Department for Environment and Heritage

Murraylands Region

Recovery Plan for the Bush Stone-curlew *Burhinus grallarius* in the South Australian Murray-Darling Basin

October 2006

Government of South Australia

Department for Environment and Heritage

South Australian Murray-Darling Basin Natural Resources Management Board

Australian Government

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Summary

The Bush Stone-curlew *Burhinus grallarius* is a large ground-dwelling woodland bird listed as 'Vulnerable' at a state level in South Australia. In the South Australian Murray-Darling basin, a population has persisted on the Ramsar-listed floodplain of the Chowilla and Ral Ral anabranches, upstream of Renmark.

The species experienced a major decline and contraction in range across southern and eastern Australia by the 1940s, and continues to do so. The decline has left few scattered records elsewhere in the state – in the South East, and on off-shore islands (the majority from Kangaroo Island). Habitat clearance and fox predation are thought to be the main reasons for decline of the species.

The Bush Stone-curlew is regarded as particularly prone to extinction as it is a large ground-dwelling woodland bird with low rates of recruitment. Our lack of knowledge of the Chowilla population remains a considerable impediment to recovery of the species in the region. While some surveys have been initiated by the Friends of Riverland Parks group, primary information to assess population viability, such as distribution and size of subpopulations, is yet to be determined. Studies in Victoria have suggested low survival rates of juveniles poses a major issue to the species' longevity, but no research has been conducted on recruitment in the Chowilla population. These knowledge gaps need to be addressed to form effective management and recovery actions.

This regional recovery plan aims to acquire primary information such as distribution and size of subpopulations to assess viability of the population. The plan's objectives are also to initiate research into threatening processes, particularly the effects of feral predation and habitat degradation.

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Acknowledgements

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1.0. INTRODUCTION

1.1. Conservation status

In South Australia the Bush Stone-curlew *Burhinus grallarius* is currently listed as 'Vulnerable' under the *National Parks and Wildlife Act* 1972 (2000 update of Schedule 8). However, a 2003 review of threatened species in South Australia has proposed that all threatened species are classified using the IUCN Red List Categories and Criteria, Version 3.1. Using this criteria it is proposed that the Bush Stone-curlew be classified as 'Rare' because the species has experienced a significant decline in abundance in greater than 50% of its former area of occupancy and/or extent of occurrence and it is observed, estimated, inferred or suspected that further decline is continuing (National Parks and Wildlife Council & Department for Environment and Heritage 2003). The Bush Stone-curlew is considered 'Endangered' in the South Australian Murray-Darling Basin (Carpenter & Reid 1998 as cited in Kahrimanis *et al.* 2001).

The Bush Stone-curlew is currently not listed nationally under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). However, it has been listed as 'Near Threatened' in the Action Plan for Australian Birds (Garnett & Crowley 2000). It is a species that is near being nationally listed because it has declined in abundance in over 50% of its former range and that decline is continuing. In New South Wales, it has been listed as 'Endangered' under the NSW *Threatened Species Conservation Act* 1995, while in Victoria it is listed as 'Threatened' under the *Flora and Fauna Guarantee Act* 1988. Recovery objectives of the NSW recovery plan for the Bush Stone-curlew include upgrading the national status of the species to 'Endangered'.

1.2. Reasons for decline

The past range of the Bush Stone-curlew extended across mainland Australia and many offshore islands, although populations tended to be localised and absent from inland deserts (Schodde & Mason 1980, Blakers *et al.* 1984, Garnett & Crowley 2000). Early records (from the late 1880s to 1995) compiled by Gates (2001) show the Bush Stone-curlew was similarly once widespread across South Australia, but has disappeared from much of the arid interior and Eyre, Yorke and Fleurieu Peninsulas. The species suffered a major decline in population and range contraction across southern and eastern Australia by the 1940s (Marchant & Higgins 1993, Gates 2001, Gates, 2005). Robinson (1998) has described the decline of the Bush Stone-curlew as occurring in three waves:

1. After European settlement; the clearing of grassy open woodlands led to a 90% reduction in population size in southeast temperate woodlands.
2. Since 1950; increases in Red Fox population and intensive farming practices are suggested reasons for further decline.
3. Since 1980; Robinson (1998) proposes the removal of bounties for fox scalps in Victoria (mid 1970s) has resulted in a further increase of fox numbers preying on the Bush Stone-curlew in southern Australia.

Gates (2005) has also suggested that fox predation has been the major contributor to the observed population declines. Webster and Baker-Gabb (1994) implicated land management practices, such as woodland clearing and grazing, as having played a greater role in the decline of this species. Indeed, Blakers *et al.* (1984) point out that the Bush Stone-curlew has persisted even in places where foxes are common such as southwest Australia and the Goldfields region of Victoria. It is likely that the continuing decline of the species will result in extinction unless such factors causing their decline, and current threatening processes, are addressed (Johnson & Baker-Gabb 1994, Robinson & Johnson 1997).

1.3. Land tenure

The current known distribution of the Bush Stone-curlew in the South Australian Murray-Darling Basin lies solely within the Chowilla floodplain, comprising both the Chowilla Game Reserve and Calperum Pastoral Lease. The land tenure and management history of these areas is directly applicable to both the historical and current distributions of this species and will influence the proposed management actions for recovery.

Chowilla Regional Reserve was constituted in 1993 after recommendations made in the Murray-Darling Basin Commission's Chowilla Resource Management Plan (1992, cited in Department of Environment and Natural Resources 1995). After a period of community consultation, the floodplain portion of Chowilla was proclaimed a Game Reserve to specifically enable continuation of controlled waterfowl hunting. Hence, Chowilla Game Reserve and Chowilla Regional Reserve are legally two separate reserves, but are effectively regarded as one unit for management (Department of Environment and Natural Resources 1995).

The present day Chowilla Regional and Game Reserves have had a history of pastoral activity. Since the first European pastoralists settled at Chowilla in 1846, the property has been stocked with cattle, sheep and horses (Department of Environment and Natural Resources 1995). The Robertson family have held and operated Chowilla station as a sheep grazing enterprise, Robertson-Chowilla Pty Ltd, since 1865, and currently lease the area for grazing (Department of Environment and Natural Resources 1995). However, selected areas have recently been excluded from grazing (Figure 6.1).

Calperum Pastoral Lease was purchased by the Commonwealth Government in conjunction with the Chicago Zoological Society in 1993 as a model for conservation and ecologically sustainable land use (Department of Environment and Natural Resources 1995). The lease is currently held by Austland Services Pty Ltd who has responsibility for managing the land and natural assets.

The Chowilla Regional and Game Reserves and Calperum Pastoral Lease form part of the Riverland Biosphere Reserve, registered under the UNESCO (United Nations Educational, Scientific and Cultural Organisation) Man and the Biosphere program in 1993 (Department of Environment and Natural Resources 1995). These, along with other parks, reserves and private land, comprise the 6060km^2 Riverland Biosphere Reserve complex (Kidman 1996). The Chowilla floodplain 'wetland' is also recognised as a wetland of international importance under the UNESCO Ramsar Convention (O'Malley & Sheldon 1990).

1.4. Recovery actions to date

Bush Stone-curlews have been monitored annually on the Chowilla floodplain since January 1999. Friends of Riverland Parks have used call playback methods to ascertain the presence or absence of Bush Stone-curlews and used this data to determine annual trends in the population. However, call response rates have been highly variable from year to year, and no trend is discernable. Observations in the following daylight hours have also helped to provide descriptions of the habitat from which the responses were documented. Reports of these surveys (Smith 2000 – 2003) have been widely distributed and have engaged interest and increased local awareness of the species in the Riverland.

Similarly, Australian Landscape Trust (ALT) staff at Calperum Station have performed call playback surveys on the floodplain region of Calperum Pastoral Lease. These surveys have been conducted annually during the summer months from 1996 to monitor the response of Bush Stone-curlews to predator control on the floodplain mainland and islands (Australian Landscape Trust 2002). A regular fox baiting program on Calperum Pastoral Lease was established prior to 1996, where baiting is carried out monthly on Reny and Hunchee islands (Hedger, *pers. comm.*).

2.0. ECOLOGY AND BIOLOGY

2.1. Taxonomy

The Bush Stone-curlew is a member of the family Burhinidae. The family comprises nine species worldwide, with two endemic to Australia (Schodde & Mason 1980). *Burhinus grallarius* and *Esacus magnirostris,* the Beach Stone-curlew, are 'thick-knees', with spindly legs and 'knee' joints that appear swollen (Schodde & Mason 1980). Bush Thick-knee is therefore among a myriad of other common names that include, Southern Stone-curlew, Bush or Land Curlew, Stone Plover, Weeloo, Willaroo, High-legged or Bridled Plover.

2.2. Description

The species is a large, nocturnal, ground-dwelling bird with cryptic grey-brown plumage that enables exceptional camouflage. In a crouched position, the bird can completely conceal its head and neck in its body feathers, making it difficult to discern (Bright 1935). If observed, slender long legs with large pale grey 'goggle' eyes and an apparent hunched appearance allow for easy recognition (Schodde & Mason 1980; Baker-Gabb *in litt*.). The species measures a beak to tail length of 54-60cm; when inactive, the long tail extends well beyond the wing tips (Marchant & Higgins 1993). In flight, the legs trail behind the long tail and the neck is stretched forward, resembling an Ibis (Baker-Gabb *in litt*.). Long bowed outstretched wings display a broad white band across the shoulders (Schodde & Mason 1980; Marchant & Higgins 1993). Female birds are slightly smaller than the males, but this size difference, and thus gender, can rarely be distinguished from appearance in wild populations (Schodde & Mason 1980).

Fürbringer (1888 cited in Schodde & Mason 1980) has describes these birds as 'precursory' waders. While they resemble plovers in appearance, ecologically they behave as woodland birds (Robinson 1998). During the day, the Bush Stone-curlew tends to lie or stand quietly with eyes half-closed in the shadows of trees in woodland habits (Marchant & Higgins 1993, Johnson & Baker-Gabb 1994). Occasionally they may rest on one leg and appear asleep (Bright 1935). The birds are shy and wary; if approached too closely they may squat motionless, walk away with head upright, run with neck stretched out in front, or taxi a short distance, frequently landing behind the observer (Bright 1935, Bedggood 1977, Schodde & Mason 1980, Marchant & Higgins 1993). The birds may give a throaty warning 'growl' if approached within a few metres (Anderson 1991).

The Bush Stone-curlew is most frequently detected by distinctive loud, mournful 'weer-loo' calls most commonly heard at night (Bedggood 1977, Schodde & Mason 1980). Typically, four or five wails are made in succession, increasing in intensity to a culmination of hysterical screeching (Schodde & Mason 1980). The birds are territorial and monogamous, and their call appears to be used by both sexes for making contact and announcing territories. They are most vocal when breeding (Schodde & Mason 1980).

2.3. Distribution

The Bush Stone-curlew is relatively common in northern Australia and in the northeast—especially on some Barrier Reef islands such as Magnetic Island—though absent from the driest inland areas. In southern Australia, the species' range is restricted to small pockets (Garnett & Crowley 2000), although larger populations exist on Kangaroo Island and north of Sydney (Blakers *et al.* 1984).

In South Australia, small populations have persisted at Chowilla near Renmark on the Murray River, near Bordertown in the South East, and on offshore islands (Robinson & Casperson 2000, Gates 2005). The majority of South Australian records in South Australia are from Kangaroo Island, considered the stronghold for the species in southern Australia, as the major threats of habitat clearance and fox predation are absent (Gates 2001, Gates 2005). A study on Kangaroo Island by Gates (2001) showed Bush Stone-curlews were present at 75% of the sites surveyed on the island, closely corresponding

with agricultural areas and associated patches of remnant vegetation. It is largely due to the findings of this study that the status of the Bush Stone-curlew in South Australia has been down listed from 'Endangered' to 'Vulnerable' (Gates 2001), with the most recent revision proposed as 'Rare'.

The species is scarce in the south-eastern states, and continuing to decline. In New South Wales, the birds mainly occur in the Riverina and on the western slopes and plains. In Victoria they have persisted mainly in the north (Marchant & Higgins 2003). A comprehensive study in Victoria counted 328 birds in Victoria in 1985 and 141 birds in 1991 (Webster & Baker-Gabb 1993).

2.4. Population estimates

The current known Bush Stone-curlew population in the lower River Murray corridor is situated on the Chowilla floodplain upstream of Renmark. The area is the largest remaining region of floodplain habitat in the lower River Murray (O'Malley & Sheldon 1990). A biological survey of the Chowilla floodplain in October 1988 recorded Bush Stone-curlew calls from three areas, and a nest with two eggs was found on Chowilla Island (O'Malley & Sheldon 1990). More recently, annual call playback surveys conducted by Friends of Riverland Parks (from 1999) and Australian Landscape Trust staff (from 1996) have recorded birds at Monomon, Chowilla and Reny Islands, as well as the floodplain 'mainland' (call survey records are presented in Figure 7.2). While these annual surveys have provided an indication of population variation, they have not been sufficient to estimate subpopulation sizes or ranges of occupancy (Smith, *pers. comm.*).

Additionally, there have been incidental reports of Bush Stone-curlew on properties close to the Murray River. Calls were heard seven years ago at Willabalangaloo, and a single call was recognised around the township of Monash in January 2005 (Smith, *pers. comm.*). Generally, these have been 'once off' calls, perhaps indicative of transitory birds.

2.5. Habitat requirements

The preferred habitat of the Bush Stone-curlew in southern Australia is open lowland woodland (Johnson & Baker-Gabb 1994), but the widespread clearance of such open woodland has led to the use of sub-optimal agricultural associated landscapes. Following European settlement, much of these woodlands were grazed and converted to pasture, or cleared because their fertile soils were conducive to agriculture (Yates & Hobbs 1997). Such widespread clearance has unequivocally contributed to declines of the species on the mainland (Blakers *et al.* 1984, Johnson & Baker-Gabb 1994, Webster and Baker-Gabb 1994, Robinson 1998, Garnett & Crowley 2000). However, the Bush Stone-curlews' resilience allowed many of the surviving birds to inhabit fragmented, degraded woodland remnants and to use adjacent farmland (Johnson & Baker-Gabb 1994, Robinson 1998, Gates 2001). Furthermore, land clearance—has in some cases—been beneficial to the birds, as was found on Kangaroo Island; farming practices have created useable open habitats from thicker native vegetation (Gates 2001). Hence the species has come to be associated with open agricultural landscapes that employ low-intensity farming practices (Pain *et al.* 1997).

The primary components of Bush Stone-curlew habitat appear to be open low-grass woodlands and sufficient tree debris. Lightly timbered open woodlands with a ground cover of short grass, little or thin understorey and rolling or flat terrain provide a clear field of vision at ground level for these wary birds (Johnson & Baker-Gabb 1994). Fallen logs and tree debris are integral in Bush Stone-curlew habitat for bird camouflage, refuge, and in providing a food source (Johnson & Baker-Gabb 1994). Even artificially placed debris have been shown to host multiple invertebrate species, providing an important food resource (Michael *et al.* 2004).

An investigation in Victoria by Johnson and Baker-Gabb (1994) found remnant vegetation stands of 1-5 hectares with large trees were most commonly used by the species in farmland. Most roosts were found to be less than 250m from a water source (eg. creek or dam) and 1km from other sites of similar habitat (Johnson & Baker-Gabb 1994); close proximity to other roost sites allows a bird to flee to another site if disturbed (Davidson 1998).

Differences between roosting, foraging, and nesting habitats have been difficult to define. Indeed, Bright (1935) reported that there appeared to be "no special place" that birds nest. Gates (2001) was able to quantify the habitat types into general components: roost sites were primarily located within vegetation, nest sites were found in both cleared areas and natural vegetation, and foraging sites were predominantly in cleared areas. Thus these requirements appeared not to be specific (Gates 2001). Other studies have found that nests were consistently located in open areas, while roosting sites were closer to trees. However, no significant differences between nest and roost sites in their proximity to tree debris and water were found (Johnson & Baker-Gabb 1994). This study also found that identified foraging areas had significantly taller (>30cm) and denser grasses than those found in day roost sites.

Call responses by the Chowilla population of Bush Stone-curlews have been observed originating from Red Gum woodland *Eucalyptus camaldulensis* and Black box *Eucalyptus largiflorens* and Lignum *Muehlenbeckia florulenta* associations where substantial amounts of fallen timber and some grass and herb ground cover occur (Smith 2000). Other birds in the Calperum floodplain called from a large open area with only a sparse cover of short grasses (<10cm) and herbs (Smith 2000). The nest observed on the Chowilla floodplain in 1990 was among Pale Beauty-heads *Calocephalus sonderi*, at the edge of a swathe of Cane grass *Eragrostis australasica* and scattered Black box (O'Malley & Sheldon 1990).

2.6. Critical habitat

The critical habitat of Bush Stone-curlews in the South Australian Murray-Darling Basin is currently unknown. However, given the probable loss of a substantial proportion of the population of this species, any habitat they now occupy should be considered as critical for the species' persistence.

2.7. Movements and home range

There has been no record of large-scale movements of the Bush Stone-curlew (Marchant & Higgins 1993). These sedentary birds can live for over 30 years and have been observed to consistently occupy the same breeding territories for 10 to 30 years (Johnson & Baker-Gabb 1994). Schodde and Mason (1980) estimated these territories can range in size from 10 to 25 hectares. However, a comprehensive study on Kangaroo Island, involving radio tracking of the birds, measured a greater home range for resident breeding birds of 26 to 64 hectares (Gates 2001).

During the non-breeding season (March to August), the birds become non-territorial and roam more widely—though still locally in a loosely defined home range—likely to be determined by availability and distance between suitable roosting areas (Johnson & Baker-Gabb 1994, Robinson 1998, Gates 2001). Some birds remain as resident pairs, while others form small flocks (Gates 2001). Flocks numbering 5 – 10 (Gates 2001), 12 – 30 (Robinson 1998), 8 – 40 (Schodde & Mason 1980) have been observed. Some birds within these flocks disperse to new areas and others subsequently establish near breeding territories (Gates 2001).

Flocks potentially function as a supply for new breeding stock (Schodde & Mason 1980). Other than on Kangaroo Island, however, there have been few records of such flocks in southern Australia in recent decades. Most reports are primarily of single birds or pairs in scattered locations, most probably a result of continued population decline (Price 2005).

2.8. Diet and foraging ecology

The major diet items of the Bush Stone-curlew are beetles, spiders, larvae/caterpillars and ants, though earwigs, centipedes, millipedes, moths, snails and vertebrates can make up a considerable portion of their diet (Gates 2001). Bedggood (1977) noted that small frogs and lizards are also taken. The species' diet appears to vary little with season (Johnson & Baker-Gabb 1994). As the birds have been recorded feeding on most items (listed in Marchant & Higgins 1993), and they are opportunistic feeders, food resources are not likely to be a limiting factor for populations (Gates 2001).

Bush Stone-curlews actively search for prey throughout most of the night, either alone, in pairs (usually dispersed at the feeding site) or with their dependent young (Johnson & Baker-Gabb 1994). The birds typically forage in a certain area for 20 to 30 minutes and fly a short distance to another foraging site (Bedggood 1977, Johnson & Baker-Gabb 1994). They adopt a 'stalking' stance when foraging; methodically probing the ground and debris, and seizing prey as it is disturbed (Johnson & Baker-Gabb 1994).

Day roosts and surrounds are commonly used for night foraging, with the fallen tree debris providing a host of ground-dwelling invertebrates (Johnson & Baker-Gabb 1994, Michael *et al.* 2004). Open pastures and watercourses during summer also support feeding birds. They may fly 1-2 km at night to reach these feeding grounds (Johnson & Baker-Gabb 1994).

2.9. Social organisation and reproduction

The Bush Stone-curlew generally nests in spring, but laying times vary with its range. In southern Australia, the breeding season is considered August through January (Schodde & Mason 1980), but first clutches have been reported in South Australia as early as mid July (Arthur 1973), and second clutches in Victoria as late as mid-January (Johnson & Baker-Gabb 1994). eggs are usually laid, though clutches of four eggs have been recorded (Arthur 1973). It is common for the last egg to be laid two days after the first (Bright 1935), after which incubation begins. The task of incubation is shared between the pair, as is care of the young (Schodde & Mason 1980).

The birds appear not to create any such nest (McGilp 1947). Eggs may be laid in a scrape on the bare ground, close to a fallen log, or on a few sticks that have been placed roughly together (Bright 1935, McGilp 1947, Arthur 1973).

Observations indicate that the colour of the eggs varies to match that of the substrate on or in which it is laid. It is likely the female chooses the ground to match the egg colour (Bright 1935, Bedggood 1977, Schodde & Mason 1980). Schodde and Mason (1980) suggest this is a possible explanation for the high nest fidelity observed in this species. Indeed, studies have shown the same nesting areas are typically used by the same pair in successive years (Johnson & Baker-Gabb 1994).

Breeding success and long-term juvenile survival of the Bush Stone-curlew is uncertain (Johnson & Baker-Gabb 1994, Gates 2001). Johnson and Baker-Gabb (1994) found that the period that young remained with parents after hatching varied greatly, but was around three to nine months from ten recorded sites. For an initial period of two to three weeks, one parent escorted the chicks around the nest site at approximately a 200m radius. The study also found that about half the observed 55 breeding pairs were able to raise one young to independence (Johnson & Baker-Gabb 1994).

3.0. THREATS TO SPECIES PERSISTENCE OR RECOVERY

The Bush Stone-curlew is regarded as particularly prone to extinction as it is a large ground feeding and nesting woodland bird with low rates of recruitment into the breeding population (Robinson & Johnson 1997). Moreover, continued occupation of the same territory by a pair of breeding birds for 10-30 years may result in young birds not having any remaining habitat in which to establish their own territories (Robinson & Johnson 1997, Webster & Baker-Gabb 1994). These ecological characteristics contribute to their vulnerability from the current and future threats to which they are prone (Robinson & Johnson 1997).

Robinson and Johnson (1997) identified the principle current threat to the species as predation by Red Foxes *Vulpes vulpes*, and a potentially increasing rate of predation by feral Cats *Felis catus*. Other major threats listed in the Action Plan for Australian Birds (Garnett & Crowley 2000) are:

- Habitat clearance and fragmentation for agriculture
- Removal of fallen tree debris from habitat remnants for firewood or 'tidying' (Johnson & Baker-Gabb 1994)

While critical to much of the remaining population in southern Australia, these threatening processes are less relevant to the local population situated on the Chowilla floodplain. As the floodplain is situated within both state (Chowilla Game Reserve) and Commonwealth (Calperum Pastoral Lease) owned land, and is encompassed within the Riverland Biosphere Reserve, the land is afforded protection from these threats under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 and the *National Parks and Wildlife Act* 1972.

3.1. Knowledge gaps

Research into the ecology, habitat and predator-prey relationship of the Bush Stone-curlew has been 'gathering momentum' in New South Wales and Victoria, where scattered pairs—predominantly existing on private properties—have heightened awareness of this threatened species. Investigations by Johnson and Baker-Gabb (1994) have set a precedent for fundamental research into the ecology of the species. More recently, a study by Price (2004) also explored measures into Bush Stone-curlew conservation. Two PhD studies are currently investigating habitat and predator-prey relationships. Such research has provided bases for recovery measures in progress: captive breeding programs, specific predator control programs and awareness campaigns. New South Wales has additionally developed a state recovery plan (NSW National Parks and Wildlife Service 2005).

In South Australia there has been a comprehensive study on the abundant Bush Stone-curlew population of Kangaroo Island by Gates (2001), who examined home range, diet and habitat preferences. Nonetheless, the island situation is a special case owing to the absence of fox predation, and research on these birds can not be assumed to be applicable to populations elsewhere.

Very little is known about the Bush Stone-curlew population in the River Murray corridor. Despite annual surveys being conducted by Friends of Riverland Parks and Australian Landscape Trust staff at Calperum Station, primary ecological data such as current distribution and size of subpopulations has not been determined. Further, no ecological studies have investigated key life history parameters of the population. While studies in Victoria (Johnson & Baker-Gabb 1994) have suggested survival of juveniles poses a major issue to the longevity of the species, no research has been conducted on breeding success or juvenile recruitment in the Chowilla population. For example, such information is critical to assess long-term population viability, along with identification of the threats specific to the regional population. These knowledge gaps need to be addressed, and the information gained used to form effective management and recovery actions.

3.2. Predation

The introduced Red Fox *Vulpes vulpes* preys on the ground-dwelling Bush Stone-curlew and is thought to be the principal cause of the species' decline (Robinson 1998, Gates 2001, Gates 2005). Of particular concern is the predation of chicks and young birds, preventing their recruitment into the breeding population (Webster and Baker-Gabb 1994). These effects are strongly demonstrated by both the large populations that exist on off-shore islands and the increased breeding success that occurs when electric fencing exclosures are used to protect nesting birds and chicks (Wheaton 2004). The threat to Bush Stone-curlews can be exacerbated by fluctuations in rabbit numbers forcing foxes to find alternative prey items such as ground nesting birds when rabbits are scarce (Bedggood 1977).

3.3. Grazing pressure

The most apparent effect of grazing is a change in vegetation structure and composition (Yates & Hobbs 1997), and this may either assist Bush Stone-curlews or decimate their habitat. Light grazing by livestock and kangaroos can benefit Bush Stone-curlews by maintaining a short ground cover and thus good visibility for the birds (Johnson & Baker-Gabb). An investigation into preferred nesting habitat of the Stone Curlew *Burhinus oedicnemus* in Britain found the species abandoned heathland nesting sites with taller grasses, and therefore it is likely that the species' continued decline has been brought about by changes in species composition associated with a reduction in grazing by rabbits and livestock (Green & Griffiths 1994). On the other hand, heavier grazing pressures are likely to reduce the amount of tree debris, decrease associated invertebrate prey, and promote the invasion of exotic grasses and invasive species (Robinson & Johnson 1997).

Intense grazing pressure is, however, largely detrimental to the species. The distribution of indicator bird species in Britain, including the Stone Curlew *Burhinus oedicnemus,* has shown a significant negative relationship with livestock units per hectare (both sheep and total). The indicator species were found to decline and fragment in correlation with a sheep livestock increase between 1970 and 1990 (Pain *et al.* 1997).

At Chowilla, Bush Stone-curlew habitat has been subject to continual grazing since the first pastoralists in 1846, though stocking rates have varied considerably. The floodplain once comprised part of a major overland stock route that received heavy grazing pressure. Stocking rates however, have been more conservative in recent years (Department of Environment and Natural Resources 1995). Impacts on the Bush Stone-curlew population have been exacerbated though, as the breeding season has tended to correspond with pastoralists moving sheep onto the floodplain (Smith 2003). However, after an agreement drawn up in June 2005, all stock will be removed from the floodplain region as of September 30, 2005 (Strachan, *pers. comm*.). An overview of recent sheep grazing history is depicted in Figure 7.1.

Impacts of domestic stock have been compounded by high populations of native and exotic mammals. A survey of kangaroos undertaken in September 1992 on the Chowilla floodplain and adjoining mallee areas estimated 52 animals per square kilometre. At these densities, kangaroos add substantially to grazing pressures in addition to browsing on regenerating plants when biomass levels are low (Department of Environment and Natural Resources 1995). Kangaroo surveys undertaken biannually on Calperum Pastoral Lease also indicate consistently high abundances of kangaroos on Reny and Hunchee Islands owing to the proximity of water (Australian Landscape Trust 2002). Rabbits, hares, goats, and pigs also add to the cumulative grazing pressure that (Department of Environment and Natural Resources 1995).

3.4. River flow regulation

The most current and foreseeable threat to the Bush Stone-curlew population at Chowilla is a change to their habitat by altered hydrological regimes. Regulation of River Murray water flows since the construction of Lock 6 have resulted in permanently higher water levels on the floodplain and continuous flows through the Chowilla anabranch system (Gippel & Blackham 2002). While the area has a natural discharge of saline groundwater, a reduction in flooding has significantly reduced the flushing of salt from the floodplain (Gippel & Blackham 2002). The saline groundwater has accumulated through the soil profile in the root zone, causing decline in the health of Black box and River Red Gum woodlands from a combination of drought and a lack of extensive or frequent flooding (Brett Lane & Associates Pty Ltd 2005). Additionally, there is a threat of soil salinisation causing gradual colonisation by salt tolerant species, with samphire communities replacing Black box woodlands (Morris 1991), although the long-term biological effects of river salinity on species and ecosystems are largely unknown and require further investigation (Goss 2003). Such processes will modify the open woodland habitat of the Bush Stone-curlew, potentially rendering it unusable.

3.5. Recreation

The anabranch system in Chowilla Game Reserve provides a unique location for a variety of water recreation activities (Department of Environment and Natural Resources 1995). Fishing, canoeing, house boating and duck hunting pursuits are often accompanied by camping and vehicle use for access. While camping permits are required and provide the ability to limit visitors—as are hunting permits during open season—increases in human and vehicle traffic are unavoidable in peak periods. Human disturbance is potentially a threat to the Bush Stone-curlews at nest sites, particularly if few breeding attempts are occurring.

4.0. RECOVERY OBJECTIVES

For the purposes of these recovery objectives, criteria and actions, the term 'region' refers to the South Australian Murray Darling Basin as defined in Kahrimanis *et al.* (2001), unless otherwise stated.

4.1. Broad goals

Short-term goals

1. Establish the status of the Chowilla population and whether other subpopulations exist elsewhere in the region.
2. Within five years have an improved understanding of the requirements for recovery of all identified subpopulations and established management programs that will increase the potential of the Bush Stone-curlew to recovery from its current state.
3. Establish ongoing monitoring of populations to assess the success of implemented management programs.

Once these short-term goals have been achieved, further targeted management could then be undertaken to ensure the long-term viability of these populations.

Long-term goals

The long-term recovery objectives for the Bush Stone-curlew in the region are to:

1. Prevent the extinction of the existing population;
2. Restore the population to levels that allow the species to persevere despite demographic and environmental stochastic processes;
3. Protect and restore habitat to support these populations; and
4. Minimise current threatening processes.

4.2. Specific objectives

1. Conduct surveys to determine the current distribution of the population in the region.
2. Gain an understanding of the demography and ecology of targeted subpopulations.
3. Identify threats specific to the population in the region, and improve understanding of how they impact on the species and with each other.
4. Prevent the decline of subpopulations resulting from predation by feral animals.
5. Prevent the decline of subpopulations resulting from habitat degradation.
6. Increase community involvement and awareness of the conservation of the Bush Stone-curlew in the region.
7. Establish processes that enhance the effective integration of plans related to the recovery of the Bush Stone-curlew in the region.
8. Ensure issues related to the region's population are integrated into state and national Bush Stone-curlew recovery processes.

5.0. RECOVERY CRITERIA AND ACTIONS

Information gaps

Objective 5.1. Conduct surveys to determine the current distribution in the region

Criteria 5.1.1. The distribution of the Bush Stone-curlew in the region is determined and used to identify appropriate management areas.

Actions

5.1.1. Conduct targeted surveys of all areas within the Chowilla floodplain to ascertain the distribution of Chowilla subpopulations.

5.1.2. Determine high priority sites for other surveys based on existing information and conduct targeted surveys of these areas to learn whether additional subpopulations exist in the region.

Demographic information is an essential baseline for assessing temporal and spatial changes in the population. Targeted surveys that use active search methods (e.g., call playback) will be conducted to ascertain distribution. Surveys will aim for systematic coverage of the Chowilla floodplain extent. Information from current known habitats and collated literature will be used to determine other potentially suitable habitat and targeted with similar active search methods (Thompson *et. al* 2004).

Objective 5.2. Gain an understanding of the demography and ecology of targeted subpopulations

Criteria 5.2.1. Research projects are developed that provide baseline and benchmark values for life history parameters in targeted subpopulations.

Criteria 5.1.1. Research projects are developed that identify important habitat for targeted subpopulations.

Actions

5.2.1. Develop long-term research programs for life history parameters to assess population status and long-term population viability.

5.2.2. Undertake research to investigate roosting, foraging and nesting habitats of targeted subpopulations and to identify important local habitat.

Research programs will be designed to gain life history data on the species. Such information is critical to understanding whether populations are increasing, stable or declining, and to determine their status. Important life history parameters include those associated with individuals (e.g., survival, longevity), subpopulations (e.g., breeding success and productivity) and populations (e.g., dispersal, local population viability). Gaining data on important local habitat is also necessary for understanding causal relationships with threatening processes and restoration potential (Actions 5.3.1. and 5.5.1.), and is essential for determining the quantity of habitat available to the species in the region. The proposed research program will be reviewed and where necessary modified annually to incorporate new information.

Threatening processes

Objective 5.3. Identify threats specific to the population in the region, and improve understanding of how they impact on the species and with each other

Criteria 5.3.1 Research projects are established that identify threats specific to the population in the region, and their outcomes are used to improve the understanding of the causal relationships between the species ecology and these threats.

Actions

5.3.1. Develop research programs to identify threatening processes specific to the region's population.

Data on current threatening processes are essential to establish causal relationships between threats, species life history (Action 5.2.1) and identified important habitat (Action 5.2.2.). Thereafter, appropriate management actions for establishing or maintaining viable local subpopulations can be taken. Preliminary assessments of threats based on this research (5.3.1.) will be used to prioritise mitigating actions for feral predators (5.4.2.) and habitat degradation (5.5.2., 5.5.3.) through adaptive management. Comprehension of the processes in which the threats impact on the species and its habitat is necessary before developing management for their control.

Objective 5.4. Prevent the decline of subpopulations resulting from predation by feral animals

Criteria 5.4.1. No subpopulations are reduced by more than 10% through predation by cats and foxes.

Criteria 5.4.2. Monitoring programs are implemented to assess the success of predator control programs.

Actions

5.4.1. Continue existing fox baiting programs and liaise with appropriate parties involved in the control of feral predators to develop further collaborative control programs.

5.4.2. Implement landscape-scale integrated predator and pest control programs in areas identified as at risk to subpopulations.

5.4.3. Develop monitoring practices to assess the effectiveness of implemented predator and vertebrate pest control programs.

Effective landscape-scale predator control programs are required for minimising damage to the population, and maintaining long-term population viability. The control of foxes and cats is most effective when employed over large scales, which requires the involvement of multiple managers. Coordinating programs for large areas will result in more cost-effective control of predators and meet a range of additional objectives (e.g., reduction of their impacts on agricultural production). Coordination will involve the adjoining landholders, and potentially may include the expertise of recognised hunting groups. Adequate monitoring of these programs should be developed to measure potential changes in the risk to subpopulations, as well as changes to the abundance of the targeted predator.

Objective 5.5. Prevent the decline of subpopulations resulting from habitat degradation

Criteria 5.5.1. Sizes of subpopulations are not reduced by more than 10% through habitat degradation.

Criteria 5.5.2. The area of grazing by domestic stock will be reduced from 17,700ha to 0ha by 2006.

Actions

5.5.1. Identify areas of habitat degradation based on results of research into local important habitat (Action 5.2.2), and assess potential restoration requirements.

5.5.2. Develop and implement appropriate management at sites where habitat degradation resulting from inappropriate grazing regimes has been identified.

5.5.3. Participate in decision processes with responsible agencies to support watering trials and the mitigation of floodplain tree decline.

The management of grazing regimes within the habitat of the species—namely stock and kangaroos—should be developed and implemented where specific impacts to the species have been identified. There is a potential that the removal of stock may decrease the suitability of habitat for the species, and therefore appropriate grazing levels need to be established. Liaison with the managers of relevant programs and leaseholders can achieve this and also identify potential problems. Management of grazing pressure from other exotic species (i.e., rabbit, hare and feral goats) covering the area of extent of target species will be addressed in Action 5.4.2.

The development process for hydrological-based solutions to saline groundwater issues at Chowilla is ongoing. The declining health of the Black box woodland is largely attributed to flow regulation of the River Murray at Lock Six and other structures at anabranches. Participation in such decision forums can provide opportunity for input and comment regarding decisions that may disadvantage or advantage the species and/or its habitat.

Community involvement

Objective 5.6. Increase community involvement and awareness of the conservation of the Bush Stone-curlew in the region

Criteria 5.6.1. Community groups are involved in the recovery process.

Criteria 5.6.2. A communication strategy for disseminating information to the public is completed and implemented.

Actions

5.6.1. Develop and implement a Communication Strategy for the Bush Stone-curlew recovery program.

The Communication Strategy will identify, develop and prioritise communication actions based on the objectives of the recovery program. These may include informing local landholders, managers and park visitors of issues associated with the Bush Stone-curlew, working with Friends of Riverland Parks to continue and improve monitoring surveys, and engaging in public and professional activities to raise the profile of the species.

Planning for recovery processes

Objective 5.7. Establish processes that enhance the effective integration of plans related to the recovery of the Bush Stone-curlew in the region

Criteria 5.7.1. Processes for the effective integration of plans are established and implemented.

Criteria 5.7.2. The Natural Resource Management board is well informed of the resourcing issues associated with long-term recovery projects.

Actions

5.7.1. Establish a Recovery Team with members from other interest groups and organisations, to ensure effective integration of this plan.

5.7.2. Conduct an external review of this Regional Recovery Plan in 2010.

5.7.3. Ensure appropriate resourcing for the effective recovery of the Bush Stone-curlew in the region.

A Recovery Team will be established representing groups with an interest for species recovery in the region. Responsibilities of the team will be to ensure consistency between the objectives and actions detailed in this plan with other relevant programs and plans. Working relations should be upheld with Australian Landscape Trust staff to integrate potential recovery strategies for the Bush Stone-curlew formed for Calperum Pastoral Lease.

Internal reviews of the progress made on the recovery plan's objectives and actions should be conducted annually. An external review should be performed at the end of the five-year planning period particularly to assess effective integration with other relevant plans.

Providing information to the relevant agencies about the resource issues associated with the long-term recovery of species will enable them to make the most effective decision about resourcing. This process requires the two-way flow of information to develop a better understanding of the limitations involved.

Objective 5.8. Ensure issues related to the region's population are integrated into state and national Bush Stone-curlew recovery processes

Criteria 5.8.1. Activities that assist in state and national recovery processes for the Bush Stone-curlew are initiated and maintained.

Actions

5.8.1. Share information through peer reviewed journals and professional conferences.

5.8.2. Work with Bush Stone-curlew recovery groups in other regions of South Australia, and interstate.

5.8.3. Maintain and update information sources on the Bush Stone-curlew, and make available to other relevant groups.

Information regarding the population in the region is important to Bush Stone-curlew recovery processes both intrastate and interstate. Thus issues related to the population will be disseminated to relevant groups, including parties responsible for the management and monitoring of Chowilla Game Reserve. Information will be entered on the national Species Profiles and Threats Database http://www.deh.gov.au/cgi-bin/sprat/public/sprat.pl, and Department for Environment and Heritage Biological database records will be up kept.

6.0. IMPLEMENTATION AND COSTING SCHEDULE

A schedule for implementation of the recovery actions is provided in Table 6.1.

Table 6.1 Implementation and costing schedule for recovery actions identified for the Bush-stone Curlew in the region

Action	Description	Priority	Stakeholders	Estimated Cost/Yr (in $1000)					Estimated Cost (in $1000)		
				Year 1	Year 2	Year 3	Year 4	Year 5	Cash	In-kind	Total Cost
5.1.1	Survey of Chowilla floodplain	1	DEH	10.0					7.0	3.0	10.0
5.1.2	Survey of other potential sites	1	DEH, FOP	8.7					5.7	3.0	8.7
5.1.3	Survey for size of subpopulations	1	DEH, FOP	10.0					7.0	3.0	10.0
5.2.1	Life history research	1	DEH. Universites	24.8	27.3	30.0	33.0	36.3	29.3	122.1	151.4
5.2.2	Determine important local habitat	2	DEH	15.1	16.7	18.4	20.3	22.3	67.8	25.0	92.8
5.3.1	Research threats	1	DEH, Universities	18.6	20.5	22.5	24.8	27.2	22.0	91.6	113.6
5.4.1	Liaise with groups about feral control	1	DEH, Landholders, Community groups	8.7	9.6	10.6	11.7	12.8	28.4	25.0	53.4
5.4.2	Implement feral control programs	2	DEH, Landholders		17.2	18.4	19.7	21.0	33.2	43.0	76.2
5.4.3	Monitor predator control program	2	DEH			6.7	7.6	8.6	15.4	7.5	22.9
5.5.1	Identify habitat degradation	3	DEH	7.7	8.8				12.0	4.5	16.5
5.5.2	Implement grazing management	3	DEH, Landholders			7.1	7.8	8.5	6.8	16.5	23.3
5.5.3	Participate in water decision processes	3	DEH	2.1	2.7	3.3	3.9	4.5	6.4	10.0	16.4
5.6.1	Implement communication strategy	2	DEH	8.7	6.6	7.0	7.4	7.8	21.4	16.0	37.4
5.7.1	Establish a Recovery Team	1	DEH, FOP, CARE team, RMCB, LAP groups	2.0					1.0	1.0	2.0
5.7.2	External review of plan	4	DEH, Recovery Team					6.3	3.2	3.2	6.3
5.7.3	Ensure appropriate resourcing	4	DEH	1.0	1.0	1.0	1.0	1.0	2.5	2.5	5.0
5.8.1	Share information	4	DEH, TSN, Recovery Team	1.5	1.5	1.5	1.5	1.5	5.0	2.5	7.5
5.8.2	Work with other recovery groups	4	DEH, Recovery Team	1.0	1.0	1.0	1.0	1.0	2.5	2.5	5.0
5.8.3	Maintain information sources	4	DEH	1.5	1.5	1.5	1.5	1.5	5.0	2.5	7.5
								TOTAL	**281.3**	**384.3**	**665.6**

In-kind represents time and resources of DEH permanent staff plus contributions from other stakeholders.

7.0. BIODIVERSITY BENEFITS TO NON-TARGET SPECIES

The Chowilla floodplain supports a large range of avian species—including many of high conservation significance—and is a corridor for bird movements along the River Murray (O'Malley & Sheldon 1990). The 1988 Biological Survey of the Chowilla floodplain found the Black box woodland supported a high proportion of avian ground foragers and hollow nesting species, including other regionally significant avian species (Table 2.1). These sightings were confirmed in the more recent 2003 DEH River Murray Biological Survey. The diversity of species is in part due to a number of habitat components sharing both riverine and arid vegetation features along the floodplain edge (O'Malley & Sheldon 1990). These avifauna would also benefit from the recovery actions for the Bush Stone-curlew proposed in this plan.

Table 7.1 Species of conservation significance observed in Black box *Eucalyptus largiflorens* woodland in the 1988 and 2003 Biological Surveys of the Chowilla floodplain (Source: O'Malley & Sheldon 1990, DEH Corporate data)

Common Name	Species	Current status in SA (*proposed)
Bush Stone-curlew	*Burhinus grallarius*	Vulnerable
Apostlebird	*Struthidea cinerea*	
White-winged Chough	*Corcorax melanorhamphos*	Rare*
Striped Honeyeater	*Plectorhyncha lanceolata*	Rare
Gilbert's Whistler	*Pachycephala inornata*	Rare*

The Biodiversity plan for the Murray-Darling Basin lists other species considered to be significant occurring in the River Corridor (Kahrimanis *et al.* 2001). Some of these species, such as Latham's Snipe, are migratory, but potentially still use the large expanse of Chowilla floodplain as a refuge and would gain from its protection (Table 6.2).

Table 7.2 Species of conservation significance associated with the Chowilla wetland in the SA Murray-Darling Basin (Source: Kahrimanis *et al.* 2001).

Common Name	Species	SA MDB status	SA status
Brush-tail Possum	*Trichosurus vulpecula vulpecula*	Endangered	
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*		Rare
Australasian Bittern	*Botaurus poiciloptilus*	Vulnerable	Vulnerable
Latham's Snipe	*Gallinago hardwickii*	Vulnerable	Vulnerable
Regent Parrot	*Polytelis anthopeplus monarchoides*	Vulnerable	Vulnerable
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Vulnerable	Vulnerable
Broad-shelled Tortoise	*Chelodina expansa*		Vulnerable

Effective feral animal control would similarly benefit other non-avian species in the vicinity. The Brush-tail possum Trichosurus vulpecula vulpecula is heavily predated by foxes and cats on the Calperum floodplain (Australian Landscape Trust 2002). An unpublished study by De Schepper found that 40% of fox scats contained possum remains (Smith, pers. comm.). This species would also be assisted by such predator control measures instated for the Bush Stone-curlew.

A reduction in grazing pressure on the floodplain would not only aid in preserving Bush Stone-curlew habitat, but increase flora species composition and diversity. It is accepted that the effects from loss of soil structure and water infiltration—caused by soil compaction—have the greatest impacts on species' composition (Yates & Hobbs 1997). In the event of a flood, water is less likely to percolate through the compacted soil to the water table, and resultant waterlogging can drown seedlings (Kahrimanis et al. 2001). Furthermore, differential palatability of plant species will result in irregular soil compaction, and selective browsing will directly affect vegetation composition and structure (Yates & Hobbs 1997). Plant communities would benefit from the removal of such degrading grazing processes and ensuing restoration.

8.0. RELEVANT LEGISLATION

Commonwealth legislation
Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999: The EPBC Act promotes the conservation of biodiversity by providing protection for listed species and communities in Commonwealth areas, including listed threatened species and ecological communities. The Riverland Biosphere Reserve is afforded protection under this act as it is a listed UNESCO Biosphere, encompasses a Ramsar listed wetland, and contains listed threatened species.

State legislation
National Parks and Wildlife Act (NPW Act) 1972: This act allows for the reservation, protection and management of natural areas and the flora and fauna contained within them. This act also has provision for the licensing of scientific investigation of these species. The Bush Stone-curlew is currently listed as 'Vulnerable' under this act.

Additionally, the NPW Act allows for the management and control of parks and reserves by the Director of National Parks and Wildlife. Under Section 38 of the Act, a management plan is required for each reserve and no operations may be undertaken unless they are in accordance with the plan.

Amendments to the NPW Act in 1988 included the establishment of a 'Regional Reserve' category, constituted "for the purpose of conserving any wildlife or the natural historic features of that land while, at the same time, permitting the utilisation of the natural resources of that land". Under Section 34a, the Minster must, at intervals of not more than 10 years, prepare a report which assesses the impact, or the potential impact, of the utilisation of natural resources both on the Regional Reserve and on the economy of the State (Department of Environment and Natural Resources 1995).

River Murray Act 2003: This act provides for the protection and enhancement of the River Murray and related areas and ecosystems, while the *Murray-Darling Basin Act 1993* provides the legislative basis for the Murray-Darling Basin Agreement between the Commonwealth, New South Wales, Victoria, Queensland and South Australia.

Water Resources Act 1997 (SA): This act provides for a range of planning and management tools for the protection and sustainable management of the State's water resources.

Crown Lands Act 1929: This act deals with the granting of leases, including pastoral leases. Within areas to be grazed, the lessee is responsible for prevention and suppression of fires, and for the control of all pests, vermin, weeds, and diseases of animals or vegetation under the *Animal and Plant Control Act (Agricultural Protection and other Purposes) Act, 1986.*

Pastoral Land Management and Conservation Act 1989: This act ensures such pastoral land is managed in such a way as to provide a sustainable yield and to allow for the monitoring of the land's condition, the prevention of degradation, and the rehabilitation of land. The act also requires that supervising agencies must act in accordance with the principles established by the Soil Conservation Authority and the Planning Authority. The lessee must also comply with the *Hunting Regulations 1975*.

Country Fires Act 1989: This act relates to the clearing of land for fire prevention and control.

Environment Protection Act 1993: This act promotes the ecologically sustainable management of resources, and provides against persons engaging in activities that pollute the environment.

Mining Act,1971 and the *Petroleum Act, 1940*: These acts regulate mining within Chowilla Game Reserve.

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10.0. APPENDICES

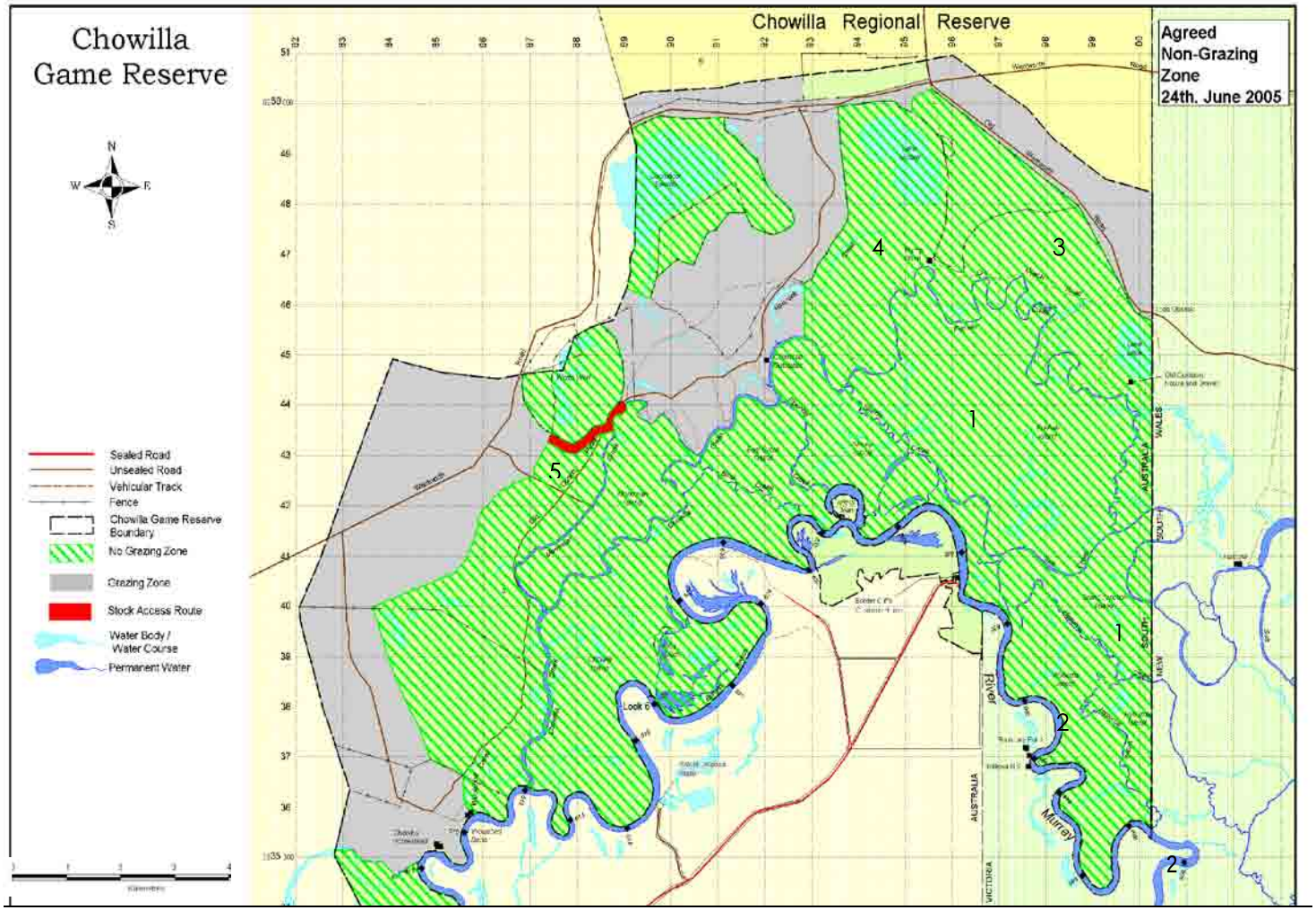

Figure 10.1 Recent grazing history of Chowilla Regional Reserve.

1. Punkah and Grand Junction Islands: grazing removed in 1993, reintroduced in 1995, and again removed 2001; 2.Wilperna and Hyperna Islands: grazing removed since 1993; 3.Old Coach Road area: grazing reintroduced 2001; 4.Lake Limbra and surrounds: grazed until 2005; 5.South of Coombool swamp: grazing removed 1993; 6.Werta wert: grazing removed 1995. Shaded green region depicts no grazing as of September 2005, as agreed June 2005. Source: Strachan, *pers. comm.* Cartography by Benno Curth.

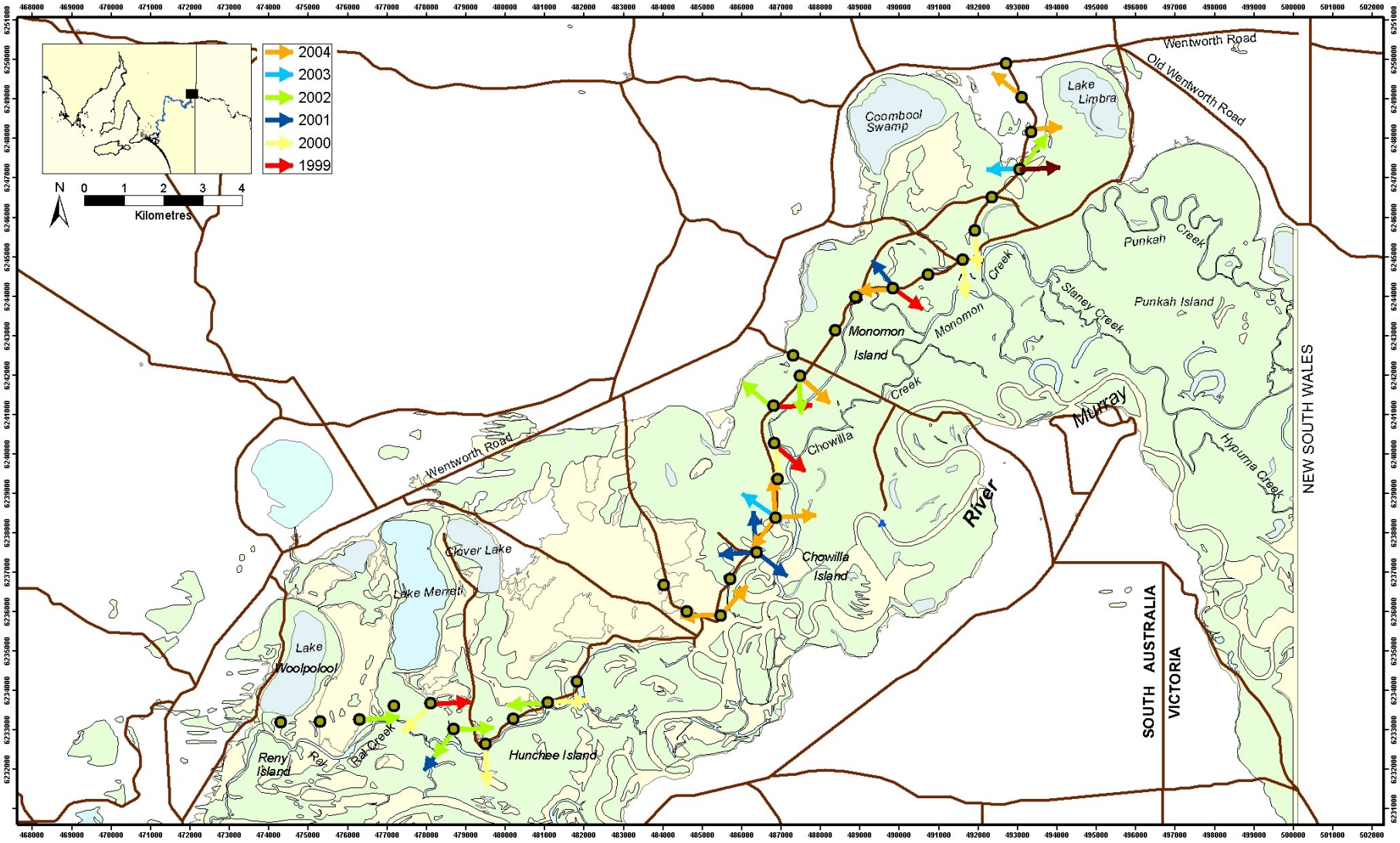

Figure 10.2 Friends of Riverland Parks call playback data for Bush Stone-curlews at Chowilla. Green circles indicate 1km spaced survey points, and arrows illustrate direction in which calls were observed. NB. Distances to calls were not estimated.