A BIOLOGICAL SURVEY OF BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT SOUTH AUSTRALIA

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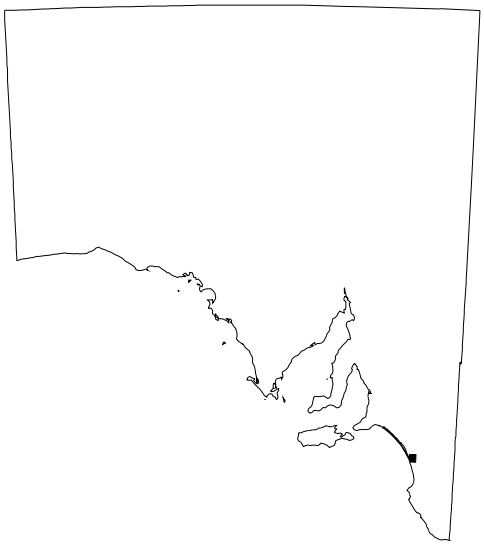
A BIOLOGICAL SURVEY OF BUNBURY SWAMP CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT SOUTH AUSTRALIA IN DECEMBER 1997



BIOLOGICAL SURVEY

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Biodiversity Information
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South East Region, Heritage and Biodiversity Division,
Department for Environment, Heritage and Aboriginal Affairs

Cover Photograph: A *Melaleuca halmaturorum* freshwater wetland beginning to show signs of salt stress in Bunbury Conservation Reserve.
(Photo. H.Stewart)

Abstract

A ten day survey of the vegetation and vertebrate fauna of Bunbury Conservation Reserve (CR) and Stoneleigh Park Heritage Agreement (HA) was undertaken between December 1 - 9, 1997. This resulted in the recognition of :

- 12 floristic plant communities containing 183 plant species (12 introduced)
- 15 mammal species (five introduced).
- 69 bird species (three introduced).
- 16 species of reptile and three species of frogs.

In addition, a further 32 species of plant, 18 species of bird and 6 species of reptile have been previously recorded in the study area (Refer to Appendices). In total 26 species of plant (21 recorded in present survey), 25 species of bird and four species of mammal (three recorded during the present survey) of conservation significance have been recorded from the study area including Bunbury CR and Stoneleigh Park HA.

The proposal to construct a surface water drain through Bunbury CR and Stoneleigh Park HA, will have several biological impacts including the clearance of approximately 7 hectares *of Melaleuca halmaturorum* in Bunbury CR, and 13 hectares of vegetation containing *Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland, *E.arenacea* open woodland, as well as *Lepidosperma* aff. *laterale* sedgeland. These plant communities contain several plant, bird and mammal species of National, State and regional conservation significance. In addition construction of a drain through the middle of the Bonneys Camp North wetland will disrupt the natural flow of the lower Bakers Range watercourse, and isolate approximately 400 hectares of regenerating native vegetation to the north of the proposed drain in Stoneleigh Park HA.

However, some of the negative impacts caused by the construction of the proposed drains may be offset by the use of fauna crossings, and habitat corridors to link the 400 hectare isolate with Messent Conservation Park to the north. Further, introduction of reasonable quality water to the wetlands of Bunbury CR may also benefit the presently degrading *Melaleuca halmaturorum* communities. A more detailed description of the potential impacts of the proposed drainage options and ensuing recommendations to ameliorate these potential impacts can be found in the “Conclusions and Recommendation” section.

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People Involved

Unlike previous Biological Surveys in this series, the data contained in this report was collected over a two week period of field work in response to the need by the Department for Environment, Heritage and Aboriginal Affairs (DEHAA), to acquire biological information to enable the Department to better assess the potential conservation impacts of proposed drainage works through Bunbury Conservation Reserve and the north eastern corner of Stoneleigh Park Heritage Agreement, in the South East of South Australia. A small team of biologists were developed and supervised by the survey coordinator, Hafiz Stewart with assistance by Helen Owens. All members made a notable contribution to the effectiveness of this survey.

Field work

Vegetation survey
The collection of all plant specimens was undertaken by Tim Croft.

Vertebrate survey
The vertebrate survey entailed obtaining records for all mammals (m), reptiles (r) and birds (b) present at the sites during the survey. These records were obtained by Hafiz Stewart (m), Helen Owens (r) and by Graham Carpenter (b).

Both groups were also assisted in a volunteer capacity by Andrew Freeman.

Specimen Identification

Plants: All plant species were identified by Tim Croft in the field. Collected specimens were verified by Rosemary Taplin and lodged in the collections of the State Herbarium.

Mammals: Hafiz Stewart and Cath Kemper from the South Australian Museum. Terry Reardon also identified recorded bat calls.

Reptiles: Helen Owens and Adrienne Edwards from South Australian Museum.

Map production : Interpretation and delineation of floristic groups, and their transfer on to Mylar was completed by Hafiz Stewart, with assistance from Tim Croft. Final map production was under taken by members of the Geographic Analysis and Research Branch (GAR) of the Department of Transport, Urban Planning and the Arts (DTUPA) and South East Region, Department for Environment and Natural Resources. Brenton Grear used MapInfo to generate several maps.

I would like to take this opportunity to recognise the help given by Brenton Grear, Tony Robinson (and others) for editing and providing useful feedback during the production of this report, and Roger Ebsary, Project Manager for the USE Integrated Catchment Management Program, who provided welcome support and facilitated funding from the USE Dryland Salinity and Flood Management Plan implementation program. I would also like to thank Terry Reardon for his advice and assistance with recording, analysing and interpretation of recorded bat calls. Lastly, I would like to thank all the land holders involved, including Tom and Pat Brinkworth, John Eastwood, and Doug and Bill Ashby for access to their land, and the many volunteers who gave their time during the survey including Andrew Freeman, Robyn Sutherland, Scott Jennings and Nigel Willoughby.

Introduction

Since 1971 the South Australian Department of Environment Heritage and Aboriginal Affairs (DEHAA) has been conducting systematic biological surveys of the vegetation and vertebrate fauna of large regions of the state as part of the Biological Survey of South Australia. The aim of these surveys is to document the range of biological variation across the state to improve long-term natural resource management.

Up to mid 1998, 12 major regions have been studied by What is now the Biodiversity Information Section, Heritage and Biodiversity Group of DEHAA: Offshore Islands (excluding Kangaroo Island) (1971 - 1982), the South-East Coast (1982 - 1983), the Nullarbor Plain (1984), the Gawler Ranges (1985), the Yellabinna area (1987), Kangaroo Island (1989 - 1990), , Murray Mallee (1990 - 1991), the South Olary Plains (1991 - 1992), , Stony Deserts (1994 - 1997), the North Olary Plains (1995 - 1996), South East (1991 & 1997) and the NW Flinders Ranges (1997 - 1998). Other comparable surveys which have been conducted by consultants or NGO's under the auspices of the Biological Survey of South Australia include Cooper Creek (1983, 1991), Breakaways Reserve (1986), Chowilla (1988), Strzelecki Dunefields (1988 - 1992) Diamantina River Area (1994) Tallaringa Area (1988 & 1993), Kulliparu Conservation Park (1990), Lake Newland Conservation Park (1991), Gammon Ranges National Park (1993), Mt Brown (1994 & 1997), Gum Lagoon Conservation Park (1995 - 1996) and Lake Eyre South (1996 - 1997) Generally the boundaries of these surveys have been based on the Environmental Regions and the Environmental Associations described and mapped for South Australia by Laut *et al.* (1977).

Surveys involving, vegetation sampling analysis and mapping only have been completed or are in progress in conjunction with the Department of Housing, Urban Development and the Arts for the South Mt Lofty Ranges (1986), Western Murray Flats (1992), Mid-North (1992), Burra Hills (1994), Yorke Peninsula (1994), and South Eyre Peninsula (1996).

Ongoing vegetation and vertebrate surveys are being conducted in the Anangu Pitjantjatjara Lands (1991 -), the Sandy Deserts (1997 -) and the Flinders Ranges (1997 -). Vegetation surveys are currently under way for the Eastern Eyre Peninsula (1995 -) and the State's Coastal Dunes and Clifftops (1995 -).

More recently, a number of more specific surveys have been undertaken in response to the need for detailed biological information for particular areas. These include the Biological Survey of Yumbarra Conservation Park (Owens *et al.* 1995b) which assessed the potential impact of the proposed mineral explorations for the Park, the Box and Buloke Grassy Woodlands Biological Survey (Stokes 1996) which collected biological information required to develop management recommendations for the conservation of remnants, and the Biological Surveys of Messent Conservation Park (Owens *et al*. 1995a), Deep Swamp (Stewart 1996, 1997) and Tilley Swamp (Stewart *et al.* 1998).which assessed the likely biological impacts of a proposed drain through these areas as part of the Upper South East Dryland Salinity and Flood Management Plan (1993).

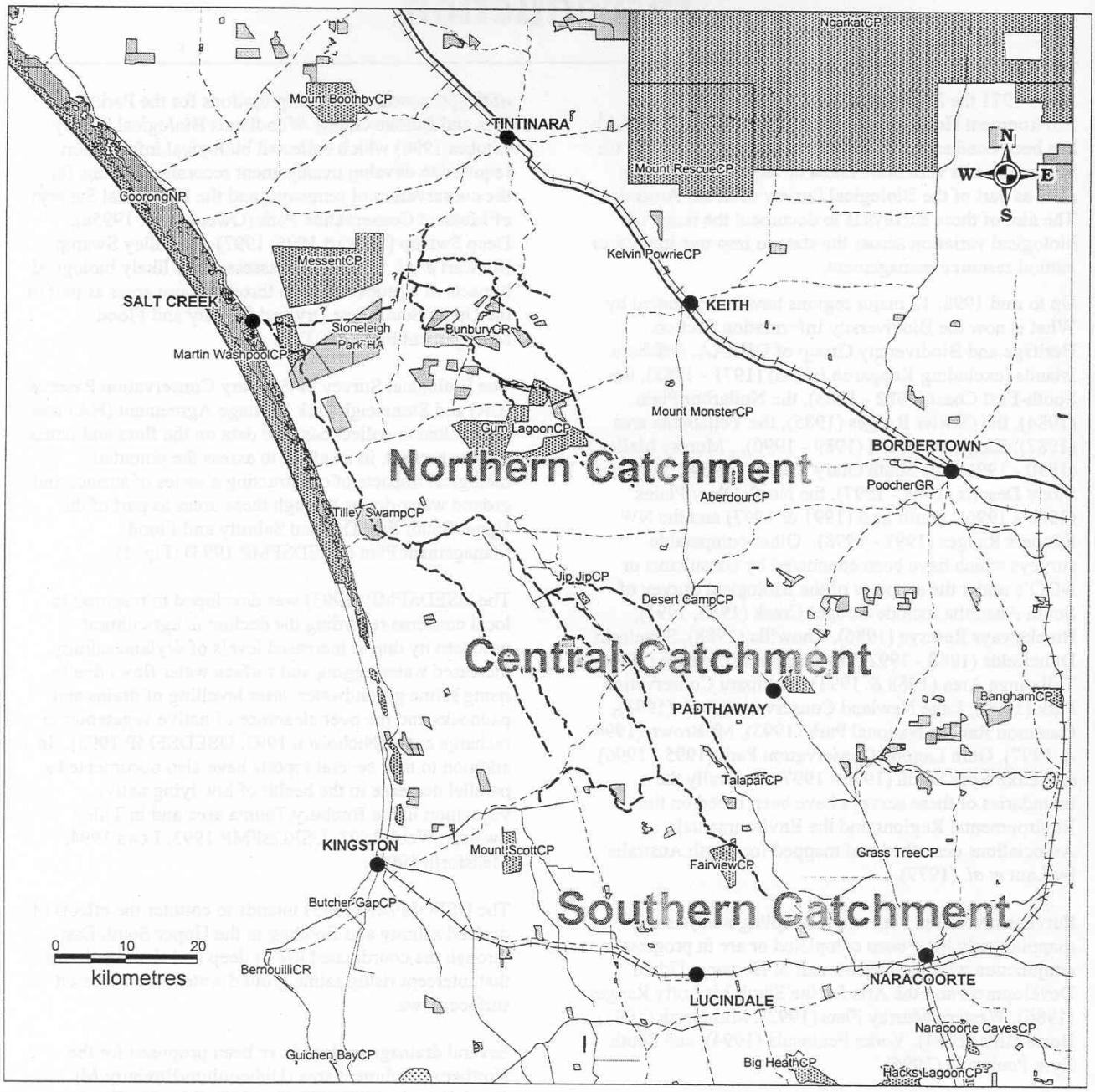
The Biological Survey of Bunbury Conservation Reserve (CR) and Stoneleigh Park Heritage Agreement (HA) was undertaken to collect baseline data on the flora and fauna species present, in an effort to assess the potential biological impacts of constructing a series of surface and ground water drains through these areas as part of the Upper South East Dryland Salinity and Flood Management Plan (USEDSFMP 1993) (Fig. 1).

The USEDSFMP (1993) was developed in response to local concerns regarding the decline in agricultural productivity due to increased levels of dryland salinity, increased waterlogging and surface water flows due to rising saline groundwater, laser levelling of drains and paddocks and the over clearance of native vegetation in recharge areas (Nicholson 1993, USEDSFMP 1993). In addition to this, several reports have also documented a parallel decrease in the health of low lying native vegetation in the Bunbury/Taunta area and in Tilley Swamp (Webb 1993, USEDSFMP 1993, Loan 1994, Mensforth 1996).

The USEDSFMP (1993) intends to counter the effects of dryland salinity and flooding in the Upper South East through the coordinated use of deep and shallow drains that intercept rising saline ground water and increased surface flows.

Several drainage options have been proposed for the Northern Catchment area (Didicoolum/Bunbury/Mt Charles) in the USEDSFMP (1993) (Fig. 2). This has resulted in the assessment of the potential biological impacts of drainage through Messent and Gum Lagoon Conservation Parks (Owens *et al*. 1995a, Davies in prep.).

This report focuses on assessing the potential impacts of instituting a series of drains through Bunbury CR and the north-eastern corner of Stoneleigh Park HA.

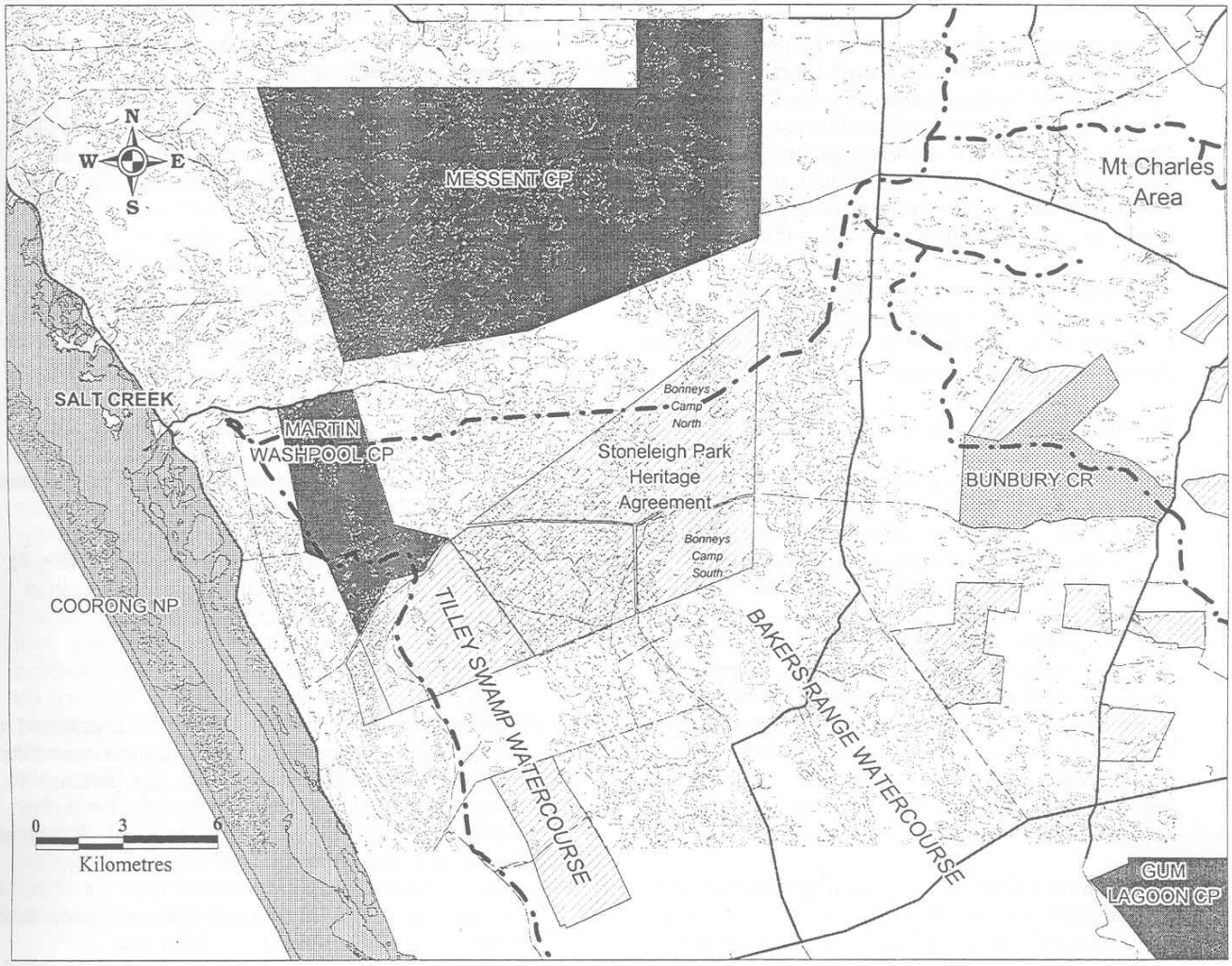


Key

----- proposed drainage routes

Figure 1

Location of Stoneleigh Park Heritage Agreement and Bunbury Conservation Reserve and delineation of catchments and possible drainage routes in the Upper South East according to the USE Dryland Salinity and Flood Management Plan (1993). and Stoneleigh Park



KEY

Reserves & Drainage Routes

- Conservation Park
- Conservation Reserve
- Game Reserve
- National Park
- Recreation Park
- Regional Reserve
- Heritage Agreements
- Possible Drainage Routes

Figure 2

Possible drainage routes - Bunbury Conservation Reserve and Stoneleigh Heritage Agreement.

Proposed drainage measures for Bunbury CR

For Bunbury CR, the proposed drainage options vary from the construction of a substantial surface water drain 1.5 metre deep, 11 metres wide and 6.5 km long (USEDSFMP 1993); to a smaller drain 0.5 metres deep, 4.6 metres wide and 6.5 km long, or simply the creation of a flow path along the existing drainage route using a hydroaxe to clear the vegetation (B. Grear, pers. comm).

The drain through Bunbury will be designed to carry brackish (salinity 2000 - 6000 mg/L) surface waters collected from the Gum Lagoon CP/Duck Island area. This drain will join another drain that comes from the Mt Charles area and heads west through Stoneleigh Park HA on its way to the Morella Basin (Figs 1 and 2). As the Bunbury drain is carrying predominantly surface water, it would be expected to flow only during the winter months.

Although this drain proposal utilises the natural watercourse as a flow path, a sand dune to the north west of Bunbury CR will need to be breached to move water through this land locked area.

Proposed drainage measures in Stoneleigh Park HA

The potential drainage path through the north eastern corner of Stoneleigh Park HA would function as a carrier drain moving surface and ground water intercepted from the Mt Charles, Bunbury, Duck Island and Tatiara catchments to the Morella Basin (Figs 1 and 2). The proposed route of the carrier drain in Stoneleigh Park HA generally follows the lowest ground from the eastern boundary of the Heritage Agreement (approximately 2 km south of the north eastern corner of the block) west through native vegetation to the middle of the Bonneys Camp North wetland on its way to the Morella Basin. The proposed drain would be nominally 1 metre deep and approximately 10 metres wide, traversing the native vegetation for a distance of 4.2 kilometres.

As this drain will be receiving intercepted surface and groundwaters, the volume and salinities are expected to be in the vicinity of 20,000 ML/year, at salinity levels of 5000-10,000 mg/L. Further, as the carrier drain will be receiving both surface and groundwater, the drain should carry a baseflow all year round, with volumes and salinities varying seasonally. In winter the volume of flow should be greater, but less saline, and in summer the volume of flows should be less, but more saline.

Characteristics of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement

Bunbury CR was purchased in June 1993 by the Native Vegetation Management Branch of the Department of Environment and Natural Resources (DENR) from Lesron Pty. Ltd. At this time, the area was known as the proposed Lesron Conservation Park and was noted as such in the USEDSFMP (1993). However, since then, this area has been officially gazetted as Bunbury Conservation Reserve under the Crown Lands Act and subsequently, this title has been used in this report.

Bunbury CR covers 2329 ha of discontinuous sand dunes primarily supporting native vegetation, and several large salt pans and samphire flats (Fig 3). Early attempts at grazing this area resulted in some sand dunes being cleared of native vegetation. The dominant vegetation type now existing on these dunes are exotic grasses and weeds.

Bunbury CR is situated in the Duck Island Environmental Association (2.2.2) which has been described as consisting of "Broad interdunal plains, mainly thinly veneered with sand, with discontinuous dunes, and locally numerous shallow swamps." (Laut *et al*. 1977: 34). In addition, the salt pans and samphire flats of Bunbury CR function as the terminal wetland (and therefore evaporation basin) for the Duck Island watercourse.

The Duck Island watercourse begins south of Gum Lagoon CP, and collects surface water in situ as it travels north-westward to Bunbury CR. It generally flows for a period of 2 - 3 months between 3 - 5 years out of every 10. The surface water is considered to be moderatly saline. Increases in surface runoff, and a highly saline watertable has resulted in the ponding of high salinity water in many of the low lying landscapes of this area, causing a local decline in health and even death of some stands of *Melaleuca halmaturorum* and *Melaleuca brevifolia* shrublands in the Bunbury/Taunta area (Nicolson 1993, Webb 1993, Mensforth 1996) (Fig. 4). Local reports state that Bunbury CR has not received significant surface flows for 10 -12 years.

Stoneleigh Park Heritage Agreement

The native vegetation of Stoneleigh Park is protected by three Heritage Agreements, all of which were proclaimed in February 1991. The property was later purchased by Tom and Pat Brinkworth who donated the land to the Wetlands and Wildlife Trust. Laut *et al.* (1977) included Stoneleigh Park in the Messent Environmental Association (2.2.1) which he described as "An extensive calcernite dune complex overlain with sand dunes. Many of the interdunal depressions are filled with water...[*containing*]..considerable areas of mallee, heath and swamp vegetation.." (Laut *et al.* 1977:30). In January of 1995 approximately one third of the Heritage Agreement was burnt by a fire. This included all of the study area in the north eastern corner of the Heritage Agreement.

With the exception of Messent CP, collectively, the Stoneleigh Park HA's represent the largest block (6112 ha) of intact native vegetation in the Upper South East, and is considered to be equal in conservation value to Messent (Nicolson 1993). In addition, the Stoneleigh Park HA's contain two interconnected wetlands of 980 ha, referred to as Bonneys Camp North and South (Fig. 5).

Historically, the Bakers Range watercourse chain of wetlands carried surface runoff from further south than Lucindale to its terminus in Messent Conservation Park. However, since the early nineteenth century, agriculturalists in the South East have been draining swamps and altering drainage patterns and discharging drainage waters westward to the sea to increase agricultural production. This has resulted in the modification of more than 80% of all wetlands in the South East (SEDB 1980).

After flooding of Bonneys Camp North and South lagoons in 1991, an embankment was built at the northern edge of Bonneys Camp North to prevent flooding of the 'Deepwater' and 'Currawong' properties. A small drain was dug from Bonneys Camp North into Messent CP but to all intents this has resulted in the Bonneys Camp wetlands becoming the terminal wetlands for the Bakers Range watercourse.

The Bonneys Camp wetlands currently receive surface water collected from north of Drain M, and from the flats eastward of Lucindale. This water flows in a north, north-westerly direction along the Bakers Range Watercourse via several wetlands including Deep Swamp, Pretty Johnnys, Mrs White's Lagoon, Mandina Marshes and Log Crossing before entering Bonneys Camp South.

Situated at the terminal end of this wetland system, Bonneys Camp North and South fill infrequently, requiring higher than average surface water flows before water makes it to Bonneys Camp (ie. approx. 1 in 15-20 years). Apart from the 1991 flood, this wetland has not filled naturally since 1963 (Nicholson 1993).

The southern lagoon of Bonneys Camp naturally receives more water than the northern lagoon due to its greater depth (average of 1.2 metres deep), and lower position in the landscape. Bonneys Camp North and South are separated by a natural embankment known as Cattle Dam Crossing. This embankment is only breeched in times of very high flows. The northern lagoon is 0.8 metres deep, and when both lagoons are full the wetland has the capacity to hold 10,000 ML (White and Brake 1995). Average salinities measured in the wetlands change as the volume of water decreases with evaporation but have been recorded to range between 3,000 - 40,000 mg/L.

The study area has a Mediterranean type climate, with long warm summers, and cold wet winters and a mean annual rainfall of between 450-550mm (Laut *et al.* 1977).

Although some of the study area has been the focus of previous research, including bird surveys (Sutton 1933, de Jong 1994), regional floristic vegetation mapping of the South East (DHUD 1991), Heritage Agreement Assessments (1986), and wetland surveys and research (White and Brake 1995), this report represents the first systematic study of both the flora and fauna of the area. These data will therefore contribute to the greater understanding of the flora and fauna communities of the Upper South East of South Australia.

The present Biological Survey was carried out between November 30 - December 9, 1997. The location of all twelve sampling sites are depicted in Figures 3 and 5.

Although the present survey used a more intensive sampling program than the previously conducted regional surveys, it utilised the standard sampling, and presentation techniques developed as part of the overall Biological Survey of South Australia. All data was therefore collected in a systematic way which is completely compatible with existing biological survey information.

Figure 4.
Localised death of low lying Eucalypt communities on agricultural land in the Bunbury - Taunta area as a result of rising saline groundwater.
(Photo. H.Stewart).

Methods

The rationale behind these regional Biological Surveys has been explained in detail by Copley and Kemper (1992). The Biological Survey of Bunbury CR and Stoneleigh Park HA was conducted in patches of remnant vegetation in the agricultural district of South Australia, where much of the natural vegetation and its associated vertebrate fauna has been fragmented by clearance and undergone substantial habitat modification for agriculture. For this reason a number of alterations to the methods adopted in the extensive areas of natural vegetation covered by previous regional surveys were required. However, more recently, a number of specific Biological Surveys have been undertaken which provided a methodology which ensured that the data collected in this survey were comparable to that collected in previous broad-scale surveys (Owens *et al.* 1995 a,b, Stewart 1996, Stokes 1996, and Stewart *et al.* 1998).

The Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement was designed with the following aims:

1) To collate any previously existing information on the biota of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement.

2) To undertake a Biological Survey of Bunbury Conservation Reserve and the north eastern corner of Stoneleigh Park Heritage Agreement to determine the presence of all flora and fauna, in a standard and comparable format. This entailed providing both the South Australian Museum and State Herbarium with voucher specimens collected during the survey, and entering all the collected data onto the South Australian Biodiversity Database.

3) To establish permanent sampling sites to collect baseline data, and monitor the potential effects of the proposed drain on the flora and fauna of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement.

4) To prepare an accurate vegetation map of Bunbury Conservation Reserve and the north-eastern corner of Stoneleigh Park Heritage Agreement at a scale of 1:30,000.

Site Selection and Nomenclature

The fundamental concept behind all the regional surveys conducted as part of the Biological Survey of South Australia to date has been that they are based on intensive sampling at a series of *sites* selected to represent the biological and geographical diversity of the study area. As the present survey was designed to assess the potential impacts of the proposed drains through a particular area, some changes were made to the site selection process. Due to the smaller size, and more intensive nature of the survey, this survey considered the two patches of vegetation to be a single *site* designated with the code BS. Given the time available, the number of vegetation types and the relatively small size of the area, a maximum of twelve principle vegetation and vertebrate sampling quadrats were established (Table 1, and Figs 3 and 5). At least one sampling quadrat was placed in each of the major vegetation types. Some vegetation types were sampled more than once in relation to their abundance and relative importance (in terms of potentially being most affected by the drainage measures). Site selection was also based on their proximity to the proposed drainage works, and on their attributes as a monitoring site.

Where practical, sampling quadrats were only placed in areas of similar habitat greater than four hectares (200 m X 200 m) to minimise any 'edge' effects associated with neighbouring vegetation types, and were placed in the centre of the vegetation patch.

Data Collection

The data were collected over a ten day period. Sampling sites were established for the first four nights in Bunbury CR. When completed, the sites were packed up and reset in the north eastern corner of Stoneleigh Park HA.

Each vegetation sampling site consisted of a 30 X 30 m quadrat, within which all vascular plants present were recorded and collected for later verification at the State Herbarium. All data on the specimens collected, including life stage, cover/abundance, vegetation association description were recorded on standard data sheets. Details on the overstorey height, canopy depth and diameter, and canopy cover were also recorded, as well as a description of the location and physical environment of each quadrat.

All twelve quadrats sampled for vegetation were also sampled for the presence of vertebrates. At each, a 50 m long line of six fenced pitfall traps were established. Each pitfall trap consisted of a 455 mm x 380 mm sheet of white, high impact polystyrene sheet joined into a cylinder using a slotted H section plastic strip (HM12). The resultant pitfall traps had a diameter of 140 mm and a depth of 380 mm.

A separate line of 15 Elliott traps were set in association with each pitfall line sampling the same habitat within the quadrat, and two possum/cat size traps were placed at each end. A line of 6 micro-pitfalls consisting of plastic vials measuring 80 X 20 mm and filled with 70% alcohol were set adjacent to the main pitfall line. All traplines were run for four nights. Reptiles and mammals were also sampled by searching each of the twelve quadrats at least once during the sampling period.

Birds were recorded for each quadrat. An observer spent from one to several hours during the best bird observation times of early morning and evening recording all birds within or flying over the quadrat during the search period. An attempt was made to put the same amount of search effort into each quadrat during the best observation times.

A permanent photographic monitoring point was established at each of the twelve vertebrate sampling quadrats using two 1.4 m long steel posts set 10m apart (Figs 6 - 17).

Observations of some plants and vertebrates encountered outside quadrats were recorded on special "opportunistic" data sheets, and entered onto the Biological Survey of South Australia Oportunistic Database.

A separate field trip was undertaken between February 6-8, to trap for bats. During this time two Harp traps were set for three nights, at the only known source of water in Stoneleigh Park HA, at Bonnys Camp South. A single Anabat bat detector was also set on three nights to record bat calls on several study sites in Stoneleigh Park HA.

At least the first specimen of each small mammal and reptile species recorded for the survey area was preserved as a museum specimen. Larger species (ie. *Varanus rosenbergi*) which had been collected from the general region in the past and did not present any identification problems were not collected.

A small amount of vehicle spotlight searching was carried out both on the quadrats and opportunistically but the demands of quadrat sampling and specimen processing did not allow this to be carried out systematically.

Samples of liver tissue were taken from all specimens collected and stored in liquid nitrogen. Tissue samples from all mammals and reptiles are permanently stored at the South Australian Museum (SAM).

Invertebrates were collected from the micro-pitfall and larger vertebrate pitfall traps or opportunistically around each quadrat. These samples were also lodged with SAM.

A summary of the sampling effort over the whole survey is given in Table 2. The number of individual observations during the survey is shown in Table 3.

Table 1. Flora and fauna sampling quadrats established in Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

Survey Site Code	Vegetation Associations
BS0101	*Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland
BS0201	*Melaleuca halmaturorum* tall shrubland
BS0301	*Eucalyptus incrassata* open mallee
BS0401	*Melaleuca halmaturorum* tall shrubland
BS0501	*Eucalyptus incrassata* open mallee
BS0601	*Melaleuca brevifolia* shrubland
BS0701	*Lepidosperma* aff. *laterale* sedgeland
BS0801	*Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland
BS0901	*Eucalyptus arenacea* open woodland
BS1001	*Eucalyptus diversifolia* mallee
BS1101	*Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland
BS1201	*Lepidosperma* aff. *laterale* sedgeland

Table 2 Trapping and spotlighting effort during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

Site	Pit Trap Nights	Elliott Trap Nights	Vehicle Spotlight Hours	Harp Trap Nights
BS0101	24	60		
BS0201	24	60		
BS0301	24	60		
BS0401	24	60		
BS0501	24	60		
BS0601	24	60		
BS0701	24	60		
BS0801	24	60		
BS0901	24	60		
BS1001	24	60		
BS1101	24	60		
BS1201	24	60		
OPPORTUNISTIC			6	(2 traps by 3 nights) 6
TOTALS	288	720	6	6

Table 3 Numbers of individual observations of plants and vertebrates during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

	Quadrats		Opportunistic	Total
Plants	368	(12 sites)	108	476
Mammals	122	(12 sites)	124	246
Birds	434	(12 sites)	134	568
Reptiles	74	(12 sites)	11	85
Amphibians	40	(12 sites)	0	40

Data Management

All collected specimens were lodged with the appropriate institutions for verification and were added to their collections if required. Whereas the State Herbarium received all collected plant specimens, the vertebrate specimens were lodged with SAM. Any corrections to specimen identification were transferred to the original data sheets and the data was entered on the Opportunistic and Survey databases administered by the Biological Survey and Research section of DEHAA.

Vegetation Mapping

Due to the relatively small number of vegetation quadrats sampled in the current survey, PATN analysis could not be used to define floristic groups (which has been the case in most previous Biological Surveys). Instead, a 1:30,000 floristic vegetation map of Bunbury CR and Stoneleigh Park HA was created from interpretation of current aerial photographs at a scale of 1:10,000 from data collected during the present survey and from previous information generated by the Regional Flora Survey undertaken by the Department of Transport, Urban Planning and Arts (DTUPA) in 1991. The vegetation boundaries were then traced from the 1:10,000 aerial photograph onto transparent overlays or 'mylars' at that scale. The mylars were corrected for topological inaccuracy, and the vegetation boundaries were then digitised by members of the Geographical Analysis and Research Group (GAR) of DTUPA. The final map was produced using ESRI's ARC/INFO GIS software.

Results

VEGETATION

Some botanical information for Bunbury CR and Stoneleigh Park HA were available prior to the present survey. These included previous field inspections carried out by the Native Vegetation Conservation Section (DEHAA) to assess private applications to clear the native vegetation of Bunbury CR (17/4/86) and Stoneleigh Park HA (22-23/5/86), as well as data collected by the Department of Transport, Urban Planning and the Arts (DTUPA) during the South East Floristic Survey (1991), and a visit to Bunbury CR made by the Botany Club on 15/5/93. These data have been included in this report where relevant (Appendix I). However, this survey represents the first systematic survey of the vegetation of the area.

Floristic Vegetation Mapping

Due to the relatively small number of vegetation quadrats sampled, PATN analysis was not used to define floristic groups (as is the case in regional Biological Surveys to date). Instead, a floristic map of the vegetation communities of the study area was created using aerial photograph interpretation, extensive ground truthing and the data generated from this and previous floristic survey work in the area. The resultant floristic vegetation maps were produced at a scale of 1:30,000 (Figs 3 and 5).

Twelve floristic plant communities were recognised in this study, including two communities associated with calcareous ridges (*Eucalyptus fasciculosa* open woodland and *E.diversifolia* closed mallee), four communities associated with sandy rises (*E.arenacea* open woodland, *E. incrassata* open mallee, *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland and *Xanthorrhoea caespitosa* shrubland) and six intergrading communities associated with areas subject to seasonal waterlogging or inundation (*Lepidosperma* aff. *laterale* sedgeland, *Melaleuca brevifolia* shrubland, *M.halmaturorum* shrubland, *Selleria radicans* herbland, *Wilsonia rotundifolia* herbland and Samphire low shrubland (Table 4, and Figs 6 - 17).

Although none of these plant communities are considered to be of high conservation significance, the *Lepidosperma* aff. *laterale* sedgeland is a unique plant community occurring in the study site and in Messent CP only.

This survey recorded 183 (12 introduced) different plant taxa. This included 21 species of high conservation significance at the State and/or regional level (Lang and Kraehenbuehl 1998). Collectively, including the pre-existing information, the twelve plant communities identified during the survey support a total of 215 plant species (12 introduced), 23 of which are considered of high conservation significance at either the state and/or regional level (Lang and Kraehenbuehl 1998).

Of the 183 plant species recorded, 182 were recorded from Bunbury CR and 114 for the north eastern corner of Stoneleigh Park HA (Appendix I).

Sampling was undertaken in early December, when most ephemeral taxa such as Orchidaceae, Droseraceae and Liliaceae species have died off. For this reason, the list of species recorded is not expected to represent all the plant species of the study area.

Species of Particular Interest

Although no plants of national significance were recorded during the survey, the nationally **rare** spiked sour-bush (*Choretrum spicatum*) has been recorded in Bunbury CR during the 1986 Native Vegetation Conservation Section assessment of the area. The nationally **endangered** Metallic Sun-orchid (*Thelmitra epipactoides*) has been recorded in Messent CP, and in the district during the South East Flora Survey, 1991, and may therefore potentially occur in the sedgelands of the study area (Owens *et al*. 1995a).

Brief descriptions of all species of high conservation significance so far recorded for the study area is provided below. As some species have different ratings at a state and regional level, both listings have been stated, as well as, where appropriate, the rating under the National Parks & Wildlife Act, 1972. This information is summarised in Table 5.

Species of State and Regional Significance

Spiked Sour-bush (*Choretrum spicatum*)

A shrub 1-2 metres in height, which flowers mainly between September to October, this species has been recorded from Victoria and several botanical regions of South Australia including Kangaroo Island and the South East. In the Upper South East it is known from *Eucalyptus arenacea* low woodlands and has been recorded in Desert Camp Conservation Park and two Heritage Agreements. As such this plant is not considered to be adequately conserved in the region.
This species is considered to be **rare** in Australia and South Australia, and **vulnerable** in the South East (National Parks & Wildlife Act 1972, Lang and

Kraehenbuehl 1998). Although not recorded during the present survey, this species was recorded during a field assessment of Bunbury CR made by officers of the Native Vegetation Conservation Section in 1986. As this species has been previously recorded in the region from deep sand, it was presumably recorded from similar *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland in the Reserve. This species is therefore not expected to be influenced by changes in hydrology, or through any proposed clearance.

Cleland's Beard-heath (*Leucopogon clelandii*)

A small shrub 13-30 cm high which flowers from April to August. *L.clelandii* has been recorded from Victoria and several botanical regions of South Australia including Lake Eyre, Eyre Peninsula, Northern Lofty, Murray Mallee, Yorke Peninsula, Southern Lofty, and Kangaroo Island. Within the South East, distribution of the species is restricted to the Upper South East where it is conserved in Ngarkat Conservation Park and several Heritage Agreements.

The species is listed as **rare** for the state and in the South East (Lang and Kraehenbuehl 1998). During this survey it was opportunistically recorded from the edge of a *Melaleuca brevifolia* shrubland in Bunbury CR and in *Lepidosperma* aff. *laterale* sedgeland on the Bonneys Camp North wetlands in Stoneleigh Park HA. As this species typically occurs in drier habitats, it would not tolerate excessive flooding of water, therefore, changes in water flow and drain construction may have a negative impact on the species in this area.

Creeping Boobialla (*Myoporum parvifolium*)

A prostrate, mat-forming shrub less than 0.1 m high. the Creeping Boobialla flowers mainly between October to March. This species has been recorded from Victoria and several botanical regions of South Australia including Eyre and Yorke Peninsulas the Murray Mallee, Southern Lofty Ranges, Kangaroo Island and the South East. In the South East , it is typically recorded from the edges of the watercourses in the Upper South East. Several populations are presently conserved in Fairview, Messent, Martin Washpool, and Gum Lagoon Conservation Parks.

Currently recognised as **rare** in South Australia and the South East (Lang and Kraehenbuehl 1998), a significant population of this species were recorded opportunistically from a *Eucalyptus fasciculosa* open woodland and a *Melaleuca brevifolia* shrubland depression within the north eastern corner of Stoneleigh Park HA. Although this species is not expected to be affected by changes in hydrology, their present location occurs on the drainage path and therefore may be cleared. In addition, elsewhere in the district, this species has been recorded from the edges of watercourses (Owens *et al*. 1995a, Stewart *et al*. 1998). Therefore undetected populations of the species may be at risk of clearance or negatively affected by changes in quality and quantity of water flow and drain construction in the Bonneys Camp North wetland.

Loose-panicle Bog-rush (*Schoenus laevigatus* - formerly *S.brachyphyllus*)

A sedge 30-60 cm high, flowering October to January. This species has only been recorded from Western Australia and the Southern Lofty botanical region of South Australia.

Although not recorded during the present survey, this regionally **rare** plant was recorded for an unlisted location in Bunbury CR by amateur botanists in 1993 (Botany Club Camp 15/5/93) (Lang and Kraehenbuehl 1998). *S.laevigatus* remains poorly conserved in the region, being recorded from Big Heath Conservation Park only. As there are no details on the specific location of the species in Bunbury CR, no comment can be made on the affects of proposed drainage and water changes in the study area. Further research may be required to determine its location and abundance.

Leafless Globe-pea (*Sphaerolobium minus*)

Formerly *S. vimineum*, the Leafless Globe-pea is a small shrub or subshrub 20-70 cm high which flowers between October to December. Elsewhere in Australia, it is recorded from Western Australia, Queensland, New South Wales, Victoria and Tasmania. In South Australia it has been recorded from the Eyre Peninsula and Southern Lofty botanical regions.

The species is listed as **rare** for the state and region (Lang and Kraehenbuehl 1998) and **rare** under Schedule 9 of the National Parks & Wildlife Act, 1972. Although the species is more typical of the low lying wet areas with fresher water from the Lower South East, small populations have been recorded from Messent, and Big Heath Conservation Parks, several PIRSA Native Forest Reserves and two Heritage Agreements. Although not recorded during the survey, a specimen was collected from an unlisted location in Bunbury CR, and was later verified at the State Herbarium. As this species occurs in wetlands, it may potentially be negatively impacted by changes in water flow in the Reserve.

Hills Daisy (*Ixodia achillaeoides* ssp. *alata*)

The Hills Daisy is an erect shrub or undershrub 0.8 - 2 metre high which flowers between October and February. This species has been recorded from Victoria and several botanical regions of South Australia including the Eyre Peninsula, Northern and Southern Lofties, Murray Mallee, Yorke Peninsula, Kangaroo Island and the South East. In the South East known populations of this regionally

uncommon species are conserved in several Heritage Agreements in the Upper South East (Lang and Kraehenbuehl 1998).
In this survey it was recorded opportunistically from an *Eucalyptus fasciculosa* open woodland within Stoneleigh Park HA. As this habitat occurs some distance from the proposed drain, it is not expected to be affected by any clearance or water diversion.

Furze hakea (*Hakea repullulans*)

An erect, open shrub to 2 metres high, flowering September to November, *H.repullulans* has a restricted distribution, having been recorded from western Victoria and the South East botanical region of South Australia only. Its distribution in the region is restricted to the Upper South East, where populations are conserved within Mt Rescue, Mt Shaugh, and Messent Conservation Parks, and a number of Heritage Agreements.

This species is currently considered to be **uncommon** in South Australia and in the South East (Lang and Kraehenbuehl 1998). In this survey, it was opportunistically recorded from *Eucalyptus arenacea* low open woodland within Bunbury CR. As the species was recorded from higher ground, it not be expected to be directly affected by any proposed drain or water diversion.

Salt Lawrencia (*Lawrencia spicata*)

A stout, erect sub-shrub, 30-100 cm high, which flowers October to December. Elsewhere in Australia it is recorded from Western Australia, New South Wales, Victoria and Tasmania, and also within South Australia from the Eyre Peninsula, Northern Lofty, Yorke Peninsula, Southern Lofty and Kangaroo Island botanical regions. In the South East this species is more typically recorded from the Upper South East water courses, and is presently conserved in Messent and Beachport Conservation Parks, Bucks Lake Game Reserve and several Heritage Agreements.

The species is listed as **uncommon** for the state and region (Lang and Kraehenbuehl 1998). During this survey, a sparsely scattered population was recorded within *Melaleuca halmaturorum* tall shrubland in Bunbury CR (BS0201). This site lies within the watercourse where water may be diverted and hence affected by the proposed scheme. However, there is insufficient ecological information known for this species to determine what effects extended flooding or drain construction may have.

Leafless Currant-bush (*Leptomeria aphylla*)

Shrub to 1-1.5 metres high, flowering mainly January to June. Elsewhere in Australia it is recorded from New South Wales, Victoria and Tasmania, and in South Australia from the Eyre Peninsula, Northern and Southern Lofties, Murray Mallee, and Kangaroo Island botanical regions. Within the region populations of *L.aphylla* are well conserved within Messent, Desert Camp, Mt Scott, and Aberdour Conservation Parks as well as a number of Heritage Agreements.

This species is rated as **uncommon** for the state and region (Lang and Kraehenbuehl 1998). During the survey, this species was recorded opportunistically in *Eucalyptus diversifolia* mallee on a rocky limestone knoll within Stoneleigh HA. The same habitat from which specimens were recorded during the 1986 NVCS survey. As the plant is recorded from higher ground away from the basin and watercourse, it is not expected to be adversely affected by water diversion or drain construction.

Ruddy Beard-heath (*Leucopogon rufus*)

An erect shrub 20-90 cm high, flowering November to June. Recorded form Victoria and the Eyre Peninsula, Kangaroo Island, Southern Lofty and Murray Mallee botanical regions of South Australia, *L.rufus* is considered to be **uncommon** in the South Australia and the South East (Lang and Kraehenbuehl 1998). Restricted to the Upper South East, populations of the species are conserved within Mt Rescue and Ngarkat Conservation Parks. During this survey, a localised population was opportunistically recorded from *Eucalyptus incrassata* open mallee in Bunbury CR. As this species was recorded from areas of higher ground with deeper sands, it is not expected to be affected by proposed changes to water flow or drain construction.

Nodding Beard-heath (*Leucopogon woodsii*)

A slender shrub 20-40 cm high, flowering between February to August, the Nodding Beard-heath has been recorded from Western Australia and Victoria, and also within South Australia from the Eyre Peninsula, Murray Mallee, Yorke Peninsula, Southern Lofty, Kangaroo Island and South East botanical regions.

Lang and Kraehenbuehl (1998) consider this species to be **uncommon** at both the state and regional level, and it is currently conserved in Ngarkat Conservation Park. During this survey, one plant was opportunistically recorded from a *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland in Bunbury CR. As this plant community occurs on the discontinuous sand dunes some height from the watercourse, it is not expected to be directly adversely affected by the proposed drainage scheme.

Woolly Daisy-bush (*Olearia lanuginosa*)

A compact shrub to 1.5 metres high, flowering October to February, this species has been recorded from New South Wales and Victoria, and from the Eyre Peninsula,

Northern and Southern Lofty, Murray Mallee, and Yorke Peninsula botanical regions of South Australia.

The plant is considered **uncommon** at the state and regional level (Lang and Kraehenbuehl 1998). The distribution of *O.lanuginosa* is restricted to the Upper South East, usually to areas of sand, where it is conserved within Messent and Mt Boothby Conservation Parks, and a number of Heritage Agreements. A localised population was opportunistically recorded from a small depression with *Melaleuca brevifolia* shrubland in Stoneleigh HA during the present survey. Although found in a lower lying swale in the dunes in this survey, it is unlikely to be adversely affected by changes in water flow or drain construction.

Short Purple-flag (*Patersonia fragilis*)

A perennial herb which forms round clumps from 30-50 cm high, flowering October to December. This species has a wide distribution, having been recorded from Queensland, New South Wales, Victoria, Tasmania and the Southern Lofty, and Kangaroo Island botanical regions of South Australia. Within the South East, the species is more typically recorded from the Lower South East. Populations are currently conserved in Messent, Big Heath, Penola, Glen Roy, and Telford Scrub Conservation Parks and a number of PIRSA Native Forest Reserves. This population and that in Messent Conservation represent the northern-most distribution of the species in the region.

A small population of this **uncommon** (at state and regional level) species was opportunistically recorded from a *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland in Bunbury CR (Lang and Kraehenbuehl 1998). It is therefore not expected to be adversely affected by the drainage scheme.

Slender Phyllota (*Phyllota remota*)

A low heathy shrub to 50 cm high, flowering irregularly all year round. Recorded from south-western Victoria and the Eyre Peninsula, Murray Mallee, Southern Lofty, and Kangaroo Island botanical regions of South Australia, Lang and Kraehenbuehl (1998) consider this species to be **uncommon** at both the state and regional level. In the South East its distribution is largely restricted to the Upper South East where populations of this species have been recorded from Mt Rescue, Messent, and Bangham Conservation Parks, and several Heritage Agreements.

Although not recorded during the present survey, *P.remota* was recorded for an unlisted location in Bunbury CR by amateur botanists in 1993 (Botany Club Camp 15/5/93). Consequently, no comment can be made on the affects of drain construction and water flow changes, however the species is typically found on shallow sand adjacent or within edge areas of *Melaleuca brevifolia* shrubland. Changes of local hydrology may have some negative impacts on the species.

Bitter Quandong (*Santalum murrayanum*)

Usually a small tree, but sometimes a shrub, to 4 metres high, flowering August to January, the bitter Quandong has been recorded from Western Australia, New South Wales, Victoria, and the Flinders Ranges, Eyre Peninsula, Murray Mallee, Yorke Peninsula, Southern Lofty botanical regions of South Australia. This species is considered to be **uncommon** at the state and regional level (Lang and Kraehenbuehl 1998). Like *S.acuminatum*, the distribution of this species is restricted to the Upper South East, where it is conserved in Mt Rescue, Messent, and Jip Jip Conservation Parks, and a number of Heritage Agreements.

In this survey, *S.murrayanum* was recorded from a *Eucalyptus diversifolia* closed mallee within Stoneleigh Park HA (BS1001). As the species is typically associated with deep sands on higher ground, it is not expected to be affected by changed water flow or drains.

Silky Wilsonia (*Wilsonia humilis* var. *humilis*)

A prostrate, slender, much-branched perennial shrub which flowers from September to December. Silky Wilsonia has a wide distribution across Australia including Western Australia, South Australia, Victoria and Tasmania. In South Australia this species has been recorded from the Lake Eyre, Nullarbor, Eyre and Yorke Peninsulas, Southern Lofty, Kangaroo Island and South East botanical regions.

In the South East it is typically recorded on the watercourses of the Upper South East, and has been collected from Martins Washpool, Messent and Gum Lagoon Conservation Parks. This species is considered to be **uncommon** at the state level and in the South East (Lang and Kraehenbuehl 1998).

During this survey, a sparsely distributed population was recorded in *Melaleuca halmaturorum* shrubland at BS0201. As the species is recorded on the watercourse, changes to flow regime (salinity increases, duration and timing of flooding) is likely to negatively affect this species.

Medic pennywort (*Hydrocotyle medicaginoides*)

A slender annual herb 3-15 cm high, flowering September to November. Elsewhere in Australia it is recorded from Western Australia and Victoria, and also within South Australia from the Eyre Peninsula and Southern Lofty botanical regions.

Listed as having an **indeterminate** (**K**) rating for the South East (Lang and Kraehenbuehl 1998), *H.medicaginoides* is considered to be at least **rare** for the region until more information is known about the species. Until this survey, no populations of this species were

known to be conserved in any government reserves or Heritage Agreements in the region. In this survey, the plant was recorded opportunistically within Stoneleigh Park HA, in the *Selleria radicans* herbland on one of the lowest points of the basin. Consequently, construction of a drain or water diversion into Bonneys Camp North may have an impact on this species.

Three-petal Poranthera (*Poranthera triandra*)

A very small annual herb, flowering August to November. Endemic to South Australia, this species has been recorded from the Eyre Peninsula, Murray Mallee, Yorke Peninsula and Southern Lofty botanical regions.

It is listed as having an **indeterminate** (K) rating for the South East (Lang and Kraehenbuehl 1998), and is as such considered to be at least **rare** for the region until more information is known about the species. No information is available on any areas where the species is conserved. In this survey, a few sparsely scattered plants were opportunistically recorded from *Melaleuca brevifolia* shrubland adjacent BS0601 (Fig. 3). As this is a low lying area associated with the watercourses in the reserve, it is expected the species will be severely affected by inundation, and hence changes in water flow.

Grey copper-wire daisy (*Podolepis canescens*)

Annual, erect herb 6 to 80 cm high. Flowers May to November. This species is widely distributed, being recorded from all mainland states including the Northern Territory. In South Australia *P.canescens* has been collected from all botanical regions except Kangaroo Island, and in the South East it has been recorded from Martin Washpool, Messent and Gum Lagoon Conservation Park.

This species is considered to be **rare** in the South East (Lang and Kraehenbuehl 1998). During this survey, the species was recorded opportunistically in a *Selleria radicans* herbland on Bonneys Camp North wetland in Stoneleigh Park HA. Populations of the species were also noted in other areas of the herbland in the basin. As such, the species is expected to be adversely affected by drain construction or ponding of water for extended periods of time.

Quandong (*Santalum acuminatum*)

Usually a small tree, but sometimes a shrub to 5 metres high, flowering October to May, this species has been recorded from all mainland states and all botanical regions of South Australia.

Considered **rare** in the South East, the Quandongs' distribution is limited to the Upper South East where small populations are conserved in Messent, Scorpion Springs and Ngarkat Conservation Parks and a number of Heritage Agreements (Lang and Kraehenbuehl 1998). In this survey, a small localised number of plants were recorded opportunistically from an *Eucalyptus fasciculosa* open woodland site in Bunbury CR. As the species in this survey was typically associated with higher ground, it is not expected to be adversely affected by the drainage scheme.

Long-hair Plume-grass (*Dichelachne crinita*)

A tall, tufted perennial grass to 1.2m high which flowers October to December. Although the distribution of this species remains unknown elsewhere in Australia it has been recorded from the Flinders Ranges, Eyre Peninsula, Northern Lofty, Murray Mallee, Yorke Peninsula, Southern Lofty, and Kangaroo Island botanical regions of South Australia. In the South East of South Australia, it has been recorded widely including Piccaninnie Ponds, Penola, Bangham, Messent and Mary Seymour Conservation Parks.

Listed as regionally **uncommon** by Lang and Kraehenbuehl (1998), this species was only recorded from one opportunistic site containing *Eucalyptus fasciculosa* open woodland in Bunbury CR. As the species was recorded from higher ground, it should not be affected by water diversion or a drain along the watercourse in Bunbury CR.

Bristly Bush-pea (*Pultenaea acerosa*)

A small rigid shrub 30-60 cm high, flowering August to September. Recorded from Victoria, and the Eyre Peninsula, Yorke Peninsula, Southern Lofty, Kangaroo Island botanical regions South Australia, Lang and Kraehenbuehl (1998) consider this species to be **uncommon** in the South East. Its distribution in the region is restricted to the Upper South East where it occurs in areas of outcropping limestone with *E. diversiflolia* mallee. Populations of the species are recorded in the region within Mt Rescue, Messent, and Gum Lagoon Conservation Parks and a number of Heritage Agreements.

Specimens of this species were recorded opportunistically from a *Eucalyptus diversifolia* mallee site on the eastern boundary of Stoneleigh Park HA. As this species was recorded from a calcareous rise, it is not expected to be adversely affected by the drainage scheme.

Neat Spear-grass (*Stipa mundula*)

A perennial grass to 60 cm high, flowering October to November. Recorded from Victoria, and from the Eyre Peninsula, Murray Mallee, and Yorke Peninsula botanical regions of South Australia, *S.mundula* is considered to be **uncommon** in the South East (Lang and Kraehenbuehl 1998). Although considered more typical of the Lower South East, populations of this species are conserved in Big Heath, Gum Lagoon and Lower Glenelg Conservation Parks as well as one Heritage Agreement. During the

present survey, this species was recorded opportunistically from a *Eucalyptus diversifolia* mallee site on the eastern boundary of Stoneleigh CR.

As the species is recorded from high ground it is not expected to be affected by changes in water flow or drains.

Squarrose fireweed (*Senecio squarrosus*)

Due to work of this and previous surveys (Owens *et al*. 1995a, Stewart *et al* 1998), the species is no longer listed to be of high conservation significance.

Plant Communities

A total of 12 plant communities were recognised for the study area during this survey, however the study area comprises two distinct areas, which have some similar vegetation types but contain vegetation communities not present in the other.

Bunbury Conservation Reserve

Bunbury Conservation Reserve comprises mainly white sand dune and watercourses. Eight plant communities were recorded from the Reserve. These were:

1. *Eucalyptus fasciculosa* open woodland restricted to small areas of red loam soils adjacent to the water courses;

2. *E. incrassata* open mallee forming extensive areas of lower sand dunes and shallower sand;

3. *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland forming the major plant community of the sandy rises of the reserve, occurring on deeper sand dunes. In some areas *Eucalyptus arenacea* became the dominant species of this plant community with a continuous canopy cover forming a low open woodland. However the understorey species remained the same. Understorey species of this and the *E. incrassata* open mallee were similar in composition;

4. *Xanthorrhoea caespitosa* shrubland in areas of semi-developed agricultural land on deep sand, regenerating to native vegetation. This community was characterised by low native species diversity and density;

5. *Melaleuca halmaturorum* tall shrubland forming the major plant community of the watercourses in the reserve;

6. *M.brevifolia* shrubland on the shallower areas of the watercourse;

7. *Wilsonia rotundifolia* herbland occurring in the open areas of the watercourse that hold water for longer periods;and

8. Samphire low shrubland.

Stoneleigh Park Heritage Agreement

The north eastern corner of Stoneleigh Park HA comprises similar areas of deep white sand dune, but contains more areas of outcropping limestone and a separate watercourse basin, which has been drying out over the last three decades. Eight plant communities were recognised in the study area of Stoneleigh Park HA. These include:

1. *Eucalyptus fasciculosa* open woodland, located in two distinct areas, fringing the basin, and on areas of shallow sand over red loam and surface strewn limestone;

2. *E.arenacea* open woodland in areas deep sand on the eastern boundary of the Heritage Agreement, which have been semicleared for agricultural land. Clearance had retained a good tree density, with the trees growing to a more substantial size in the reduced competition condition, compared to more natural areas;

3. *E.diversifolia* closed mallee on areas of outcropping limestone with red loam;

4. *Banksia ornata* shrubland/*Eucalyptus arenacea* low open woodland forming extensive areas of the sand dune country;

5. *Melaleuca brevifolia* shrubland forming a minor plant community in small swales in the sand dunes;

6. *Xanthorrhoea caespitosa* shrubland in areas of semi-developed agricultural land on deep sand, regenerating to native vegetation. It is characterised by low native species diversity and density. It is similar to the *E.arenacea* open woodland, except more disturbed and lacking in eucalypt canopy;

7. *Lepidosperma* aff. *laterale* sedgeland forming extensive areas of the watercourse basin. At times, the *Baumea juncea* becomes more dominant.

8. *Selleria radicans* herbland located in the lowest and wettest sections of the watercourse basin.

Plant Communities of Conservation Significance

Although no plant communities surveyed in the study area are considered of high conservation significance at either the state or regional levels (Davies 1982, Neagle 1995, Croft & Carpenter 1996), the *Lepidosperma* aff. *laterale*

sedgeland is considered to be a unique community for the state.

The taxonomic status of *Lepidosperma* aff. *laterale* is uncertain and needs clarifying. The plant is recorded from areas of the Upper South East within *Eucalyptus camaldulensis* woodlands and forms its own small, localised plant community on the drier edges of seasonal swamps. However, extensive areas of the plant community are presently located on the lower lying areas of Messent Conservation Park and Stoneleigh Park HA. Prior to extensive drainage of the region, these areas are considered to have periodically filled with water in wetter years. These flats do not now regularly receive water, only receiving local runoff. The current plant community of these flats is therefore very different from that historically occurring in the basin. It is therefore very difficult to establish the conservation significance of such a plant community, which may be transitional to another plant community.

As the plant community occurs on the lower lying basin within Stoneleigh Park HA, it is considered that drain construction will have a deleterious impact. Similarly, ponding of water is expected to have a serious impact on the plant community, whose importance is unknown.

Maintenance of this unique plant community will depend on maintaining the dry nature of the basin.

Table 4. Floristic plant communities recorded during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

Plant communities associated with sandy rises

1. *Eucalyptus arenacea* open woodland OVER an open shrub understorey dominated by *Xanthorrhoea caespitosa*, *Leptospermum myrsinoides*, *Banksia marginata*, and a ground cover of native and introduced grasses.
2. *Eucalyptus incrassata* open mallee OVER a diverse heath understorey dominated by *Banksia ornata*, *Leptospermum myrsinoides*, *Xanthorrhoea caespitosa*, *Allocasuarina mackliniana* ssp. *mackliniana, Baeckea behrii* and *Phyllota pleurandroides*.
3. *Banksia ornata* shrubland / *Eucalyptus arenacea* low open woodland OVER a diverse heath understorey dominated by *Banksia ornata*, *B.marginata*, *Leptospermum myrsinoides*, and *Xanthorrhoea caespitosa.*
4. *Xanthorrhoea caespitosa* shrubland OVER a sparse low shrub understorey and native and introduces grasses (especially *Ehrharta calycina*)

Plant communities associated with calcareous rises

5. *Eucalyptus fasciculosa* open woodland OVER a sparse tall shrub understorey dominated by *Dodonaea viscosa* ssp. *spathulata* and herbaceous, native and introduced grass ground cover on red loam with some surface limestone.
6. *Eucalyptus diversifolia* mallee OVER a sparse shrub layer dominated by *Allocasuarina muelleriana* ssp. *muelleriana, Acacia myrtifolia, Acrotriche cordata* on limestone outcrops.

Plant communities subject to seasonal waterlogging or inundation

***7. Melaleuca halmaturorum* tall shrubland** OVER a very sparse samphire spp. understorey**.**
***8. Melaleuca brevifolia* shrubland** OVER an open shrub and sedge understorey of *Darwinia micropetala*, *Gahnia filum*, *Leptocarpus brownii*, *Baumea juncea*.
9. Samphire low shrubland (areas of shallow standing water)
10. *Lepidosperma* aff. *laterale* sedgeland with emergent *Gahnia trifida* OVER *Baumea juncea*, *Leptocarpus brownii*. In some areas of the main basin of Stoneleigh HA, *Baumea juncea* is co-dominant or the dominant species in this community.
11. *Selleria radicans* herbland with other herbaceous understorey, occurring in the lowest lying areas of the basin of Stoneleigh Park HA.
12. *Wilsonia rotundifolia* herbland in an area of the watercourse within Bunbury CR.

Table 5. Plants of conservation significance recorded during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

COMMON NAME	SCIENTIFIC NAME	$^{+}$A	^{N}SA	^{L}SA	^{L}SE
*Spiked Sour-bush	*Choretum spicatum*	R	R		V
*Loose-panicle Bog-rush	*Schoenus laevigatus*			R	R
*Leafless Globe-pea	*Sphaerolobium minus*			R	R
Creeping Boobialla	*Myoporum parvifolium*			R	R
Clealand's Beard-heath	*Leucopogon clelandii*			R	
Three-petal Poranthera	*Poranthera triandra*				K
Medic Pennywort	*Hydrocotyle medicaginoides*				K
Grey Copper-wire Daisy	*Podolepis canescens*				R
Quandong	*Santalum acuminatum*				R
Bitter Quandong	*Santalum murrayanum*			U	U
Leafless Currant-bush	*Leptomeria aphylla*			U	U
Salt Lawrencia	*Lawrencia spicata*			U	U
Ruddy Beard-heath	*Leucopogon rufus*			U	U
Nodding Beard-heath	*Leucopogon woodsii*			U	U
Woolly Daisy-bush	*Olearia lanuginosa*			U	U
Short Purple-flag	*Patersonia fragilis*			U	U
*Slender Phyllota	*Phyllota remota*			U	U
Neat Spear-grass	*Stipa mundula*			U	U
Silky Wilsonia	*Wilsonia humilis* var. *humilis*			U	U
Bristly Bush-pea	*Pultenaea acerosa*				U
Long-hair Plume-grass	*Dichelachne crinita*				U
Hills Daisy	*Ixodia achillaeoides ssp alata*				U
Furze Hakea	*Hakea repullulans*				U

A=Australia; SA=South Australia; SE=South East region

+ Conservation significance according to the Schedules of the Commonwealth Endangered Species Act 1992.
^{L} Conservation significance after Lang and Kraehenbuehl (1998)
^{N} Conservation significance according to the Schedules of the SA National Parks & Wildlife Act 1972.
* Denotes those species not recorded during the present survey, but have been recorded previously in Bunbury CR and/or Stoneleigh Park HA.

Figure 6. BS0101. *Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland
Photo. H.Stewart

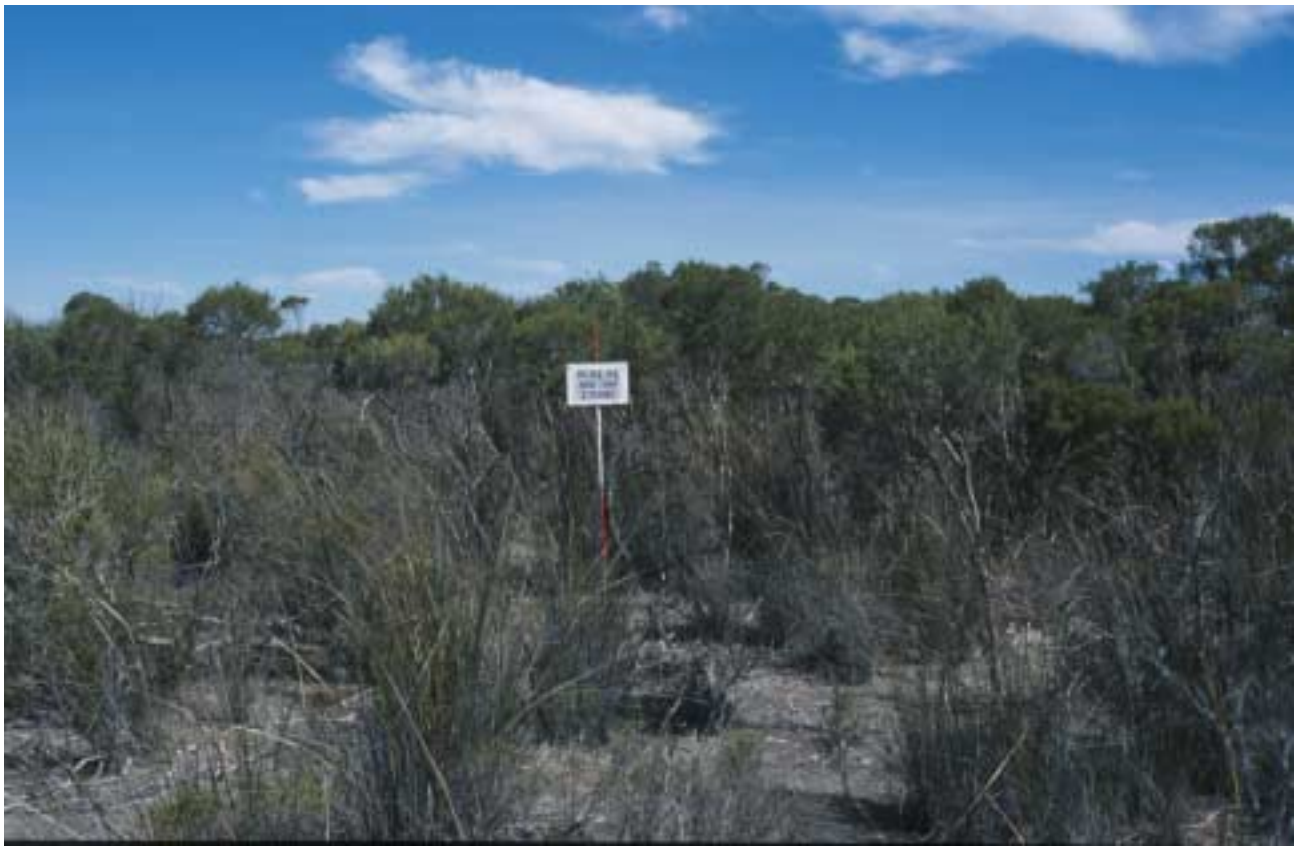


Figure 7. BS0201. *Melaleuca halmaturorum* tall shrubland.
Photo. H.Stewart

Figure 8
BS0301. *Eucalyptus incrassata* open mallee.
Photo. H.Stewart

Figure 9. BS0401. *Melaleuca halmaturorum* tall shrubland.
Photo. H.Stewart

Figure 10. BS0501. *Eucalyptus incrassata* open mallee.
Photo. H.Stewart

Figure 11. BS0601. *Melaleuca brevifolia* shrubland.
Photo. H.Stewart

Figure 12. BS0701. *Lepidosperma* aff. *laterale* sedgeland.
Photo. H.Stewart

Figure 13. BS0801. *Banksia ornata/Eucalyptus arenacea* low-open woodland.
Photo. H.Stewart

Figure 14. TS0901. *Eucalyptus arenacea* open woodland.
Photo. H.Stewart

Figure 15. BS1001. *Eucalyptus diversifolia* mallee.
Photo. H.Stewart

Figure 16. BS1101. *Banksia ornata* shrubland/*Eucalyptus arenacea* low-open woodland.
Photo. H.Stewart

Figure 17. B1201. *Lepidosperma* aff. *laterale* sedgeland.
Photo. H.Stewart

MAMMALS

Most of the previous biological research undertaken in the study area has concentrated on vegetation or avifauna. This survey represents the first systematic mammal trapping conducted in Bunbury CR and Stoneleigh Park HA.

A total of 15 species (five introduced) of mammal were recorded during the survey. Of these only three species, the Common Wombat, Silky Mouse and Little Pygmy Possum are of conservation significance. However, at least one other species of conservation significance, the Red-necked Wallaby, occurs in the study area, as well as several other bat species not recorded during the survey.

Although not recorded at any of the sampling sites during the survey, both the Common Wombat, and the Red-necked Wallaby have been recorded in mature vegetation in Stoneleigh Park HA during the past five years (Thompson 1997,. J.White, pers. comm). These species have therefore been included in the following report.

Species of Particular Interest

Vulnerable Species

Common Wombat (*Vombatus ursinus*)

The Common Wombat is a nocturnal burrowing herbivore distributed from the northern border of New South Wales, south along the temperate coast to Salt Creek in South Australia. Although, this species has been undergoing a reduction in distribution since the Pleistocene, European settlement has exacerbated this decrease (Mc Ilroy 1995). Presently, in the south east of South Australia the Common Wombat exists in isolated populations on the eastern sides of dunes where sufficient cover, and perennial native grasses and sedges exist (Mallet and Cook 1986, Croft and Carpenter 1996). Mallett and Cooke (1986) suggest, that this may be because the native perennial grasses that the Common Wombat feed on may be dependent on the existence of shallow ground water, allowing for fresh growth during summer.

Although the Common Wombat is considered to be **common** at the national level, it is listed as **vulnerable** in the National Parks and Wildlife Act 1972 in South Australia and in the South East (Kemper and Queale 1990, Croft and Carpenter 1996). The Common Wombat remains moderately conserved within the Reserve system being recorded from seven Conservation Parks (including Martin Washpool CP which represents the most north-western limit of its distribution), two National Parks, five PIRSA Forestry Reserves and at least one Heritage Agreement area in the South East in the last ten years (Results taken from the South Coast Biological Survey 1982-86, and the South East Biological Survey 1997).

Although no fresh evidence of their existence was recorded in either Bunbury CR or Stoneleigh Park HA, several old burrows and scats were recorded in the north eastern section of Stoneleigh Park HA. However, Wombats were recorded in the Biological Survey of Tilley Swamp in Martin Washpool CP (Stewart *et al.* 1998), and more recently, Thompson (1997) studied a population of Wombats in the mature vegetation surrounding Bonneys Camp South. Thompson (1997) also found no fresh evidence of Wombats or their activity in the north eastern corner of Stoneleigh Park HA.

Given the presence of old burrows in the north eastern corner of Stoneleigh Park, and the existence of a population around Bonneys Camp South, it may be only a matter of time before Wombats recolonise the burnt north eastern corner of Stoneleigh Park HA. This should be taken into consideration during drain construction.

Construction of a drain with dimensions 10 metres wide by one metre deep may act as a barrier to the re-colonisation of the north eastern corner of Stoneleigh Park HA by Wombats. Wombats may be further negatively impacted if the drain floods the sedgeland community of Bonneys Camp North as this will result in the death of this potential food source.

In addition, wombats have also been known to investigate and turnover disturbed soil. Drain design and maintenance will need to take into consideration the potential for the Common Wombat to dig/burrow any disturbed soil associated with drain construction.

Red-necked Wallaby (*Macropus rufogriseus*)

The Red-necked Wallaby has a wide distribution from southern Queensland through the temperate east coast of Australia to the south east of South Australia and Tasmania. At a national level this species is considered to be **common** with a distribution that has remained largely unchanged since European settlement (Calaby 1995). However, this is not the case in the South East, as the distribution of this species has markedly declined since European settlement and now only exists in the larger remnants of native vegetation left uncleared for agriculture (Aitken 1983, Best and Croft 1995). At a state level, and in the South East *M.rufogriseus* is considered to be **rare** (NPW Act 1972, Kemper and Queale 1990, Croft and Carpenter 1996). Populations of the Red-necked Wallaby have been recorded from Fairview, Martin Washpool, Bangham and Big Heath Conservation Parks, at Kingston, in the "Deepwater" property, and at Deep Swamp (Owens *et al.* 1995a, Stewart 1996, Stewart *et al.* 1998). The population in Martins Washpool and in the

'Deepwater' water property are particularly interesting, as they exist on the most western part of their distribution.

Although not recorded at either Bunbury CR or the north eastern corner of Stoneleigh Park HA, a Red-necked Wallaby was recorded opportunistically during the survey in the pasture on the southern boundary of Messent CP. Red-necked Wallabies have also been frequently recorded in the mature vegetation around Bonneys Camp South (J.White, pers. comm).

As for the Wombat, it is probably only a matter of time until the Red-necked Wallaby recolonises the burnt area. The proposed drain may inhibit the dispersal of wallabies to the northern side of the drain.

Uncommon Species

Little Pygmy-possum (*Cercartetus lepidus*)

The Little Pygmy-possum is a small nocturnal inhabitant of open heath, open scrub and low woodland with a dense understorey. This species has a wide but disjunct distribution including Tasmania, Kangaroo Island and in a small area in the south east of South Australia. *C.lepidus* has been recorded from a number of Conservation Parks in the South East, including Messent, Gum Lagoon, Martin Washpool, Ngarkat, Fairview, Big Heath and Mt Scott (South Australian Biodiversity Database, and records of the South Australian Museum). Although this species is considered to be nationally **common**, the Little Pygmy-possum is considered to be **uncommon** (Watts 1990) or **rare** in the South East (Croft and Carpenter 1996).

C.lepidus were recorded from six sites including both Bunbury CR, and Stoneleigh Park HA (Appendix II). This species was recorded from *Banksia ornata* shrubland, *Eucalyptus arenacea* open woodland, *E.incrassata* open mallee, and *E.diversifolia* mallee. All of these communities except for the *E.arenacea* open woodland occur on the ridges of sand dunes and should therefore not be affected by the drain. However, the *E.arenacea* open woodland at site BS09 is on the proposed drainage route in Stoneleigh Park HA. Construction of this drain will require the clearance of some of this habitat, and will therefore negatively impact this species. Construction of the drain will also separate the population of Little Pygmy Possums occurring on the north side of the proposed drain from the population occurring on the south.

Silky Mouse (*Pseudomys apodemoides*)

The Silky-Mouse is an inhabitant of the dry mallee heathlands of north western Victoria, and eastern South Australia (Cockburn 1981). The presence of this species is usually conspicuous because of the large spoil heaps created during burrow construction. This species has been recorded from a number of Conservation Parks including Messent, Gum Lagoon, Ngarkat, Mt Scott and Fairview (South Australian Biodiversity Database and records from the South Australian Museum). A solitary pregnant *P.apodemoides* was captured in *E.arenacea* low open woodland at the south western corner of Stoneleigh Park HA during the Biological Survey of Tilley Swamp.

The Silky Mice is considered to be **uncommon** in the South East (Watts 1990). Silky Mice were captured in both Bunbury CR, and Stoneleigh Park HA in *Banksia ornata* shrubland, *Eucalyptus incrassata* open mallee, and on the Bonneys Camp North wetlands in *Lepidosperma* aff. *laterale* sedgeland.

Construction of a drain through Stoneleigh Park HA will separate the population of Silky Mice, causing the isolation of the inhabitants to the north of the proposed drain. Captures of two pregnant female Silky Mice suggests that this primarily granivorous species may be supplementing their diet with seed heads of sedges or their bulbs. Construction of a drain through the Bonneys Camp North wetland will therefore negatively impact on this species, particularly if the drain is allowed to overflow and fill the basin for long periods of time.

Other Species Captured During the Survey

Several other native mammal species were captured or observed during the survey. These included the Short-beaked Echidna (*Tachyglossus aculeatus*), Western Grey Kangaroo (*Macropus fuliginosus*), Western Pygmy-possum (*Cercartetus concinnus*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Gould's Wattled Bat (*Chalinalobus gouldii*), Large Forest Eptesicus (*Vespadelus darlingtoni*) and either[1] the King River Eptesicus (*Vespadelus regulus*) or the Little Forest Eptesicus (*Vespadelus vulturnus*). All of these species are classified as **common** in the NPW Act, 1972, as well as at the state level and in the South East (Kemper and Queale 1990, Croft and Carpenter 1996).

In addition to the above, five species of introduced mammals were recorded during the survey. These include the Red Fox (*Vulpes vulpes*), Fallow Deer (*Cervus dama*), Rabbit (*Oryctolagus cuninculus*), Hare (*Lepus capensis*) and House Mouse (*Mus domesticus*).

Construction of a drain through the study area may also negatively impact on the native small mammal fauna by providing improved access for introduced predators to hunt them (May and Norton 1996).

[1] Most of the bat species recorded were identified by recordings of their calls. Due to the poor quality of the recordings, the calls of *V.vulturnus*/*V.regulus* were not able to be confidently separated (pers. comm T.Reardon).

BIRDS

The avifauna of the Bunbury district has received attention since the early 1930s when Salt Creek formed the focus of ornithological surveys "8.3 miles eastwards" to the "Freshwater Lakes" (Messent - Bonneys Camp area) (Hanks 1930, Sutton 1930, 1933). Birds were listed within the study area as part of the Royal Australasian Ornithological Union's bird atlas from 1977 to 1981. G.Carpenter recorded birds as part of the native vegetation assessment of a Heritage Agreement over Bonneys Camp on 22-23/5/86. Harper and Weinert (1992), de Jong (1994) and J. White (pers. comm.) provided lists of birds seen at Bonneys Camp wetlands following the diversion of water there in the early 1990s.

A total of 87 species (3 introduced) have been recorded in the study area, of which 69 were recorded from the twelve survey sites (Appendix III). Although too few sites were surveyed to analyse habitat use using PATN analysis, in general, the eucalypt low woodland and open mallee vegetation types supported more species than sites with sedgelands and *Melaleuca* shrublands. The highest number of bird species (36) was recorded at BS09 in a regenerating *Eucalyptus arenacea - E.fasciculosa* low woodland site in the Stoneleigh Park HA.

Fourteen species of conservation significance in South Australia were recorded in the survey area (Table 5). They include one nationally **vulnerable** species, two species considered **vulnerable** in South Australia and two of **rare** or **indeterminate** conservation status in South Australia. A further eleven have conservation significance in the South East only, one being **vulnerable** and the remainder **uncommon**. Conservation ratings follow the Schedules of the Commonwealth Endangered Species Act 1992, the Schedules of the SA National Parks and Wildlife Act 1972 and Carpenter and Reid (1988).

Species of Conservation Significance Recorded During the Present Survey

Vulnerable species

Malleefowl (*Leipoa ocellata*)

The Malleefowl is sparsely but widely distributed in mallee and adjacent low woodlands across southern Australia. Its distribution has declined extensively due to introduced predators, land clearance for agriculture and introduced grazing animals (Blakers *et al.* 1984).

Malleefowl occur in small numbers within the study area, being observed in *Eucalyptus incrassata* open scrub at BS03 and BS05 and in nearby habitats (including *Melaleuca halmaturorum*) in Bunbury CR. No evidence of Malleefowl was recorded in the north eastern corner of the Stoneleigh Park HA, which is not surprising given that all of the study area is recovering from a fire in January 1995. Malleefowl would be expected to colonise the burnt area when enough leaf litter has accumulated to allow nest building (>10 years, pers. obs.), because J.White (unpub. data) and de Jong (1994) have reported Malleefowl in unburnt vegetation immediately to the south.

As Malleefowl are known to forage over a range of habitats, including lower-lying areas of *Melaleuca halmaturorum* open scrub-shrubland in the South-East (Possingham 1983, Stewart 1996, Stewart *et al.* 1998), they may be affected by the clearance associated with the construction of a drain and any subsequent indirect effects on native vegetation in Bunbury CR.

Blue-winged Parrot (*Neophema chrysostoma*)

The Blue-winged Parrot is a mobile and poorly known species which breeds in a limited area of south-eastern Australia and disperses widely into the inland during autumn-winter (Blakers *et al.* 1984). In South Australia it breeds in stringybark forests in the South East north to about Naracoorte. In winter it disperses widely as far as the north-east of the State, with concentrations in the saltmarshes and dunes along the South East and Coorong coast.

The species probably does not breed in the study area, occurring only as a post-breeding visitor in small numbers. Little is known of their habitat requirements in the study area because birds seen at survey sites were flying over only. However, a flock of about 10 was observed on the southern boundary of Bunbury CR feeding on the ground in samphire (*Sarcocornia* spp.) under *Melaleuca halmaturorum* and flushed from adjacent thick patches of *Banksia ornata*.

Given the small numbers of birds which occur in the study area, it is unlikely that the proposed drain would have a significant impact on this species.

Painted Button-quail (*Turnix varia*)

The Painted Button-quail is a sparsely but widely distributed mobile species which occupies a range of eucalypt associations across southern Australia, wherever leaf litter is prominent. It has declined generally due to clearance and grazing of woodland habitats (Blakers *et al.* 1984).

Although secretive, this species' presence is revealed by numerous circular clearings of 10-15 cm diameter in the leaf litter, usually exposing bare ground. Painted Button-quail were recorded in *Eucalyptus incrassata* open mallee in Bunbury CR (BS0301 and BS0501), and in *Banksia*

ornata shrubland/*Eucalyptus arenacea* low open woodland (BS0801) recovering from a recent fire in the north eastern corner of the Stoneleigh Park HA. One juvenile was observed in Bunbury CR at BS05 and four were caught in a pitfall trap at BS08 in the Stoneleigh Park HA, indicating that the survey area provides good quality breeding habitat. This species was also recorded by Stewart *et al.* (1998) in Martin Washpool CP.

The proposed drain may impact on this species if the disturbance it causes encourages more ground dwelling predators (cats, foxes) into relatively undisturbed areas of native vegetation (eg. May and Norton 1996).

Indeterminate Species

Elegant Parrot (*Neophema elegans*)

Like the Blue-winged Parrot, the Elegant Parrot is a poorly known mobile species which is distributed in southern and western Australia. In South Australia it occurs mostly in woodlands and low open forests, dispersing into coastal and inland habitats during winter. In the field it is easily confused with the Blue-winged Parrot, especially when not seen clearly (eg. flying overhead).

During the survey adult and immature Elegant Parrots were identified in *Eucalyptus arenacea* low woodland with a semi-cleared understorey at BS09 in the Stoneleigh Park HA, and opportunistically in adjacent farmland along the southern boundary of Bunbury CR. Given that Sutton (1930) reported a nest with young in a eucalypt hollow "8 miles east of Salt Creek" attributed to this species, it is possible that small numbers of Elegant Parrots may breed in low woodlands in the survey area.

Further assessment may be required to determine whether this species breeds in the study area (eg. in *E. fasciculosa* and *E. arenacea* low woodlands), and if so, what impacts the drainage works would have on breeding habitat.

Rare Species

Southern Emu-wren (*Stipiturus malachurus*)

The Southern Emu-wren is a small secretive species with poor dispersive powers (T.Littley, pers. comm) which has declined in many areas due to drainage, clearance of habitat and introduced predators. It is widely distributed in wet heaths throughout southern Australia.

During the survey the Southern Emu-wren was recorded from five sites (BS02, BS03, BS06, BS08 and BS11), especially where dense patches of *Melaleuca brevifolia* or *Xanthorrhoea caespitosa* were present. It was also reported widely at the burnt sites in the Stoneleigh Park HA where mallee and *Xanthorrhoea* regrowth provided adequate cover.

Clearance of these habitats by drain construction would adversely affect this species. Current research also suggests that the Southern Emu-wren rarely ventures far from cover, with ten metres being the furthest dispersal recorded across cleared land (T.Littley pers. comm.). Construction of a ten metre wide drain across the Stoneleigh Park HA would require at least 30 metres of vegetation to be cleared. This would therefore create a barrier to the species' dispersal, thus isolating the population north of the drain.

Species of conservation significance likely to occur in or adjacent to the study area

Vulnerable species in South Australia

Latham's Snipe (*Gallinago hardwickii*)

Latham's Snipe is a non-breeding summer (October - February) visitor to Australia mostly from Japan. This species frequents ephemeral and permanent freshwater swamps with dense sedges and adjacent shelter, especially red gum and tea-tree swamps in the South East, River Murray and Murray Lakes. Areas of flooded grasses and samphire adjacent the Murray Lakes occasionally support large numbers. In South Australia numbers have declined, probably due to clearance and drainage of wetlands (Naardang 1983), and historically because of hunting.

Latham's Snipe have been recorded in several of the Watervalley Wetlands including Mandina Marshes and Jip Jip and was also recorded opportunistically in a wetland during the Tilley Swamp Biological Survey (Harper and Weinert 1992, Stewart *et al.* 1998).

The study area would provide habitat for small numbers in late spring-early summer when wetlands contain water, especially areas of flooded *Baumea juncea - Lepidosperma spp*. sedgelands and *Melaleuca brevifolia* open heath where dense cover is available.

Latham's Snipe would be adversely affected by any loss of freshwater habitats in the study area. Conversely, if the drains retain fresh water in the study area into the summer months, habitat may improve for this species.

Painted Snipe (*Rostratula benghalensis*)

The Painted Snipe is a rarely reported mobile species in South Australia. Although not recorded during the present survey, R. Jaensch and others observed this species nesting in flooded *Melaleuca halmaturorum* open shrubland in Tilley Swamp during December 1981.

If the drains retain fresh water in the study area into the summer months, habitat may improve for this species

Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*)

This large distinctive cockatoo occurs as a non-breeding mostly winter visitor to the study area, where it feeds primarily on the flowers (and seeds) of *Banksia ornata* and possibly *B. marginata*, as well as the seeds of *Pinus* spp. in adjacent agricultural land. The species is threatened in many areas due to the lack of suitable

breeding habitat, large, hollow bearing eucalypts with feeding areas nearby.

Although not recorded during the survey, a flock of 20 was observed in *E. fasciculosa* low woodland at Bonneys Camp immediately south of the study area on 22-23 May 1986.

The species is unlikely to be affected by the proposed drain.

Slender-billed Thornbill (*Acanthiza iredalei hedleyi*)

The subspecies *A. i. hedleyi* "Dark Thornbill" is sparsely distributed in low heath habitats in the southern Murray Mallee and has recently been recorded in the South East as far south as Naracoorte where it occurs in low *Melaleuca brevifolia* and *Darwinia micropetala* open heaths (Possingham 1983, Parker 1985). Parker (1985) suggested that the low heaths they inhabit may have been colonised following extensive drainage of more permanent wetlands in the region.

Slender-billed Thornbills are likely to occur in the study area because they have been observed on the margins of the *Lepidosperma* spp. - *Baumea* sp. flats nearby at Messent Conservation Park (Matthew 1994, Owens *et al*. 1995a, H. Stewart, pers. obs.), Gum Lagoon Conservation Park (Possingham 1983) and Deep Swamp (Stewart *et al.* 1997).

The species may be affected by the proposed drain if vegetation at the margins of the *Lepidosperma-Baumea* sedgelands is damaged.

Freckled Duck (*Stictonetta naevosa*)

The Freckled Duck is a nomadic and irruptive species which occasionally congregates in large numbers in the South East following periods of inland drought (Parker *et al.* 1985). Harper & Weinert (1992) reported 400 birds in the Bonneys Camp wetlands.

Retention of fresh water into the summer months would improve the habitat for this species in the survey area.

Beautiful Firetail (*Emblema bellum*)

This finch inhabits coastal and subcoastal scrubs and low open forests throughout south-eastern Australia and has declined due to clearance and introduced predators. It feeds mostly on the seeds of a variety of native plants, especially sedges (Read 1994), and was recorded widely in areas of *Melaleuca brevifolia* open heaths and adjacent *M. halmaturorum* shrublands in the Tilley Swamp watercourse (Stewart *et al.* 1998). It has also been recorded at Bonneys Camp (J. White pers. comm.).

Clearance of *Melaleuca halmaturorum* and *M.brevifolia* shrublands during construction of the drain would adversely affect this species.

Blue-billed Duck (*Oxyura australis*)

The Blue-billed Duck is a poorly known species which in South Australia occurs mainly in the South East. It breeds in deeper waters with dense cover, especially tea-tree and *Gahnia* swamps (Parker *et al.* 1985). de Jong (1994) reported the species in the Bonneys Camp South wetlands. Retention of fresh water into the summer months would improve the habitat for this species in the survey area.

Australasian (Blue-winged) Shoveler (*Anas rhynchotis*)

This duck occurs throughout wetlands in south-eastern Australia and has declined generally with the drainage of swamps and lack of suitable flooding events to trigger breeding. Relatively large numbers may occur in the study area during floods, with areas of temporarily flooded *Melaleuca brevifolia* shrubland providing suitable breeding habitat.

Harper & Weinert (1992) reported 300 birds in the Bonneys Camp wetlands. Small numbers were recorded at a freshwater wetland in the Tilley Swamp watercourse in December 1996 (Stewart *et al.* 1998).

Retention of fresh water into the summer months would improve the habitat for this species in the survey area.

Glossy Ibis (*Plegadis falcinellus*)

The Glossy Ibis is a wide-ranging inhabitant of open freshwater swamps with shallow margins. In South Australia its breeding strongholds are in the South East, in a variety of native habitats (eucalypts, tea-tree, lignum, reeds) after flooding.

The Bonneys Camp wetlands are likely to provide suitable habitat for this species when fresh water is present. Retention of fresh water into the summer months would improve the habitat for this species in the survey area.

Baillon's Crake (*Porzana pusilla*)

Baillon's Crake is a spring-summer breeding visitor to South Australia where it favours freshwater swamps with floating aquatic plants, especially *Triglochin procerum*, *Vallisneria* spp, *Potomageton* spp, and *Baumea* spp.

The Bonneys Camp wetlands are likely to provide suitable habitat for this species when fresh water is present. Retention of fresh water into the summer months would improve the habitat for this species in the survey area.

Shining Bronze Cuckoo (*Chrysococcyx lucidus*)

The Shining Bronze Cuckoo is an elusive species generally confined to the canopy of open forests. Two adults were recorded in *Allocasuarina verticillata* low woodlands by Stewart *et al.* (1998). Although the Shining Bronze-cuckoo has been recorded breeding near Salt Creek (Sutton 1933), the survey area would not be considered to provide an important breeding habitat, but may be important during migration.

The species is unlikely to be affected by the proposed drain.

Rose Robin (*Petroica rosea*)

Rose Robins breed in the wetter forests of south-eastern Australia and disperse into drier woodland and open forest habitats during winter. In South Australia it occurs as a rare non-breeding visitor, mostly to the southern Mount Lofty Ranges. One individual was recorded at Martin Washpool Conservation Park in July 1981 (May 1981), possibly on migration.

The species is unlikely to be affected by the proposed drain.

Other species of interest

Grey-crowned Babbler (*Pomatostomus temporalis*)

Sutton (1930, 1933) recorded this species in sheoak woodlands during visits to Salt Creek in October of 1929 and 1932, including two nests on the latter visit. Now **endangered** and virtually extinct in South Australia, the Grey-crowned Babbler has not been recorded in the district for many years.

White-winged Chough (*Corcorax melanorhamphos*)

Sutton (1933) recorded a flock of White-winged Choughs near a lake inland from Salt Creek, and Condon in Sutton (1936) reported a group of White-winged Choughs "near Tilley Swamp" on 22 September 1935. This **vulnerable** species is unlikely to still occur in the district.

Purple-gaped Honeyeater (*Lichenostomus cratitius*)

The Purple-gaped Honeyeater is an **uncommon** species which occurs in a variety of mallee-heath habitats. The study area is close to its southern limit of distribution in South Australia.

In the study area it was reported in small numbers from sites with *Eucalyptus incrassata* or *E. diversifolia* at BS03, BS08 and BS10.

Brown / Inland Thornbills (*Acanthiza pusilla* / *A. apicalis*)

Although not considered of conservation significance, these two closely related taxa are of scientific interest because they overlap and probably interbreed in the study area, rendering accurate identification difficult (Boles 1983). For the purposes of this study all records are attributed to *A. apicalis*. However, a morphological and genetic study of specimens from the area is required.

Table 6. Birds of conservation significance recorded during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

COMMON NAME	SCIENTIFIC NAME	+A	*SA	#SA	*SE
Malleefowl	*Leipoa ocellata*	V	V	E	V
Blue-winged Parrot	*Neophema chrysostoma*		V	V	V
Painted Button-quail	*Turnix varia*		V	V	V
Elegant Parrot	*Neophema elegans*		K	K	K
Southern Emu-wren	*Stipiturus malachurus*		R	V	R
Purple-gaped Honeyeater	*Lichenostomus cratitius*		U		R
Brush Bronzewing	*Phaps elegans*		U		U
Eastern Yellow Robin	*Eopsaltria australis*		U		U
Grey Currawong	*Strepera versicolor*		U		U
Mallee Ringneck	*Barnardius barnardi*		U		U
Shy Heathwren	*Sericornis cautus*		U	V	U
Yellow-rumped Pardalote	*Pardalotus xanthopygus*		U	V	U
Southern Scrub-robin	*Drymodes brunneopygia*		U		U
Tawny-crowned Honeyeater	*Phylidonyris melanops*		U		U
Crested Bellbird	*Oreioca gutturalis*		C		V
Collared Sparrowhawk	*Accipiter cirrhocephalus*		C		U
Grey Butcherbird	*Cracticus torquatus*		C		U
Jacky Winter	*Microeca leucophaea*		C		U
Variegated Fairy-wren	*Malurus lamberti*		C		U
Golden Whistler	*Pachycephala pectoralis*		C		U
Rufous Whistler	*Pachycephala rufiventris*		C		U
Hooded Robin	*Melanodryas cucullata*		C		U
White-browed Babbler	*Pomatostomus superciliosus*		C		U
Weebill	*Smicrornis brevirostris*		C		U
White-browed Scrubwren	*Sericornis frontalis*		C		U

A=Australia; SA=South Australia; SE=South East region

+ Conservation significance according to the Schedules of the Commonwealth Endangered Species Act 1992.
* Conservation significance after Carpenter & Reid (1988)
# Conservation significance according to the Schedules of the SA National Parks & Wildlife Act 1972.

REPTILES AND AMPHIBIANS

A total of 16 species of reptile and three species of amphibian were recorded from the survey region (Appendix IV). 14 of these species were recorded from survey sites within Bunbury CR and Stoneleigh Park HA. An additional four species were recorded from opportunistic observations only.

Seven species were common to both survey areas, four were found only in Bunbury CR and three were found only in Stoneleigh Park HA. The variation of species between survey areas can be partially attributed to the variation in weather conditions during the trapping period (Appendix V). Warmer weather experienced during trapping at Bunbury CR lead to several Eastern Tiger Snake (*Notechis scutatus*) sightings and the rain experienced during trapping at Stoneleigh Park HA resulted in numerous captures of two common amphibian species, the Eastern Banjo Frog (*Limnodynastes dummerili*) and Burrowing Frog (*Neobatrachus pictus*, and a single capture of the Brown Froglet (*Crinia signifera*).

All sites recorded at least one species of reptile, and amphibians were recorded at all six of the sites in the north eastern corner of Stoneleigh Park HA following rain. Woodland and heath habitats recorded the highest number of species. Habitats with little ground cover such as the *Melaleuca sp*. sites and the *Lepidosperma* aff. *laterale* sites recorded the lowest species richness.

Little information was available on the herpetofauna of the study area prior to this survey. However biological surveys of Messent Conservation Park (Owens *et al*. 1995a) to the north, Gum Lagoon Conservation Park (Davies in prep) to the south and the Tilley Swamp area (Stewart *et al.* 1988) to the west have provided a comprehensive inventory of herpetofauna in the region. Several museum records have also added to this information. Species known from the region that were not recorded during this survey include:

Eastern Bearded Dragon (*Pogona barbata*)- likely to be in the survey area although it may not be common as it overlaps here with the Central Bearded Dragon (*P.vitticeps*);

Master's Snake (*Drysdalia masteri*) - likely to be in the survey area but is often overlooked due to its secretive habits;

Heath Goanna (*Varanus rosenburgi*) - records from the region are sparse but a single individual was captured nearby at Messent Conservation Park as recently as 1994 (Owens *et al*. 1995a);

Five-lined earless Dragon (*Tympanocryptus lineata*)- very few records from the region however the species was recorded at two sites (*Banksia ornata* shrubland) in Messent Conservation Park in 1994 (Owens *et al.* 1995a);

Brown Toadlet (*Pseudophryne bibroni*) -several records to the south of the study region;

Spotted Grass Frog (*Limnodynastes tasmaniensis*) - although the species is considered to occur throughout the region there have been few records despite several surveys.

Although none of the species recorded during this survey are considered to be of conservation significance (Hutchinson 1992, 1993) two of the species considered likely to occur in the area are potentially under threat (Hutchinson 1993). *Varanus rosenburgi* and *Pseudophryne bibroni* are both known to occur over a significant area, however, it is thought that some populations have been reduced or become locally extinct since European settlement which may explain the lack of records for these and other unconfirmed species from the region.

Conclusions and Recommendations

Study Limitations

The Biological Survey of Bunbury CR and Stoneleigh Park HA was undertaken between the 1 - 9 of December, 1997. Although some previous biological research had been undertaken in both areas, this survey represents the first systematic study of their biota. At the time of the survey, some of the vegetation communities of Bunbury CR and the north-eastern corner of Stoneleigh Park HA were in transition. As previously recognised, much of the low lying vegetation communities (eg. *Melaleuca halmaturorum*, and *M.brevifolia* shrublands) of the Bunbury-Taunta area have been degrading over a number of years due to the problems of dryland salinity caused by rises in the saline water table (Webb 1993, Nicholson 1993, Mensforth 1996). In severe cases this has resulted in the localised death of patches of *M.halmaturorum*, as well as the general deterioration of health of other patches of *M.halmaturorum* and a decrease in the species diversity of these communities (Webb 1993, Mensforth 1996, this report).

Similarly, the north-eastern corner of Stoneleigh Park is regenerating after a wild fire which burnt all of the study area in January 1995. The current Biological Survey of Bunbury CR and Stoneleigh Park HA has therefore documented the biota of these areas during transitional phases, and does not therefore conclusively represent all of the biota that may use the area. This is an important consideration, given that many native species are sensitive to successional changes in their habitat (Specht 1981, Fox 1982, 1990). Further research may be required to determine whether more species use these areas as the habitat matures, as this information will be important when considering the potential biological impacts of drain construction and maintenance.

In addition, a ten day survey can not hope to detect those species that only use the study area seasonally, or were dormant during the study period. However, some of this bias has been offset by including the results of other biological research conducted in the area.

Biological Importance of Bunbury CR and Stoneleigh Park HA

During this survey, a total of 49 taxa (25 bird species, 21 plant species and three mammal species) of conservation significance at either the national, state or regional level were recorded. In addition a further 11 taxa (five plant species, five bird species, and one mammal species) of conservation significance at either the national, state or regional level have been previously recorded in the study area.

Stoneleigh Park HA supported a greater number of bird (65 vs. 46) and mammal (10 vs 8) species, but fewer plant species (114 vs 182) than Bunbury CR. However, 10 species of reptiles were recorded from both areas. Similarly, the number of species of conservation significance known (including data from other sources) from Stoneleigh Park HA is greater than that known from Bunbury CR for birds (10 spp. vs 6 spp.) and mammals (4 spp. vs 2 spp), but not for plants (12 spp. vs 12 spp.). No reptiles of conservation significance were recorded during the survey, or have been recorded in either of the two areas previously.

However, the vegetation communities of both Bunbury CR and Stoneleigh Park HA complement each other. Collectively, these areas contain resident populations of the nationally **vulnerable** Malleefowl, as well as the Painted Button-quail, Southern Emu-wren, Common Wombat and Red-necked Wallaby. In addition they provide seasonal habitat for the Blue-winged Parrot, Elegant Parrot, and when the Bonneys Camp wetlands fill the study area supports several species of waterfowl of conservation significance including Latham's Snipe, Freckled Duck, Musk Duck, Blue-billed Duck and the Australasian Shoveler (Harper and Weinert 1993, de Jong 1994, J. White unpub. data).

The study area also supports 26 plant species of conservation significance the most important being the Spiked Sour Bush, Loose-panicle Bog-rush and the Leafless Globe-pea, all of which were previously recorded in the study area. The most important plant species recorded during this survey were the Creeping boobialla, Cleland's Beard-heath and the Grey-copper wire daisy.

Bunbury CR and Stoneleigh Park HA are also very important regionally because of their large size, generally intact nature and position in the landscape. Collectively Bunbury CR and Stoneleigh Park HA conserve 8441 hectares of relatively undisturbed natural vegetation. This improves the long-term viability of most of the resident bird, mammal and plant species. These areas are also scientifically interesting because they exist on the boundary of the 'Bassian' and 'Eyrean' zoogeographic provinces where many 'Bassian' (species that inhabit the eastern seaboard) species reach the western edge of their distribution (eg. Common Wombat and Red-necked Wallaby) (Twidale and Tyler 1983). Further, this area characterises the transition between mallee and wetter

heaths and woodlands and thus supports species pairs of scientific interest (eg. Brown and Inland Thornbills *Acanthiza pusilla* and *A.apicalis*, Superb and Variegated Fairy-wrens *Malurus cyaneus* and *M. lamberti*), and also provides a link between the wetter forested habitats of the South East and the Mount Lofty Ranges.

Drainage Options and their Potential Affect on the Flora and Fauna of Bunbury CR and Stoneleigh Park HA

The construction of a drain through native vegetation negatively affects local flora and fauna in several ways. These include destruction of habitat through clearance, modification of habitat through changes to local hydrology (either through drying out or flooding of habitat and/or food supply) and providing linear corridors for the introduction of weeds and feral pests. In addition, the drain may act as a physical barrier impeding the dispersal of some flora and fauna. Therefore, the flora and fauna of Bunbury CR and Stoneleigh Park HA potentially most threatened by the proposed drainage options are those species

- existing on or using areas subject to clearance for drain construction;
- existing on or using the *Melaleuca halmaturorum* flats of Bunbury CR, and Bonneys Camp North wetlands in Stoneleigh Park HA which are sensitive to changes in hydrology;
- species with poor dispersive powers;
- fauna prone to predation by exotic species (eg. small ground dwelling mammals and birds);
- flora cleared for drain construction and prone to competition with introduced weeds, and potentially soil borne fungus (eg. *Phytopthora sp.)*

The degree to which each species is affected will depend on drain design, location and the ensuing water flow regime.

Several alternative drainage options have been proposed for Bunbury CR, and Stoneleigh Park HA as described in the "Introduction". The following section details how the proposed drainage options may affect resident flora and fauna.

Proposed drainage options for Bunbury CR.

At least three options to manage surface water in Bunbury CR have been proposed these include :

- Option 1: Construction of a surface water drain nominally 1.5 metre deep, and 11 metres wide traversing the northern boundary of the Reserve for 6.5 km (USEDSFMP 1993).

- Option 2: Construction of a drain 0.5 metres deep, 4-6 metres wide (but requiring 20 metres initial clearance for access) and 6.5 km long positioned in the middle of the major wetland as depicted in Figure 2.

- Option 3: Clearance of a flow path using a hydroaxe, therefore not requiring major soil disturbance, or heavy earth moving machinery.

Option 1

As the exact pathway was not described in the UPSEDSFMP (1993), it is difficult to determine exactly what biological implications exist. However, this option would require 7.2 hectares of land to be dug up and a similar area disturbed during construction.

Option 2

This option proposes to locate the drain through the salt flats of the central eastern section of the Reserve, then on through the major watercourse that connects these pans to the west (Figs 2, 4 and 6). As approximately half the drain is positioned on the major watercourse, this option would result in the clearance of approximately 7-8 hectares of the watercourse containing *Melaleuca halmaturorum* tall shrubland, *M.brevifolia* shrubland and some Samphire communities (Fig. 4). This drain would be expected to regularly spill over into the adjoining vegetation.

Although these plant communities are not considered to be of conservation significance, at least three species of plant may be directly and/or indirectly affected. These include Loose-panicle Bog-rush (nationally **rare**), Cleland's Beard-heath (**rare** in SA), Three-petal Poranthera (**K** - considered to be at least **rare** in the SE) and Salt Lawrencia (**uncommon** in SA and SE) (Lang and Kraehenbuehl 1998). Although a specific location for the Bog-rush is currently not known, being a sedge species it would be associated with the watercourse, and as such, individuals might be cleared during construction of the drain, and may also be affected if local hydrology is disturbed. Both the Three-petal Poranthera and Clealand's Beard-heath were located on the edge of a *Melaleuca brevifolia* shrubland. These species may be affected if the local hydrology regime is changed. Salt Lawrencia was located in *Melaleuca halmaturorum* shrubland at BS0201. As the proposed drain route passes through this area, individuals of this species would be killed during construction. However, the population of this species is not expected to be threatened in the Reserve.

As this drain is expected to only carry water through winter it is not expected to severely impede the movement of any small mammals or birds. However, a Malleefowl (nationally **vulnerable**) was recorded opportunistically in *Melaleuca halmaturorum* tall shrubland during this and other surveys, and therefore it may be affected by the clearance of this vegetation type (Possingham 1983, Stewart 1996, Stewart *et al*. 1998). Similarly, clearance of any *Melaleuca brevifolia* shrubland in Bunbury CR, may negatively impact on the population of Southern Emu-wrens (**rare** in SA and SE) through clearance of its preferred habitat type (Carpenter and Reid 1988).

Conversely, if the salinity levels of the surface water are not too great, regular flooding of the main watercourse may in fact favour some native species, and potentially provide breeding habitat for some waterfowl of conservation significance.

In addition, the creation of a clearing may indirectly negatively impact the ground dwelling fauna if the drain allows greater access to introduced predators (ie. May and Norton 1995). This would potentially affect the Painted Button-quail (**vulnerable** in SA and SE), and Southern Emu-wren as well as the Little Pygmy Possum (**rare** in SE) and Silky Mouse (**uncommon** in SE).

Option 3

The biological implications of instituting Option 3 are essentially the same as those for Option 2 and will not therefore be re-iterated. However, regular maintenance by re-hydroaxing the clearing would be required.

Proposed drainage option for the north eastern corner of Stoneleigh Park HA

The proposed drainage route for Stoneleigh Park HA generally follows the lowest ground from the eastern boundary of the Heritage Agreement (approximately 2 km south of the north eastern corner of the block) west through the native vegetation and the middle of the Bonneys Camp North wetlands (Fig. 2). The proposed drain may be up to one metre deep and approximately ten metres wide, traversing the native vegetation for a distance of 4.2 kilometres.

This will result in the clearance of about 12.6 hectares of native vegetation of which approximately half is terrestrial vegetation (including *Xanthorrhoea caespitosa* shrubland, *Eucalyptus arenacea* open woodland and *Banksia ornata* shrubland) and the other half being *Lepidosperma* aff. *laterale* sedgeland existing on the Bonneys Camp North wetland.

As this drain is expected to carry more saline water and flow for the whole year the biological implications for this drain are greater than those for Bunbury CR. This is particularly true considering that Stoneleigh Park HA generally has a higher species diversity and number of species of conservation significance recorded (except for plants).

Construction of a one metre deep, ten metre wide drain would require the initial clearance of vegetation of up to 30 metres wide (12.6 ha). This would result in part clearance of the *Eucalyptus arenacea* open woodland BS0901 which supported the highest diversity of bird species recorded during the survey including the Elegant Parrot (**K** -considered at least **rare** in SA and SE) and six bird species considered **uncommon** in the South East (eg. Grey Butcherbird, Grey Currawong, Jacky Winter, Golden Whistler, White-browed Scrubwren, and the Southern Scrub-robin) (Carpenter and Reid 1988, Lang and Kraehenbuehl 1998). In addition, the regionally **rare** Grey Copper-wire Daisy and the Little Pygmy Possum were also recorded at this site (Carpenter and Reid 1988, Lang and Kraehenbuehl 1998).

Also recorded on the drainage route were populations of the Creeping Boobialla (rated **rare** in SA and SE) and the Wooly Daisy-bush (rated **uncommon** in SE), individuals of these small populations will be destroyed during drain construction.

Construction of a drain through the Bonneys Camp North wetland will require clearing of approximately 6.3 hectares of *Lepidosperma* aff. *laterale* sedgeland. The only plants of conservation significance recorded in this vegetation type occur on the edges (ie. Cleland's Beard-heath), and in the lowest point of the basin (ie. Medic pennywort). These species should not be affected if the drain is positioned in the middle of the wetland, however, filling of the basin for prolonged periods of time may lead to their local extinction.

Potentially the biggest negative impact created by this drain will be indirectly through the isolation of approximately 400 hectares of vegetation to the north of the proposed drainage route. The dimensions of this drain may act to impede the free movement of a range of flora and fauna between these areas, thereby decreasing the long term viability of resident populations of biota on the north side of the drain. As discussed in the Biological Survey of Messent Conservation Park (Owens *et al*. 1995a), those species at most risk are those that have specialised habitat requirements, require large areas, are sedentary or have poor dispersive powers, exist at low densities and/or are already threatened (eg. already have a conservation rating). Therefore the species most at risk are the Red-necked Wallaby, the Common Wombat, the Western Pygmy Possum, Little Pygmy Possum, Silky Mouse, Southern Emu-wren and several other small and less mobile bird species (eg. Shy heathwren, Southern Scrub-robin).

As the vegetation on both sides of the drain is still at an early successional stage post fire, it is important that the drain does not impede the dispersal of flora and fauna between the two areas. This is particularly true for the Common Wombat and Red-necked Wallaby, which have been recorded in the mature vegetation around Bonneys Camp South, but were not recorded in the north eastern corner of Stoneleigh Park HA.

Preferred Options

Historically, much of the native vegetation of the South East has been cleared and modified for agricultural purposes. Presently only 6 % of the original vegetation cover remains, existing generally as small and isolated patches of scrub. These changes have severely impacted on the resident flora and fauna of the area and in many cases has lead to serious declines in the distribution and abundance of many species, and consequently their being listing as species of conservation significance. Therefore from a conservation standpoint, it would be preferable to locate the drains outside of the last remaining fragments of intact vegetation. However, if the decision is made to

construct drains through Bunbury CR and the north eastern corner of Stoneleigh Park HA then the least biologically destructive drainage options should be utilised. In this instance the preferred surface water drainage scheme for Bunbury CR would be Option 3. Although this option has very similar biological implications to Option 2, use of a hydroaxe to clear the vegetation may cause less disturbance to habitats in the Reserve. It should not disturb the soil, and would leave the stumps and roots of cleared vegetation behind. This should help maintain the stability of the Bunbury watercourse. Although only one option has been proposed for Stoneleigh Park HA, further measures may be required to offset the clearance and creation of the 400 hectare isolate to the north of the proposed drain.

RECOMMENDATIONS

Selection of drainage option

1. That subject to the passage of adequate surface water flow volumes along the drainage route, on biological grounds Option 3 (use of a hydro-axe to clear a flow path) be utilised to manage surface water flows from the Duck Island/Gum Lagoon area through Bunbury CR.

Construction of drains and maintenance of habitat connectivity

1. That all cleared vegetation and top soil be removed and stock piled for later use. Great care should be taken when removing and storing the first 0.5m of soil, as this soil contains a seed store that can be used later in revegetation.

2. That a series of fauna crossings be constructed along the terrestrial section of the proposed drain for Stoneleigh Park HA. Ideally, this would require piping of water for a section or sections totalling 60 - 100 metres wide. These pipes should then be covered with the stock piled top soil in the reverse order that the soil layers were removed.

3. That all native vegetation removed during clearance for the drain be immediately replaced over the fauna crossings and any clear areas of sand to inhibit weed growth and take advantage of the natural seed store in the soil. The aim would be to return the area to a vegetation type similar to that which was previously present. All revegetation must be undertaken using local provenance seed. Some species may not regenerate from the seed store, but may need to be specifically treated and planted out as tube-stock.

4. Location of fauna crossings may be placed where the drain is required to breach any sandy rises or sand dunes. These sand dunes or rises could then be dug out until the invert level for the drain is established, and then the piped sections could be re-covered with some of the original sub-soil, and all of the top soil.

5. Biologists from the Department for Environment, Heritage and Aboriginal Affairs should be consulted when deciding exactly where to locate any fauna crossings.

6. All remaining sub-soil removed during construction of the drains should be removed from the Heritage Agreement.

7. Where practical, all heavy machinery must be washed down every time the machinery enters the adjacent paddocks and then enters the scrub, as this will reduce the introduction of weed seeds.
8. That habitat corridors be established between the 400 hectare fragment created by the drain in the north eastern corner of Stoneleigh Park HA and the south eastern corner of Messent CP; and the north eastern corner of Martin Washpool CP with the south western corner of Messent CP. These actions will go some way to offsetting the biological impact caused by the clearance and fragmentation of habitat created by the drain in Stoneleigh Park HA, and to a lesser degree Bunbury CR.

Maintenance of wetland habitats

As the brief of this study did not entail developing detailed management options for the Bonneys Camp wetlands, the required data was not collected. However, the following recommendations are suggested:

1. The Bonneys Camp wetlands are predominantly a fresh water - brackish system (Sutton 1933, White and Brake 1995). Water being carried in the proposed drain for Stoneleigh Park HA should be managed so that it is not allowed to leave the drain unless the salinity level is below 5,000 mg/L.

2. The proposed drain for Stoneleigh Park HA, bisects the natural direction of flow from Bonneys Camp South. This may result in further drying out of the *Lepidosperma* aff. *laterale* sedgeland to the north of the drain. This may be offset by allowing fresh water out on to the northern side of the drain. This water would periodically need to be allowed to drain out of the basin so that the sedgeland can dry out.

Monitoring of biological impacts

1. In addition to maintaining the collection of data from the biological survey sampling established during this survey for several years post drain construction or modification of water flow to Bunbury CR and Stoneleigh Park HA, more specific monitoring of populations of flora and fauna of conservation significance should be established and maintained.

2. Monitoring of the movement of fauna across the fauna crossings should be undertaken. This should be undertaken for a range of species including the Southern Emu-wren, as well as the Red-necked Wallaby and Common Wombat, and should be undertaken for a number of years.

3. Monitoring of the resident small mammal and sedentary bird species of the 400 ha fragment should be undertaken to determine whether isolation is affecting the viability of these populations. This would entail conducting regular trapping and bird transects in the fragment over several years. This research would also help to identify whether animals use the fauna crossings.

4. Regular monitoring of the quality of water being transported in Stoneleigh Park HA drain should be undertaken. This might include monitoring of seasonal fluctuations in salinity levels, concentrations of agricultural pesticides, heavy metals and nutrient loads (especially Phosphorus). This water is eventually destined for the southern Coorong, and should therefore be as 'clean' as possible.

5. If water is allowed to be ponded in Bonneys Camp North, assessment of the impacts of varying the duration of submergence on the *Lepidosperma* aff. *laterale* sedgeland should be undertaken. In addition, it would be useful to record the use of the 'newly created wetland' by birds of conservation significance.

6. Construction of a surface water drain through Bunbury CR provides the opportunity to determine whether an increase in fresh water may increase the health of the low lying plant communities in the Reserve (eg. *Melaleuca halmaturorum* and *M.brevifolia* shrublands). This would entail establishing a quantitative set of data describing the current situation before any drainage work is conducted, and then repeating the same data collecting process over several years to pick up changes in species diversity and abundance as well general tree health.

Other Issues

The clearance of intact native vegetation and scattered trees and the construction of drains through a Conservation Reserve and Heritage Agreement require assessment and consent by the Native Vegetation Council, and the Minister for Environment and Heritage. This report should go some way towards providing information from which these bodies can make their decisions.

In conclusion, although both Bunbury CR and the north eastern corner of Stoneleigh Park HA are in transitional stages (the former suffering from dryland salinity, and the later recovering from a recent fire), both areas support a range of flora and fauna species of conservation significance. These areas are also important because of their relatively large size, and strategic position in the landscape. Although diversion of fresh water through Bunbury CR may benefit some of the vegetation of the Reserve, construction of a drain through Stoneleigh Park HA will directly affect several species of conservation significance existing on the proposed drainage route. In addition the drain will cause the isolation of 400 hectare of native vegetation, as well as disrupt the normal flow regime of the lower Bakers Range Watercourse.

However, if the proposed drain is constructed, and the recommendations are instituted, then the biological impacts of the drain will be minimised, both on site and further down stream. Further, if water quality permits, the Bonneys Camp wetlands may be able to be used as a semi-permanent wetland providing important habitat for several waterbirds of conservation significance.

Resource Material and Bibliography

MAPS

1:250 000 Topographic

Naracoorte	SJ 54-2	1988

1:50 000 Topographic

Taunta	6825-I	1982

Unpublished Floristic Vegetation Map (DTUPA)

AERIAL PHOTOGRAPHS

Naracoorte 1:40 000, Svy 5251 Photos: 069, 087, 089, 091 (16 January 1997).

Photo composite covering the north eastern corner of Stoneleigh Park HA : 1:10 000, Svy 5251 Photos : 087, and 070 (16 January 1997).

Photo composite covering Bunbury Conservation Reserve : 1:10 000, Svy 5251 Photo : 090 (16 January 1997).

BIBLIOGRAPHY

Aitken, P.F. (1983). Mammals **In** Tyler, M.J., Twidale, C.R., Ling, J.K. and Holmes, J.W. (eds.). *Natural History of the South East.* Royal Society of South Australia.

Best, L. and Croft, S. (1995). *Impact of Drain, as Proposed by Upper South East Dryland Salinity and Flood Management Plan Draft Environmental Impact Statement, on the conservation value of Messent Conservation Park*. Unpublished Report, Resource Management Branch, Department of Environment and Natural Resources, South Australia.

Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984). *The Atlas of Australian birds*. RAOU and Melbourne University Press.

Boles, W.E. (1983). A taxonomic revision of the Brown Thornbill *Acanthiza pusilla* (Shaw) 1790 with description of a new subspecies. *Emu* **83**: 51-58.

Calaby, J.H. (1995) Red-necked Wallaby *(Macropus rufogriseus*). **In** Strahan, R (ed.)*The Mammals of Australia* Reed Books, Australia.

Carpenter, G. and Reid, J. (1988). *The status of native birds in South Australia's agricultural regions*. Department of Environment and Planning, Adelaide (unpub. report).

Christidis, L. and Boles, W.E. 1994. *The taxonomy and species of birds of Australia and its territories*. Royal Australasian Ornithological Union, Melbourne.

Cockburn, A. (1981). Diet and habitat preferences of the silky desert mouse, *Pseudomys apodemoides*. *Australian Wildlife Research* **8**: 499-514.

Copley, P.B. and Kemper, C.M. (1992). *A Biological Survey of the Yellabinna Dunefield, South Australia in October 1987*. South Australian National Parks and Wildlife Service, and South Australian Museum, Adelaide.

Croft, T. and Carpenter, G.C. (1996*). The Biological Resources of the South East of South Australia*. Native Vegetation Conservation Section, Resource Management Branch, Department of Environment and Natural Resources. (Unpublished report).

Davies, R. J-P. (1982). *The Conservation of the Major Plant Associations in South Australia*. Conservation Council of South Australia Inc.

Davies, R. J-P. (in prep) (ed.) *A biological Survey of Gum Lagoon Conservation Park*. Nature Conservation Society of South Australia.

de Jong, M. (1994). *The effects of altering the diversity of the structure of habitat in a seasonal swamp in the Watervalley Wetlands, upper south east of South Australia*. Bachelor of Applied Science Honours Thesis, University of South Australia, Salisbury.

Edwards, A. and Tyler, M.J. (1990). Reptiles and Amphibians. **In** : Watts, D.H.S. (ed). *A list of the vertebrates of South Australia*. Biological Coordinating Committee and the Department of Environment and Planning, South Australia.

Fox, B.J. (1982). Fire and mammalian secondary succession in an Australian coastal heath. *Ecology*, **63 (5)**: 1332-1341.

Fox, B.J. (1990). Changes in the structure of mammal communities over successional time scales. *Oikos* **59**: 321-329.

Hanks, E.S. (1930). Notes on the Camp-out at Salt Creek, The Coorong, S.A. *Emu* **29**: 246-251.

Harper, M. & Weinert, M. (1992). *Watervalley Wetlands management plan*. Department of Environment & Planning, Adelaide.

Hutchinson, M. (1992). Threatened Reptiles in South Australia. **In** Soon Poh Tay (ed) *Threatened species and habitats in South Australia: a catalyst for community action*. Conservation Council of South Australia Inc

Hutchinson, M. (1993). Herpetofauna in South Australia - threatened species and those of uncertain status. Unpublished report.

Hutchinson (in prep) Checkist and Common Names of South Australian Reptiles - as at 31 March 1995.

Jaensch, R. and Auricht, C. (1989). *Waterbirds in the South East of South Australia,* 1981. South Australian Ornithological Association, Adelaide.

Jessop, J.P. and Toelken, H.R. (eds.). (1986). *Flora of South Australia*. Parts I - IV. South Australian Government Printer, Adelaide.

Jessop, J.P. (1993). A List of the Vascular Plants of South Australia. State Herbarium of South Australia, Adelaide.

Kemper, C.M. and Queale, L. (1990). Mammals. **In** : *A list of the Vertebrates of South Australia*. Biological Survey Coordinating Committee and Department of Environment and Planning, South Australia.

Lang, P.J. and Kraehenbuehl, D.N. (1998 update). *Plants of Particular Significance in South Australia's Agricultural Regions. Unpublished data*. Resource Management Branch, Department of Environment and Natural Resources.

Laut, P., Heylingers, P.C., Keig, G., Loffler, E., Margules, C., Scott, R.M. and Sullivan, M.E. (1977). *Environments of South Australia . Province 2. Murray Mallee*. Canberra, CSIRO Division of Land Use Research.

Loan, L. (1994). *The response of native vegetation to rising groundwater and salinity levels in the upper south east of South Australia*. Honours Thesis, Department of Geography, University of Adelaide.

Mallet, K.J, and Cooke, B.D. (1986). *The Ecology of the Common Wombat in South Australia*. Nature Conservation Society, Adelaide.

Matthew, J. (1994). The status, distribution and habitat of the Slender-billed Thornbill *Acanthiza iredalei* in South Australia. *South Australian Ornithologist* **32**: 1-19.

May, I.A. (1981). **In** Glover, B. (ed.) Bird Notes. *South Australian Ornithological Association Newsletter* **99**: 8-13.

May, S.A. and Norton, T.W. (1996). Influence of fragmentation and disturbance on the potential impact of feral predators on native fauna in Australian forest ecosystems. W*ildlife Research* **23**, 387-400.

Mc Ilroy, J.C. (1995) The Common Wombat (*Vombatus ursinus*). **In** Strahan, R. (ed.) *The Mammals of Australia* Reed Books, Australia.

Mensforth, L.J. (1996). *Water use strategy of Melaleuca halmaturorum in a saline swamp*. PhD Thesis, Botany Departement, University of Adelaide.

Naardang, J.A. (1983). Latham's Snipe (*Gallinago hardwickii*) in Southern Australia. *Tasmanian Wildlife Division Technical Report* **83/1**:1-89.

Neagle, N. (1995). *An Update of the Conservation Status of the Major Plant Associations of South Australia*. Native Vegetation Conservation Section, Department of Environment and Natural Resources, Adelaide.

Nicolson, C. (1993). Conservation Parks and Wetlands in the Upper South East - Surface Water Recommendations and an Assessment of Impacts Associated with Rising Groundwater. Department of Environment, and Land Management, Adelaide.

Owens, H.M., Robinson, A.C., Dendy, A.T.H. and Lang, P.J. (1995a). *A Biological Survey of Messent Conservation Park, South Australia.* Department of Environment and Natural Resources, Adelaide.

Owens, H.M., Hudspith, T.J., Robinson, A.C., Dobrzinski, I., Armstrong, D.M., Pedler, L.P. and Lang, P.J. (1995b). *A Biological Survey of Yumbarra Conservation Park in March 1995*. Biological Survey and Research, Resource Management Branch, Department of Environment and Natural Resources, South Australia

Parker, S.A. (1985). First record of the Slender-billed Thornbill from the South-East of South Australia. *South Australian Ornithologist* **29**: 212.

Parker, S.A., Eckert, H.J. and Ragless, G.B. (1985). *An annotated checklist of the birds of South Australia. Part 2A: Waterfowl.* South Australian Ornithological Association, Adelaide.

Parker, S.A. and Horton, P. (1990). Birds. **In** : *A list of the Vertebrates of South Australia*. Biological Survey Coordinating Committee and Department of Environment and Planning, South Australia.

Possingham, H. P. (1983). *The avifauna of Conservation Parks in the South East of South Australia*. Unpublished. report to Reserves Advisory Committee, South Australian National Parks & Wildlife Service.

Read, J. L. (1994). The diet of three species of firetail finches in temperate South Australia. *Emu* **94**: 1-8.

South East Drainage Board. (1980). *Environmetal impact study on the effects of drainage in the South East of South*

Australia. SEDB 28/76, 13/79, Adelaide, South Australia.

Specht, R.L. (1981). Responses to fires in heathlands and related shrublands. Pp 395-415. **In** A.M. Gill, R.H. Groves and I.R. Noble (eds) *Fire and the Australian biota*. Australian Academy of Science: Canberra.

Stewart, H.J. (1996). *A Biological Survey of Deep Swamp, South Australia.* Department of Environment and Natural Resources, Adelaide.

Stewart, H.J., van Weenen, J., Croft, T. and Matthew, J. (1997). *A Supplement to the Biological Survey of Deep Swamp, South Australia, December 1996*. Department of Environment and Natural Resources, Adelaide.

Stewart, H.J., van Weenen, J., Croft, T., Carpenter, G. and Matthew, J. (1998). *A Biological Survey of Tilley Swamp, South Australia.* Department of Environment, Heritage and Aboriginal Affairs, Adelaide.

Stokes, A.L. (1996). *A Biological Survey of Box and Buloke Grassy Woodlands in the Upper South East of South Australia*. Department of Environment, and Natural Resources, Adelaide.

Sutton, J. (1930). The birds at Salt Creek, Coorong. *South Australian Ornithologist* **10**: 186-194.

Sutton, J. (1933). Birds of Salt Creek district and some island-sanctuaries in the Coorong. *South Australian Ornithologist* **12**: 5-28.

Sutton, J. (1936). Colour of conjunctiva of the White-winged Chough *Corcorax melanorhamphus*. *South Australian Ornithologist* **13**: 184-186.

Thompson, D.S. (1997). The spatial distribution of the Common Wombat *Vombatus ursinus* (Shaw 1800), and several environmental variables on the Watervalley properties in the Upper South-East of South Australia. Bachelor of Applied Science Honours Thesis, University of South Australia, Levels Campus.

Twidale, C.R. and Tyler, M.J. (1983). Introduction. **In** Tyler, M.J., Twidale, C.R., Ling, J.K. and Holmes, J.W. (eds.). *Natural History of the South East*. Royal Society of South Australia Inc.

Upper South East Dryland Salinity and Flood Management Plan Steering Committee (1993). *Upper South East Dryland Salinity and Flood Management Plan. Draft Environmental Impact Statement - for Public Comment*. Government Printer, South Australia.

Watts, C.H.S. (1990) (ed.). *A list of the vertebrates of South Australia*. Biological Survey Coordinating Committee and Department of Environment and Planning, South Australia.

Webb, L. (1993). *An Investigation into the Environmental Effects of Rising Groundwater and Salinity on Native Vegetation in the Bunbury - Taunta Area (Including the proposed Lesron Conservation Park) in the Upper South East of South Australia*. Department of Environment and Land Management, Adelaide.

White, J.M. and Brake, L.A. (1995). Description, history, and water chemistry of the recently restored Watervalley Wetlands in the South East of South Australia. *Wetlands* **15**: 247-257.

Appendices

Appendix I

PLANT SPECIES RECORDED FROM BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT

Plant taxonomy and nomenclature is in accordance with Jessop (1993). All common names were derived from Jessop and Toelken (1986) and/or the SA Flora database. All species have been listed alphabetically in order of Family. Exotic species have been marked with an asterisk (*). Plants of conservation are listed in Table 5. These ratings follow the National Parks and Wildlife Act 1972, and the SA Flora database. The following descriptions of conservation significance was taken from Lang and Kraehenbuehl (1998 update).

X **Extinct**/Presumed Extinct: not located despite thorough searching of all known and likely habitats; known to have been eliminated by the loss of localised population(s); or not recorded for more than 50 years from an area where substantial habitat modification has occurred.

E **Endangered**: rare and in danger of becoming extinct in the wild.

V **Vulnerable**: rare and at risk from potential threats or long term threats which could cause the species to become endangered in the future.

T[2] **Threatened**: likely to be either Endangered or Vulnerable but insufficient data for a more precise assessment.

R **Rare**: having a low overall frequency of occurrence: confined to a restricted range or scattered sparsely over a wide area. Not currently exposed to significant threats, but warranting monitoring and protective measures to prevent reduction of population sizes.

K **Uncertain**: likely to be either Threatened or Rare but insufficient data for a more precise assessment.

U **Uncommon**: less common species of interest but not rare enough to warrant special protective measures.

Sources of extra plant species records

1. Botany Club Camp 15/5/1993.

2. Native Vegetation Conservation Section's assessment of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement in 1986.

[2] This category does not appear in the NPWS Act 1972.

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
AMARANTHACEAE															
[2]*Hemichroa pentandra*	trailing hemichroa														+
CAMPANULACEAE															
Lobelia gibbosa	tall lobelia										+				
Wahlenbergia litticola	coast bluebell													+	
CASUARINACEAE															
Allocasuarina mackliniana ssp. mackliniana	Macklin's oak-bush					+									
Allocasuarina muelleriana ssp. muelleriana	common oak-bush			+					+	+	+			+	
Allocasuarina pusilla	dwarf oak-bush	+							+		+				
CENTROLEPIDACEAE															
Centrolepis aristata	pointed centrolepis										+				
[2]*Centrolepis polygyna*	wiry centrolepis														+
CHENOPODIACEAE															
[2]*Halosarcia pergranulata* ssp. *pergranulata*	rib-fruited glasswort														+
Sarcocornia blackiana	thick-head samphire		+		+										
Sarcocornia quinqueflora	beaded samphire						+								
[2]*Sclerostegia arbuscula*	scrubby samphire														+
COMPOSITAE															
Angianthus preissianus	salt angianthus		+		+									+	
Argentipallium blandowskianum	woolly everlasting							+	+		+	+			
Argentipallium obtusifolium	blunt everlasting								+		+	+			
Chrysocephalum baxteri	fringed everlasting													+	
Helichrysum leucopsideum	satin everlasting													+	
Helichrysum scorpioides	button everlasting													+	
**Hypochaeris glabra*	smooth cat's ear									+				+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
**Hypochaeris radicata*	rough cat's ear							+		+				+	
Ixodia achillaeoides ssp. alata	hills daisy													+	
Millotia muelleri	common bow-flower								+					+	
Olearia axillaris	coast daisy-bush									+					
Olearia ciliata var. ciliata	fringed daisy-bush													+	
Olearia lanuginosa	woolly daisy-bush													+	
Olearia ramulosa	twiggy daisy-bush						+								
Podolepis canescens	grey copper-wire daisy													+	
Podotheca angustifolia	sticky long-heads									+					
[2]*Pseudognaphalium luteoalbum*	cudweed														+
Senecio picridioides	purple-leaf groundsel													+	
Senecio quadridentatus	cotton groundsel									+				+	
Senecio squarrosus	squarrose groundsel						+							+	
**Sonchus oleraceus*	common sow-thistle									+					
Vittadinia australasica var. australasica	New Holland daisy													+	
CONVOLVULACEAE															
Wilsonia backhousei	narrow-leaf wilsonia				+		+							+	
Wilsonia humilis var. humilis	silky wilsonia				+										
Wilsonia rotundifolia	round-leaf wilsonia				+									+	
CRASSULACEAE															
Crassula closiana	stalked crassula													+	
Crassula sieberiana ssp. tetramera	Australian stonecrop									+		+			
CYPERACEAE															
Baumea juncea	bare twig-rush						+	+					+	+	
Caustis pentandra	thick twist-rush								+					+	
Gahnia filum	smooth cutting-grass		+				+								
Gahnia trifida	cutting grass							+							

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Isolepis nodosa	knobby club-rush													+	
Lepidosperma carphoides	black rapier-sedge	+		+		+			+	+	+	+	+	+	
[2]*Lepidosperma concavum*	spreading sword-sedge														
Lepidosperma aff. *laterale*	sharp sword-sedge							+					+	+	
Lepidosperma viscidum	sticky sword-sedge	+		+		+			+		+	+		+	
Schoenus breviculmis	matted bog-rush	+		+		+			+		+		+		
[2]*Schoenus deformis*	tufted bog-rush														+
[1]*Schoenus laevigatus*	loose panicle bog-rush														+
Schoenus nitens	shiny bog-rush													+	
Tetraria capillaris	hair sedge						+							+	
DILLENIACEAE															
Hibbertia riparia (glabriuscula)	guinea-flower													+	
Hibbertia sericea var. scabrifolia	rough-leaf guinea-flower	+		+					+	+	+	+	+	+	
Hibbertia virgata	twiggy guinea-flower													+	
DROSERACEAE															
[2]*Drosera macrantha ssp. planchonii*	climbing sundew														+
EPACRIDACEAE															
Acrotriche cordata	blunt-leaf ground-berry													+	
Acrotriche serrulata	cushion ground-berry	+		+											
Astroloma conostephioides	flame heath	+		+		+			+	+	+				
Astroloma humifusum	cranberry heath	+		+					+			+		+	
Leucopogon clelandii	Cleland's beard-heath												+	+	
Leucopogon costatus	twiggy beard-heath			+		+									
Leucopogon rufus	ruddy beard-heath													+	
Leucopogon woodsii	nodding beard-heath													+	
Styphelia exarrhena	desert heath			+		+			+		+				

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
EUPHORBIACEAE															
Poranthera triandra	three-petal poranthera													+	
GENTIANACEAE															
**Centaurium erythraea*	common centaury						+							+	
**Centaurium tenuiflorum*	branched centaury				+										
GERANIACEAE															
Pelargonium littorale	native pelargonium									+					
GOODENIACEAE															
Dampiera marifolia	velvet dampiera												+		
[2]*Goodenia blackiana*	native primrose														+
Goodenia geniculata	bent goodenia			+					+	+	+	+			
[2]*Goodenia varia*	sticky goodenia														+
Selliera radicans	shiny swamp-mat													+	
GRAMINEAE															
[2]*Agrostis avenacea var.avenacea*	blown grass														+
**Aira cupaniana*	small hair-grass						+			+				+	
**Bromus rigidus*	rigid brome	+													
Danthonia geniculata	kneed wallaby-grass									+				+	
Danthonia setacea var. setacea	small-flower wallaby-grass						+				+	+		+	
Dichelachne crinita	long-hair plume-grass													+	
**Ehrharta calycina*	perennial veldt grass									+					
Elymus scabrus var. scabrus	native wheat-grass													+	
**Lagurus ovatus*	hare's tail grass									+			+	+	
Neurachne alopecuroidea	fox-tail mulga-grass			+											
**Polypogon monspeliensis*	annual beard-grass						+							+	
[2]*Sporobolus virginicus*	salt couch														+
[2]*Stipa drummondii*	cottony spear-grass														+

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Stipa hemipogon	half-beard spear-grass						+						+		
Stipa mollis	soft spear-grass	+		+		+			+	+	+				
Stipa mundula	neat spear-grass													+	
**Vulpia muralis*	wall fescue									+				+	
GYROSTEMONACEAE															
Gyrostemon australasicus	buckbush wheel-fruit								+		+				
									+						
HALORAGACEAE															
Gonocarpus tetragynus	small-leaf raspwort	+		+		+			+	+		+	+		
IRIDACEAE															
Patersonia fragilis	short purple-flag													+	
JUNCACEAE															
[2]*Juncus bufonius*	toad rush														+
Juncus kraussii	sea rush													+	
[2]*Juncus pallidus*	pale rush														+
JUNCAGINACEAE															
Triglochin striatum	streaked arrowgrass													+	
LAURACEAE															
Cassytha glabella forma dispar	slender dodder-laurel	+		+			+		+		+		+		
Cassytha pubescens	downy dodder-laurel	+		+							+			+	
LEGUMINOSAE															
Acacia brachybotra	grey mulga-bush													+	
Acacia longifolia var. *sophorae*	coastal wattle													+	
Acacia myrtifolia var. myrtifolia	myrtle wattle			+										+	
Acacia pycnantha	golden wattle													+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Acacia spinescens	spiny wattle	+		+		+									
Daviesia brevifolia	leafless bitter-pea	+		+		+			+	+	+				
Dillwynia hispida	red parrot-pea			+					+	+	+		+		
Dillwynia sericea	showy parrot-pea								+						
Gompholobium ecostatum	dwarf wedge-pea			+					+			+	+		
Kennedia prostrata	scarlet runner											+		+	
Phyllota pleurandroides	heathy phyllota	+		+		+			+		+	+			
[2]*Phyllota remota*	slender phyllota														+
Pultenaea acerosa	bristly bush-pea													+	
[2]*Pultenaea prostrata*	silky bush-pea														+
Pultenaea tenuifolia	narrow-leaf bush-pea			+			+								
[3]*Sphaerolobium minus*	leafless globe-pea														+
**Trifolium arvense var. arvense*	hare's-foot clover									+					
LILIACEAE															
Dianella revoluta var. revoluta	black-anther flax-lily			+										+	
Laxmannia orientalis	dwarf wire-lily			+					+	+	+				
Lomandra collina	sandhill mat-rush													+	
Lomandra juncea	desert mat-rush	+		+		+				+			+		
[2]*Lomandra leucocephala* ssp. *robusta*	woolly mat-rush														+
Lomandra micrantha ssp. micrantha	small-flower mat-rush													+	
Thysanotus juncifolius	rush fringe-lily			+		+			+		+		+		
Thysanotus patersonii	twining fringe-lily	+				+			+	+		+		+	
[2]*Tricoryne elatior*	yellow rush-lily														+
Tricoryne tenella	tufted yellow rush-lily					+					+				
Xanthorrhoea caespitosa	sand-heath yacca	+		+		+			+	+	+	+			
LINACEAE															
Linum marginale	native flax						+								

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
LORANTHACEAE															
Amyema melaleucae	tea-tree mistletoe													+	
Amyema pendulum ssp. pendulum	drooping mistletoe									+					
MALVACEAE															
Lawrencia glomerata	clustered lawrencia		+		+										
Lawrencia spicata	salt lawrencia		+												
Lawrencia squamata	thorny lawrencia						+								
MYOPORACEAE															
Myoporum parvifolium	creeping boobialla													+	
MYRTACEAE															
Baeckea behrii	silver broom-bush	+		+		+									
Baeckea ericaea	mat baeckea													+	
Calytrix alpestris	snow heath-myrtle	+		+							+	+			
Calytrix tetragona	common fringe-myrtle	+		+											
Darwinia micropetala	small darwinia					+	+								
Eucalyptus arenacea	dune stringybark	+							+	+	+	+			
Eucalyptus diversifolia	coastal white mallee	+		+						+	+			+	
Eucalyptus fasciculosa	pink gum											+		+	
Eucalyptus incrassata	ridge-fruited mallee			+		+			+	+	+				
Eucalyptus leptophylla	narrow-leaf red mallee											+		+	
[2]*Eucalyptus leucoxylon*	South Australian blue gum														+
Kunzea pomifera	muntries									+					
Leptospermum continentale	prickly tea-tree						+					+			
Leptospermum coriaceum	sandhill tea-tree													+	
Leptospermum myrsinoides	heath tea-tree	+		+		+			+	+	+	+			
Melaleuca brevifolia	short-leaf honey-myrtle						+							+	
Melaleuca halmaturorum ssp. halmaturorum	swamp paper-bark		+		+										
Melaleuca lanceolata	dryland tea-tree													+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Melaleuca uncinata	broombush					+									
ONAGRACEAE															
[2]*Epilobium billardierianum ssp.x intermedium*	variable willow-herb														+
ORCHIDACEAE															
[2]*Genoplesium rufum*	red midge-orchid														+
[2]*Microtis unifolia complex*	common onion-orchid														+
Pterostylis sanguinea	red banded green-hood													+	
Thelymitra nuda	scented sun-orchid													+	
OXALIDACEAE															
Oxalis perennans	native sorrel													+	
PITTOSPORACEAE															
Billardiera cymosa	sweet apple-berry	+		+		+	+			+	+			+	
PLANTAGINACEAE															
Plantago sp. B	little plantain													+	
POLYGALACEAE															
Comesperma calymega	blue-spike milkwort								+		+	+		+	
Comesperma scoparium	broom milkwort			+											
Comesperma volubile	love creeper						+							+	
PRIMULACEAE															
Samolus repens	creeping brookweed				+		+								
PROTEACEAE															
Adenanthos terminalis	yellow gland-flower	+		+		+			+		+				
Banksia marginata	silver banksia	+				+				+		+			
Banksia ornata	desert banksia	+				+		+	+		+	+	+		
Conospermum patens	slender smoke-bush								+					+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Grevillea ilicifolia var.ilicifolia	holly-leaf grevillea													+	
Hakea muelleriana	heath needlebush	+		+											
Hakea nodosa	yellow hakea													+	
Hakea repullulans	furze hakea													+	
Hakea rostrata	beaked hakea			+							+	+			
Hakea vittata	limestone needlebush													+	
Isopogon ceratophyllus	horny cone-bush	+		+		+			+	+	+	+			
Persoonia juniperina	prickly geebung									+	+			+	
RANUNCULACEAE															
Clematis microphylla	small-leaved clematis													+	
RESTIONACEAE															
Hypolaena fastigiata	tassel rope-rush	+		+		+			+	+	+	+			
Lepidobolus drapetocoleus	scale shedder	+		+		+			+	+	+				
Leptocarpus brownii	coarse twine-rush		+				+	+					+		
RHAMNACEAE															
Cryptandra tomentosa	heath cryptandra			+		+			+		+		+		
Spyridium subochreatum var. subochreatum	velvet spyridium								+		+				
Spyridium thymifolium	thyme-leaf spyridium													+	
Spyridium vexilliferum var. vexilliferum	winged spyridium								+		+				
RUBIACEAE															
Opercularia scabrida	stalked stinkweed								+		+				
Opercularia turpis	twiggy stinkweed													+	
RUTACEAE															
Boronia coerulescens ssp. coerulescens	blue boronia			+					+		+				

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
SANTALACEAE															
[2]*Choretrum spicatum*	spiked sour-bush														
Exocarpos sparteus	slender cherry			+											
[2]*Leptomeria aphylla*	leafless currant-bush													+	
Santalum acuminatum	quandong													+	
Santalum murrayanum	bitter quandong										+				
SAPINDACEAE															
Dodonaea viscosa spatulata	sticky hop-bush													+	
STACKHOUSIACEAE															
Stackhousia aspericocca ssp. (sterile)	bush candles													+	
Stackhousia aspericocca ssp. "Cylindrical inflorescence"	bush candles													+	
STERCULIACEAE															
Lasiopetalum behrii	pink velvet-bush													+	
Thomasia petalocalyx	paper-flower			+										+	
STYLIDIACEAE															
[2]*Levenhookia dubia*	hairy stylewort														+
Stylidium graminifolium	grass trigger-plant	+		+		+			+			+			
THYMELAEACEAE															
[2]*Pimelea glauca*	smooth riceflower														+
Pimelea octophylla	woolly riceflower								+		+				
Pimelea phylicoides	heath riceflower								+						
UMBELLIFERAE															
Daucus glochidiatus	native carrot													+	
Hydrocotyle laxiflora	stinking pennywort													+	
Hydrocotyle medicaginoides	medic pennywort													+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
Xanthosia dissecta var. floribunda	cut-leaf xanthosia								+		+	+		+	
Xanthosia pusilla	hairy xanthosia								+		+				

Appendices

Appendix II

MAMMAL SPECIES RECORDED FROM BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT

Species are arranged in alphabetical order of Family using the taxonomy of Kemper and Queale (1990). The following list includes all mammals observed in the sampling quadrats, opportunistic sightings during the survey and records of species recorded by other researchers. All records of species are marked with a + in the column of the site where they were observed, or in the opportunistic column. Those species recorded by other people in the study area are listed in the column labelled OTHER. The source of these data are indercated by the superscript numbers in front of the species name. All exotic species are marked with an asterisk (*). The State conservation ratings are shown in bold following the scientific name. These have been taken from Kemper and Queale (1990). Those species with no conservation ratings have not been labelled.

The definition for the status codes are as follows (after Kemper and Queale (1990) :

E Endangered: taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

V Vulnerable: taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

R Rare: taxa with small populations in South Australia that are not at present endangered or vulnerable, but are at risk.

In addition two other categories have been used for species not considered at risk (Watts 1990).
The definitions for these status codes are as follows:

U Uncommon: taxa occurring in relatively low numbers in South Australia, but not rare.

C Common: the category of greatest abundance; relatively numerous generally, locally and/or seasonally. (Local abundance applies to species with restricted distribution.)

Sources of extra mammal species records

1. Janice White, University of South Australia,unpublished data.

2. David Thompson, Honours research (1997), University of South Australia.

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
BURRAMYIDAE															
Cercartetus concinnus	Western Pygmy-possum								+						
Cercartetus lepidus	Little Pygmy-possum	+		+		+				+	+	+			
CANIDAE															
**Vulpes vulpes*	Fox (Red Fox)	+			+			+			+			+	
CERVIDAE															
**Cervus dama*	Fallow Deer							+		+	+	+		+	
LEPORIDAE															
**Lepus capensis*	Brown Hare													+	
**Oryctolagus cuniculus*	(European) Rabbit	+	+	+	+		+	+		+	+	+		+	
MACROPODIDAE															
Macropus fuliginosus	Western Grey Kangaroo	+	+	+	+		+	+		+				+	
[1]*Macropus rufogriseus*	Red-necked Wallaby													+	+
Macropus sp.		+		+											
MOLOSSIDAE															
Mormopterus planiceps	Little Mastiff Bat													+	
MURIDAE															
**Mus domesticus*	House Mouse	+	+		+	+	+	+	+	+	+	+	+		
Pseudomys apodemoides	Silky Mouse	+		+		+			+			+	+		
TACHYGLOSSIDAE															
Tachyglossus aculeatus	Short-beaked Echidna	+		+			+		+	+	+	+			

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
VESPERTLIONIDAE															
Chalinalobus gouldii	Gould's Wattled Bat													+	
Nyctophilus geoffroyi	Lesser Long-eared Bat													+	
Vespadelus darlingtoni	Large Forest Eptesicus													+	
Vespadelus sp														+	
VOMBATIDAE															
[1,2]*Vombatus ursinus*	Common Wombat											+			+

Appendices

Appendix III

BIRD SPECIES RECORDED FROM BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT

Species are arranged in alphabetical order of Family using the taxonomy and nomenclature of Parker and Horton (1990). The following list includes all birds observed in the sampling quadrats as well as those recorded opportunistically. Some other bird species recorded by other researchers have been included where relevant. The sources of these records appear as superscript to each of he species concerned. The presence of each bird species at the sampling sites is indicated by a cross (+) at the site number. Introduced species are preceded with an asterisk (*). Species of conservation significance are shown in Table 6. State conservation ratings follow the NPWS Act 1972, Kemper and Queale (1990) and Carpenter and Reid (1994).

The definition for the status codes are as follows (after Kemper and Queale 1990) :

E Endangered: taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

V Vulnerable: taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

R Rare: taxa with small populations in South Australia that are not at present endangered or vulnerable, but are at risk.

In addition Watts (1990) also used the category Uncommon for species not considered at risk. The definition for this category follows:

U Uncommon: taxa occurring in relatively low numbers in South Australia, but not rare.

All species considered common, and therefore not at immediate risk have not been labelled.

Sources of extra bird species records

1. Harper and Weinert (1992). See Resource Material and Bibliography section

2. de Jong (1994). Honours thesis , University of South Australia.

3. Matthew (1994). See Recource Material and Bibliography section.

4. Janice white personal communication.

5. R.Jaensch , December 1981.

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
ANATIDAE															
[1] *Anas rhynchotis*	Blue-winged Shoveler														+
[2] *Oxyura australis*	Blue-billed Duck														+
[1] *Stictonetta naevosa*	Freckled Duck														+
ACCIPITRIDAE															
Accipiter cirrhocephalus	Collared Sparrow Hawk													+	
Accipiter novaehollandiae novaehollandiae	Grey Goshawk						+								
Aquila audax audax	Wedge-tailed Eagle	+								+				+	
Circus approximans	Swamp Harrier							+					+		
ALAUDIDAE															
Alauda arvensis	Skylark							+					+		
ARTAMIDAE															
Artamus cyanopterus	Dusky Woodswallow									+					
Artamus personatus	Masked Woodswallow									+					
Artamus superciliosus	White-browed Woodswallow									+	+	+	+		
Cracticus torquatus torquatus	Grey Butcherbird	+		+		+				+	+				
Gymnorhina tibicen	Australian Magpie		+	+			+				+	+	+	+	
Strepera versicolor	Grey Currawong	+	+	+	+	+				+					
CACATUIDAE															
Cacatua roseicapilla	Galah	+		+								+			
CASUARIIDAE															
Dromaius novaehollandiae	Emu		+	+	+	+	+	+	+	+	+	+			

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
COLUMBIDAE															
Phaps chalcoptera	Common Bronzewing	+		+	+					+	+	+		+	
Phaps elegans elegans	Brush Bronzewing					+			+		+			+	
CORVIDAE															
Corvus coronoides coronoides	Australian Raven			+				+		+	+				
Corvus mellori	Little Raven	+	+	+		+			+	+	+			+	
Grallina cyanoleuca	Magpie-lark													+	
CUCULIDAE															
Cacomantis flabelliformis flabelliformis	Fan-tailed Cuckoo			+											
Chrysococcyx basalis	Horsfield's Bronze Cuckoo						+								
DICRURIDAE															
Rhipidura fuliginosa	Grey Fantail	+	+	+	+	+				+				+	
Rhipidura leucophrys leucophrys	Willie Wagtail										+	+		+	
EOPSALTRIIDAE															
Drymodes brunneopygia	Southern Scrub-robin													+	
Melanodryas cucullata	Hooded Robin													+	
Microeca leucophaea	Jacky Winter									+					
FALCONIDAE															
Falco berigora	Brown Falcon							+	+	+				+	
Falco cenchroides cenchroides	Nankeen Kestrel												+	+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
FRINGILLIDAE															
**Carduelis carduelis*	European Goldfinch													+	
HIRUNDINIDAE															
Hirundo neoxena	Welcome Swallow	+										+	+		
Hirundo nigricans nigricans	Tree Martin									+				+	
MALURIDAE															
Malurus cyaneus	Superb Blue Wren	+	+		+	+	+		+	+	+	+		+	
Malurus lamberti	Variegated Wren			+		+					+				
Stipiturus malachurus	Southern Emu-wren		+	+			+		+			+			
MEGAPODIIDAE															
Leipoa ocellata	Malleefowl			+		+									
MELIPHAGIDAE															
Acanthagenys rufogularis rufogularis	Spiny-cheeked Honeyeater		+		+	+	+								
Anthochaera carunculata carunculata	Red Wattlebird	+		+		+				+	+	+		+	
Epthianura albifrons albifrons	White-fronted Chat								+	+					
Gliciphila melanops	Tawny-crowned Honeyeater	+		+		+	+		+		+				
Lichenostomus cratitia	Purple-gaped Honeyeater			+					+		+			+	
Meliphaga leucotis novaenorciae	White-eared Honeyeater		+	+		+			+	+	+	+			
Melithreptus brevirostris	Brown-headed Honeyeater					+			+	+	+				
Phylidonyris novaehollandiae novaehollandiae	New Holland Honeyeater	+	+	+	+	+	+			+	+			+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
MOTAACILLIDAE															
Anthus novaeseelandiae	Richard's Pipit							+	+				+		
ORIOLIDAE															
Coracina novaehollandiae novaehollandiae	Black-faced Cuckooshrike			+								+			
Lalage sueurii	White-winged Triller											+			
PACHYCEPHALIDAE															
Colluricincla harmonica	Grey Shrikethrush	+	+	+	+	+			+	+	+	+		+	
Oreoica gutturalis	Crested Bellbird								+		+				
Pachycephala pectoralis	Golden Whistler	+	+	+	+	+			+	+	+	+			
Pachycephala rufiventris rufiventris	Rufous Whistler									+					
PARDALOTIDAE															
Acanthiza apicalis	Inland Brown Thornbill	+	+	+	+	+	+		+		+				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill								+	+				+	
[3]*Acanthiza iredalei hedleyi*	Slender-billed Thornbill														+
Acanthiza lineata	Striated Thornbill	+				+				+	+	+		+	
Acanthiza pusilla	Brown Thornbill									+	+				
Acanthiza reguloides reguloides	Buff-rumped Thornbill	+							+	+	+			+	
Acanthiza sp.											+				
Hylacola cauta	Shy Heathwren	+		+		+			+		+	+		+	
Pardalotus striatus	Striated Pardalote		+							+				+	
Pardalotus xanthopygus	Yellow-tailed Pardalote	+		+		+			+	+		+			
Sericornis frontalis frontalis	White-browed Scrubwren		+		+					+	+			+	
Smicrornis brevirostris	Weebill	+		+		+			+			+		+	

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
PASSERIDAE															
[4]*Emblema bellum*	Beautiful Firetail														+
PETROICIDAE															
Drymodes brunneopygia	Southern Scrub-robin	+				+				+	+				
Melanodryas cucullata	Hooded Robin								+		+				
Petroica multicolor	Scarlet Robin		+		+					+					
PHASIANIDAE															
Coturnix novaezelandiae	Stubble Quail							+			+	+			
POMATOSTOMIDAE															
Pomatostomus superciliosus	White-browed Babbler				+						+			+	
PSITTACIDAE															
Barnardius zonarius barnardi	Port Lincoln Parrot			+		+				+		+		+	
Calyptorhynchus funereus	Yellow-tailed Black Cockatoo														
Glossopsitta porphyrocephala	Purple-crowned Lorikeet													+	
Neophema chrysostoma	Blue-winged Parrot		+	+		+			+					+	
Neophema elegans	Elegant Parrot									+					
Platycercus elegans	Crimson Rosella								+						
Platycercus eximius eximius	Eastern Rosella											+			
Psephotus haematonotus	Red-rumped Parrot	+								+		+			
ROSTRATULIDAE															
[5]*Rostratula benghalensis*	Painted Snipe														+
SCOLOPACIDAE															
[1]*Gallinago hardwickii*	Latham's Snipe														+

Scientific Name	Common Name	BS0101	BS0201	BS0301	BS0401	BS0501	BS0601	BS0701	BS0801	BS0901	BS1001	BS1101	BS1201	OPPT	OTHER
STURNIDAE															
Sturnus vulgaris vulgaris	European Starling	+												+	
SYLVIIDAE															
Cincloramphus cruralis	Brown Songlark							+					+		
TURNICIDAE															
Turnix varia varia	Painted Button-quail			+		+			+						
Turnix velox	Little Button-quail								+						
ZOSTEROPIDAE															
Zosterops lateralis	Silvereye	+	+	+	+	+	+			+	+	+		+	

Appendices

Appendix IV

REPTILE SPECIES RECORDED FROM BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT

Reptile taxonomy follows follows Hutchinson (in prep), amphibians follows Edwards and Tyler (1990). All common names are those proposed by Hutchinson (in prep.). Species have been listed alphabetically in order of Family. None of the following reptiles are considered to be of conservation significacne. Site numbers have been abbreviated to displaying the data more easily (eg. site BS0101 has been abbreviated to 1).

		Sites												
Scientific Name	**Common Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**OPPT**
AGAMIDAE														
Amphibolurus norrisi	Mallee Tree-Dragon					+				+				+
Pogona vitticeps	Central Bearded Dragon													+
CHELIDAE														
Chelodina longicollis	Common Long-necked Tortoise													+
ELAPIDAE														
Notechis scutatus	Eastern Tiger Snake		+											+
Pseudonaja textilis	Eastern Brown Snake													+
LEPTODACTYLIDAE														
Limnodynastes dumerili	Eastern Banjo Frog							+	+	+	+	+	+	
Neobatrachus pictus	Burrowing Frog							+				+	+	
PYGOPODIDAE														
Aprasia striolata	Lined Worm-lizard			+			+							
Pygopus lepidopodus	Common Scaly-foot			+										
SCINCIDAE														
Bassiana duperreyi	Eastern Three-lined Skink						+	+	+		+	+		
Ctenotus robustus	Eastern Striped Skink									+	+			
Ctenotus uber	Spotted Ctenotus	+	+	+		+			+	+	+	+		
Hemiergis peronii	Four-toed Earless Skink	+	+		+							+		
Lampropholis delicata	Delicate Skink	+		+			+							
Lerista bougainvillii	Bougainville's Skink	+								+	+		+	
Morethia obscura	Mallee Snake-eye	+		+		+			+		+			
Tiliqua rugosa	Sleepy Lizard	+				+	+					+		+
Tiliqua scincoides	Eastern Bluetongue													+

Appendices

Appendix V

WEATHER CONDITIONS DURING THE BIOLOGICAL SURVEY OF BUNBURY CONSERVATION RESERVE AND STONELEIGH PARK HERITAGE AGREEMENT

Table 7
Weather conditions during the Biological Survey of Bunbury Conservation Reserve and Stoneleigh Park Heritage Agreement, December 1997.

DATE	SUN		SHADE		COMMENTS
	MIN	MAX	MIN	MAX	
1/12/1997	13	39	16	29	cool breeze, sunny day
2/12/1997	12	44	16	23	overcast, patchy sun
3/12/1997	6	50^{+}	14	31	warm say with some cloud
4/12/1997	7	43	10	26	
5/12/1997	12	50^{+}	12	31	light rain
6/12/1997	12	50^{+}	12	31	light rain
7/12/1997	10	24	11	20	grey, overcast day, but still warm

Table 8
Weather conditions during bat trapping field trip to Stoneleigh Park Heritage Agreement, February 1998.

DATE	SHADE		COMMENTS
	MIN	MAX	
6/12/1998	8	20	cloudy night, slight rain for few hours
7/12/1998	11	18	windy, scattered showers, bright moon set after midnight
8/12/1998	4	22	clear cold night, no wind, moon bright set between 3 - 4 am