, genetic bottlenecks and inbreeding, climate change and human disturbance.

The long-term objective of this Eastern Bristlebird recovery program is the stabilisation of all populations. This will involve enhancing the northern population to a viable size, maintaining the stability of the central populations, and establishing an additional southern population in Victoria, bringing the size of the southern population to a viable level. Viable population size will be determined by population viability analysis (PVA). Attaining this long-term objective will involve the protection and management of habitat, the management of threats and enhancement of wild

populations through captive breeding, augmentation and reintroduction. The objectives, criteria and actions proposed in this recovery plan work towards that objective and build on those in previous plans.

Actions required for the recovery of the Eastern Bristlebird include: survey, monitoring and mapping of all populations and habitat; maintenance or improvement in the condition and extent of habitat; management of threats, including fire, feral predators, exotic herbivores, weeds, genetic bottlenecks and climate change; enhancement of the northern and southern populations to viable levels; research to improve knowledge of the species; effective coordination of the recovery effort; improved communication between stakeholders and community involvement. The estimated total cost of implementing recovery actions is \$3,609,000 over the five years of this plan.

SPECIES INFORMATION

Conservation Status

The Eastern Bristlebird (*Dasyornis brachypterus*) is listed as 'Endangered' in Australia under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). It is listed as 'Endangered' in Queensland (*Nature Conservation (Wildlife) Regulation* 2006, Schedule 2, subordinate legislation to the *Nature Conservation Act* 1992 (NC Act)); 'Endangered' in New South Wales (Schedule 1 of the *Threatened Species Conservation Act* 1995 (TSC Act)); and 'Threatened' in Victoria (Schedule 2 of the *Flora and Fauna Guarantee Act* 1988 (FFG Act)) (DSE 2010) where it is also classified as 'Endangered' (DSE 2007).

The Eastern Bristlebird is listed as 'Endangered' on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species because of its small range and severely fragmented populations and sub-populations.

The northern population of the Eastern Bristlebird also meets the criteria for 'Critically Endangered' under the IUCN (IUCN 1994) categories of threat (criteria A1+2bc, B1+2bde, C2a, D).

Taxonomy

The ancient origins of the Eastern Bristlebird can be dated back to Gondwanaland (Christidis and Norman 2010).

The bristlebirds have traditionally been placed in the family Acanthizidae which includes the scrubwrens, thornbills and gerygones. This family has its greatest diversity in Australia, Papua New Guinea and nearby islands. Schodde and Mason (1999) considered the closest relative to the bristlebirds to be the Pilotbird (*Pycnoptilus floccosus*). However, most recent texts have placed the bristlebirds in a separate family (Dasyornithidae) (Dickinson 2003; Gill and Wright 2006; Gregory 2006; Christidis and Boles 2008) and recent research supports this separation (Gardner *et al.* 2010).

Within the Dasyornithidae there are three bristlebird species within a single genus: Eastern (*Dasyornis brachypterus*), Rufous (*D. broadbenti*) and Western (*D. longirostris*). The Eastern and Western Bristlebirds are the two species most closely related and in the past have been treated as one species (Keast 1957). All three species are endemic to Australia, similar in appearance and inhabit temperate habitats along the southern and south-eastern coastal and subcoastal regions of Australia (see **Figure 1**). They have all declined in both distribution and abundance and are threatened with extinction.

The Eastern Bristlebird is confined to three regions in south-eastern Australia. Recent genetic investigations (Roberts *et al.* 2011) have concluded that there are four distinct populations or management units: one northern, two central and one southern, which will be discussed more fully in the Distribution section. Limited evidence suggests that Eastern Bristlebirds in the northern population are morphologically distinct from the two more southerly populations. Northern birds appear to be larger and have brighter plumage (Chaffer 1954) and make bulkier nests (Holmes 1989) than southern birds. Schodde and Mason (1999) found several consistent but subtle plumage differences between the northern population and the central and southern populations, and proposed that the northern population should be recognised as a distinct sub-species with the name *Dasyornis brachypterus*

monoides. They also proposed that the central and southern populations comprise the nominate sub-species *Dasyornis brachypterus brachypterus*.



Figure 1. Current distribution of the three bristlebird species.

This separation into sub-species is not supported by available genetic data (Elphinstone,2008; Roberts *et al.* 2011. The Action Plan for Australian Birds (Garnett *et al.* 2011) notes this, yet nevertheless 'recognises' the split proposed by Schodde and Mason (1999). However, the separation into subspecies has no formal status under state or Commonwealth legislation.

Species Description

The Eastern Bristlebird is a small, well-camouflaged, ground-dwelling bird. It is dark cinnamon-brown above, with pale colouring around the eyes and base of the bill, an off-white chin and throat, and a rufous-brown panel on each wing. It is greyish-brown below, with an off-white centre to the belly. It has red to red-brown irises, an off-white to pinkish-white gape, and pinkish-brown legs and feet (Higgins and Peter 2002).

Body length is between 18 and 21 centimetres (Higgins and Peter 2002) with the broad tail accounting for about half the bird's length. Adults weigh approximately 42 grams (range 35-50 g) (Baker 1998; Bramwell 1990; Higgins and Peter 2002). The wings are small (23 to 24 cm wingspan) and the legs are long and strong. The sexes are alike, but females are slightly smaller than males (Bain 2007). Juveniles are similar to the adults, but can be identified, if viewed at close range, by their pale brown or brown irises, and pale yellow gape (Higgins and Peter 2002).

The species spends most of its time in low, dense vegetation, rarely appearing in the open or flying. Due to its small wings the Eastern Bristlebird flies weakly, but sturdy feet and legs help it move through dense habitat. While plumage provides excellent camouflage, other adaptations to its habitat include a low forehead profile with bristles near the eyes. The rictal bristles which project from the beak are modified

contour feathers that are thought to play a part in prey capture. The bristles may also provide protection for the bird's eyes as it consumes its struggling prey (Cornell Lab of Ornithology 2007). Another theory is that the bristles may function as sensors, providing tactile feedback, like the whiskers on a dog or cat (Lederer 1972) to facilitate obstacle avoidance. Other bird species are thought to benefit from elongated facial plumage that mechanically detects obstacles or provides protection for the eyes and face within dense or tangled habitat e.g. Manu Antbird (*Cercomacra manu*) or Whiskered Auklet (*Aethia pygmaea*) (Fitzpatrick and Willard 1990; Seneviratne and Jones 2008).

Behaviour

The Eastern Bristlebird is generally shy and cryptic. It usually occurs singly or in pairs, or rarely in small groups of three or four (Baker 1998; Chapman 1999). It is a terrestrial species and occasionally birds may be glimpsed scampering across openings or making low laboured flights of up to 20 metres. When disturbed or alarmed, a bird may move to a lookout perch a metre or more above the ground and call, then disappear into thick vegetation (Baker and Whelan 1996).

The Eastern Bristlebird has a distinctive call that is loud and melodic. 'Pretty birdie' (or variations) is the most characteristic call, although the presence of an Eastern Bristlebird is often signalled by an alarm call: a loud, strident 'prist' or softer 'chip'. Dueting and other calling interactions often occur. Using call playback to survey for cryptic, terrestrial birds, including the Eastern Bristlebird, is a method that has been used extensively and only about one quarter of the Eastern Bristlebirds detected by their calls are sighted (Baker 1992; Bramwell *et al.* 1992). However, some expertise is required to recognise calls and to distinguish them from the calls of other species such as Brown Thornbills (*Acanthiza pusilla*) and Pilotbirds (*Pycnoptilus floccosus*). The Eastern Bristlebird is less vocal outside the breeding season.

Distribution and Populations

Historical Distribution

It is likely that changes in vegetation due to past climatic fluctuations and Aboriginal fire regimes had reduced the distribution of the Eastern Bristlebird to three isolated regions on the east coast of Australia prior to European settlement (Chisholm 1951; Keast 1957; Smith 1977). Last century, the species occurred in scattered and isolated local populations along the east coast from Conondale Range in south-eastern Queensland to Marlo in Victoria, with a number of populations located along the central coast of NSW from Sydney to Ulladulla (Baker 1998). **Figure 2** shows the past and recent distribution of the Eastern Bristlebird.



Figure 2. Past (○) and recent (●) distribution of the Eastern Bristlebird (based on Baker 1997).

The northern population has undergone a dramatic population decline and range contraction (e.g. Holmes 1989, 1998; Sandpiper Ecological Surveys 2000b, 2003, 2005a, 2008). Historically the distribution of the northern population extended much further south, to the Dorrigo Plateau and possibly to Wootton near the Myall Lakes (Chisholm 1958; Holmes 1982, 1989). Eastern Bristlebirds have not been recorded in the Conondale Range for several years despite extensive searches in previously known territories and known and potential habitat by DEHP and BirdLife Australia/Birds Queensland. Local populations known to have become extinct include several sites at Main Range, Lamington NP and Border Ranges NP.

The southern population has also undergone a significant population decline and range contraction in Victoria. Surveys in the late 1990s failed to locate the species at nine confirmed former sites and two unconfirmed sites in Victoria (Baker 1998; Clarke and Bramwell 1998). There are historical records at scattered sites from the NSW border to near Lake Tyers (White 1915; Clarke and Bramwell 1998), unconfirmed reports from Wilsons Promontory and Tarwin Lower-Walkerville (Cooper

1975; Emison *et al.* 1987; Mitchell 1995), and subfossil deposits indicating that the distribution once extended west at least as far as Nelson in far south-western Victoria (Blakers *et al.* 1984; Baird 1992).

In the central populations, there are historical records of the species at several locations between Sydney and Ulladulla where the species is thought to now be extinct. Surveys since 1997 have failed to locate the species at many former sites in this area (e.g. Baker 1998).

Current Distribution and Abundance

Since European settlement, the distribution and abundance of the species has further declined due to extensive clearing and habitat degradation and it is now severely fragmented (Holmes 1989, 1998; Hartley and Kikkawa 1994; Baker 1997, 2009; Chapman 1999; Garnett *et al.* 2011). The Eastern Bristlebird's current discontinuous geographic distribution is shown in **Figure 2**. The species has contracted to three disjunct regions of south-eastern Australia: southern Queensland/northern NSW, the Illawarra and Jervis Bay region (the stronghold of the species) and the NSW/Victorian border (see **Figure 2**). Each of the geographically separate regional populations is comprised of one or more disjunct local populations or colonies (Blakers *et al.* 1984; Holmes 1989, 1997; Stewart 1997, 1998; Baker 1998; Clarke and Bramwell 1998; Barrett *et al.* 2003).

The total national population of the Eastern Bristlebird is estimated at approximately 2500 birds – see **Table 1** for population estimates. However, population estimates should be recalculated with updated vegetation mapping and results of standard census techniques (see Actions).

Location	Estimated population size	Population status	References
Northern:			
Northern NSW/ Queensland	<40	Decreasing	Sandpiper Ecological Surveys (2012); Whitby (2009); D Rohweder and D Stewart pers. comm. (2010)
Central:			
Barren Grounds NR and Budderoo NP	1000	Stable	Baker (2008)
Woronora Plateau (Cataract Dam)	15+	Unknown	Baker <i>et al</i> . (2012)
Bherwerre Peninsula (Jervis Bay NP, Booderee NP, Defence land, private land)	1000	Stable	Baker (1997), N. Dexter pers. comm. 2010
Beecroft Peninsula	94+	Increasing	Baker <i>et al.</i> (2012)
Morton NP Red Rocks NR	few 10+	Unknown	Baker (1997) Bain & McPhee (2005)
Southern:			•
Nadgee NR, NSW	250	Stable	L Evans pers. comm. 2012 Bramwell (2008, pers.
Croajingolong NP, Vic	140-160		comm. 2010)
Totals	~2500		

 Table 1. Distribution and abundance of the Eastern Bristlebird.

The species' area of occupancy^{*}, as defined by the IUCN (1994), is estimated to be less than 120 km² and in reality in the order of about 29 km² (Baker 1998). The extent of occurrence[†] is estimated to be over 1100 km² (Garnett and Crowley 2000; Stewart 2001, 2006).

The Eastern Bristlebird mainly occurs within the national reserve system (Baker 1998; Clarke and Bramwell 1998; Holmes 1998; Stewart 2001, 2006), with some colonies on other tenures as discussed below.

Important populations

The small size of the Eastern Bristlebird national population means that all extant populations are likely to be important to the long-term survival and recovery of the species. Approximately 90% of the national population occurs in the two central populations (Baker 1998; Roberts *et al.* 2011).

At <40 individuals, the northern population is of particular significance. As discussed previously, this population is considered Critically Endangered under IUCN criteria (see section 1).

All four populations occur in Important Bird Areas (IBAs) - sites recognised as internationally important for bird conservation and known to support key bird species (Dutson *et al.* 2009). IBAs are designated by Birdlife Australia (formerly Birds Australia) and have no legal implications. They are areas of high priority for conservation efforts and resources (Dutson *et al.* 2009). **Figure 3** shows a map of Important Bird Areas and Eastern Bristlebird distribution - northern population: Scenic Rim IBA; central population Budderoo and Barren Grounds IBA and Jervis Bay IBA; and southern population: Nadgee to Mallacoota Inlet IBA.

^{*} Area of occupancy is the area within its 'extent of occurrence' which is occupied by a taxon, excluding unsuitable or unoccupied habitats.

[†] Extent of occurrence is the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy.



Figure 3. Important Bird Areas and Eastern Bristlebird distribution (Data from Birds Australia 2010)

Northern Population

The northern population habitat occurs in south-eastern Queensland and northeastern NSW, from Conondale Range (Sunshine Coast Qld) south to the Tweed Range (northern NSW) (see Holmes 1982, 1989 and 1997).

This population has been surveyed intensively in the last 25 years (e.g. Holmes 1989, 1992, 1997, 2001; Lamb *et al.* 1993; Stewart 1997, 1998; Sandpiper Ecological Surveys 1999, 2000b, 2002, 2003, 2005a, 2005b, 2006a, 2008, 2010, 2012; J. Young unpublished data). The largest number of birds known to have occurred in the northern population is 154 found during a survey in 1988 (Holmes 1989). Garnett and Crowley (2000) estimated that the northern population had declined by approximately 80% during the previous 30 years, and at that time several previously known populations had not been recorded for many years.

The northern population has now decreased to fewer than 40 individuals (see **Table 1**). Surveys in 2009, 2010 and 2012 failed to visually locate any birds in Queensland (Whitby 2009; D. Stewart pers. comm. 2012), although two unconfirmed calls were detected in 2010 and two calls were recorded in the Lamington Plateau area in 2012. Experts believe that up to 10 birds may still be present in Queensland habitat mainly on private land (D Rohweder and S. Gillman pers. comm. 2010; D. Stewart pers. comm. 2012). Habitat mapping undertaken by the Department of Environment and Heritage Protection (EHP) is being used to identify additional areas of potentially suitable habitat as priorities for future survey effort.

The numbers of birds within northern NSW has been fairly consistent since 1996; with a current estimate of between 11 and 35 birds (Sandpiper Ecological Surveys 2012). The majority of birds in northern NSW now occur on private land (D. Charley pers. comm. 2010). Rohweder (Sandpiper Ecological Surveys 2012) discussed whether the dramatic decline in numbers between 1988 and 1996 could be due to stochastic events such as drought, severe fires, and substantial shifts in habitat (although severe drought between 2002 and 2005 and substantial fire-induced habitat change at some locations e.g. Richmond Gap have also occurred since 1996). Alternatively, the carrying capacity of locations (i.e. the ability of the location to sustain a population) may have declined in that period due to gradual changes in habitat quality, such as shrub growth and reduced ground cover (suggesting regular fires may be required to maintain grassy forests on southern aspects). However, evidence gathered since 1999 suggests that change is gradual and it is possible that the sharp decline recorded between 1988 and 1996 is partly due to an elevated population estimate in 1988 (Sandpiper Ecological Surveys 2012).

The northern population is vulnerable to further local declines (Holmes 1989, 1997; Stewart 1997, 1998; Sandpiper Ecological Surveys 2008, 2012; Whitby 2009; D. Stewart pers. comm. 2010).

Central Populations

The central populations make up the current stronghold of the species, consisting of two genetically isolated populations (Roberts *et al.* 2011) in the Illawarra and Jervis Bay regions of NSW. Scattered colonies of the Illawarra population occur at Budderoo NP and the adjoining Barren Grounds NR and in the Morton NP-Red Rocks NR area (Baker 1998; Barrett *et al.* 2003; DEC 2006). The population at Jervis Bay is found on a variety of tenures including NSW Jervis Bay NP, Booderee NP, HMAS CRESWELL, Beecroft Weapons Range, Shoalhaven City Council land and freehold lands. Approximately 10 percent of the Jervis Bay population occurs on private land (Bain and McPhee 2005).

Central Eastern Bristlebird populations have been well studied, surveyed and monitored in the last two decades (e.g. Baker and Whelan 1996; Baker 1998; Bain 2001; Bain and McPhee 2005). Ten years ago the central population was considered to be stable (Garnett and Crowley 2000). The populations have experienced temporary loss of habitat from a number of fire events since then, however monitoring of sub-populations has shown that the central populations can recover rapidly (e.g. Lindenmayer *et al.* 2009).

The central populations are estimated to comprise more than 2000 birds (see **Table 1**), including 1000 birds at Barren Grounds NR / Budderoo NP, 1000 birds at Jervis Bay and a small number of birds in a very small area at Morton NP-Red Rocks NR (Baker 1998; Bain and McPhee 2005).

In addition, two translocated populations have been established within the species' original distribution. At Jervis Bay, 45 birds were translocated from Bherwerre Peninsula to Beecroft Peninsula between 2003 and 2005 (Bain *et al.* 2012), with a current estimate of more than 94 birds (Baker *et al.* 2012). In the Illawarra, 50 birds were translocated from Barren Grounds NR to the Woronora Plateau in 2008, with evidence of breeding and a current estimate of more than 15 birds (Baker *et al.* 2012).

Southern Population

The southern population occurs on the NSW/Victoria coastal border, in Nadgee NR (NSW) and the adjoining Croajingalong NP (Vic) at Howe Flat (Holmes 1982; Gosper

and Baker 1997; Baker 1998; Clarke and Bramwell 1998; Barrett *et al.* 2003; Bramwell 2008).

In 1998, the southern population appeared to be stable (Baker 1998) with the prospect of the Nadgee sub-population naturally increasing provided there were no large-scale fires or other disruptions (Baker 1997). The current estimate is 380 birds (see **Table 1**) in an area of about 2800 ha. This includes estimated populations of 250 birds at Nadgee NR (L. Evans pers. comm. 2012) and 120-140 birds in 800ha of suitable habitat in the Howe Flat area of Croajingalong NP (Bramwell 2008). In 2009, a range extension into heathlands two to four kilometres north of Howe Flat in Croajingolong NP was recorded, increasing that population by an estimated 20 birds in approximately 100-150 ha of suitable habitat (M. Bramwell pers. comm. 2010).

The southern population of the Eastern Bristlebird is vulnerable to local extinction because of its small size and the high likelihood of widespread catastrophic fire. The Victorian Scientific Advisory Committee (SAC 1994) determined that the Eastern Bristlebird is significantly prone to future threats that are likely to result in local population extinction or significant declines in abundance or distribution.

Habitat

The habitat of the Eastern Bristlebird is defined by a similar structure of low, dense, ground or understorey vegetation (Lamb *et al.* 1993; Clarke and Bramwell 1998; Chapman 1999; Baker 2000). The species occupies a broad range of vegetation types with a variety of species compositions, including grassland, sedgeland, heathland, swampland, scrubland, grassy sclerophyll forest and woodland, and rainforest (e.g. Smith 1977, 1987; Holmes 1989, 1998; Baker 1997, 2000; Chapman 1999; Miles 2004; Bramwell 2008). Eastern Bristlebird habitat primarily occurs as coastal, subcoastal and coastal escarpment scrubland / grassland / sedgeland and as open grassy forest on inland ranges (Blakers *et al.* 1984; Holmes 1989). **Table 2** has been adapted from Baker (2000) and lists the varied vegetation types utilised by the Eastern Bristlebird in all populations.

Habitat Critical to Survival

All habitat currently occupied by the Eastern Bristlebird is critical to its survival.

Northern Population:

Eastern Bristlebirds in the northern population mainly occur in scattered areas of montane open forest where the undergrowth is dense and grassy, and contains diverse structural features which provide the birds with protection and nesting locations. The ground-layer vegetation is usually about 1.0–1.5 m tall, providing about 65–90% ground cover. Typical ground cover includes tussock-grasses such as *Sorghum leiocladum*, and other grasses, with a variety of scattered small shrubs, woody herbs, patches of ferns and vine tangles (Holmes 1989, 1998; Lamb *et al.* 1993; Hartley and Kikkawa 1994; Sandpiper Ecological Surveys 2000a).

Birds in the northern population sometimes occur in other vegetation types such as heathland with stunted shrubs, or swampland with dense ferns and sedge tussocks. Habitat is typically either interspersed with, or adjacent to, mature subtropical rainforests, although some birds live up to 750 metres away from rainforest (Holmes 1989; Sandpiper Ecological Surveys 2000a; Stewart 2006). Adjacent rainforest or damp gullies are likely to be refuge areas for the birds during and after fires. In the more exposed situations, suitable habitat tends to be confined to intermittent watercourses (Holmes 1989, Hartley and Kikkawa 1994; Stewart 2006).

Central and Southern Populations

Birds in the central and southern populations have been recorded in a variety of vegetation communities with dense understorey. They often occur in low heathland, sometimes interspersed with thickets of taller shrubs or small trees (Loyn 1985; Pyke *et al.* 1995; Gosper and Baker 1997; Clarke and Bramwell 1998; Baker 1998, 2000; Bain and McPhee 2005; Bramwell 2008). The species also occurs in *Gahnia* sedgeland (Baker 1998) and in dense swamp shrubland or in coastal or riparian scrub and often with tussock-grasses or sedges in the understorey (White 1915; Pyke *et al.* 1995; Gosper and Baker 1997; Clarke and Bramwell 1998; Baker 1998, 2000; Higgins and Peter 2002; Bramwell 2008).

Birds sometimes occur in open sclerophyll woodland or forest, with a shrubby understorey and a dense ground layer of grasses or bracken (Emison *et al.* 1987; Bramwell *et al.* 1992; Pyke *et al.* 1995; Gosper and Baker 1997; Clarke and Bramwell 1998; Baker 1998, 2000; Bain and McPhee 2005; Bramwell 2008;). They occasionally occur in temperate rainforest that contains *Acmena smithii* (Emison *et al.* 1987; Clarke and Bramwell 1998; Baker 2000). In Croajingolong NP, Eastern Bristlebirds have also been recorded in rainforest along creeks and lowland forest dominated by Red Bloodwood *Corymbia gummifera* (DSE 1999).

In a recent study to select suitable habitat for translocations in Jervis Bay and the Woronora Plateau, Baker (2009) radiotracked 12 individual Eastern Bristlebirds and found that while heathland to woodland ecotones may provide suitable habitat for some individual Eastern Bristlebirds, the species is neither dependant on, nor confined to, heathland to woodland ecotones.

Vegetation Communities	References	
Southern population		
Warm temperate rainforest	Clarke & Bramwell (1998)	
Limestone box forest	Clarke & Bramwell (1998)	
Open forest of <i>Eucalyptus sieberi, C. gummifera, Angophora floribunda</i> and/or <i>E. baxteri</i> to 20 m	Recher (1981), Clarke & Bramwell (1998), Baker (2000)	
Woodland of <i>Banksia integrifolia</i>	Clarke & Bramwell (1998)	
Woodland and low woodland with <i>E. sieberi</i> and understorey of dense shrubs and herbs	Baker (2000)	
Scrub: coastal dune and riparian, coastal <i>Melaleuca armillaris</i> and <i>Leptospermum laevigatum</i>	Clarke & Bramwell (1998), Baker (2000)	
Hind-dune swamp with <i>Melaleuca ericifolia</i> to 2 m in wetter areas and <i>M. armillaris</i> to 5 m, some <i>Leptospermum</i> <i>juniperinum</i> and dense herbs, e.g. <i>Leptocarpus tenax</i> , in drier areas	Clarke & Bramwell (1998), Baker (2000)	
Wet heathland similar to closed swamp with Melaleuca squarrosa, M. ericifolia, Sprengelia incarnata, Gleichenia and/or dense herbs, e.g. Gymnoschoenus sphaerocephalus, Leptocarpus tenax, Lepidosperma forsythii or Xyris spp.	Clarke & Bramwell (1998), Baker (2000)	
Low to tall closed heathland and heathland with Allocasuarina paludosa, Hakea ulicina and/or Banksia serrata	Baker (2000)	
Xanthorrhoea plain	Baker (2000)	
Nadgee Upland Heath	L. Evans pers. comm. (2010)	

Vegetation Communities	References		
Central populations			
Wet forest/rainforest relic with <i>Eucalyptus botryoides</i> and <i>Acmena smithii</i>	Baker (2000)		
Forest of <i>E. pilularis, Corymbia gummifera</i> and/or <i>E. botryoides</i> to 35 m	Baker (2000)		
Open forest of <i>E. obliqua, C. gummifera, E. cypellocarpa</i> and/or <i>E. fastigata</i> to 35 m	Baker (2000)		
Open forest of <i>E. pilularis, Syncarpia glomulifera</i> and/or <i>C. gummifera</i> to 25 m	Baker (2000)		
Former pine plantation now covered densely with logs, <i>Pteridium esculentum</i> and shrub regeneration	Baker (2000)		
Woodland with <i>E. sclerophylla, C. gummifera</i> and/or <i>E. piperita</i> to 15 m and dense understorey of herbs and shrubs	Baker (2000)		
Woodland and open woodland of <i>E. sieberi</i> and/or <i>C. gummifera</i> 10-20 m and dense understorey of herbs and shrubs	Baker (2000)		
Closed scrub of Banksia ericifolia, Allocasuarina distyla and/or Hakea teretifolia and of Melaleuca squarrosa	Baker (2000)		
Closed coastal scrub of Leptospermum laevigatum	Baker (2000)		
Closed shrub swamp	Baker (2000)		
Mallee of C. gummifera or E. dendromorpha	Baker (2000)		
Closed low (< 0.5 m) to tall (2 m) heathland with Banksia ericifolia, Xanthorrhoea spp., Sprengelia incarnata, Hakea teretifolia, H. dactyloides, Darwinia leptantha, Allocasuarina paludosa, Baeckea imbricata, B. linifolia, Banksia paludosa, Cloichenia spp. and/or Leptospermum juniperinum	Smith (1985), Baker (2000)		
Closed sedgeland and closed wet heathland with Empodisma minus, Gymnoschoenus sphaerocephalus, Lepidosperma forsythii, Chorizandra sphaerocephala, Gahnia spp., Gleichenia spp. with taller shrub clumps of Sprengelia incarnata, Banksia ericifolia and/or Leptospermum juniperinum	Baker (2000)		
Disturbed area of Blady Grass <i>Imperata cylindrica</i> with scattered <i>Macrozamia communis</i> and stunted wattles on deep latite soils. Adjacent to Illawarra Blue Gum <i>Eucalyptus botryoides x saligna</i> with small occurrences of Forest Red Gum <i>Eucalyptus tereticornis</i> up to 25m.	Gaia Research (2010)		
Northern population			
Rainforest	Holmes (1989), Baker (2000)		
Open forest with <i>Eucalyptus saligna, Allocasuarina torulosa,</i> <i>E. andrewsii, Xanthorrhoea glauca, Acacia melanoxylon</i> and/or <i>A. implexa</i> and understorey/ground cover of tussocks <i>Imperata cylindrica, Poa sieberiana, P. labillardieri, Themeda</i> spp., <i>Sorghum leiocladum</i> and/or bracken <i>Pteridium</i> <i>esculentum</i> : understorey may be dominated by weeds <i>Lantana camara, Rubus</i> spp. (blackberry) and <i>Ageratina</i> spp. (crofton and mist weeds), e.g. at Richmond Gap	Holmes (1989), Lamb <i>et al.</i> (1993), Baker (2000)		
Mallee heath with <i>E. approximans</i> , shrubs, <i>Gleichenia</i> spp. and <i>Gahnia</i> spp. at Mt Barney	Holmes (1989)		
<i>Eucalyptus eugenioides, E. biturbinata, E. melliodora</i> open forest on Cainozoic igneous rocks	Regional Ecosystem 12.8.14 (DEHP 2011)		

<i>Eucalyptus crebra, E. tereticornis</i> woodland on Cainozoic igneous	Regional Ecosystem 12.8.16 (DEHP 2011)
Eucalyptus dunnii tall open forest on Cainozoic igneous rocks	Regional Ecosystem 12.8.11 (DEHP 2011)
Montane shrubland on Cainozoic igneous rocks	Regional Ecosystem 12.8.19 (DEHP 2011)
<i>Eucalyptus tereticornis, Corymbia intermedia</i> open forest on metamorphics with or without interbedded volcanics. Higher altitudes	Regional Ecosystem 12.11.9 (DEHP 2011)
Mixed tall open forest with <i>Eucalyptus siderophloia, E.</i> <i>propinqua</i> on metamorphics with or without interbedded volcanics	Regional Ecosystem 12.11.3 (DEHP 2011)
Mixed tall open forest with <i>Corymbia citriodora, Eucalyptus siderophloia, E. major</i> on metamorphics with or without interbedded volcanics	Regional Ecosystem 12.8.5 (DEHP 2011)
<i>Eucalyptus crebra</i> woodland on metamorphics with or without interbedded volcanics	Regional Ecosystem 12.8.7 (DEHP 2011)

Table 2. Vegetation communities inhabited by Eastern Bristlebird(adapted from Baker 2000 and Queensland DEHP Regional Ecosystem
Mapping 2011)

(As in Baker 2000, the names used for the vegetation communities generally follow Ingwersen (1976), Hermes & Jordan (1990) and Taws (1997) for the central populations, Gilmour (1983) for the southern populations and otherwise those of the cited authors.)

The Eastern Bristlebird is also occasionally recorded in sites dominated by invasive weeds such as Lantana, Bitou Bush, Blackberries (*Rubus*) and Mistflower (*Ageratina riparia*) (Gibson 1977; Lamb *et al.* 1993; Chapman 1999; Lindenmayer *et al.* 2009; E. Gould pers. comm.).

Habitat and Fire

The Eastern Bristlebird inhabits fire-prone habitats and the relationship between the species and fire has been well studied (e.g. Holmes 1989, 1998; Lamb *et al.* 1993; Baker 1997, 1998, 2000, 2003; Bramwell *et al.* 1992; Hartley and Kikkawa 1994; Clarke and Bramwell 1998; Bain and McPhee 2005; Bain *et al.* 2008; Lindenmayer *et al.* 2009), although ongoing research is being conducted to address existing knowledge gaps. The response of Eastern Bristlebird populations to fire is highly variable and strongly context-dependent (Bradstock *et al.* 2005; Bain *et al.* 2008), but they are particularly vulnerable to large-scale, intense fires (e.g. Clarke and Bramwell 1998; Baker 2000). The extent, intensity and frequency of fires are all important in determining habitat suitability.

Small-scale or low-intensity fires may leave small patches of unburnt habitat that provide refuge during fire and a base for the recolonisation of burnt areas post-fire. The presence of nearby unburnt habitat as a refuge is an important landscape component for the survival of Eastern Bristlebirds following fire (Holmes 1989; Pyke *et al.* 1995; Baker *et al.* 1997; Baker 1997, 2000; Bain *et al.* 2008). Birds may escape fire by temporarily moving to nearby unburnt vegetation and then return when conditions are suitable (Bain *et al.* 2008). Intense and/or extensive fires can eliminate large areas of suitable habitat, without leaving unburnt refuges, and lead to extinction of local populations (Baker 2000). Unburnt patches may result from topographic

features such as wet depressions, drainage lines and escarpment edges (Whelan 1995; Baker 2000) or from fire suppression activities. The northern Eastern Bristlebird population utilises rainforest as a refuge from fire (Holmes 1989). For a refuge to be effective during a fire, it must be close and be accessible under the prevailing fire conditions (Baker 2000).

Frequent fires may prevent vegetation from becoming dense enough to be inhabited by the species and they are of greatest threat in fragmented or small areas of habitat. The central and southern populations may reach maximum densities in habitat that has not been burnt for at least 15 years (Baker 1997). In the Booderee NP subpopulation, the recolonisation of burned habitat within two years of fire was attributed to the patchiness of the 2003 fire (leaving unburnt refuges) and the intensive fox control program (Lindenmayer *et al.* 2009; Lindenmayer *et al.* 2010). Lindenmayer *et al.* (2010) concluded that the decline of Eastern Bristlebirds after fire is largely due to the exposure to exotic predators following the loss of dense protective cover during a fire.

Hartley and Kikkawa (1994) found that, in the northern population, the structure and invertebrate fauna of the understorey could recover within six months to be suitable for foraging by the Eastern Bristlebird. The tussock grass habitat of the northern population may be suitable for breeding at two years post fire (Hartley and Kikkawa 1994). Grass cover exceeded pre-fire levels two years post fire at both Richmond Gap and Grassy Spur and declined 4-5 years after fire at both sites (Sandpiper Ecological Surveys 2007). To manage bristlebird habitat, it is important to understand the relationship between tussocks, which are used for nesting, and other ground vegetation such as Kangaroo Grass, which provide cover for foraging and shelter. Frequent fires have been shown to increase Kangaroo Grass cover at the expense of tussocks (Sandpiper Ecological Surveys 2007).

A fire regime that is too infrequent in the northern population could allow vegetation to become unsuitable for nesting through trees and shrubs becoming established and shading the growth of suitable grassy ground cover, grassy tussocks becoming too long and collapsing or weeds invading (Sandpiper Ecological Surveys 2000a). Different studies have proposed different fire intervals to maintain suitable habitat: 10-20 years (Holmes 1989); 5-15 years (Lamb *et al.* 1993) or, more recently 4-5 years (Sandpiper Ecological Surveys (2007). Buffer zones, mosaic burns and refuge areas are needed to protect the birds and their habitat from destructive wildfires (Hartley and Kikkawa 1994). Hartley and Kikkawa (1994) proposed that burning in the cooler winter months was preferred to avoid breeding season, and maximising regeneration of habitat.

Life History

Banding records indicate that birds are capable of surviving to more than four years of age (Bramwell and Baker 1990; Higgins and Peter 2002) and the longevity of birds that survive to maturity is probably at least six years (Holmes 1998, Baker unpubl. data). The generation length[‡] is estimated to be five years (Garnett and Crowley 2000).

The Eastern Bristlebird breeds from August to February (Campbell 1900; Chaffer 1954; Morris *et al.* 1981; Higgins and Peter 2002). Females build a small, globular nest that has a side entrance and is made from grass, bark, sedges or reeds, and

[‡] Generation length is the average age of parents in the population (IUCN 1994).

sometimes leaves (North 1901-1904; McNamara 1946; Chaffer 1954; Holmes 1989, Higgins and Peter 2002; Booth 2009). The nest is generally constructed at 10 to 45cm above the ground in low dense vegetation, in grass tussocks, sedges, ferns and shrubs (Campbell 1900; North 1901-1904; McNamara 1946; Holmes 1989; Chapman 1999; Baker 2000; Higgins and Peter 2002). Occasionally, nests are built in lower branches of shrubs (Holmes 1998).

Birds in the northern population nest in large living grass tussocks, in clearings not shaded by trees (J. Young unpublished data). In north-eastern NSW in the 2009 breeding season, most nests were located in *Poa* tussocks, even where other tussock grass species were present (J. Young unpublished data). In previous studies nesting has been observed most frequently in *Sorghum leiocladum*, and less often in *Poa sieberiana*, *P. labillardieri* and *Pennisetum alopecuroides* (Holmes 1989; Chapman 1999). Birds in the central population nest in grasses, in sedges such as *Gymnoschoenus sphaerocephalus*, *Gahnia* spp. and *Lepidosperma laterale*, and in the rush *Leptocarpus tenax* (McNamara 1946; Chaffer 1954; Baker 2000; Higgins and Peter 2002). There are no nest data for Howe Flat or Nadgee NR (L Evans and M Bramwell pers. comm. 2010). **Table 3** lists the nesting microhabitat recorded for the Eastern Bristlebird (from Baker 2000).

Clutches consist of two or sometimes three eggs (Campbell 1900; North 1901-1904; Chaffer 1954; Holmes 1989; Higgins and Peter 2002). The eggs are creamy-white and speckled with brownish or greyish spots, darker at the blunt end (North 1901-1904; McNamara 1946; Chaffer 1954; Booth 2009). The eggs are incubated by the female bird (Booth 2009), for a period of at least three weeks (Chaffer 1954). The nestlings are fed by both parents (Chapman 1999) during the nestling period of at least 16 days (Chapman 1999; Higgins and Peter 2002). It is thought that pairs probably rear only one brood per season, and that usually only one young is fledged per successful breeding attempt (Chaffer 1954; Holmes 1989, 1998; Baker 1998).

Field studies in southern Queensland by J. Young (unpubl.) have identified that birds can re-clutch following the failure of a first nesting attempt, and in captivity re-laying has occurred in four cases after an average of 17 days since egg removal (Booth 2009). Breeding failure is common. Nest and/or chick desertion is known to occur after human interference (Chaffer 1954; Hartley and Kikkawa 1994), and may also occur after other disturbances such as intrusion by potential predators or storm damage.

Eastern Bristlebirds raised in captivity reach sexual maturity at approximately 317 days (Booth 2009).

Location	Nest Microhabitat	References
Northern populations	Usually in grass tussocks Poa spp. or	Holmes (1989);
generally	Sorghum leiocladum, away from the	J. Young
	shade of trees.	(unpublished data)
Clarence River near	Nest of grasses and leaves built in a tuft	Jackson (1907)
Grafton	of rushes near the river	
Middle Harbour,	Nest made of grass, 0.5 m off the	Jackson (1907)
Sydney	ground in a <i>Banksia robur</i> shrub	
Unspecified	Nest of grasses and debris at the foot of	Ramsay (1882)
	bushy shrub	

Barren Grounds Five nests 0.15-0.45 m off ground, all in the sedge <i>Gymnoschoenus</i> sphaerocephalus.		McNamara (1946)
	Three nests in <i>Gahnia</i> clumps, one was 0.3 m above ground; four nests hidden in grasses; one in a clump of long grass; one nest woven with grasses and some papery (<i>Leptospermum</i>) bark, one 0.9 m above ground.	Chaffer (1954)
	One nest 0.1 m above ground in dense sedge below 2 m high <i>Leptospermum</i> .	Birdlife Australia nest record scheme
Marlo, Victoria	A nest in a clump of <i>Gahnia</i> at the foot of a <i>Melaleuca</i> shrub.	Howe (1947)

Table 3: Nesting microhabitat of the Eastern Bristlebird (from Baker 2000).

Diet and Foraging Ecology

The Eastern Bristlebird feeds mainly on invertebrates (ants, beetles, flies, cockroaches, bugs (hemipterans), cicadas, grasshoppers, crickets, mantids and caterpillars, but also earthworms and spiders), seeds and small fruits of grasses and other plants including *Acacia, Carex, Exocarpos* and, possibly, *Lycium ferocissimum*, but may also take fungi and occasionally nectar from *Banksia ericifolia*, food scraps and tadpoles (Gould 1865, Lea and Gray 1935; Barker and Vestjens 1990, Holmes 1998; Chapman 1999; Gibson 1999; Gibson and Baker 2004).

Eastern Bristlebirds forage mostly on the ground, where they toss aside leaf litter with their bill, peck food items from the surface and probe into soil, but they do not use their feet to scratch the ground. They occasionally glean food items from foliage or branches, or capture insects in flight (Robertson 1946; Blakers *et al.* 1984; Hartley and Kikkawa 1994; Baker 1998; Holmes 1998; Chapman 1999; Gibson and Baker 2004).

Hartley and Kikkawa (1994) suggested that drought may impact heavily on bristlebird breeding through a reduction in invertebrates suitable for feeding nestlings.

Movement Patterns

The Eastern Bristlebird is a sedentary (McNamara 1946; Gibson 1977; Blakers *et al.* 1984; Holmes 1989; Lamb *et al.* 1993; Hartley and Kikkawa 1994) or resident (Morris *et al.* 1981; Cooper 1991) species that undertakes some local movements (Baker 1998; Baker and Clarke 1999) and can recolonise some areas after being displaced by fire (Bramwell and Baker 1990; Hartley and Kikkawa 1994; Jordan 1984; Pyke *et al.* 1995). The birds are only capable of making weak, low, short-range flights (Chaffer 1954; Holmes 1989; Bramwell and Baker 1990; Lamb *et al.* 1993; Hartley and Kikkawa 1994; Baker 1998; Chapman 1999), which suggests that dispersal is likely to be mostly through ground movements (Higgins and Peter 2002) and, consequently, that they have a limited ability to disperse (Clarke and Bramwell 1998).

Studies of radio-tagged birds indicate that Eastern Bristlebirds are capable of travelling a total distance of at least 1.5 km during the course of a day (Baker and Clarke 1999). In 2009, Eastern Bristlebirds were recorded two to four kilometres from Howe Flat in heathland where they had previously not been detected, requiring a 2km movement through coastal forest vegetation (M. Bramwell pers. comm. 2010). Translocated birds at Cataract Dam dispersed 5 km in 3 years, and at Beecroft

Peninsula a maximum dispersal distance of 6 km was recorded after 6 years (Baker *et al.* 2012).

The Eastern Bristlebird is territorial during the breeding season and possibly throughout the year (Hartley and Kikkawa 1994; Chapman 1999; Higgins and Peter 2002). The results of one study suggest that the territory is a core-area within the home range that is defended from conspecifics and advertised by loud directional song (Holmes 1989). Territories, some of which are probably permanent (Chapman 1999; Higgins and Peter 2002), range in size from about one to four hectares (McNamara 1946; Holmes 1989; Bramwell and Baker 1990; Hartley and Kikkawa 1994). Home ranges are estimated to be about 10 hectares (Baker 2001).

Population densities within suitable habitat are low compared to those of other heathland birds (Gosper and Baker 1997) with maximum densities of four birds/10ha recorded at Barren Grounds NR (Baker 1998). In the Howe Flat population, 1.5-2 birds/10ha were recorded (Bramwell 2008).

THREATS

The main threat to the Eastern Bristlebird is the loss or fragmentation of suitable habitat which can be caused by inappropriate fire regimes and clearing for urban or agricultural development. Habitat loss is recognised as the main process that has reduced the distribution and abundance of the Eastern Bristlebird in the last 150 years. Another potential threat to the species is predation, particularly by feral predators and particularly after fire. Habitat degradation is also a significant threat, particularly in fragmented habitat, and can be caused by disturbance from feral animals (e.g. pigs) and livestock and invasion of weeds. Other potential threats include genetic bottlenecks and inbreeding, climate change and human disturbance (DEC 2004, Garnett and Crowley 2000; Holmes 1998; Stewart 2006).

Habitat clearing

Historical clearing of coastal heath and escarpment forest is a major reason for the current endangered status of the species. Further loss or degradation of any habitat that supports the Eastern Bristlebird is deemed significant. The possibility of further habitat loss through the application of unsuitable fire regimes and clearance for urban development remains a key threat. "Land Clearance" is listed as a Key Threatening Process under the EPBC Act, including clearance of native vegetation for crops, improved pasture, plantations, gardens, houses, mines, buildings and roads (TSSC 2001a).

While habitat on conservation reserves may be managed for Eastern Bristlebirds, recovery of habitat is not possible in some areas due to current land-zoning for urban development. Protection and management of habitat on private land, particularly for the northern population and at Jervis Bay, is extremely important but challenging as the cumulative impact of residential developments remains a key threat to some local populations.

Clearance or disturbance of habitat due to forestry practices is a threat to individuals or populations on Forests NSW tenure. Forestry activities may cause direct loss of habitat and potential secondary consequences from disturbance and improved access.

Fire

The Eastern Bristlebird has little ability to escape fire (ground dwelling, weak flier) and recover afterwards (cover dependant, poor disperser, low fecundity), making it particularly sensitive to certain fire regimes (Smith 1977; Baker 2000; Whelan *et al.* 2006; Bain *et al.* 2008). In all populations the species and its habitat are threatened by extensive, intense and/or frequent fires which may cause local extinctions (Gilmour 1983; Baker 1997, 2000; Clarke and Bramwell 1998; DSE 1999). More detail is provided in the Habitat section.

Inappropriate fire regimes can result in indirect or temporary loss of habitat for the Eastern Bristlebird. Post-fire recovery of some habitat may be possible with rehabilitation and/or reintroduction. Much of the known habitat for the species is now reserved so recovery will depend largely on how reserves are managed, but management of habitat and fire on other tenures is particularly important in the Jervis Bay area and the northern population. The aim of fire management in Eastern Bristlebird habitat or former habitat should be to: a) restore important habitat

components at degraded sites; and b) maintain important habitat components at occupied sites (Sandpiper Ecological Surveys 2007).

Fire intensity, scale and frequency are all important features to be considered in managing fire in Eastern Bristlebird habitat (see **Table 4**). Buffer zones and refuge areas are necessary to protect the species from fire and aid its recovery. Feral predator control is another important factor that may influence the re-occupancy of habitat by Eastern Bristlebirds after fire (e.g. Lindenmayer *et al.* 2009) and is discussed further in the Predation section.

Fire characteristic	References
Intensity and scale: Mosaic, low-intensity or small-	Bain et al. (2008); Baker
scale burns to create / maintain unburnt refuge areas.	(1997, 2000); Baker <i>et al</i> .
Refuges must be close and accessible to the birds	(1997); Holmes (1989);
under prevailing fire conditions. Not to be lit on two	Pyke <i>et al</i> . (1995);
fronts due to the chance of trapping birds.	Sandpiper Ecological
	Surveys (2007)
Frequency: Ensure fire frequency will maintain suitable	Baker (1997); Hartley
habitat for a specific site (too frequent may prevent	and Kikkawa (1994);
vegetation from becoming dense enough to be suitable	Sandpiper Ecological
and too infrequent may cause a change in the	Surveys (2000a, 2007);
vegetation community to an unsuitable habitat). Site	Stewart (2006); D.
specific but generally >15 years for central and	Stewart pers. comm
southern, 4-5 years for northern.	(2012)
Buffers: Create / maintain buffer zones &/or	Hartley and Kikkawa
management tracks (to protect habitat from wildfire)	(1994)
Seasonality: Cooler weather (autumn, winter) burning	Hartley and Kikkawa
to avoid breeding season and maximise regeneration.	(1994); Sandpiper
Not during drought conditions	Ecological Surveys
	(2007)

 Table 4: Fire characteristics important for Eastern Bristlebird habitat

Northern Population

There have been several studies on the fire ecology and habitat requirements of the northern population (Holmes 1989, 1997; Lamb et al. 1993; Hartley and Kikkawa 1994; Sandpiper Ecological Surveys 2000a, 2007). Where fire is too infrequent bristlebird habitat is adversely affected and local extinctions are likely to occur (Holmes 1997). A lack of fire may render habitat unsuitable for nesting through trees and shrubs becoming established and shading the growth of suitable grassy ground cover, grassy tussocks becoming too old and collapsing or weeds invading (Sandpiper Ecological Surveys 2000a). In some northern locations, fire exclusion or suppression may be causing a change in the vegetation and promote plant communities which are not suitable habitat for the Eastern Bristlebird (Stewart 2006). Habitat studies suggest that a fire frequency of 5-15 years will maintain suitable habitat (Lamb et al. 1993; Hartley and Kikkawa 1994). In general, a fire regime of 7 to 10 years frequency is considered to be appropriate for the maintenance of grassy habitat for the northern population (Holmes 1998). However, individual sites require specific assessment. Some higher intensity and more frequent fires may be required in degraded unoccupied habitat to restore the habitat to suitable condition.

Central and Southern Populations

There have been many investigations into the effects of fire regimes on the Eastern Bristlebird's heathland habitat (e.g. Forshaw *et al.* c1969; Gilmour 1983; Pyke *et al.* 1995; Baker 1997, 2000; Bain *et al.* 2008). Generally, densities of Eastern

Bristlebirds increase with time since fire and are highest in vegetation of the oldest fire age. Populations have been found to recover more quickly from large-scale fire when unburnt refugia are available, as was the case after the Booderee NP wildfire in 2003 (Bain *et al.* 2008; Lindenmayer *et al.* 2009). Studies following large-scale and/or frequent fires in Barren Grounds and Nadgee NRs have indicated that population recovery may take over 10 years when there is a lack of refugia (Gilmour 1983; Baker 1997, 2003; Woinarski and Recher 1997).

Predation

Predation of the Eastern Bristlebird by native and feral predators is known to occur (e.g. Clarke and Bramwell 1998; Hartley and Kikkawa 1994; J. Baker unpubl. data; J. Young unpubl. data) but the extent of this at a population level is unknown. Potential native predators include birds of prey, snakes, goannas, quolls, currawongs and honeyeaters, while potential feral predators include cats, foxes, rats, dogs and pigs. The brood parasitism of cuckoos may also impact on Eastern Bristlebirds, Fan-tailed Cuckoos have been known to parasitise nests in south-eastern Queensland (J. Young pers. comm. 2006).

The Eastern Bristlebird's long incubation period and close proximity of nests to the ground are likely to make nesting birds, eggs and young particularly susceptible to predation (Hartley and Kikkawa 1994). The bristlebird's habit of calling and showing themselves may also make birds and their nests susceptible to predation. Charley (2010) suggests that nest predation and/or disturbance may affect a large proportion of nesting attempts in the northern population each year. The impact on recruitment is unknown, but likely to be significant.

Small to medium sized ground-dwelling fauna are particularly susceptible to predation by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*). A predation study at Howe Flat suggests that cats and foxes appear to provide the greatest predation threat to that Eastern Bristlebird population, with cats more likely to prey on adults than foxes or dogs (*Canis lupus familiaris* or *Canis lupus dingo*), but all three (and especially cats and foxes) are likely to take nestlings and juveniles (Mitchell 2001). Feral cats are a consistent presence at Barren Grounds NR (F. Kristo pers. comm. 2010) and cats are thought to be the main feral predator in the northern population (Hartley and Kikkawa 1994). At Howe Flat foxes are moderately common but cats are not abundant (Mitchell 2001).

While systematic control of dogs and foxes is both feasible and cost effective through use of buried 1080 baits, control of cats is much more difficult and expensive as it currently requires live trapping or shooting. Mitchell (2001) suggested that, at Howe Flat, care should be taken with fox control alone as a reduction in fox numbers could result in an increase in the cat population, thus having a greater impact on the Eastern Bristlebird. This is consistent with the mesopredator release theory, which suggests that where fox numbers are declining, feral cats should increase their activity. Control programs may also impact on dingo populations, thus affecting their function as a high-order predator and possibly leading to an increase in numbers of foxes and cats (Glen et al. 2007; NSW Scientific Committee 2008b; DECC 2009; DECCW 2010).

Claridge *et al.* (2010), however, monitored the activity of wild dogs, foxes and cats during a 10-year fox-baiting program in south-eastern NSW and found that the relative abundance of all three feral predators is much more complex than previously thought. The authors reported no increase in cat numbers during the long-term intensive fox-baiting program.

"Predation by the European Red Fox (*Vulpes vulpes*)" and "Predation by feral cats" have been listed as Key Threatening Processes under the EBPC Act, and threat abatement plans have been prepared (DEWHA 2008a, 2008b). Further information is required to quantify the overall impact of cat and fox predation on the Eastern Bristlebird.

Fire and feral predation - interaction between threatening processes

Fire is thought to lead to increased predation (Recher and Christensen 1981; Brooker and Brooker 1994; Loyn 1997) for cover-dependent species such as the Eastern Bristlebird. After fire, reduced ground cover may result in greater numbers of birds in small refuge areas, less protection for individual birds and/or easier access for feral predators. Lindenmayer *et al.* (2010) concluded that the decline of Eastern Bristlebirds after fire is largely due to the exposure to exotic predators following the loss of dense protective cover during a fire. The interaction between fire and feral predators requires further investigation (Bain *et al.* 2008).

Habitat disturbance by exotic herbivores

Feral pigs (Sus scrofa)

"Predation, habitat degradation, competition and disease transmission by feral pigs" has been listed as a key threatening process under the EBPC Act, and a threat abatement plan has been prepared (DEH 2005). Feral pigs can impact on the Eastern Bristlebird through destruction or disturbance of habitat, spreading weeds and diseases (including *Phytophthora cinnamomi*); and increasing access for feral predators such as the European Red Fox. Feral pigs can also affect the species directly by consuming chicks and eggs, along with various components of its diet and habitat.

Overgrazing

Overgrazing by domestic livestock is a potential threat to northern populations, particularly during the breeding season. Grazing by exotic herbivores degrades habitat, destroys nests and probably limits dispersal of the most severely threatened populations (Holmes 1989). In addition, the promotion and planting of exotic legumes for fodder is degrading habitat and may lead to the replacement of native grasses (D. Charley pers. comm. 2010).

Limited seasonal grazing on some of the habitat on private land may be beneficial in controlling introduced legumes and shrub development, if undertaken outside the breeding season (Charley 2010).

Habitat degradation due to dieback or invasive weeds

The dieback disease caused by the root-rot fungus *Phytophthora cinnamomi* is listed as a Key Threatening Process under the EBPC Act, and a threat abatement plan has been prepared to provide a national strategy to manage its impact on biodiversity (DEH 2001). Although dieback has the potential to impact on the habitat of the Eastern Bristlebird, to date there is no evidence of widespread loss of habitat. The pathogen may be spread by the tyres of vehicles or on walking boots, especially during the period of the infective southern spring. The spread of dieback resulting from human activity can be reduced by limiting human access to certain areas (quarantine). However it is also spread by natural vectors such as native or feral animals which can be more difficult to control (DEH 2001). Bell Miner associated forest dieback (BMAD) is affecting extensive areas of forest in north-eastern NSW and south-eastern Qld. This has been identified as a significant threat to the long-term survival of the open grassy forests of the region and is a potential threat to Eastern Bristlebird habitat (Charley 2010). The BMAD working group has identified strategies to reduce the impact of BMAD (BMAD working group 2010).

Invasion of weeds into the habitats of threatened species is widely accepted as a limiting factor in the effective management of those species. Control of invasive weed species is important for maintenance of habitats in all Eastern Bristlebird populations. It is important to note however, that Eastern Bristlebirds in Booderee NP can utilise Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*) as it has the low dense vegetation structure required by the species.

Species such as Lantana (*Lantana camara*), Crofton Weed (*Ageratina adenophora*) and Mist Flower (*A. riparia*) are all significant threats to the habitats of the northern population. Bitou Bush occurs in Booderee NP, and may be a problem for other locations throughout the Eastern Bristlebird's range. Blackberry (*Rubus fruticosus* aggregate) poses a weed problem at Howe Flat in Victoria.

Bitou Bush, Lantana and Blackberry are all listed in the top 20 Weeds of National Significance (WONS), identified by the Australian and state governments because of their invasiveness, impacts on primary production and the environment, potential for spread and socioeconomic impacts (DEH 2003a, 2003b, 2003c).

Small sub-populations and genetic bottlenecks

The national Eastern Bristlebird population has become severely fragmented. Fragmentation and isolation may be adversely affecting regional populations. Smith (1977) considered that the specialised habitat requirements of the Eastern Bristlebird prevented remnant populations from expanding. This is compounded by the limited amount of extant habitat available to the species. The dispersal potential and the need for dispersal corridors are unknown. Fragmented small populations are prone to deleterious genetic consequences related to their lack of genetic variability (Usher 1987). The extent of this effect on populations of the bristlebird is unknown.

The history and ecology of the species strongly suggest that as populations become small and fragmented, local extinctions ensue quickly. Some local populations are now so small in the north (only a few birds or pairs of birds in each) that young produced may not physically be able to find birds from other local populations to pair up with. Without augmentation in numbers in these locations to allow this pairing to happen, these sub-populations will not persist (D. Charley pers. comm.).

Fragmentation of habitat and isolation of populations can also occur on a smaller scale as a result of the construction or maintenance of public roads and utility corridors. Where possible further habitat loss should be avoided and regeneration of habitat on unused tracks should be undertaken.

Climate change

Climate change is one of the major threats to biodiversity on a global scale, and human-induced climate change has been listed as a key threatening process under the EPBC Act (TSSC 2001b). It is driven predominantly by the release of greenhouse

gases into the atmosphere by the combustion of fossil fuels, and also from agriculture and industry.

Climate change will affect biodiversity directly and indirectly through temperature change, changes in rainfall and water quality and increases in extreme events such as fires, floods, storms, heatwaves and droughts. Ecological responses are largely driven by extreme weather events rather than by changes in mean climate (Steffen 2006), and more frequent or severe extreme events will increase the threat to species and ecosystems already under stress.

Smith (1977) suggested that remaining populations of Eastern Bristlebird are occupying marginal habitats, thus rendering them more vulnerable to small environmental changes. When climate change is superimposed on all other threats, it is expected to exacerbate their effects. As a result, current threats to Eastern Bristlebird, including fire, habitat loss, weeds and pest animals, are expected to intensify under climate change scenarios.

Individual species have two possible survival mechanisms in response to changes in climate – adaptation or migration (Hinckley and Tierney 1992). However the main threat from anthropogenic climate change is a magnitude and rate of change which exceeds the capacity of species and ecosystems to survive. Across the range of the Eastern Bristlebird, climate change impacts are likely to vary, but the fragmented nature of their habitat in some populations and their poor dispersal ability leaves few opportunities for the species to move to areas where the climate is more suitable. In populations with contiguous habitat such as in Nadgee NR, it could be argued that there is a degree of landscape resilience, although if habitat is marginal this may not help the bristlebird in the long term.

Human disturbance

The presence of humans may have an adverse impact on breeding birds and many authors have suggested closure of bristlebird areas during the nesting period (Hartley and Kikkawa 1994).

The use of call playback to detect Eastern Bristlebirds may interfere with breeding behaviour during the breeding season, potentially leading to nest abandonment.

Off-road vehicles (4WD and motor bikes) damage habitat in some areas occupied by the Eastern Bristlebird (e.g. Budderoo NP).

As a ground-dwelling species, the Eastern Bristlebird will run across busy peri-urban roads and tracks, resulting in some birds being hit by vehicles. Birds have been killed by vehicles in the Jervis Bay area but the extent of this threat to the local population is unknown. Specific Eastern Bristlebird wildlife road signage has been displayed and speed limits enforced but the extent to which this may assist in reducing the number of roadkills is unknown and roadkills are still occurring at Jervis Bay (J. Baker pers. comm.).

Recovery Information

Previous Recovery Actions

In the last 20 years, information on the occurrence, ecology and population status of the Eastern Bristlebird has increased significantly and a number of recovery actions have been implemented for its conservation. Much of the impetus for action arose from the involvement of Birdlife Australia at the Barren Grounds Bird Observatory. A variety of studies have documented these actions, and many of these are listed below, although the lists are not exhaustive. The findings and recommendations of many previous studies and outcomes of previously implemented actions have been taken into consideration in the development of proposed recovery actions in this plan.

Recovery Planning

In 1996 a recovery program for the Eastern Bristlebird commenced in NSW. The National Recovery Team was established in 1997 by the then Queensland Department of Environment and is now convened by NSW OEH. Three working groups (northern, central and southern) have also been operating for a number of years, due to the complexities of implementing recovery actions for geographically isolated populations. These working groups are represented on, and share information with, the national team.

A draft national recovery plan was prepared for the Eastern Bristlebird in 1998 (Holmes 1998). Draft national recovery plans have also been prepared for the northern population (Stewart 2001, 2006).

A draft state recovery plan has been prepared for the Eastern Bristlebird in NSW (DEC 2004) but was never exhibited publicly. The NSW TSC Act Priorities Action Statement comprises recovery actions that are consistent with this plan (DECCW 2010c). The Victorian Eastern Bristlebird Action Statement was published in 1999 (DSE 1999).

The efficacy of these plans and progress towards the implementation of recovery actions have been considered by the National Recovery Team. This recovery plan sets out the actions required to build on the successes already achieved in the recovery of this species. It builds upon the previous plans, incorporating improved knowledge of the species, and the changing priorities as objectives in earlier plans were achieved or altered.

The recovery effort has been a successful collaboration between natural resource management agencies in three states, bird research and conservation groups, DEWHA, local Government agencies, private landholders, volunteers and others. All have made significant contributions to the operation of the recovery effort. A summary of the actions that have already been undertaken is provided below.

Survey and Monitoring

The distribution and abundance of the Eastern Bristlebird have been well documented (e.g. Bramwell 2008; Clark and Bramwell 1998; Baker 1996, 1997; Baker and Whelan 1996; Holmes 1989, 1997; Sandpiper Ecological Surveys 1999, 2000b, 2002, 2003, 2008). Habitat monitoring has been undertaken in the northern population (e.g. Sandpiper Ecological Surveys 2006b). Resurveys or long-term monitoring of bird abundance have been conducted at many sites, yielding important information on population trends (e.g. Baker 1998; Bain and McPhee 2005; Holmes 1989, 1997, 2001; Sandpiper Ecological Surveys 2000b, 2002, 2003, 2008; L.

Evans pers. comm. 2010). In some cases this has been assisted by volunteer groups (e.g. Birds Queensland). Ongoing monitoring at Nadgee NR and Howe Flat have indicated stable trends for the southern population (M. Bramwell pers. comm. 2010).

A long-term vegetation and habitat monitoring program has been established for the northern population. Forty permanent survey transects have been set up in NSW and 16 in Queensland. Initial data have been analysed and findings acted upon (Sandpiper Ecological Surveys 2006b; Charley 2010). Twelve long-term vegetation monitoring plots were established at Howe Flat in 1999 (M. Bramwell pers. comm. 2010).

Habitat Mapping

The habitat of the Eastern Bristlebird has been studied and mapped to a varying degree in each population. In Jervis Bay, detailed habitat mapping was specifically conducted for development planning purposes in high urban growth areas (Bain 2001). A draft essential habitat map for Queensland has been prepared (R. Williams pers. comm. 2010). However, there is no specific niche mapping for the four populations. Currently, existing vegetation community mapping is used as a surrogate for determining potential habitat and population size. Future habitat mapping should be focused specifically on Eastern Bristlebirds, extended to cover the entire species distribution and refined using updated vegetation information (see Actions).

Research and specialist knowledge

Extensive and detailed research has been undertaken into the ecology, habitat requirements, taxonomic status and threats of the Eastern Bristlebird (e.g. Bramwell *et al.* 1992; Baker 1997, 1998, 2000, 2001, 2003, 2009; Baker and Clarke 1999; Gibson 1999; Schodde and Mason 1999; Gibson and Baker 2004; Bain *et al.* 2008), although not consistently across all populations. In particular, research into the species' relationship with fire has been published, particularly for the central population.

<u>Genetics</u>

Genetic analysis, however, has produced no evidence supportive of sub-speciation (Elphinstone 2008; Roberts *et al.* 2011) although four currently genetically isolated populations have been identified. These are: (1) the 'northern' population (northern NSW/southern QLD); (2) Barren Grounds (central); (3) Jervis Bay (central); and (4) the 'southern' population (Nadgee NR (NSW)/Croajingalong NP (Vic)) (Roberts *et al.* 2011). Microsatellite genetic distances among populations are correlated with geographic distance (a pattern of isolation by distance) (Roberts *et al.* 2011), and may have arisen over recent timeframes. The largest pool of genetic variability is in the central population, now divided into the Jervis Bay population and the Barren Grounds population.

Management and Planning

There are numerous existing plans, strategies and programs with relevance to the management of the Eastern Bristlebird and/or its habitat. Most of the known populations and habitat occur on National Parks and Nature Reserves and on Defence land. Protected area and other land management plans of interest include Plans of Management (PoM) and Fire Management Plans or Strategies (FMP or FMS) with recommendations for (or implications of) the management of Eastern Bristlebird habitat, especially in relation to fire. These plans are listed in Appendix 1.

There are numerous state, regional and local government plans and strategies that incorporate conservation requirements of the Eastern Bristlebird on private land,

particularly around Jervis Bay and in northern NSW. The NSW South Coast Regional Strategy (SCRS) (DoP 2007), for example, precludes new development (i.e. rezoning) in areas of high conservation value (HCV). Conservation on private land requires ongoing cooperation between landholders, government and CMAs and NRM bodies, and linking in to programs such as the Hotspot Fire Project (NCC 2010; RFS 2010) in the northern population. Relevant plans and strategies are listed in Appendix 1.

Weed, Feral Predator and Disease Control

Feral predator baiting has been undertaken in many of the reserves occupied by Eastern Bristlebird populations to date. For example, an extensive, coordinated feral predator baiting program has been undertaken in Booderee NP since 1999 (Lindenmayer *et al.* 2009). The Border Ranges Biodiversity Management Plan (BMP) (DECCW 2010a) recommends undertaking coordinated and cooperative cat and fox control strategies at locally significant sites, specifically listing Eastern Bristlebird as a threatened species at risk.

Ongoing weed control is being carried out in areas occupied by Eastern Bristlebird, on public and private lands, although not at all sites. Lantana, Crofton Weed, Mistflower, Bitou Bush and Blackberry are all threats to the species and control programs being undertaken include spraying and removing by hand. In the northern population, the Border Ranges Rainforest BMP recommends identification of priority grassy wet sclerophyll areas known to contain Eastern Bristlebird and Hastings River Mouse; and development and application of appropriate fire management strategies to control weed and shrubby acacia encroachment while protecting adjacent rainforest (DECCW 2010a).

Phytophthora hygiene practices are applied in day to day management at many of the parks and reserves inhabited by Eastern Bristlebird, e.g. Beecroft Weapons Range and Nadgee NR. In the Nadgee Wilderness Area the hygiene protocol is to spray vehicles with a fungicide and use a foot-bath to remove the fungus from boots (D. Oliver pers. comm. 2010)

Grazing management and exclusion

There has been ongoing liaison between the Northern Working Group and landholders to exclude grazing on Eastern Bristlebird habitat, especially during the breeding season. Stock exclusion fencing has been constructed at two sites in northern NSW with fences yet to be erected on private land in southeastern Queensland (Charley 2010, E. Gould pers. comm.). Grazing permits have been terminated and stock removed from Border Ranges NP.

Habitat Management Burns

A number of habitat management burns have been conducted in south-eastern Qld and north-eastern NSW (Charley 2010). The Border Ranges Rainforest BMP (DECCW 2010) recommends establishment of five trial fire management sites in previously occupied Eastern Bristlebird territories at Richmond Gap in NSW.

Translocations

Between 2003 and 2005, a total of 51 birds were translocated from Bherwerre Peninsula (Jervis Bay and Booderee NPs) to the nearby Beecroft Peninsula (Beecroft Weapons Range) that had been unoccupied by the species for over a century. Radio-tracking of the individuals indicated a colony was successfully established (Bain 2003a, 2003b, 2006). Surveys have shown medium-term success with high bird counts and evidence of breeding (Bain 2006; Baker 2009). Surveys in

spring 2009 estimated at least 73 birds at Beecroft (M. Armstrong pers. comm. 2009).

In 2008, 50 Eastern Bristlebirds were translocated from Barren Grounds NR to the previously unoccupied Sydney Catchment Authority (SCA) Metro Special Area on the Woronora Plateau near the Cataract Reservoir (DECC 2008, Baker 2009). Follow-up monitoring showed medium-term success with evidence of breeding in the first year after release. Although a low number of birds (12) was detected 18 months after release, this may be due to access difficulties and the variable responsiveness of the birds to the call playback (Baker 2009) and potential dispersal away from survey sites.

Captive Breeding and Reintroduction

A pilot captive breeding program for the northern population commenced at David Fleay Wildlife Park in 2004 (Booth *et al.* 2005). Two sibling nestlings were acquired from the wild, and the evidence from five breeding seasons suggested that the species will breed readily in captivity, provided adequate numbers of founders can be acquired.

A pilot reintroduction of eight captive-bred birds from David Fleay Wildlife Park was carried out in 2008 in north-eastern NSW and south-eastern Qld. Birds were radio-tracked for four weeks post-release, with two individuals being predated in that period (R. Booth and D. Stewart pers. comm. 2009). Two of these banded captive-bred birds were observed in the wild in north-eastern NSW in 2010 (J. Young unpublished data).

Results from this study have provided information on the Eastern Bristlebird, including life history details, future captive breeding methods and optimal radio-transmitter attachment (Booth and Stewart 2007).

Community Awareness

The Eastern Bristlebird Public Contact Action Plan (York 2002) prepared in consultation with the Northern Working Group has raised the profile of the species and improved liaison with landholders and birdwatching groups. Interpretive notices, road signs and information pamphlets in central and southern population areas have increased public awareness and support.

Volunteer Involvement

Birds Queensland has been closely involved in population survey and monitoring which has involved training of skilled observers. Volunteers have assisted with survey, banding and monitoring effort at Howe Flat, Victoria. Volunteers have also been very active at many locations in the central population.

Recovery Objectives

Long-term Overall Objective

The long-term objective [by 2030] of this plan is the recovery of all populations of the Eastern Bristlebird to a position where all four populations are stable. The northern population will be enhanced to increase to a viable level. The central populations will remain stable. An additional southern population will be established in Victoria, bringing the southern population to a viable size. Viable population size will be determined by population viability analysis (PVA). Attaining this long-term objective will involve the protection and management of habitat, the management of threats

and enhancement of wild populations through captive breeding, reintroduction and translocation. The objectives, criteria and actions proposed in this recovery plan work towards that objective and build on those in previous plans.

Specific Objectives [within the 5 year projected timeframe of this plan]

Objective 1: Maintain and improve the condition and extent (carrying capacity) of Eastern Bristlebird habitat and minimise known or likely threats for all populations, with particular emphasis on fire prescriptions, minimising habitat fragmentation and control of: feral predators, exotic herbivores, overgrazing and weeds.

Objective 2: Undertake survey, monitoring and mapping to improve knowledge of all Eastern Bristlebird populations. Population dynamics and habitat condition will be monitored in each population. Methods including survey effort and frequency will be reviewed and standardised and will be subject to ongoing review according to census results or special circumstances such as wildfire. Potential habitat will be surveyed to locate new colonies in the northern and southern populations, and to estimate more accurately the population size for all populations.

Objective 3: Enhance/augment northern and southern populations, building towards viable populations as determined by population viability analysis.

Objective 4: Conduct research to increase knowledge of ecology, threats and habitat management requirements of the Eastern Bristlebird.

Objective 5: Increase community awareness, understanding and involvement in the Eastern Bristlebird recovery effort, particularly on private land. Improve communication between working groups and stakeholders including Australian and State Government agencies, CMAs and other NRM bodies, the Aboriginal community, landholders, land managers, rural fire services and interest groups.

Objective 6: Effectively organise and administer the recovery effort to ensure that recovery plan objectives are met.

Recovery Actions

<u>OBJECTIVE 1:</u> Maintain and improve the condition and extent (carrying capacity) of Eastern Bristlebird habitat and minimise known or likely threats for all populations, with particular emphasis on fire prescriptions, minimising habitat fragmentation and control of: feral predators, exotic herbivores, overgrazing and weeds.

The recovery of the Eastern Bristlebird will depend on minimising the further loss and fragmentation of habitat and improving its condition, as well as population enhancement, security and maintenance. An increase in areas of potential habitat, appropriate fire prescriptions and control of feral pests and weeds will provide greater security to all Eastern Bristlebird populations.

Recovery criterion 1: Eastern Bristlebird populations are protected from wildfires where possible; species requirements and strategies have been incorporated into fire management strategies within occupied or potential habitat; feral predator control programs are implemented; impact of feral pigs has been investigated and control programs used where necessary; weed and *Phytophthora* control programs are

implemented and fragmentation of habitat is minimised and the condition and extent of habitat is improved or maintained.

A: Fire prescriptions

This plan recognises that the implementation of site-specific actions for Eastern Bristlebird must occur within the context of broader fire-management issues. Clearly the requirements of all threatened species must be taken into account in the range of fire management policies and plans across the Eastern Bristlebird's range, along with protection of human life and operational requirements. In some cases specific Eastern Bristlebird fire prescriptions may not be compatible with other management obligations. The Biodiversity Benefits section (page 45) lists other significant species within the range of Eastern Bristlebird. Some threatened species may have different habitat requirements in terms of fire frequency, e.g. New Holland Mouse.

However, where possible, fire management plans for known Eastern Bristlebird habitat and adjacent land tenures (as described in the following actions) should:

-provide for suppression of intensive and extensive wildfire (with the exception of Nadgee Wilderness);

-ensure site-appropriate burning regimes;

-contain prescriptions for habitat monitoring and habitat management;

-be updated regularly;

- -provide for fire suppression using only *Phytophthora*-free water;
- -create refugia where necessary;

-maintain fire breaks and fire management tracks; and

-maintain and update fire histories on shared computerised GIS files.

For areas adjacent to known sites, plans should also cover multi-owner areas so numerous properties can be managed together.

<u>Action 1.1:</u> Incorporate Eastern Bristlebird requirements and strategies into bushfire management plans where this has not occurred for all Eastern Bristlebird habitat in the **northern population**. Site-specific strategies will require ongoing liaison with land managers, landholders and species experts. The National Recovery Team and Northern Working Group will support the ongoing work with landholders and property-based fire planning programs of the South-eastern Queensland and Northern Rivers Fire and Biodiversity Consortiums and Hotspots Fire Project in north-eastern NSW.

Conduct habitat management burns in previously occupied territories in the northern population and ensure burns coincide with management plans for these tenures. Habitat management burns are required to maintain and rehabilitate important breeding habitat in Border Ranges NP.

Priority: Very High

Potential contributors: EHP, NPRSR, OEH, RFS and Northern Working Group

<u>Action 1.2:</u> Incorporate Eastern Bristlebird requirements and strategies into bushfire management plans where this has not occurred for all Eastern Bristlebird habitat in the **central populations**. Site-specific strategies will require ongoing liaison with land managers, landholders and species experts, but will follow principles of protection

from wildfire over the five years of the plan and ensure that a high proportion of habitat remains unburnt.

At Barren Grounds NR and Budderoo NP, modify existing management tracks (principally track widening and upgrading for all weather use) and construct additional track links (to escarpment edges, etc) to provide a higher level of protection against wildfire. This will include preparation of a Review of Environmental Factors (REF) for identified works, upgrade of management tracks and amend Reserve Fire Management Strategy as required. It is important to note that lightning strikes and car arson are relatively common occurrences in the vicinity of these reserves. (The increasing incidence of car arson due to rapidly increasing residential development in nearby population centres is now a significant threat.) The frequency of these incidents, and therefore, the risk they pose is predicted to increase. The proposed works would provide a considerable fire control advantage and a very practical method of providing a higher level of security for a viable, critical population of Eastern Bristlebirds.

Priority: Very High

Potential contributors: OEH, Parks Australia, Department of Defence, Wreck Bay Community Council, RFS, National Recovery Team and Central Working Group.

<u>Action 1.3:</u> Incorporate Eastern Bristlebird requirements and strategies into bushfire management plans where this has not occurred for all Eastern Bristlebird habitat in the **southern population**. Site-specific strategies will require ongoing liaison with land managers, landholders and species experts.

Conduct an experimental burn in areas of long-unburnt (greater than 20 years) heathland north of Howe Flat. Bristlebird abundance and vegetation structure and floristics will be monitored as per Action 3.4.

Given the remoteness of the sites and lack of fire advantages, protection of refuges in Nadgee NR could only be achieved by helicopter water bucketing. Nadgee has not been burnt for 30 years but the upper biodiversity vegetation thresholds may be exceeded if it is to the advantage of the conservation of the Eastern Bristlebird population (NPWS 2003).

Priority: Very High

Potential contributors: OEH, Parks Victoria, DSE, National Recovery Team and Southern Working Group

<u>Action 1.4</u>: Monitor bristlebird abundance and vegetation response to fire at selected sites in **each population** (management dependent).

Priority: High

Potential contributors: OEH, DSE, Parks Victoria, EHP, NPRSR, BirdLife Australia/Birds Queensland, National Recovery Team and Working Groups, research organisations (e.g. ANU, UoW, UQ, Griffith University).

B: Feral pest animal control

<u>Action 1.5</u>: Implement feral predator control where Eastern Bristlebirds are vulnerable to predation by cats and foxes, which are a major threat to the species. Vulnerable populations include small isolated populations close to urban areas and **all populations** immediately after large-scale fire in Eastern Bristlebird habitat.

Post-fire control programs should be implemented in conjunction with other relevant land management agencies and adjoining landholders to protect remaining birds in refuge areas and maximise effective area of fox control. Where possible, cat and fox control should be carried out in unison and control programs should seek to minimise impact on dingo populations. All predator control work after fire should be monitored.

In Nadgee NR, vertebrate pest control programs will be considered by OEH adjacent to key refuge areas after a major fire event.

At Barren Grounds NR and Budderoo NP, intensive vertebrate pest control and control monitoring will be carried out on completion of proposed prescribed burns. Annual cat/fox trapping, 1080 baiting and control monitoring will also be undertaken.

Priority: Very High

Potential contributors: OEH, EHP, NPRSR, Parks Victoria, Department of Defence, Parks Australia, Wreck Bay Community Council, LHPAs and private landholders, National Recovery Team and Working Groups.

<u>Action 1.6:</u> Continue feral pig control program at Conondale Range and Spicer's Gap (Main Range NP) (**northern population**).

Priority: Very High

Potential contributors: Local landowners, NPRSR

<u>Action 1.7</u>: Monitor level of habitat damage by pigs, pig locations and densities in **southern population**: near Howe Flat and in Nadgee NR, **northern population**: Spicer's Gap. Pigs are in the vicinity, the level of impact needs to be assessed.

Priority: Low

Potential contributors: OEH, DSE, Parks Victoria, EHP and NPRSR.

C: Control of weeds, invasive native woody regrowth and plant-soil disease

<u>Action 1.8</u>: Establish and/or maintain weed and *Phytophthora* hygiene practices in **all populations**.

This could include spraying or washing down vehicles with a fungicide and using a foot bath station to minimise the chance of *Phytophthora* and weeds being spread by walkers' boots.

Priority: High

Potential contributors: National Recovery Team and Working Groups, OEH, Parks

Victoria and NPRSR.

<u>Action 1.9</u>: Continue control programs for invasive weeds (particularly Bitou Bush, Lantana and Blackberry) in **all populations**.

Priority: Very High

Potential contributors: OEH, Parks Victoria, NPRSR, Parks Australia, Department of Defence, Wreck Bay Community Council.

<u>Action 1.10:</u> Undertake trial mechanical manipulation of habitat (removing midstorey / shrub layer that will not be affected by fire) to maintain grassy understorey in **northern population**. Establish transects to monitor responses to habitat manipulation.

Priority: Very High

Potential contributors: Northern Working Group, OEH, EHP and private landholders.

D: Site protection

<u>Action 1.11</u>: Strategic domestic livestock grazing management in key Eastern Bristlebird habitat in the **northern population**. This requires funding to construct fencing at key sites to temporarily exclude stock from key habitat. Liaise with landholders to manage stocking rates during breeding season in key areas and provide stewardship payments to landholders to offset costs of temporarily reducing available grazing resources.

Priority: High

Potential contributors: Local landowners, OEH, EHP, Northern Working Group

Action 1.12: Ensure minimal impacts on Eastern Bristlebird and its habitat in **all populations** from urban developments. State agencies should liaise with relevant land managers to encourage protection of bristlebird habitat. In particular, all possible actions should be taken to minimise habitat loss in localities already zoned for development.

For example, in the central population, OEH, DoP and Shoalhaven City Council should ensure that new development (i.e. rezoning) is precluded in areas of high conservation value (HCV) as per the NSW South Coast Regional Strategy (DoP 2007) (all Eastern Bristlebirds habitat in Jervis Bay is considered HCV).

Priority: Medium

Potential contributors: State Government agencies, Local Government, National Recovery Team and Working Groups.

<u>OBJECTIVE 2:</u> Undertake survey, monitoring and mapping to improve knowledge of all Eastern Bristlebird populations. Population dynamics and
habitat condition will be monitored in each population. Methods including survey effort and frequency will be reviewed and standardised and will be subject to ongoing review according to census results or special circumstances such as wildfire. Potential habitat will be surveyed to potentially locate new colonies in the northern and southern populations, and to estimate more accurately the population size for all populations.

Ongoing monitoring of birds, their habitat and threats is essential to guiding and informing the future management of Eastern Bristlebirds, particularly in light of predicted climate change impacts on the environment (Hansen and Biringer 2003).

Recovery criterion 2: Population size and trends are more accurately estimated through the application of standard monitoring methodology, and as many sites as possible are systematically sampled during the term of this plan. Improved mapping of Eastern Bristlebird habitat on all tenures aids management of all populations, assists in better estimating population sizes and guides future recovery actions. Habitat condition and response to threats and threat management is regularly monitored.

A: Survey

<u>Action 2.1:</u> Standard survey and monitoring methods and standard recording sheets will be developed for **all populations**. This is likely to require a different approach for the northern population to that for the central and southern populations. Input from all those experienced in surveying the species will be required. The standard techniques should be used by all observers, including volunteers. Survey data from all populations will be stored by respective government species managers. Results should be made available and be regularly reviewed.

To ensure rigour and competence in surveys, volunteer surveyors should be trained by experts. To detect birds requires a familiarity with all of the songs and calls of the Eastern Bristlebird. In their Booderee NP study, Lindenmayer *et al.* (2009) duplicated bird counts at each site on different days to compensate for observer and weather variabilities. These methods are relevant to monitoring of known populations (see Action 2.3) as well as surveying new sites (see Action 2.2).

Priority: Very High

Potential contributors: Coordinated by OEH, DSE, Parks Victoria, EHP, NPRSR, BirdLife Australia/Birds Queensland, National Recovery Team and Working Groups, with input from species experts and trained volunteers.

<u>Action 2.2:</u> Survey potential habitat to locate undetected local populations and resurvey locations of historical records in **all regions**. This is of particular urgency in the northern population. Survey data from the four populations will be stored by respective government agencies.

Standard methodology should be used, along with duplication to compensate for observer bias and weather effects (as in Action 2.1).

Priority: High

Potential contributors: National Recovery Team and Working Groups, State

Government agencies, species experts and trained volunteers.

B: Monitoring

<u>Action 2.3</u>: Continue regular population census / monitoring of **all populations** and, where appropriate, habitat condition every one to two years. This will include long-term monitoring of translocated colonies at Beecroft Peninsula and Cataract Dam. Monitoring data from each population will be stored by respective government species managers. Results should be made available and be regularly reviewed. The Eastern Bristlebird recovery program relies heavily on adaptive and active management guided by population and habitat monitoring data.

Standard methodology should be used, along with duplication where necessary to compensate for observer bias and weather effects (as in Action 2.1).

Priority: Very High

Potential contributors: Australian and State Government agencies, National Recovery Team and Working Groups, species experts, volunteers

<u>Action 2.4</u>: Trial and evaluate the automated acoustic monitoring being trialled by OEH for Ground Parrots and Eastern Bristlebirds in **all populations**. Evaluate the potential for the acoustic signal analysis being undertaken by Queensland University of Technology (QUT) to be a valuable tool for Eastern Bristlebird monitoring. These techniques may prove to be more efficient and frequent methods of ongoing monitoring of the Eastern Bristlebird, particularly the small and scattered local populations in northern NSW and southern Qld, in the future if deemed accurate.

Priority: Medium

Potential contributors: OEH, EHP, National Recovery Team, QUT

C: Habitat mapping

<u>Action 2.5:</u> For **all populations**, continue to map specific Eastern Bristlebird habitat on all tenures including private land and update maps with records, territory boundaries and fire histories.

Priority: Medium

Potential contributors: National Recovery Team and Working Groups, Australian and State Government agencies.

<u>Action 2.6</u>: Refine Eastern Bristlebird habitat mapping in **southern population**. Refine vegetation mapping to align with Eastern Bristlebird habitat using new air photos for Howe Flat. More accurate vegetation mapping will facilitate the identification of other potentially suitable habitat in the area for survey. Redefine potential habitat based on the updated and more accurate vegetation map for Nadgee. This information will then be used to refine population estimates for the reserve.

Priority: High

Potential contributors: DSE Victoria, Parks Victoria and OEH

<u>Action 2.7:</u> Finalise latest vegetation mapping in **northern population** and align with Eastern Bristlebird habitat mapping to allow incorporation into legislative and planning protection. More accurate vegetation mapping will facilitate the prediction of other suitable habitat in the area for potential survey.

Priority: High

Potential contributors: Northern Working Group, OEH

<u>OBJECTIVE 3:</u> Enhance/augment northern and southern populations, building towards viable populations as determined by population viability analysis.

Genetic bottlenecks are a particular concern for small isolated populations in fragmented habitat. Once a population is reduced to a certain size, it may become genetically unviable in the long term and prone to extinction. Recent genetic studies (Roberts *et al.* 2011) have indicated that the four Eastern Bristlebird populations are genetically isolated.

The northern population is very small (<40 birds) and has declined substantially in the past 25 years. The southern population appears to be stable but small, estimated at around 400 birds. The recovery of the Eastern Bristlebird will depend on improving the numbers and stability of each of the northern and southern populations. This could be achieved by rebuilding existing small populations and/or establishing new local populations in appropriately managed habitat. For species such as the Eastern Bristlebird, ex-situ conservation measures such as captive breeding and species translocation may be the only options to ensure their survival under predicted climate change scenarios (DECC 2007). In considering possible ex situ responses, the National Recovery Team considers the priority option is to establish a captive breeding and reintroduction program to enhance the northern population (L Baker pers. comm. 2012, D Oliver pers. comm. 2012).

It is acknowledged however that this is not without risks, in particular inability to access enough wild northern birds for captive breeding, and given the critical state of the northern population, other options including wild-to-wild translocations between the populations should be considered. This is consistent with calls to consider within species translocation programs, the strategic mixing of populations to increase their genetic adaptive potential to better respond to and persist in the face of environmental change (Frankham *et al.* 2011, Weeks *et al.* 2011).

In response it is proposed that a translocation strategy be developed in which an appropriate risk management framework is applied (Weeks *et al.* 2011) to consider and implement, if appropriate, wild-to-wild translocation of birds from the southern or central populations, if there are insufficient numbers of wild birds remaining in the northern population.

For the southern population translocation of wild birds into managed habitat would provide increased resilience and improved risk management in the case of catastrophic fire. *Recovery criterion 3:* The decline of the northern population is halted, and the wild population is augmented by the reintroduction of captive-bred and/or wild birds. The southern population is enhanced by the establishment of a second Victorian population in Croajingolong NP through translocation.

<u>Action 3.1</u>: Undertake Population Viability Analysis for the Eastern Bristlebird to determine the viable population size to build towards.

This should be done with reference to the other modelling in Action 4.2.

Priority: High

Potential contributors: This is likely to be undertaken by an academic institution and coordinated by the National Recovery Team and Working Groups.

<u>Action 3.2</u>: Establish a captive breeding program for the **northern population** incorporating knowledge gained during the previous northern population captive breeding pilot program (Booth 2009).

A captive husbandry program should provide adequate stock to: provide insurance against the extinction of a wild population; reintroduce birds to rehabilitated habitat; and continuously improve captive breeding and husbandry techniques.

Priority: Very High

Potential contributors: OEH, EHP, species experts, public or private zoological park/facility, National Recovery Team and the Northern Working Group.

<u>Action 3.3</u>: Collect chicks or eggs from north-eastern NSW to provide founder stock for the newly established **northern population** captive breeding program. This will require engaging an expert contractor and/or the potential use of trained sniffer dogs to survey and locate nests in the breeding season to allow eggs or chicks to be used in the captive breeding program.

Priority: High

Potential contributors: OEH, species experts, National Recovery Team and the Northern Working Group.

<u>Action 3.4</u>: Reintroduce captive-bred birds into unoccupied habitat at sites where active threat management / enhancement has occurred in the **northern population**. This will be contingent on the outcomes of Actions 2.2 and 4.1 which involve investigating microhabitat requirements, coupled with surveys of potential habitats on private land to identify suitable release sites, and implementing active management of the sites prior to re-introductions. A project planning process for a reintroduction program (in Year 1) will also be required and a detailed captive release protocol will be prepared by Year 2. Monitoring will be required to measure survivorship of re-introduced birds.

Priority: Very High

Potential contributors: OEH, National Recovery Team and the Northern Working Group

<u>Action 3.5</u>: Develop a Translocation Strategy to investigate and implement if required wild-to-wild translocation of birds from the southern or central populations in the event that captive breeding (using northern population birds) and release fails to achieve the outcome of augmenting the **northern population**

Priority: High

Potential contributors: EHP, National Recovery Team and Northern Working Group

<u>Action 3.6</u>: Complete a Translocation Strategy and Site Management Plan aimed at establishing a second **southern population** in Victoria. The Strategy will be prepared in Year 1 and will assess options for translocation, address policy and PVA issues and the Plan will occur in Year 2 and outline specific site management necessary for the successful establishment of the second population. Implementation of the actions in the Site Management Plan will occur in Year 3-5.

Priority: High

Potential contributors: DSE, Parks Victoria, National Recovery Team and Southern Working Group

<u>OBJECTIVE 4:</u> Conduct research to increase knowledge of ecology, threats and habitat management requirements of the Eastern Bristlebird.

In relative terms, the Eastern Bristlebird has been well-studied and its ecology is well understood. However, there is a lack of detailed ecological knowledge at a population-level to guide and critically evaluate management actions intended to recover populations and mitigate threats, including climate change.

Robust baseline information is essential for quantifying change, which will inform future strategies to assist the Eastern Bristlebird to cope with climate change (Hansen and Biringer 2003). Increased links with external research organisations and programs are essential for these actions to be implemented.

Recovery criterion 4: Greater ecological understanding, at a population-level, of the species, its habitat requirements and responses to management actions.

<u>Action 4.1</u>: Collect ecological data and habitat information to fill knowledge gaps at a population-level to guide and critically evaluate management actions. These data may include: microhabitat selection, recruitment rates, mortality factors, predation, diet and nutrition, fire, roadkill risk, home range or territory size, dispersal capacity and morphometric information for **all populations**.

Priority: High

Potential contributors: Coordinated by National Recovery Team and Working Groups, Commonwealth and State Government agencies, research organisations, volunteers.

<u>Action 4.2</u>: Investigate scenarios for the management of the species. Undertake modelling to investigate management options for the species including bioclimatic analysis, study of the implications of climate change and investigation of possible adaptive strategies for the species.

This should be done with reference to the Population Viability Analysis as in Action 3.1.

Priority: High

Potential contributors: This is likely to be undertaken by an academic institution and coordinated by the National Recovery Team and Working Groups.

<u>Action 4.3</u>: Conduct further investigations into the genetic relationships between and within **the four populations** as required.

Priority: Low

Potential contributors: National Recovery Team and Working Groups

<u>Action 4.4</u>: Determine the sources of nest predation and disturbance and the effects of this disturbance on breeding outcomes in the **northern population**.

Priority: Low

Potential contributors: This is likely to be undertaken by an academic institution and coordinated by Northern Working Group, with input from species experts and volunteers.

<u>OBJECTIVE 5:</u> Increase community awareness, understanding and involvement in the Eastern Bristlebird recovery effort, particularly on private land. Improve communication between working groups and stakeholders including Australian and State Government agencies, CMAs and other NRM bodies, the Aboriginal community, landholders, land managers, rural fire services and interest groups.

Recovery criterion 5: Improved communication between stakeholders, increased involvement in the recovery actions by the Aboriginal community, interest groups and volunteers. Increased community awareness and ownership of the recovery of the Eastern Bristlebird will lead to increased opportunities for local populations of Eastern Bristlebirds to be detected and protected.

<u>Action 5.1</u>: Develop networking strategies to improve communication between stakeholders to facilitate increased involvement in the recovery program for **all populations**. This will help promote awareness of the precarious conservation status of the species, provide a potential pool of volunteers, and facilitate cooperative projects with established programs. Interest groups and the public must be kept informed of the problems facing the Eastern Bristlebird, actions being taken under this plan, and progress and achievements. Liaison with land managers will be undertaken at several different levels; by agency extension officers, the Recovery

Team and Working Groups. Where appropriate this liaison should involve the development of informal partnerships with the land managers.

Effective communication is essential between the three working groups, Government agencies, researchers and stakeholder groups for the implementation of this plan. Improved coordination of data sharing between relevant groups will result from the establishment of shared and regularly updated databases and maps.

Priority: High

Potential contributors: Coordinated by National Recovery Team, Working Groups and State Government agencies

<u>Action 5.2</u>: Support the ongoing community/volunteer survey program in the **northern population**. Establish or enhance similar programs in **central and southern populations**.

Develop consistent training guidelines and protocols for volunteers and birdwatching groups, etc. These will include bristlebird call recognition in each region at suitable locations and will discourage the use of unauthorised, non-scientific call playback at bristlebird sites in northern population. Interest groups and interested individuals should have the opportunity to participate in the recovery effort where practicable.

Priority: Medium

Potential contributors: National Recovery Team and Working Groups, State Government agencies, Birdlife Australia and community groups, volunteers.

<u>Action 5.3</u>: Recognise the cultural values of the Eastern Bristlebird to Aboriginal communities and engage these communities in the protection and management of bristlebird populations.

Continue consultation with Aboriginal groups to determine the significance of the species and its landscapes to Aboriginal people or whether recovery actions may occur in culturally important areas. Knowledge gained from the process will only be used by the Recovery Team with approval from the consulted communities. Seek advice from local Aboriginal community elders on appropriate site management regimes based on Indigenous knowledge. Involve local Aboriginal communities in on-ground management activities including providing training and employment opportunities. Seek partnerships with Aboriginal communities owning land that supports Eastern Bristlebird habitat or potential habitat to prepare property management plans and seek funding to manage the properties for protecting Eastern Bristlebirds.

Priority: Medium

Potential contributors: State and Commonwealth agencies, Aboriginal groups and individuals, National Recovery Team and Working Groups.

<u>Action 5.4:</u> Encourage private landholders with bristlebird habitat to engage in conservation agreements with regional bodies (CMAs, NRM bodies, Nature Conservation Trust, etc.) in **northern and central populations**.

Priority: High

Potential contributors: CMAs, NRM groups, State Government agencies, landholders, National Recovery Team and Working Groups.

<u>OBJECTIVE 6:</u> Effectively organise and administer the recovery effort to ensure that recovery plan objectives are met.

Recovery criterion 6: Recovery objectives achieved within the life of this plan, with high levels of stakeholder and Government support. New ecological and threat management information reviewed and incorporated into recovery actions.

<u>Action 6.1</u>: The National Recovery Team and three regional working groups (for the southern, central and northern populations) will continue to meet annually and share information as appropriate.

The National Recovery Team will oversee and coordinate recovery actions, assist implementation of this plan, review the progress of the recovery across the species range and advise on refinements to the plan in the next review period. Regional working groups will identify detailed actions, specific to each population including local monitoring, survey and extension tasks, as well as recommendations, which flow from research as outlined below. Working Groups will continue to include at least one member of the National Recovery Team and local representatives of CMAs, NRM groups, Commonwealth and State Government agencies, interest groups, local government, etc. National Recovery Team meetings will be held in each region on a rotational basis.

This is a complex and multi-disciplinary recovery effort including numerous individuals and organisations. It is imperative that all parties make a long-term commitment to the implementation of this plan through collaboration, consultation and effective communication. Working groups will liaise with all relevant government agencies, LandCare groups, bird study organisations and other NGOs; attendance at meetings will vary from time to time depending upon the actions needed to achieve the recovery objective.

Priority: High

Potential contributors: Coordinated by the convenors of the National Recovery Team and Regional Working Groups, with representatives from Australian and State Government, CMAs, NRM bodies, etc.

<u>Action 6.2:</u> Regional working groups should develop a plan of action or business plan specifically for their region. In conjunction with the National Recovery Team, each group will develop a concise plan based on guidelines developed by the National Team. The plans will list, in priority order, the priority actions, and the individuals or agencies involved. These plans will incorporate many of the actions described in the National Recovery Plan and will be endorsed by all parties before finalisation. The Northern Working Group has a draft business plan (Charley 2010).

Priority: High

Potential contributors: Coordinated by the convenors of the National Recovery Team and Regional Working Groups, with representatives from Australian and State Government, CMAs, NRM bodies, etc.

<u>Action 6.3:</u> Ongoing and regular review of population monitoring results, fire management prescriptions and vegetation management response monitoring. Within five years of adoption of this recovery plan, the National Recovery Team will contribute to a review of the success of implementing the actions in this plan. All working group members will be asked to contribute and participate in the review.

Priority: High

Potential contributors: Coordinated by National Recovery Team, with input from Regional Working Groups, State Government agencies and community stakeholders.

			Cost estimate (\$,000)					
Action	Description	Priority	Year	Year	Year	Year	Year	Total
			1	2	3	4	5	
Enhanc	e habitat and minimis	se threats	5	I	I	I	I	
1.1	Fire management – northern	VH	15	15	15	15	12	72
1.2	Fire management – central	VH	50	50	50	50	50	250
1.3	Fire management – southern	VH	20	10	10	10	10	60
1.4	Monitor bird and veg response to fire	Н	40	40	40	40	40	200
1.5	Feral predator control	VH	50	50	50	50	50	250
1.6	Feral pig control – northern	VH	30	30	30	30	30	150
1.7	Investigation of feral pig impact – southern	L	0	10	0	10	0	20
1.8	Phytophthora and weed management	Н	40	40	40	40	40	200
1.9	Ongoing weed control	VH	50	50	50	50	50	250
1.10	Mechanical manipulation of midstorey - northern	VH	40	5	5	5	5	60
1.11	Exclude grazing from habitat – northern	Н	10	10	10	10	10	50
1.12	Reduce impacts of urban developments	М	1	1	1	1	1	5
Survey, monitoring and mapping								
2.1	Develop standard survey methodology	VH	5	1	1	1	1	9
2.2	Survey potential habitat and historical records	Н	15	15	15	15	15	75
2.3	Population monitoring	VH	50	50	50	50	50	250
2.4	Evaluate acoustic monitoring & analysis techniques	М	10	10	10	10	10	50
2.5	Habitat mapping	М	5	5	5	5	5	25
2.6	Refine veg mapping - southern	H	20	0	0	0	0	20
2.7	Refine veg mapping - northern	Н	10	0	0	0	0	10
Enhance Northern and Southern Populations								
3.1	PVA	Н	20	0	0	0	0	20
3.2	Captive breeding program	VH	500	100	100	100	100	900

Estimated Costs for Recovery Actions

3.3	Collect wild chicks or eggs for captive breeding program	VH	5	5	5	5	5	25
3.4	Reintroduction of captive bred birds	VH	20	20	20	20	20	100
3.5	Translocation strategy for northern population	Н	0	0	20	15	15	50
3.6	Translocation strategy for southern population	Н	20	20	40	40	40	160
Resea	rch			•	•			
4.1	Essential species and habitat data	Н	20	20	20	20	20	100
4.2	Modelling and analysis for future management	Н	15	0	0	0	0	15
4.3	Further genetic research	L						30
4.4	Determine the sources of nest predation - northern	L						30
Comm	nunity liaison							
5.1	Communication strategy	Н	10	2	2	2	2	18
5.2	Community survey(s)	Н	5	5	5	5	5	25
5.3	Cultural values and engagement	М	20	20	20	20	20	100
5.4	Conservation agreements	Н	1	1	1	1	1	5
Admin	nister recovery effort							
6.1	Recovery Team and working group meetings	Н	3	3	3	3	3	15
6.2	Action Plans for each population	Н	10	0	0	0	0	10
6.3	Ongoing review of new data	Н	0	0	0	0	0	0
Total cost = \$3,609,000								

VH = very high, H = high, M = medium, L = low

Table 5: Summary of Approximate Costs for Recovery Actions

Some of these actions are already underway (or planned) in existing management plans and programs (as listed in Appendix 1). Integration of this plan with existing programs will result in the most efficient and effective use of resources for the conservation of Eastern Bristlebirds.

Management Practices

Management practices necessary to avoid significant impacts on Eastern Bristlebirds include:

- compliance with existing protection under the EPBC, TSC, NC and FFG Acts;
- site-appropriate fire and grazing management for known locations, potential habitat and adjoining land;
- compliance with existing clearing and development restrictions and regulations;
- conservation management of all relevant National Parks, Nature Reserves and other protected areas;
- private land conservation schemes;
- retention of suitable habitat and minimisation of fragmentation;
- continuation of feral predator programs;
- captive breeding, in accordance with the protocols and policies developed; and
- community engagement and education activities.

Actions that result in any of the following within habitat critical for survival may result in a significant impact on the Eastern Bristlebird:

- loss or intensified use of habitat, such as clearing for urban development and inappropriate burning regimes;
- construction of new roads or substantial upgrades to existing roads;
- medium to long-term removal of substantial areas of grassy undergrowth;
- habitat disturbance from overgrazing by livestock, feral pigs, weeds or dieback;
- unauthorised, non-scientific use of bristlebird call playback at occupied territories; and
- unlawful taking of an Eastern Bristlebird or any bristlebird product (e.g. eggs, nests etc).

Affected interests

This plan aims to promote a co-operative approach to the protection and management of the Eastern Bristlebird and its habitat involving governments, the community, landholders and Indigenous peoples, in accordance with the EPBC Act.

A range of community stakeholders including private landholders, public authorities and organisations may be affected by actions to recover the Eastern Bristlebird. This plan aims to provide guidance to the community members, agencies and public authorities listed below for the management of Eastern Bristlebirds within their borders.

Australian Government

Department of Defence (Royal Australian Navy: Beecroft Weapons Range, Jervis Bay Range Facility and HMAS CRESWELL)

Department of Sustainability, Environment, Water, Population and Communities (Booderee NP)

<u>Qld Government</u> Department of Environment and Heritage Protection Department of National Parks, Recreation, Sport and Racing Qld Fire and Rescue Service <u>NSW Government</u> Office of Environment and Heritage, Department of Premier and Cabinet (including National Parks and Wildlife Service) Sydney Catchment Authority

<u>Vic Government</u> Parks Victoria Department of Sustainability and Environment

Queensland NRM bodies and NSW and Victorian CMAs SEQ Catchments Condamine Alliance Northern Rivers CMA Southern Rivers CMA Hawksbury–Nepean CMA East Gippsland CMA

Aboriginal councils and other bodies South East Queensland Traditional Owner Alliance **Githabul Nation** Muli Muli LALC Gugin Gudduba LALC Tweed Byron LALC Nowra LALC Illawarra LALC Jerrinja Aboriginal Community (LALC) Wreck Bay Aboriginal Community Council Eden LALC Far South Coast Elders Council (Eden District) Nindi-Ngudjam Ngarigu Monero Aboriginal Corporation **Bidawal Traditional Owners** East Gippsland LALC Aboriginal Affairs Victoria

Local government Sunshine Coast Regional Council Scenic Rim Regional Council Tweed Shire Council Kyogle Council Shoalhaven City Council Wingecarribee Council Kiama Municipal Council Bega Valley Shire Council East Gippsland Shire Council

Others

Private landholders Birds Queensland Birdlife Australia (formerly Birds Australia) Border Ranges Alliance Burnett-Mary Regional Group Northern Rivers and SEQ Fire and Biodiversity Consortiums Hotspots Program Rural Fire Service Nature Conservation Council of NSW Bush Care Groups Birdwatching groups Conservation groups Research organisations

International Obligations

This plan will assist in the co-operative implementation of Australia's international environmental responsibilities, including for treaties such as the World Heritage Convention, and the National Strategy for the Conservation of Australia's Biological Diversity (DEST 1996).

The Eastern Bristlebird occurs in the Gondwana Rainforests of Australia World Heritage Area (WHA), listed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to preserve its outstanding value to humanity. This area is also listed as an area of National Environmental Significance on the National Heritage List. The Gondwana Rainforests are of extremely high conservation value and provide habitat for more than 200 rare or threatened plant and animal species. The WHA comprises more than 50 individual reserves in north-eastern NSW and south-eastern Queensland, and the northern population of Eastern Bristlebird occurs in a number of these reserves, including Border Ranges National Park (NP), Lamington NP, Main Range NP and Mt Barney NP.

Eastern Bristlebirds occur in declared wilderness in the Border Ranges NP and Nadgee Nature Reserve (NR) (declared under the *Wilderness Act* 1987). Nadgee NR and the adjoining Croajingalong NP in Victoria form the Croajingalong Biosphere Reserve, dedicated in 1977 under the UNESCO Man and the Biosphere program (UNESCO 2005; DEWHA 2010a). Eastern Bristlebirds also occur on the Beecroft Peninsula, an area listed on the Commonwealth Heritage list. The Eastern Bristlebird occurs within the Scenic Rim, Budderoo and Barren Grounds and Nadgee to Mallacoota Inlet Important Bird Areas (IBAs), which are considered to be of global conservation significance for threatened birds (Dutson *et al.* 2009).

The Eastern Bristlebird is not listed on any relevant international agreements, i.e. JAMBA, CAMBA, CMS/Bonn Convention or CITES.

In 1993, Australia ratified the Convention on Biological Diversity. The aims of the Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the use of genetic resources. The main implementation measure for the Convention is national strategies, plans or programs, to be developed in accordance with each country's particular conditions and capabilities. This plan will outline recovery actions for the Eastern Bristlebird which are consistent with Australia's international environmental responsibilities.

Biodiversity Benefits

The implementation of actions within this recovery plan will contribute to the conservation of a diverse range of sympatric (co-existing) fauna and flora. In particular, this plan recommends improvement in the condition and extent of Eastern Bristlebird habitat and minimising threats including fire, fragmentation, feral predators and overgrazing. These actions may benefit the suite of significant species that occur in or near bristlebird habitat, although it should be noted that some species may have different habitat requirements in terms of fire frequency, e.g. New Holland Mouse (*Pseudomys novaehollandiae*) which is an early successional stage species.

Research and monitoring proposed for the Eastern Bristlebird may provide additional beneficial data on the distribution and habitat of some of these species (e.g. Striated Fieldwren (*Amytornis striatus*) and Ground Parrot (*Pezoporus wallicus wallicus*)). Conservation agreements with landholders will provide further biodiversity benefits on private land.

For the northern population, the sympatric open forest species that are poorly conserved or threatened are listed in **Table 6**. For the central and/or southern populations the sympatric heathland and riparian scrub species that are poorly conserved or threatened are listed in **Table 7**.

Common name	Scientific name	EPBC status			
Species listed under the EPBC Act that live in or near northern population bristlebird					
habitat					
Hastings River Mouse	Pseudomys oralis	E			
Spotted-tailed Quoll	Dasyurus maculatus maculatus	E			
Brush-tailed Rock-wallaby	Petrogale penicillata	V			
Long-nosed Potoroo	Potorous tridactylus tridactylus	V			
Koala	Phascolarctos cinereus	V (Qld, NSW			
		& ACT pops)			
Other significant species that will benefit from protection of Eastern Bristlebird habitat					
Eastern Chestnut Mouse	Pseudomys gracilicaudatus				
Yellow-bellied Glider	Petaurus australis				
Grey Goshawk	Accipiter novaehollandiae				
Red-browed Treecreeper	Climacteris erythrops				
	Saproscincus rosei				
	Ophioscincus truncatus				
Other species listed under the EPBC Act that will also benefit through protection of					
important parts of their habitat include					
Coxen's Fig Parrot	Cyclopsitta diophthalma coxeni	E			
Black-breasted Button Quail	Turnix melanogaster	V			
Red Goshawk	Erythrotriorchis radiatus	V			

 Table 6: Other important species which will benefit from the conservation of

 Eastern Bristlebirds in the northern population

(EPBC status: E=Endangered; V=Vulnerable)

Common name	Scientific name	EPBC status		
Species listed under the EPBC Act that live in or near southern or central population				
bristlebird habitat				
Jervis Bay Leek Orchid	Prasophyllum affine	E		
Giant Burrowing Frog	Heleioporus australiacus	V		
New Holland Mouse	Pseudomys novaehollandiae	V		
Leafless Tongue-orchid	Cryptostylis hunteriana	V		
Other significant species that will benefit from protection of Eastern Bristlebird habitat				
Ground Parrot	Pezoporus wallicus			
Striated Fieldwren	Calamanthus fuliginosus			
Beautiful Firetail	Stagonopleura bella			
White-footed Dunnart	Sminthopsis leucopus			
Eastern Chestnut Mouse	Pseudomys gracilicaudatus			
Eastern Pygmy Possum	Cercartetus nanus			
Swamp Skink	Lissolepis coventryi			

Martin's Toadlet	Uperoleia martinii	
Tyler's Toadlet	Uperoleia tyleri	
Glossy Grass Skink	Leiolopisma rawlinsoni	
She-oak Skink	Cyclodomorphus casuarinae	
Diamond Python	Morelia spilota spilota	
Tartan Tongue-orchid	Cryptostylis erecta	

Table 7: Other important species which will benefit from the conservation of Eastern Bristlebirds in the southern or central populations

(EPBC status: E=Endangered; V=Vulnerable)

More broadly, increased public awareness of the recovery program for the Eastern Bristlebird, and providing people with the opportunity to participate in its recovery, will raise the profile of threatened species generally. This in turn will lead to greater opportunities for the conservation of threatened species and increased protection of general biodiversity.

Indigenous Interests

The connection between Aboriginal communities and the Eastern Bristlebird is likely to vary in significance throughout the range of the species. Recovery of the Eastern Bristlebird will be enhanced by the knowledge and experience of Aboriginal elders and communities, especially those with cultural responsibilities or kinship obligations to protect the species. Aboriginal people's involvement in threatened species recovery enables them to fulfil cultural obligations to care for Country, maintain cultural traditions and practices and contributes to the wellbeing of their community (English and Baker 2003).

Eastern Bristlebird populations and their habitat occur across areas of cultural significance to numerous indigenous groups. The landscape, and the plants, animals and physical features within the landscape, are all an integral part of Aboriginal cultural heritage. The small areas occupied by the Eastern Bristlebird are part of a larger landscape which is recognised for its significance and connectivity to people and places beyond the scope of this recovery plan.

The advice of the Indigenous Engagement Unit (DERM), Cultural Heritage Unit (OEH NSW) and a traditional owner in Cann River, Victoria was sought regarding a strategy for engaging indigenous groups and individuals. While Aboriginal people may not wish to be consulted on every listed species, population or ecological community, involving Aboriginal people in the earliest stages of preparation of recovery plans allows them to determine which recovery plans they want to be involved in (English and Baker 2003).

The involvement of traditional owners was initially sought through information brochures and questionnaires (one for each of the three regions where Eastern Bristlebirds occur). The brochures invited comment regarding cultural responsibilities, kinship obligations or other knowledge of Eastern Bristlebirds. OEH staff offered to attend meetings, make presentations, provide more information and/or organise field visits for community members to observe the birds in the wild.

The Draft Recovery Plan was also distributed to Aboriginal groups and comment invited. The National Recovery Team has provided input to this plan on known interests or existing relationships with Aboriginal groups or individuals specifically relating to the species. In the past, comment has been sought from Local Aboriginal Land Councils (LALCs) and traditional owners on draft copies of previous state or population recovery plans for this species.

This Recovery Plan recognises that Indigenous peoples have a right to control their traditional knowledge and traditional cultural expressions, and the right to have them protected and recognised as intellectual property (United Nations Declaration on the Rights of Indigenous Peoples as cited in Janke 2009). Any traditional knowledge incorporated in the recovery of the Eastern Bristlebird will be protected and managed appropriately.

Throughout the life of this plan, liaison with traditional owners, Aboriginal elders and their communities will continue and increase as partnerships become better established. Aboriginal people will continue to be encouraged to incorporate their knowledge and experience, and be involved in further consultation and implementation of recovery actions. Implementation of recovery actions under this plan will include the role and interests of relevant indigenous community groups, including the Wreck Bay Aboriginal Community Council.

Northern population:

Aboriginal groups have been engaged in planning, on ground resource management and education and cultural tourism projects in north-eastern NSW, as part of the Northern Rivers Regional BMP (DECCW 2010b) and the Border Ranges Rainforest BMP (DECCW 2010a). During these regional scale biodiversity planning projects, considerable time and resources were employed to build strong partnerships between government agencies, community groups and Aboriginal communities. Aboriginal communities and work crews have been involved in Eastern Bristlebird habitat management planning and rehabilitation.

In previous draft recovery plans, traditional owner involvement was sought through Aboriginal Land Management Facilitators from the SEQ Catchments Natural Resource Management regional body and Aboriginal Community Support Officers from Northern Rivers Catchment Management Authority (CMA).

Central population:

This bird and its family is of high cultural significance for the Dharawal and Dhurga Aboriginal people from southern Botany Bay down to Wreck Bay. The original habitats or "country" for this bird is of high significance for the local aboriginal families.

For the Dharawal and Dhurga the Eastern Bristlebird indicates extreme weather can be on its way, such as fire. We have always known the Eastern Bristlebirds make their nests in the old native sedge and lomandra gardens where our people once gathered seasonal plant seeds for food, such as bush rice from the lomandra species and other local grass seeds and also hard seed local fruits. (R. Mason pers. comm.)

Jervis Bay has been a focus of human activity for at least 7,000 years and has an Aboriginal cultural heritage that is remarkable for its diversity; richness and significance to Aboriginal people (NPWS 2007; DEWHA 2010b). Occupation of the area by Aboriginal people in traditional and recent times and continuing use today for food gathering, educational and ceremonial activities has given the area high Aboriginal social value. Many of the traditional storylines linking different elements of the landscape are still recounted and spiritual ties to the land are maintained through stories, on-going use and the passing on of knowledge through the generations.

Through their cultural traditions, the South Coast (Yuin) Aboriginal people of the Dharawal-Dhurga language group and the Jerrinja community identify the Jervis Bay area as their Traditional Country. Booderee National Park and Booderee Botanic Gardens have been jointly managed by the Wreck Bay Aboriginal Community Council and the Australian Government since 1995 in accordance with the EPBC Act.

Southern population:

The Eastern Bristlebird was well known by Aboriginal people on the Far South Coast of NSW in the past. This bird was the skin of a local group. When European settlers moved into the area and cleared the land for farming, both the bird and the people disappeared from the area (G. Moore pers. comm. 2010).

Nadgee NR is highly culturally significant, with numerous stone arrangements, burials and middens (G Moore pers. comm. 2010). The abundance of artefacts and middens within the Croajingolong Biosphere Reserve (including Nadgee NR) indicates a history of occupation by fairly large populations of Indigenous communities, who were probably concentrated around the inlets, estuaries and wetlands (UNESCO 2005).

In Victoria, Aileen Blackburn (a traditional owner with the Nindi-Ngudjam Ngarigu Monero Aboriginal Corporation) liaised with East Gippsland LALC, Bidawal community, and the East Gippsland CMA. In far south NSW, Graham Moore and Paul House (OEH) liaised with the Eden Elders Council, Eden LALC, Bega Valley Shire Council Cultural Heritage Working Group (including Bega LALC and Merrimans LALC). Although there was considerable interest in the brochures among the Eden Elders, no feedback has been received to date.

Socio–Economic Impacts

Actions proposed in this plan may have certain economic and social impacts in the short-term. Any proposed or future works or developments that are likely to have a significant impact on the Eastern Bristlebird will need to be considered under the EPBC Act. See <u>http://www.environment.gov.au/epbc/approval.html</u> for further information on the referral and assessment process. This plan will help guide that consideration.

Possible conflicting interests in some catchments include: future developments, use of recreational vehicles, grazing, tourism and companion animals.

Site-specific management of Eastern Bristlebird populations is likely to cause a reduction in the frequency and extent of prescription burning in some areas with the potential social and economic benefits of reduced management costs and reduced smoke pollution leading to improved human health. The potential cost of reduced prescription burning may be an increased fire risk to peri-urban areas.

Cats have been identified as a potential threat to the Eastern Bristlebird (DEWHA 2008b) so there may be small social and economic costs associated with companion animal restrictions should local government authorities decide to implement such measures. This would particularly be the case in the Jervis Bay area where there is a significant interface between urban centres and the habitat of the Eastern Bristlebird.

The recovery plan could provide social benefits for the general public, by increasing awareness of the natural heritage values of coastal remnants that the Eastern Bristlebird is found in. Through increased awareness and education, local residents may become involved in programs to assist the recovery of the Eastern Bristlebird, including weed control and appropriate management of habitat on private lands. Proposed actions include maintaining and rehabilitating Eastern Bristlebird populations and habitat on private land and areas managed by Aboriginal communities. This will involve liaising with landholders and negotiating conservation agreements. The economic consequences of this recovery plan relate to any implementation costs and possible development and primary production restrictions. Implementation costs may include captive breeding, habitat restoration, targeted survey, population and habitat monitoring, community liaison and research into the biology and ecology of the species. For northern local populations, there will be a cost associated with reducing grazing on private lands. Expense will also be incurred from liaison and negotiation with landholders and managers. It is anticipated that many of the recovery actions (especially monitoring) will involve community groups and may be funded by grants received by these groups.

Management costs for public land and reserves should be reflected in the plans of management. These are costs associated with on-park pest species management, fire management, and habitat management.

Abbreviations and Acronyms used in this plan

ANU	Australian National University, Canberra
BMAD	Bell Miner Associated Forest Dieback
BMP	Biodiversity Management Plan
CAMBA	China-Australia Migratory Bird Agreement
CITES	Convention on International Trade In Endangered Species of Wild
	Fauna and Flora
CMA	Catchment Management Authority
CMS/Bonn Co	nvention Convention on the Conservation of Migratory Species
	of Wild Animals
DECCW	Former Department of Environment Climate Change and Water
	(NSW)
	(now OEH - Office of Environment and Heritage)
DERM	Former Department of Environment and Resource Management (Qld)
DEST	Department of the Environment, Sport and Territories
	(Commonwealth)
DEWHA	Former Department of the Environment, Water, Heritage and the Arts
	(Commonwealth)
DOF	
DSE	Department of Sustainability and Environment (Vic)
DSEVVPC	Department of Sustainability, Environment, water, Population and
	Communities (Commonwealth)
EPBC ACI	Commonwealth Environment Protection and Biodiversity Conservation
спр	ACC 1999 Department of Environment and Heritage Protection (Old)
EFC Act	Elera and Fauna Guarantea Act 1988 (Via)
	Important Bird Area
	International Union for Conservation of Nature
	Japan-Australia Migratory Bird Agreement
	Local Aboriginal Land Council
	Livestock Health and Pest Authorities (NSW)
NC Act	Nature Conservation Act 1992 (Qld)
NCC	Nature Conservation Council (NSW)
NP	National Park.
NPWS	National Parks and Wildlife Service (NSW)
NPRSR	National Parks, Recreation, Sport and Racing (QLD)
NR	Nature Reserve
NRM	Natural Resource Management
NSW	New South Wales
OEH	Office of Environment and Heritage (NSW) (previously DECCW -
	Department of Environment Climate Change and Water)
Qld	Queensland
RFS	Rural Fire Service (NSW Government)
SEQC	South-eastern Queensland Catchments
SCA	Sydney Catchment Authority
TSC Act	Threatened Species Conservation Act 1995 (NSW)
UNESCO	United Nations Educational, Scientific and Cultural Organization
UoW	University of Wollongong
Vic	Victoria(n)
WHA	World Heritage Area

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Appendix 1

Existing plans, strategies and programs with relevance to the Eastern Bristlebird and/or its habitat.

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