Surveys of waterbirds in selected wetlands of south-western Australia in spring-summer 2009-10

with further assessment of changes in habitat and waterbird usage over 2-3 decades

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Cover image captions

Flat-topped Yates *Eucalyptus occidentalis* in Yellilup Lake (Jerramungup Shire), alive in October 1979 (upper left) and dead in December 2009 (lower right).

CONTENTS

APPENDICES

FIGURES

TABLES

Summary

In 2008, the Western Australian Department of Environment and nservation (DEC) commissioned a survey of a small group of wetlands in the south-west of the State, with the aim of documenting any long-term changes in waterbird habitats and their use by waterbirds. The survey, which was supported by DEC scientific staff, was led by Wetland International - Oceania's waterbird specialist Roger Jaensch, who had surveyed the same wetlands in the 1980s and 1990s, and was therefore well-qualified to both repeat the waterbird surveys and subjectively assess any subs ntial changes, or lack thereof, in habitats.

The selected wetlands were: Nine Mile Lake (DEC Swan R gion); Lake Davies (South West Region); Yarnup Lagoon and Boat Harbour Lake 1 (W rren Region); and Lake Pleasant View, Mettler Swamp, Yellilup Lake, Esperance reserve 26410 and Shark Lak (South Coast Region). The survey was focussed on waterbird species that depend upon the presence of fringing and emergent wetland vegetation (live trees, shrubs, rushes and sedges) for cover, especially for nest sites. These 'sensitive' species were bitterns, crakes, small rails, Blue billed and Freckled Ducks, and tree-nesting colonial herons, egrets, ibises, spoonbills and cormorants.

The surveys were conducted in November - December 2008 and January 2009, matching dates of previous surveys and records of nesting by bitterns, crakes and small rails. Searching by wading or from a boat, the observers employed methods for finding secretive birds and concealed nests modelled on methods used in previous decades. Nest searching at all wetlands was at least as compreh nsive as in the past and more so at some. The surveys typically took 3-7 hours to complete and, where habitat was judged appropriate, included periods of listening at n t for calling bitterns. The location of each nest was geo-referenced by GPS and other information that would benefit future surveys, such as listening positions and routes walked, were documented or mapped.

The January 2009 surveys at four of the nine wetlands ere to compensate for probable dispersal of birds and delay or disruption of nesting caused by exceptional rainfall and increases of up to 0.5 metres in wetland water levels ring the weeks of the November-December surveys.

The 2008-9 surveys were only snapshots in time, nevertheless some marked changes were apparent at several wetlands, particularly Nine Nile Lake (principally declinin water levels and invasion by Bulrush), Yarnup Lagoon (increasing salinity, pH declines and death of vegetation) and Yellilup Lake (salinisation and death of emergent eucalypt woodland). These habitat changes were accompanied by apparent changes in use by waterbirds.

Some wetlands appeared little changed. Three of these (Boat Harbour Lake 1, Lake Pleasant View and Mettler Swamp) were identified as potential candidates for listing as internationally important under the Ramsar Convention on Wetlands because they have supported the globally-threatened Australasian Bittern in the past 2-3 decades and continued to do so in 2008-9. Further surveys were recommended to confirm their current status. Other recommendations concerning management of wetlands, surve of waterbirds, hydrological investigations, colonial-nesting waterbirds and Australasian Bitterns were also made.

In 2009-10 further waterbird surveys were undertaken, this tim lead by DEC Senior Technical Officer Alan Clarke, who had assisted Roger Jaensch in the 2008-9 surveys and on previous occasions.

Two wetlands, Owingup Swamp (DEC Warren Region) and Al any 27157 (Cheyne Road Nature Reserve in DEC South Coast Region), were a ded to the project, increasing the total number of wetlands in the project o eleven. Both were included on the basis of their documented past use by sensitive species, particularly bitterns, their history of hydrological monitoring and the potential for changes to have occurred.

The 'sensitive breeding species' was also expanded in 009-10, and retrospectively to the 2008-9 data set, to include Swamp Harriers, as nesting by this species is mainly within wetland rushbeds in south-western Australia and there are very few nest records from this region. In 2009-10, breeding was recorded, for the first time, in Nine e Lake and Yarnup Lagoon.

The 2009-10 surveys revealed further changes in habitat condition for waterbirds at several wetlands. At Yarnup Lagoon some regeneration of sedge and melaleuca shrub thicket is occurring and breeding by two sensitive species has resumed. At Owi up there has been some expansion of Bulrush stands, with hort and possibly long term implications for use by waterbirds. At Esperance 26410 there has been further deterioration in the health of eucalypts and melaleucas and some are dying. At Shark Lake melaleucas have died and fallen. This change will be of concern if continues and regeneration does not occur.

Further surveys have been conducted in 2010-11 and results are to be reported.

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The Surveyed Wetlands

Nine Mile Lake (19May2008)

Lake Davies (19May2008)

Yarnup Lagoon (24May08)

Boat Harbour Lake 1 (26May2008)

Owingup Swamp (20May2008)

Lake Pleasant View (21May2008)

Albany 27157 (21May2008)

Mettler Swamp (21May2008)

Yellilup Lake (21May2008)

Esperance 26410 (16May2009)

Shark Lake (16May2009)

Introduction

The study area

This report presents further results from a wetland an waterbird survey project commenced in south-western Australia in 2008-09 and continued in 2009-10. The study area extended from north of Bunbury to Albany and Esperance (Fig. 1). Hence it included parts of the Swan, South West, Warren and South Coast regions of the WA Department of Environment and Conservation (DEC), and parts of the Swan Coastal Plain, Jarrah Forest, Warren and Esperance Plains bior ions[1]. The study area experiences cool wet winters and hot dry summers with an annual rainfall between about 500 and 1000 mm.

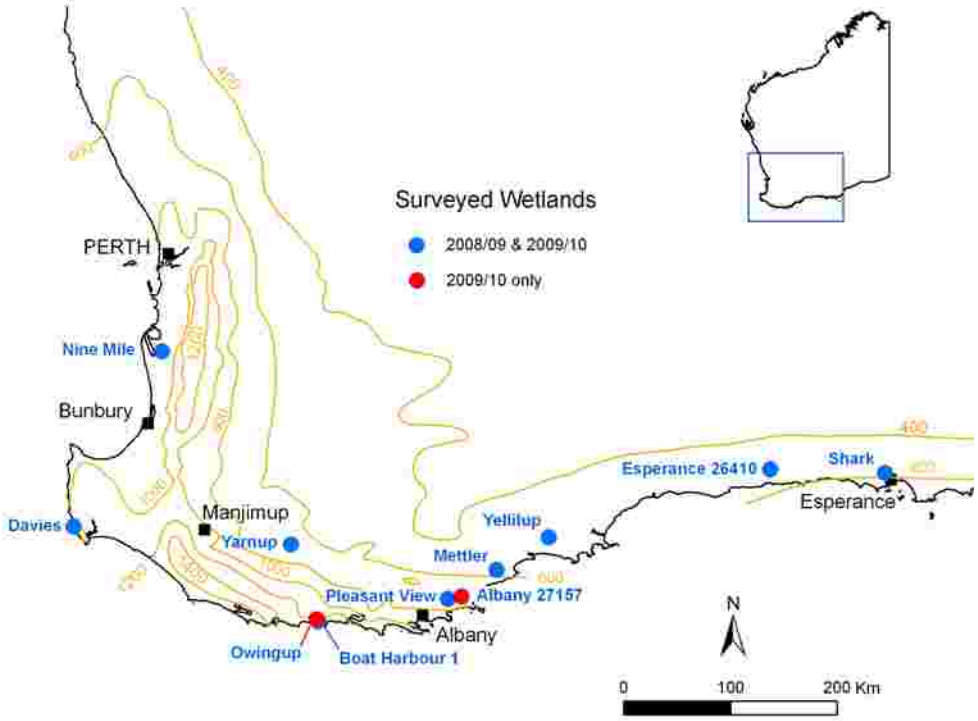

Figure 1. Locations of the eleven wetlands surveyed during 2008-2010.

Origins of the project

The origins of this project have been described in det il in our previous report (Jaensch *et al.* 2009).

[1] (http://florabase.calm.wa.gov.au/help/ibra)

The project stems from an awareness that, since the comprehensive surveys of waterbird use of wetlands in south-western Australia in the 1980s (e.g. Jaensch *et al.* 1988) and early 1990s (e.g. Storey *et al.* 1993, Halse *et al*. 1994), some of these wetlands have undergone significant changes in water l ls and salinities (e.g. Lane *et al.* 2009a) and, in some cases, undocumented changes in fringing and emergent vegetation (J. Lane, pers. obs.). These changes were thought likely to have impacted on use by waterbirds, in most cases negatively. Because of the previously-established, high level of importance of some of these sites for waterbirds (e.g. ANCA 1990), the possibility that some adverse changes could be at least partially remedied through management, and the widespread and substantial threat posed to south-west wetlands by secondary salinisation (Government of Western Australia 2002) and declining rainfall (Hope & Foster 2005, IOCI 2010), we considered it important to re-survey a sample of these wetlands in order to identify and document changes in waterbird use and vegetation that have occurred in the past several deca es.

While the project is concerned about changes in use by waterbirds of all species, a particular focus is changes in use by species that are highly dependent on the existence of healthy emergent or fringing vegetation for all of, or at least c ical stages of, their life cycles. Two species within this category, the Austral sian Bittern and Australian Little Bittern, are being given particular attention, due to n apparent decline in reporting and, it is inferred, their numbers.

In 2008, DEC contracted Wetlands International – Oceania (WIO) to undertake a two-week field survey program (in November-December) to address the abovementioned issues. WIO specialises in wetland and waterbird surveys and staff (Roger Jaensch) have had considerable first-hand experience with wetlands and waterbirds of the st y area, specialising in secretive species and nest surve s. This work (Nov-Dec 2008) was undertaken jointly with DEC, who contributed a senior technical officer (Alan Clarke), 4WD vehicle, boat, other field equipment and water chemistry analyses. DEC (Alan Clarke plus volunteers) also conducted a follow-up survey at a subset (4) of the wetlands in January 2009.

In our previous report (Jaensch *et al.* 2009), we made the point that the 2008-09 surveys were only 'snapshots' for comparison with previous studies and recommended that further surveys be undertaken to more-conclusively establish changes and current values.

In 2009-10, additional surveys were undertaken, by Alan Clarke of DEC, with assistance from other DEC staff and volunteers. This follow-up work is the subject of this report.

Project objectives

The objectives of this 'changing wetlands' project are:

1. to identify and describe any **significant long-term changes** (or clear indicators of change) in waterbird usage and habitat availability at a small number of carefully selected wetlands of south-western Australia 2-3 decades after substantial, previous, waterbird survey effort.
2. to obtain information on **present usage by sensitive waterbird species** (see below for definition) especially those that are threat ned, that are secretive and

thus difficult to find, and/or that breed on-site, with an emphasis on bitterns (this work was to be primarily for the purpose of achieving objective 1).

3. to **facilitate future monitoring** of waterbirds through establishing well documented survey procedures at each wetland, and by building the survey capabilities of local people, initially near Albany.

In 2009-10, the emphasis was on further assessment of present usage of the same set of wetlands by waterbirds, particularly sensitive species, with a focus on bitterns. Two 'new' wetlands were added to the project because they lso met the target wetland selection criteria and could be accommodated within 2009-10 resource and time constraints.

Target wetlands and waterbird species

The context for selection of target wetlands for the project is described in the corresponding section of Jaensch *et al.* (2009). The wetlands surveyed in 2009-10 were the same nine, plus Owingup Swamp and 'Albany 27157'. All except one (Nine Mile Swamp) of these eleven wetlands are located on or near the south coast of Wes ern Australia, between Cape Leeuwin and Esperance. Nine Mile is on the west coast, north of Bunbury and south-west of Pinjarra.

For this project, as well as previous survey projects, the common definition of waterbirds as being birds that depend on wetlands for at least a art of their life cycle has been adopted. A list of waterbird species mentioned in this report, with their scientific names, is in Appendix 1.

All waterbirds seen or heard were recorded in the fiel nd details are in the report appendices (see Methods below) but analysis of results cuses on certain 'sensitive' species.

Sensitive species

In Jaensch *et al.* (2009) and in this report the term **sensitive** species refers to waterbird species that:

- typically depend on inundated, dense live vegetation (sedge beds/tussocks, shrub thickets) or live trees for shelter and/or breeding, ***and***
- that are, or may become, of conservation concern because:
  - they have numerically small populations in the study a a (Australasian Bittern, Blue-billed Duck, Freckled Duck: Wetlands International 2006), ***or***
  - they are rarely recorded in large numbers (bitterns, crakes and small rails: Jaensch *et al.* 1993) because they are highly secretive ***or***
  - they are known to occur in relatively few wetlands (bitterns, Blue-billed Duck, Freckled Duck: Jaensch *et al.* 1988; Halse *et al.* 1990) ***or***
  - they breed in relatively few wetlands (bitterns, Freckled Du k, Swamp Harrier[1] and colonial herons, egrets, ibises, spoonbills, cormo ants: Jaensch *et al.* 1988, Blakers *et al.* 1984).

[1] Swamp Harrier was not considered a sensitive species in Jaensch *et al.* (2009), but following further consideration of its breeding habits in south-western Australia (where nesting is largely confined t wetland rushbeds and has been recorded at very few locations), it has been added to the list.

Several species meet the first but not second criterio bove and so have been excluded from the category 'sensitive'. Thus Purple Swamphen and Dusky Moorhen have been excluded because they occur in many wetlands and sometimes occur in large numbers (hundreds: Jaensch *et al.* 1988, pp. 87, 257; Jaensch *et al.* 1993) and so are not presently of conservation concern. Australian Reed-Warbler and Little Grassbird have been excluded because they occur in many wetlands, probably in all wetlands of the study area that have tall sedge beds or *Typha* (based on RJ pers. obss.), and so are not presently of conservation concern. Musk Duck have been excluded because, while not as abundant as many other duck species, it meets n ne of the four conditions under the second criterion above.

The importance of trees, both dead and alive, for nesting by various species of waterbirds in Australia was discussed in the corresponding section of Jaensch *et al.* (2009). Relevant findings of several related studies (alse 1987, Halse *et al.* 1993, Briggs & Thornton 1995, Briggs *et al.* 1997) were also presented and so are not reported here.

In summary, the species and species groups regarded as 'sensitive waterbirds' for the purposes of this project are: bitterns, crakes, small ails, Blue-billed Duck, Freckled Duck Swamp Harrier[1] and colonially breeding herons, egrets, ibises, spoonbills and cormorants. During the two years since commencement of the project, the following 'sensitive species' have actually been recorded:

- 'Sensitive' on the basis of Numbers or Breeding: Australasian Bittern, Australian Little Bittern, Spotless Crake, Baillon's Crake, Australian Spotted Cr e, Buff-banded Rail, Blue-billed Duck and Freckled Duck.
- 'Sensitive' only on the basis of Breeding: Swamp Harrier[1], Yellow-billed Spoonbill, Little Pied Cormorant, White-necked Heron and Nankeen Night-Heron.

Methods

Selection of target wetlands

Target wetlands for survey in 2008-09 were selected after close consideration of the project objectives, trends in depth and salinity, known changes in vegetation, prior use by waterbirds, survey logistics and budgetary constraints. These nine wetlands are listed in Table 1, together with the two wetlands (Owi up and Albany 27157) that were added to the project in 2009-10. Graphs of depths and salinities of the eleven selected wetlands over the entire DEC monitoring period to February 2010 are in Appendix 2.

Selection criteria variously met by these wetlands (Ta e 1) are as follows:

1. located on or near the south coast.
2. vegetated at present or in the past.
3. depth and salinity have been monitored by DEC over a long period (all but one of the selected wetlands have been monitored at least 15 years and most for more than 25 years; ALB2 was monitored 1980-84 and in 2009).
4. monitoring has shown a definite long-term change in depth and/or salinity.
5. there are early indications of possible long-term change in depth and/or salinity.

6. a substantial change in vegetation structure and/or ar ngement has occurred.
7. vegetation structure and/or arrangement will be substantially affected if long term change in depth and/or salinity occurs.
8. early in the depth/salinity monitoring period the wetl nd was important for waterbirds that were highly dependent on emergent/frin ing vegetation.
9. known to support sensitive waterbirds (see definition above).
10. in the DEC South Coast or Warren Regions and suitable for training in survey of secretive waterbirds.

There are three broad groups within this set of wetlan n terms of dominant vegetation: those where the vegetated areas are dominated by trees (paperbarks such as Saltwater Paperbark *Melaleuca cuticularis* or Flat-topped Yate *Eucalyptus occidentalis*) but with tall sedges absent (YELL, ESP1); those dominated by sedges such as *Baumea* spp. (DAVI, PLEA, ALB2, SHAR); and those with substantial areas of both trees d sedges (NINE, YARN, BOA1, OWIN, METT). Survey methods suitable for each situation were adopted for the project.

Table 1. Wetlands selected for survey in 2008-09 and 2009-10.

wetland name	***code***	***selection criteria met***	***surveys 2008-09***	***surveys 2009-10***
Nine Mile Lake	NINE	2, 3, 4, 6, 8, 9.	1	1
Lake Davies	DAVI	1, 2, 3, 4, 7, 9.	1	1
Yarnup Lagoon	YARN	2, 3, 4, 6, 8, 9.	2	2
Boat Harbour Lake 1	BOA1	1, 2, 3, 5, 7, 8, 9, 10	2	2
Owingup Swamp	OWIN	1, 2, 3, 7, 8, 9, 10	-	2
Lake Pleasant View	PLEA	1, 2, 3, 5, 7, 8, 9, 10.	2	1
Albany 27157	ALB2	1, 2, 7, 8, 9, 10	-	2
Mettler Swamp	METT	1, 2, 3, 4, 5, 7, 8, 9.	2	2
Yellilup Lake	YELL	1, 2, 3, 4, 6, 8, 9.	1	1
Esperance Res. 26410	ESP1	1, 2, 3, 4, 5, 7, 9.	1	2
Shark Lake	SHAR	1, 2, 3, 5, 7, 8, 9, 10.	1	2

It is important to note that only one (PLEA) of the eleven selected wetlands is also included in the set of 25 south-western Australian (mainly Wheatbelt) wetlands that have been intensively monitored by DEC under the State Sali ity Strategy since 1997 (Cale *et al.* 2004, Cale & Halse 2006a-u, Gibson *et al.* 2004, Lyons *et al.* 2007). This is because the objectives, criteria, geographic extent and time scales of the two projects are different.

Field survey methods

Survey methods employed in 2008-09 were described in detail in the corresponding section of Jaensch *et al.* (2009). A very similar approach, building on the previous year's experience, was taken by the authors in 2009-10.

Field datasheets and project reports from surveys in the 1980s and 1990s were reviewed during preparation for field surveys of the two additional wetlands, OWIN and ALB2. This enabled AC to understand, wetland by wetland, the routes and coverage of previous surveys and the waterbird species recorded, both breeding and not breeding. Recent vertical (Landgate) and oblique (DEC; see Lane *et al.* 2009b, Table 8) aerial photographs of these wetlands were also used to assist in this pro ess.

The following procedures were then adopted for the 2009-10 surveys:

- All surveys were conducted or, when others assisted, conducted and lead by the one experienced observer (AC), who was able to draw upon knowledge gained from his substantial involvement in the 2008-09 and 1991-1992 surveys, from additional advice and guidance provided by RJ in 2009-10 and from a general familiarity with all of the surveyed wetlands arising from his ongoing involvement in DEC's multi-decadal South West Wetlands Monitoring Program.
- The surveys were conducted in spring and summer, as in 008-09, and as was most common in the projects of the 1980s and 1990s..
- Two surveys were conducted; the first in the first week of December (one week later than in 2008) and the second in mid February (five weeks later than in 2009). The differences in timing between 2008-09 and 2009-10 were due primarily to other commitments, however it is thought that the one week difference in the first surveys is too small to be of biological importance and that the five week difference in the second surveys, while hampering direct comparison of results from year to year, could yield additional information on the temporal extent of occurrence and, in particular, breeding activity of the various waterbird species.
- The 2009-10 surveys were conducted in the likely breeding season of sensitive species (particularly bitterns) which, based on previous survey results and general experience of the authors in south-western Australia, is spring-summer with a tendency on the south coast to be late spring a early summer (Australian Little Bittern and Spotless Crake are considered summer breeding species: Halse & Jaensch 1989).
- The same wetlands as in 2008-09 were surveyed in 2009-10, plus two (OWIN and ALB2). In most cases the same areas (whole or par h wetland as in 2008-09 were surveyed. In some cases (e.g. YARN, PLEA, YEL e additional areas were surveyed. In a few instances (e.g. NINE, BOA1) smaller, more-promising areas were surveyed, in order that these cou be searched more intensively than in 2008-09.
- Prints of recent aerial oblique photographs of each wetland were carried during survey to guide navigation and ensure optimal survey coverage of each wetland.
- Wherever possible (NINE, DAVI, YARN, ESP1, SHAR), the entire wetland was surveyed (including, in some cases, by boat) as this is normally necessary to ensure that survey results truly reflect the diversity and numbers of waterbirds present (because individuals and species are often pat hily distributed within wetlands). It was found to be impractical to survey all areas of the other wetlands due to their large size, impenetrable vegetation and, in some parts, overly penetrable sediments.

- Where habitat potentially suitable for bitterns was present at the wetlands, the observer(s) listened from one or more vantage points for calling bitterns for approximately ½ - 1 ¾ hours around dusk or later in the evening.
- AC was familiar with the advertising calls of Australasian Bittern and stralian Little Bittern and attempted to elicit response calls from the latter species by imitating their vocalisations. If Australasian Bitter were not heard during the initial listening period, AC attempted to elicit calls from that species by briefly amplified recordings of their calls
- A substantial portion of any inundated, dense, wetland vegetation (emergent or fringing), which could potentially harbour nests of ducks, bitterns, crakes, small rails, waterhens and swamp warblers, was searched intensively; hence, wading in the wetland was essential.
- inundated and recently-inundated (previous 12-24 months or so) trees were examined for indications of nesting by sensitive colonial species such as spoonbills and cormorants.
- **depth** and **salinity** were recorded by AC at each of the wetlands during the surveys, consistent with SWWMP monitoring protocols
- **safety** of observers when wading was addressed by working closely in pairs, carrying recovery devices such as a boat oar when in boggy or 'floating' substrate, and wearing leg protection and carrying a compression bandage in snake habitat.

AC led the surveys at each wetland and was assisted by one or more additional observers[1] at all except DAVI and ESP1. During these surveys he rovided training in methods of survey and searching for bitterns and other ecretive waterbirds and their nests.

Waterbirds were found, identified and counted using st ndard methods as described for previous surveys (e.g. Jaensch *et al.* 1988, Jaensch 1992). Total counts of all waterbirds present at the wetlands were attempted on most occasions, but not at OWIN in the early December survey, nor at YARN or METT in the mid-February survey. Secretive species perhaps were missed and undoubtedly were undercounted in some cases, particularly at large water bodies with extensive dense sedgeland such as at BOA1. A tripod-mounted telescope was used to identify birds that were far from the observers.

In densely vegetated wetlands some nests were found si ly by thorough searching of all inundated dense sedge/shrub habitat, but, where ha at was extensive and time or energy limited, some prioritisation or focus of effort n most-suitable areas was needed. This depended heavily on the experience of AC (with some prior guidance by RJ), who was able to draw on 2008-09 and 1991-1992 experience of nest searching.

Figure 2 of Jaensch *et al.* (2009) illustrates typical nest sites of six waterbird species occurring in the study area.

[1] See the Acknowledgements section for the names of thes tional observers, seven of whom were DEC Regional staff.

Data recording and management

To ensure adequate capture of information and provisio f a record that could be used in planning the conduct of future surveys at the same tlands, the following procedures were followed for data capture and management:

- Counts of waterbirds and descriptions of nests and vegetation were entered into a pocket **notebook.**
- The **route** taken at each wetland was captured and saved on a Gar in GPS unit
- The positions of all active **nests** and old nests additional to those found in 2008-09 were recorded by GPS.
- Digital **photographs** were taken of active nests and some old nests (especi ly where identity of bird species was unknown), habitat at nests, vegetation change (e.g. recently dead shrubs or trees at ESP1 and SHAR) and of other relevant subjects. Photographs were also taken of some non-nests (e.g. feeding platforms, which, in some instances, resemble nests).
- The digital photographs were subsequently stored on computer and named by wetland name and general location within the wetland. **Keywords**/tags to describe the subject(s) were added to the file properties to aid interpretation and file searches.
- All field data were transcribed from pocket notebook to hardcopy data sheets within days to weeks of each survey, and subsequently to the digital data sheets (Appendix 4) of this report.
- The routes of survey and key points of interest were annotated by hand in the field onto hardcopy maps of the wetlands and subsequently tran ferred onto digital vertical (Landgate) aerial photographs, together with the estimated approximate extent of surface water at the time of each survey.
- Datasheets, maps and photographs (digital or scanned) have been backed up on the DEC computer **network**. The pocket notebooks of AC have been retained by AC at the DEC Busselton office.

Summary datasheets and route maps for each of the eleven wetlands are in Appendix 4.

Coverage achieved

Most of the surveys were conducted 2-10 December 2009 (10 wetlands) and 15-17 February 2010 (5 wetlands). One wetland was surveyed in September 2009 and two in November 2009 (Tables 2 & 4). The typical daily routine for wetlands with dense sedgeland was as follows:

- late afternoon to dusk (or when visibility was lost): unt waterbirds and search for nests (4-6 hours)
- within two hours after sunset: listen for calling bitt ns (up to 1 ¾ hours)
- early TO MID morning, conduct a follow-up waterbird/nest survey if warranted and if time permitted
- mid morning to early afternoon: travel to next wetland (several hours)

This was the most effective use of time and effort because past experience (RJ) indicated more records of bitterns calling in the even ng than before sunrise, though this may have been partly an artefact of observer effort. F thermore and given the long day

length (hence early sunrise) in December, after conduct ng evening surveys an adequate sleeping period for observers precluded surve g very early the next day.

Table 2a. Dates of surveys, hours of survey effort and approximate area of water, and percentage of inundated area surveyed, Sep and Nov 2009.

wetland	*survey date/s*	*hours of survey effort **	*approx. area ** of water (ha)*	*% of inundated area surveyed*	*boat used?*
ESP1	15 September 2009	2.0	19.8	<100	No
ESP1	12 November 2009	2.0	13.2	<100	No
SHAR	13 November 2009	2.0	7.5	>60	No

Table 2b. Dates of surveys, hours of survey effort and approxim e area of water and percentage of inundated area surveyed, Dec 2009.

wetland	*survey date/s*	*hours of survey effort **	*approx. area ** of water (ha)*	*% of inundated area surveyed*	*boat used?*
NINE	10 December 2009	5.0	3.9	40	No
DAVI	9 December 2009	1.25	1.3	<100	No
YARN	8 & 9 December 2009	5.4	21.3	80	No
BOA1	2 December 2009	4.8	99.0	~ 70	Yes
OWIN	3 December 2009	2.0	365.1	10	No
PLEA	3 & 4 December 2009	5.3	151.7	~ 70	No
ALB2	5 December 2009	2.4	54.0	30	No
METT	4 December 2009	4.2	25.8	~ 50	No
YELL	7 December 2009	3.45	124.6	<80	No
ESP1	-	-	-	-	-
SHAR	6 December 2009	4.0	6.9	>80	No

* not including additional survey conducted by AC in January 2009 – see Table 4

** measured from Google Earth satellite image, guided eld survey maps. This is also the inundated area.

At wetlands without dense low cover or that were relat ely small, surveys could be completed more easily and survey duration was shorter 1-3 hours); also the time of day was less important, because listening for bitterns was not warranted.

Coverage of the water area ranged from nearly 100% at all wetlands to 70% or less (minimum 10%) at some larger wetlands and wetlands with extensive dense low vegetation.

Training delivered

Acting on an offer (by JL) to DEC's South Coast Region, RJ arranged training for DEC ecologists and community volunteers in survey of secretive waterbirds at Lake Pleasant View, near the Region's headquarters in Albany, during 2008-09. This training took place at 0830-1230 on Saturday 28 November 2008 and comprised instruction, listening to call recordings and discussion/questions followed by illustration of points made by all wading through bittern habitat at the south end of the lake. It was reinforced by

involvement of some of the same staff in the follow-up survey led by AC in January 2009.

In 2009-10, the surveys were conducted and lead by AC with the involvement and assistance of DEC staff based in Manjimup, Walpole, Albany and Esperance and experienced volunteers from Birds Australia in Perth and Albany. AC provided training to these participants in waterbird survey techniques, articularly the finding and identification, both visually and aurally, of secretiv species and their nests. He also imparted his knowledge and experience in safe survey of wetlands that are, in parts, thickly vegetated, deep, boggy and populated by tiger snakes *Notechis scutatus.* Survey participation also provided AC with opportunities to i m regional and district DEC staff about the project, its background, objectives and findings to date.

Wetland and weather conditions

At the regional scale, rainfall in the 12 months to 30 November 2009 was below average (2^{nd} - 3^{rd} deciles) in the vicinity of NINE, YELL and ESP1 and average (4^{th}-7^{th} deciles) in the vicinity of DAVI, YARN, BOA1, OWIN, PLEA, ALB2, METT and SHAR. In the six winter-spring months to 30 November 2009, rainfall was above average (8^{th}-9^{th} deciles) in the vicinity of DAVI, YARN, BOA1 and OWIN, average in the vicinity of NINE, PLEA, ALB2, METT and SHAR, and below average in the vicinity LL and ESP1. Rainfall in the three following months of summer was average to very much below average across the south-west (Bureau of Meteorology website www.bom.gov.au).

Wetland water levels and salinities in spring and summer of 2009-10 reflected the varied occurrence of rainfall and were influenced by conditions in previous years and by long-term trends.

Long-term depth (water level) and salinity records from the selected wetlands are presented in graphical form in Appendix 2. These data are collected routinely by DEC in mid September and early November each year and indicate wetland conditions following the wetter months of winter and spring. The routinely-collected DEC data of September and November 2009, together with depths and salinities recorded on the days of wetland survey during this project (i.e. in early December 2009 and mid February 2010), are shown in Table 3 and in the graphs of Appendix 2.

From Appendix 2 (with assistance from Table 3) we see that, in early November 2009:

- depth was very low (compared with depths of previous Novembers) at NINE. YELL and ESP1.
- depths were at or near typical or average levels at DAVI, YARN, BOA1, OWIN, METT and SHAR.
- depths were relatively high at PLEA and ALB2?
- salinities were at or near typical or average levels at NINE, BOA1, OWIN, PLEA, ALB2, METT and SHAR.
- salinities were relatively high at DAVI, YARN, YELL an ESP1.

Typically, it could be expected that (apart from perha in the highest rainfall areas on the mid-west of the south coast), by November each year, water depths generally would have reached their peak and in many cases begun to dec ne with the onset of the dry season. However, between the first week of November 2008 and the period of the first

2008-9 survey (25 November – 3 December 2008) and especially during the first few days of the survey, unseasonably heavy rainfall occurred on parts of the south and south-east coasts. This caused rapid rises in depths at sev ral wetlands: BOA1 (by 19 cm), PLEA (53 cm), METT (43 cm), and YELL (25 cm). Depths at some of the wetlands were also *continuing* to rise in late November 2008 as considerable surface low was seen at YARN, BOA1 and PLEA at that time. These events had implications for waterbird nesting activity and success in 2008-9, as detailed in the corresponding section of Jaensch *et al.* (2009).

Table 3. Depths and salinities of the eleven selected wetlands in spring and summer 2009-10. Measurements taken at the time of bird surveys are shown in bold.

wetland	*depth (m), early Sep 09*	*depth (m), early Nov 09*	*depth (m), early Dec 09*	**depth (m), mid Feb 10*
NINE	0.46	0.35	**~ 0.20 (dry at gauge)**	-
DAVI	4.66	4.44	**4.34**	-
YARN	1.17	0.96	**0.85**	**0.48**
BOA1	1.29	1.09	**1.01**	**0.66**
OWIN	1.70	1.20	**~ 1m (gauge submerged)**	**0.85**
PLEA	1.23	1.18	**1.09**	-
ALB2	1.32	1.26	**1.19**	**0.92**
METT	0.86	0.78	**0.71**	**0.40**
YELL	1.26	1.10	**0.99**	-
ESP1	**0.33**	**0.16**	-	-
SHAR	2.41	**2.29**	**2.18**	-

wetland	*salinity (ppt), early Sep 09*	*salinity (ppt), early Nov 09*	*salinity (ppt), early Dec 09*	**salinity (ppt), mid Feb 10*
NINE	0.27	0.44	**0.73**	-
DAVI	2.55	2.60	**2.67**	-
YARN	3.30	3.7	**4.47**	**9.53**
BOA1	0.65	0.73	**0.80**	**1.36**
OWIN	0.24	0.52	**1.02**	**-**
PLEA	0.26	0.39	**0.44**	-
ALB2	0.17	0.29	**0.34**	**0.64**
METT	0.38	0.44	**0.48**	**0.86**
YELL	49.2	59.2	**69.3**	-
ESP1	**18.8**	**44.4**	-	-
SHAR	1.35	**1.46**	**1.55**	-

* see below regarding the second (February 2010) survey.

In 2009-10, virtually the opposite occurred. Instead of increasing as in 2008 or tapering off as is normal, rainfall in the lower south-west and on the south coast ceased abruptly in October and wetland water levels dropped. This is illustrated by October 2009 versus mean October and October 2008 rainfalls for Denmark (Oct 2009 46 mm, mean 96 mm;

Oct 2008 131 mm), Albany Airport (48, 72; 89) and Mettler (24, 55, 103); and by November 2009 versus mean November and November 2008 rainfalls for Denmark (Nov 2009 35 mm, mean 53 mm; Nov 2008 153 mm), Albany Airport (31, 46; 137) and Mettler (42, 44;162); (Bureau of Meteorology data www.bom.gov.au). Wetland water levels, instead of rising as in some surveyed wetlands in November 2008, or falling slowly as in more normal years, fell more sharply than normal.

The sudden cessation of rainfall and decline in water vels in Spring 2009 was thought likely to result in less nesting activity occurring in 2009-10; this activity finishing earlier than usual; reduced calling by nesting Australasian Bitterns and more 'no longer active' nests to be identified to species. This was a very different situation compared with 12 months previously. 2009, like 2008 but for the opposite reason, was probably an atypical year as far as nesting activity in November-December was concerned.

Second survey – February 2010

In January 2009, AC and JG conducted follow-up surveys at four wetlands (YARN, BOA1, PLEA, METT) that were both affected by rising water levels and high priority in relation to the 2008-09 project objectives. This was in order to at least partially compensate for the impacts of unusually heavy November 2008 rainfall on what was initially a snapshot survey program.

Unlike the November 2008 survey, the December 2009 survey was not impacted by unseasonal rainfall. However, based on the 2008-09 experience, and in order to provide a comparison, it was thought useful to also conduct a follow-up survey in 2009-10. Accordingly, in February 2010, AC re-surveyed YARN, BOA1, OWIN, ALB2 and METT (Table 4). Objectives and procedures were essentially for the previous (Dec 2009) survey but special attention was given to:

- YARN: searching for ALiB nests because two ALiB were heard calling here in Dec 2009 but no evidence of nesting was found at that time. If further survey work was undertaken, perhaps nests would be found?
- BOA1: searching and listening for AusB and ALiB because these species were neither heard nor seen here in Dec 2009. Perhaps they would be present later in the season? Windy weather experienced during the Dec 009 survey of this wetland perhaps impaired survey effectiveness.
- OWIN: was not surveyed in 2008-9 so an early 2010 survey would be the first (of the 2008-10 program) assessment of waterbird use at this time o he year.
- ALB2: also not surveyed in 2008-9 so an early 2010 survey would be the first assessment of waterbird use at this time of the year. An added consideration was that in Dec 2009 most of the potential bittern nesting habitat was to deep to be searched by wading and could not be searched by boat due to the density of *Baumea* stands. It was expected that by Feb 2010 the water l l would have dropped sufficiently for searching by wading.
- METT: searching for ALiB nests because two, possibly three ALiB were heard calling here in Dec 2009 but no evidence of nesting wa found at that time. If further survey work was undertaken, perhaps nests would be found?

For each of the above five wetlands, two survey datasheets (Dec 2009 and Feb 2010) are shown in Appendix 4 but the survey results are com ned in the Results section below.

Additional skills transfer was achieved in Feb 2010, to Birds Australia volunteer Anne Bondin at ALB2 and METT and to DEC staff Jackie Manning and Justin Ettridge at OWIN and BOA1, and Sarah Comer and Janet Newell at ALB .

Table 4. Dates of surveys, hours of survey effort and pproximate area of water and percentage of inundated area surveyed, February 2010. See Table 3 for depths at the time of survey.

wetland	*survey date/s*	*hours of survey effort **	*approx. area * of water (ha)*	*% of inundated area surveyed*	*boat used?*
NINE	-				
DAVI	-				
YARN	15 February 2010	2.5	18.8	20	No
BOA1	16 February 2010	3.15	46.0	~ 40	Yes
OWIN	16 February 2010	2.4	180.2	20	No
PLEA	-				
ALB2	17 February 2010	3.45	41.1	60	No
METT	17 February 2010	1.5	14.7	20	No
YELL	-				
ESP1	-				
SHAR	-				

* measured from Google Earth satellite image, guided b eld survey maps; assumed largely unchanged since late November 2008

Limitations

A number of limitations were recognised in presenting the results and conclusions of the 2008-09 report. They are repeated in reduced and updated form below as they are also applicable to the present report and readers should bear them in mind:

- The December 2009 and February 2010 surveys are just two **temporal snapshots** of wetland habitat and waterbird usage of the surveyed wetlands and therefore cannot capture the considerable natural variability th may occur on-site over one year let alone several or more years. However, the sur eys were timed to coincide with the optimal time of year for detecting the priori waterbird species and their nesting activity.
- Waterbirds, including sensitive species, are highly mobile; variability in patterns of usage are driven both by on-site factors and by availability of **habitat elsewhere** in the region and even farther afield. Therefore, in the bsence of a concurrent survey of all similar habitat in the study area and beyond, it is not possible to be entirely definitive about reasons for presence or absence of sp ies and/or breeding at the local wetland.
- **Limitations of time** available for survey precluded 100% coverage being ac ieved at most of the wetlands; less than a full day was available per wetland, due to large distances to travel between wetlands. Hence, some spec es and nests may have been missed. However in 2009-10 AC (primarily) and RJ (advisory role only) applied their collective experience to targeting both representative and optimal

areas of waterbird habitat at each wetland, to ensure that survey results in 2009-10 broadly represented the total situation.

- Information from **previous surveys** (1980s-1990s) of waterbirds at the selected wetlands varied greatly in detail and scope, hence accuracy in replicating these previous surveys in 2008-09 and 2009-10 was inconsistent, wetland-to-wetland. In some cases (e.g. METT) RJ and AC conducted more intensive nest searching than was done in the past. Nonetheless, we consider that the methods of our present survey were appropriate and sufficient to address the rimary objective in terms of whether or not certain sensitive species still occur or could occur at the wetland.
- Finding **secretive waterbirds** and their nests are inherently difficult tasks even for experts and our time for this work was quite limited. Thus it is likely that we missed some secretive species and their nests at some of the eleven surveyed wetlands. However, we consider that our collective experience in understanding the habitat and nesting requirements of most of the waterbird species surveyed enables us to draw meaningful conclusions about the continued suitability of the subject wetlands for supporting secretive (and other sensitive) species.
- Some **old nests** cannot be identified as to the waterbird species that sed them and the year when the nest was last active can, in some instances, be impossible to discern, especially if no eggshells or feathers remain in the nest. However, although some valuable knowledge remained unattainable, this loss generally as not significant with respect to our project objectives.

Results

Habitats and changes over 2-3 decades

An assessment of habitats and changes in habitats from the 1980s and early 1990s to 2008-9 was presented in our previous report (Jaensch *et al.* 2009). That assessment has been updated to include 2009-10 observations and is re-presented below in Table 5.

As in the previous report, the following classes of in ndated habitat have been adopted:

- **TS** = Tall sedgeland: tall (1-3 m high) beds and/or clumps of sedge, principally *Baumea articulata.* Often including low thin rush and occasional shrubs. Shelter and nest sites for bitterns, crakes and small rails, and n st sites for ducks.
- **TY** = Typha beds: tall (1-3 m high) beds and/or clumps of *Typha* (probably *T. orientalis*) typically as mono-specific stands. Shelter and nest sites for bitterns, crakes and small rails, and nest sites for ducks.
- **GA** = *Gahnia* tussocks: low (up to 1.5 m high) tussocks and beds of saw-sedge *Gahnia trifida*. Shelter for Australasian Bittern, crakes and small rails, and when deeply inundated may support duck nests.
- **LS** = Low sedgeland: low (up to 1.5 m high) beds of dense dge dominated by *Baumea juncea*, *B. vaginalis, Leptocarpus* sp., *Lepyrodia* sp. and/or similar sedge/rush species. Feeding habitat for Australasian Bittern, but on its own generally not structurally adequate to support bittern rake, small rail or duck nests.
- **SH** = Shrub thicket: relatively low (up to 3 m high) dense thickets and clumps of *Melaleuca lateritia*, *M. teretifolia*, *M. cuticularis* and *Agonis* spp. Shelter and nest sites for Australian Little Bittern, crakes, small rai and ducks if plenty of sedge is included.

- **WO** = Wooded swamp: tall (3-15 m high) woodland and/or clumps of trees in the zone of inundation, mainly Saltwater Paperbark *Melaleuca cuticularis*, Warren River Cedar Agonis *juniperina* and Flat-topped Yate *Eucalyptus occidentalis*. Substantial trees provide nest sites for colonial-breeding cormorants, herons, egrets, ibis and spoonbills, and Freckled Ducks may nest in trunk junctions near water level.

Major classes of Inundated Habitat

TS = Tall sedgeland (AC, 8Dec09, YARN)

TY = *Typha* beds (AC, 10Dec09, NINE)

GA = *Gahnia* tussock (RJ-WI, 28Nov08, METT)

LS = Low sedge (AC, 13Dec09, PLEA)

SH = Shrub thicket (AC, 8Dec09, YARN)

WO = Wooded swamp (AC, 4Dec09, METT)

Combinations of Inundated Habitats

Mixed Tall & Low Sedge (AC, 4Dec09, PLEA)

Tall sedge with Low Sedge (AC, 3DEC09)

Mixed *Gahnia* & Low Sedge (AC, 16Feb10, BOA1)

Gahnia with *Baumea* (AC, 2Dec09, BOA1)

Shrubs, *Typha* & Sedge (RJ-WI, 26Nov08, NINE)

Mixed sedge, shrubs, trees (AC, 4Dec09, PLEA)

Mixed Trees and Low Sedge (AC, 5Dec09, ALB2)

Fallen Timber (AC, 15Sep09, ESP1)

Table 5. Change in habitat for sensitive waterbird species at the surveyed wetlands, 1980s-90s to 2008-9 and 2009-10.

wetland	*habitat present in 1980s and/or early 1990s*	*habitat present in 2008-9*	*summary of change to 2008-9*	*summary of change to 2009-10*
NINE	Mainly open water in main lake, small variable areas of TS[1], small areas of SH; satellite swamps occupied by SH and WO.	Mostly (over 95%) TY in main lake with fringing patchy TS and SH; satellites' vegetation unchanged.	Major **loss** of open water; major **gain** of dense cover.	No discernible further change
DAVI	Mainly open water with narrow fringe of semi-continuous LS; some LS clumps. This is suggested also by Photo 1 of Robinson (1992).	Similar but LS with no clumps and possibly more dense.	Possible **loss** of varied structure; otherwise unchanged	No discernible further change
YARN	Mainly TS with some open water (depth dependent); most of margin with SH and WO narrow zone. No definite signs of salinity increase in swamp in 1987-8 (Halse *et al.* 1993a)[2]	Area of TS reduced markedly, especially in south, and open water increased; TS no longer the dominant habitat. In SH zone, the prominent *Melaleuca lateritia* element dead or nearly so and the formerly common, tall, thin sedge element mostly lost.	Major **loss** of dense cover in broad basin and margins.	Some regeneration of *Melaleuca lateritia* and thin sedge
BOA1	Large area of open water; also large areas of LS with complex mosaic of GA, TS and SH; broad to narrow areas of WO, SH and TS at some margins and in back-swamps; small areas of TY at NE margins.	Unchanged.	No discernible loss or gain.	No discernible change
OWIN	Large areas of open water. Areas of narrow fringe semi-continuous TS and LS. Continuous broad areas of TS and LS mixed with patches of GA	Not assessed in 2008-9	Not assessed in 2008-9	No discernible change since 1980s and/or early 1990s except expansion of *Typha* at southern end
PLEA	Some open water (depth dependent) but dominated by LS with patches of TS especially at some margins; small patches of SH and GA in margins[3]. In 1987-8 GA was the main sedge in the lake (Halse *et al*. 1993a)	Unchanged except for probable increase in occurrence and extent of SH, notably in the north. Cale *et al.* (2004) estimated open water comprised only 5% of PLEA's 'wetted area' in 1999-00[4].	No net loss or gain of dense cover; probably some LS & TS replaced by SH	No discernible further change

[1] Halse *et al.* (1993a) suggested that NINE had only 3% open water so time between 1969 and 1978, but the present authors have been unable to find evidence to support t 1965 and 1980 aerial photography indicate >95% open water.

[2] Halse *et al.* (1993a) described YARN as being at an early stage of change in 1987-8. Salt scalds were reported to have appeared in the YARN nature reserve ~ 200m south of the wetland in 1983 or 1984.

[3] Note that Cale *et al.* (2004) suggested the amount of open water in PLEA is ariable, on the basis that Halse *et al.* (1993a) reported <1% of PLEA's area being open water (at time of field investigation between Dec 1987 and Feb 1998 or from aerial photography between 1969 and 1978?), whereas Cale's estimate (based on personal observation) of area of open water in 1985-6 was 75%. Note also that the map on p.92 of Halse *et al.* (1993a) indicates a much larger area (~ 30%) of open water than stated in the text (0.04%).

[4] See previous footnote.

Table 5 continued

wetland	habitat present in 1980s and/or early 1990s	habitat present in 2008-9	summary of change to 2008-9	summary of change to 2009-10
ALB2	Some open water in centre. Extensive areas of continuous LS and patches of TS	Not assessed in 2008-9	Not assessed in 2008-9	No discernible change since 1980s and/or early 1990s
METT	Extensive live WO and broad area of TS; mixed WO, SH and TS in eastern margins and interior; GA scattered under western WO; some open water.	Unchanged; incidence of (the few) dead trees in deepest areas seemed 'natural' though some Melaleucas had thin canopies.	No discernible loss or gain.	No discernible change
YELL	Extensive live WO and broad eastern area of open water; low shrubs in open water zone exposed at low water levels.	All trees below 2.5 m gauge depth dead; some live seedlings and a few live paperbarks in 2.5-2.8 m zone; samphire common on outer bed.	Total **loss** of dense live tree cover in lake interior (also salinisation effects).	No discernible further change
ESP1	Extensive live WO and interior area of open water; GA scattered under some WO.[1]	Similar, but zone up to 50 m wide of dead Yates around W to N sides of open water; some regrowth (seedlings 0.3-2.0 m) above 0.8 m depth.	Some **loss** of dense live tree cover.	More dead, fallen and storm-damaged Yates. Some melaleucas dying and damaged by falling Yates.
SHAR	Mainly open water but with semi-continuous narrow zone of TS and some SH.	Unchanged.	No discernible loss or gain.	Many of the well-established Melaleuca trees at the western end have died and fallen

In summary, by 2008-9 major loss of habitat for sensitive waterbirds had occurred at two wetlands (YELL, YARN), minor loss or possible loss had occurred at two wetlands (ESP1, DAVI?), and no significant net loss had occurred at four wetlands (BOA1, PLEA, METT and SHAR). Major gain of habitat for some sensiti e waterbirds (crakes, small rails, bitterns) had occurred at one wetland (NINE).

Habitat gains and losses to 2008-9 for other (i.e. non-sensitive) waterbirds were not thoroughly examined. However, notable changes were:

- loss of open (and deeper) water at NINE, which greatly reduced suitability for several waterbird species including diving species such as Great Cormorant and for shorebirds such as dotterels
- loss of sedgeland at YARN, which reduced the area of h bitat for non-sensitive waterbirds such as grassbirds and reed-warblers.

During the 2009-10 surveys, AC noted some improvement in habitat for sensitive species at YARN and some deterioration at ESP1 and SHAR. The changes at ESP1 and SHAR may be of some small benefit to non-sensitive waterbirds, by providing roosting and nesting habitat for several species such as some ducks.

[1] Extensive shrub *Acacia glaucoptera, Melaleuca glaberrima* understorey flooded in 1986 was dead by Jan 1988 (Halse *et al.* 1993a). These shrubs may have invaded during the extended dry period before 1986 (see Appendix 3).

OWIN and ALB2 (Cheyne Rd Nature Reserve) were added to the project in 2009-10. No change in habitat was apparent at ALB2, and at OWIN change appeared to be limited to the expansion of *Typha* at the southern end.

Changes in Habitats

NINE, *Typha* dominating the lake bed
(RJ-WI, 25Nov08)

YARN, Increased extent of open water
(AC, 8Jan09)

YARN, Dead thicket of *Melaleuca lateritia*
(RJ-WI, 26Nov08)

YARN, Some regeneration of *M. lateritia*
(AC, 8Dec09)

OWIN, Expansion of *Typha* (AC, 16Feb10)

YARN, Some regeneration of thin sedge
(AC, 8Dec09)

Changes in Habitats — Continued

PLEA, Probable increase in SH in north
(AC, 4Dec09)

YELL, Death of all live trees on lake bed
(RJ-WI, 29Nov08)

YELL, Dead paperbarks (RJ-WI, 29Nov08)

ESP1, Dead Yate trees (RJ-WI, 1Dec08)

ESP1, Yates have fallen on melaleucas
(AC, 15Sep09)

SHAR, Melaleucas at W end have died
(AC, 6Dec09)

Numbers of waterbird species recorded, and species rec rded breeding

Table 6 compares survey effort, number of species and number of breeding species recorded at each wetland, before and during the 2008-9 and 2009-10 surveys. All waterbird species, not just sensitive species, are considered.

Table 6. Number of waterbird species recorded and number of species recorded breeding, at each wetland, pre-2008, 2008-09 and 2009-10.

	No. of surveys			*Species Recorded*			*Breeding Species*		
	pre-2008	*2008-9*	*2009-10*	*pre-2008*	*2008-9*	*2009-10*	*pre-2008*	*2008-9 **	*2009-10**
NINE	32	1	1	22	9	8	6	3	4
DAVI	2	1	1	5	3	2	4	1	0
YARN	23	2	2	14	11	10	4	6	8
BOA1	22	2	2	34	13	4	0	3	4
OWIN	18	-	2	39	-	5	9	-	4
PLEA	35	2	1	24	13	7	5	5	5
ALB2	9	-	2	8	-	8	1	-	4
METT	19	2	2	16	13	11	0	7	4
YELL	9	1	1	40	15	9	11 **	2	7
ESP1	5	1	2	12	15	14	3	3	3
SHAR	60	1	2	43	15	14	8	7	4

* Breeding data for 2008-9 include unidentified nests where the nest was of a species not otherwise recorded breeding at the time, and include old nests (up to about three years old). In this Table, breeding data for 2009-10 do not include old (pre- 2009-10) nests.

** Includes 2 species (Night-Heron, Wood Duck) found breeding only in October 1979 (J Lane & G Pearson).

Pre-2008 data are from the RAOU Waterbirds Database 1981-9 (partly reported in Jaensch *et al.* 1988), Jaensch 1992, Jaensch & Clarke 1993, Storey *et al.* 1993, Clarke & Lane 2003, and some 1979 DEC datasheets (J Lane).

The number of species recorded or recorded breeding te s to increase with number of surveys (Jaensch *et al.* 1988; Halse *et al.* 1993b); hence results for 2008-9 or 2009-10 alone could be expected to be poorer than suggested by previous (accumulated) knowledge, especially at wetlands with a large number of pre-2008 surveys (e.g. SHAR, PLEA). However, at one wetland (ESP1) the number of species recorded was higher in 2008-9 and 2009-10 at another (ALB2) it equalled (in 2009-10) the pre-2008 number. Furthermore, the number of species recorded breeding w higher in 2008-9 and/or 2009-10 than pre-2008 at four wetlands: YARN, BOA1, ALB2 and METT. Some of these increases reflect a greater intensity of effort and/or expansion of survey methods applied; nest searching by experts probably had not occurred previously at METT or ALB2. Others may reflect seasonal or inter-annual variability in wetland water levels and thus th area and type of habitat that is inundated.

Notwithstanding the above, some of the marked changes (Table 6) can be confidently attributed to changes in habitat extent or quality. At YELL, both the lower number of waterbird species and lower number of breeding species are surely due to loss of live

tree habitat and changes to food resources with the ri n salinity. At NINE, the lower number of species in 2008-9 and 2009-10 may be partly due to the loss of open water habitat, but the lower number of breeding species probably reflects the lower number of 2008-9 and 2009-10 surveys. At DAVI, the lower number of breeding species in 2008-9 and 2009-10 is perhaps due to increased salinity.

The increase (from 2 to 7) in number of breeding speci at YELL in 2009-10 is thought to be entirely due to changes in survey technique, the type and area f habitat searched and the amount of time spent searching. In 2008-9 the search was by two observers in one boat and was limited to the open water area and th inner (deeper) margin of the dead tree zone. In 2009-10 the water level was too low to operate a boat and t searches were conducted on foot by two observers walki some distance apart through the dead tree zone.

The decrease in number of species recorded (from 39 to 5) and breeding species recorded (from 9 to 4) from pre-2008 to 2009-10 at OWIN is thought to be due to differences in survey technique and area covered. The 2009-10 surveys were focussed on searching for bitterns and other sensitive breeding species and were confined to the eastern end of this swamp.

Sensitive species

Table 7 compares the number of individuals counted, an breeding activity recorded, in 2008-9 and 2009-10 and previously ('pre-2008'), for each wetland, and is confined to sensitive species.

In our previous report (Jaensch *et al.* 2009), we concluded that there were marked differences between the 2008-9 and pre-2008 occurrences of sensitive species at two wetlands. In that report we stated:

- *"At YARN (despite two 2008-9 surveys), there was loss of all previously-recorded sensitive species, both breeding [ALiB, SpCk] and non-breeding [AusB]. It is not yet apparent as to whether or not these losses, due at east partly to major changes in habitat on-site, are reversible. One sensitive species was newly recorded at YARN: breeding by (presumed) Little Pied Cormorant in fr ging live paperbark trees".*
- *"At YELL there was loss of all previously-recorded sensitive species, both breeding and non-breeding. This is likely to be an irreversible loss arising from major changes in habitat on-site".*

Yarnup

In 2009-10, two of YARN's 'lost' sensitive breeding species [ALiB, Crake] 'returned' and breeding by LPiC was confirmed. The ALiB and Crake nests of 2009-10 were in regenerating fine sedge within the regenerating *M. lateritia* thicket.

In 2008-9, ALiB were not heard calling on YARN and could not be induc to call (by vocalisations), suggesting that they were, in fact, not present. In 2009-10, ALiB were not, at first, heard calling, but were later induced to call by vocalisations by RJ. These

observations, and the lack of any other evidence that ALiB's were present in 2008-9, support the conclusion that ALiB were not breeding and not present in YARN in 2008-9.

Crakes were not heard calling in YARN in 2008-9 or 2009-10, but were present and breeding in 2009-10. The absence of calling in 2008-9 is therefore not strong evidence that they were not present in 2008-9. They were perhaps present but undetected.

2009-10 produced the first known record of SwHa breeding in YARN. Searching of the tall, dense stand of *Baumea articulata* in which an active nest was found in 2009-10 was not as intensive in 2008-9 so it is possible that 2009-10 is not the first time that SwHa have bred in YARN.

Yellilup

Two sensitive breeding species also 'returned' to YELL in 2009-10. One YbSl nest with young and one unidentified heron nest that appeared to have been rec ntly used were found in two tall dead trees within this lake's dead t e zone. These were the only active spoonbill and heron nests found, despite extensive searching.

Nine Mile

2009-10 also produced the first known record of SwHa breeding in NINE. This nest was in tall, dense, 'live' (green) *Typha* near the centre of the swamp. SwHa may thus have benefitted to some extent from the long-term decline in water levels and the consequent expansion of *Typha* into areas of NINE that were formerly open water.

Davies

Concerning DAVI, we observed in our previous report that by 2008-9 there had been a possible loss of a sensitive species but more surveys would be needed to confirm this. In 2009-10 no crakes or crake nests were recorded, adding weight to the suggestion that these species have been lost from this wetland.

Owingup

Notable differences between pre-2008 and 2009-10 results for sensitive species at OWIN were the smaller number of AusB recorded in 2009-10 (from 5 to 1), the first record of possible breeding by ALiB in 2009-10, and the fact that no breeding by Dart or LiBC was recorded in 2009-10. All of these changes may be wholly or partly due to differences in the number, areal extent and intensity of surveys between the two periods, but it is noteworthy that the lower number of AusB recorded in OWIN in 2009-10 is consistent with the supposition (Wetlands International 2006) that this species has declined in numbers in the south-west, and elsewhere in Australia, in recent decades.

Albany 27157 (Cheyne Rd Nature Reserve)

2009-10 produced the first record of AusB breeding in ALB2 (Albany 27157). This wetland was not extensively searched for sensitive breeding species pre-2008, so it is not known if breeding by AusB is new to this wetland.

Table 7. Number counted and breeding activity of sensitive species at each wetland pre-2008, 2008-09 and 2009-10.

Numbers and breeding: AusB = Australasian Bittern, ALiB = Australian Little Bittern, SpCk = Spotless Crake, BaCk = Baillon's Crake, ASCk = Australian Spotted Crake, BbaR = Buff-banded Rail, BbiD = Blue-billed Duck, and FreD = Freckled Duck

Breeding only: SwHa = Swamp Harrier; YbSl = Yellow-billed Spoonbill; LPiC = Little Pied Cormorant; WnHe = White-necked Heron; NaNH = Nankeen Night-Heron.

Br = breeding, one nest/brood unless otherwise indicated nd on only one occasion unless otherwise indicated.

wetland	*sensitive species pre-2008*	*sensitive species 2008-09*	*Sensitive species 2009-10*
NINE	ALiB (1, **Br**); SpCk (8, **Br?**: several old crake nests).	ALiB (1); SpCk (10, **Br?**: 3 old crake nests).	SpCk (1); SwHa (**Br**: one nest used this year)
DAVI	SpCk (1, **Br**).	No crakes or their nests recorded.	No crakes or their nests recorded.
YARN	AusB (2); ALiB (**Br**: in 4 years in 1980s, up to 19 nests, with 12 active nests in 1983-4 season); SpCk (18; **Br,** 3+ nests, mid 1980s).	LPiC (**Br**: 11 nests probably of this species). No bitterns or crakes recorded and no old nests found of these species.	SwHa (**Br**: one nest, large juvenile nearby); LPiC (**Br**: 7 nests used this year); crake (**Br**: 2 new nests); ALiB (2, **Br**: 2 new nests in *M. lateritia*)
BOA1	AusB (3); SpCk (13).	AusB (up to 3); ALiB (3); SpCk (up to 6, a possible old nest); BbiD (6).	crake (**Br**: 2 new nests in fine sedge tussocks); SpCk (4)
OWIN	AusB (5), SpCk (19, **Br**: 1 active & 1 old nest); BbiD (6); LiBC (**Br**: 10 active nests); Dart (**Br**: 2 active nests).	Not surveyed.	BbiD (1); crake (2); AusB (1); ALiB (**Br?**)
PLEA	AusB (5, **Br**: a nest reported in Dec 1986 by Tony Bush); ALiB (1, **Br**); SpCk (4); SwHa (2, BR: young in nest.	AusB (2); ALiB (2, **Br**: an old nest and a probable new nest); SpCk (6).	AusB (4, **Br**); ALiB (1); SpCk (4)
ALB2	AusB (5); SwHa (**Br**: 1 active nest in 1979 reported by JLane).	Not surveyed.	SpCk (2); AusB (1, **Br**: an old nest and two new nests)
METT	AusB (2); ALiB (1); SpCk (3).	AusB (1); ALiB (1, **Br**: old nest, new nest); LPiC (**Br**: 40 nests).	ALiB (2, **Br**); SpCk (4, **Br**)
YELL	BbiD (30); FreD (2); **Br**: by NaNH (20 nests), LPiC (17 nests), a few YbSl & WnHe.	No BbiD or FreD; no colonial nesting recorded (one very old heron nest was recorded).	heron (**Br**); YbSl (**Br**)
ESP1	BbiD (1). Potential for small breeding colonies in live trees.	BbiD (1); FreD (2). Potential for small breeding colonies in live trees.	No sensitive species of either category (numbers or breeding)..
SHAR	AusB (1); SpCk (11, **Br**); BaCk (4); ASCk (6, **Br**); BbaR (1); BbiD (9).	ALiB (1, **Br**: a new nest); BbiD (13, **Br**: a nest with eggs); SpCk (1, **Br**: an old nest).	BbiD (1); SpCk (4); crake (1, **Br**)

Pre-2008 data are from the RAOU Waterbirds Database 1981-9 (partly reported in Jaensch *et al.* 1988), Jaensch 1992, Jaensch & Clarke 1993, Storey *et al.* 1993, Clarke & Lane 2003, and some 1979 DEC datasheets (J Lane).

The table shows records of colonial tree-nesting species and some other sensitive species, e.g. SwHa, only in relation to their breeding.

See datasheets in Appendix 4 for details of 2008-9 records.

Waterbird breeding efforts

The numbers of waterbird nests, of any age, found at each wetland duri surveys in 2008-9 and 2009-10 are shown in Table 8. In those wetlands where second surveys (i.e. in Jan 2009 and/or Feb 2010) were conducted, it was possible to determine, from records of survey paths and GPS positions of nests, which nests were additional to those found in the first surveys of late 2008 and late 2009 respectively. In some cases the older nests examined in 2009-10 were known to be active (those found in 2008-9) or were possibly active (those *not* found in 2008-9) in 2008-9. In other cases they were older. See Appendix 3 for detail.

Table 8. Number of waterbird nests found at each wetla d in 2008-9 and 2009-10.

(HhGb = Hoary-headed Grebe; MusD = Musk Duck; PuSn = Purple Swamphen; LPiC = Little Pied Cormorant; AReW = Australian Reed-Warbler; LiGd = Little Grassbird; PaBD = Pacific Black Duck; Hard = Hardhead; Coot = Eurasian Coot; ChTl = Chestnut Teal; Swan = Black Swan; ALiB = ralian Little Bittern; SpCk = Spotless Crake; BbiD = Blue-billed Duck; YbSl = Yellow-billed Spoonbill; SwHa = Swamp Harrier).

	2008-09			*2009-10*		
wetland	***number of active or recent (2008-9) nests***	***number of older nests *****	***breeding species (number of nests of any age)***	***number of active or recent (2009-10) nests***	***numb er of older nests *****	***breeding species (number of nests of any age)***
NINE	0	7	AReW (3), crake (3), duck (1).	7	0	Swan (2), AReW (3), SwHa (1), MusD (1)
DAVI	3	0	HhGb (1), grebe (2).	0	0	0
YARN *^	20	9	LPiC? (11), PuSn (7), HhGb (3), MusD (2), LiGd (2), AReW (1), duck (2), other (1).	41	4+	HhGb (4), LiPC (9), MusD (9), PuSn (4), AReW (8+), SwHa (1), crake (2), duck (4), other (2), ALiB (2)
BOA1 *^	3	1	PuSn (2), Swan (1), crake? (1).	8	0	Swan (2), MusD (1), crake (2), duck (1), PuSn (1), other (1)
OWIN ^	-	-	-	9	0	MusD (2), LiGd (5), ALiB (1), PuSn (1)
PLEA *	7	1	ALiB (2), Hard (2), MusD (2), PaBD (1), PuSn (1).	10	0	MusD (3), LiGd (1), PuSn (3), AReW (2), AusB (1)
ALB2 ^	-	-	-	16	3	MusD (8), PuSn (5), other (2), duck (1), AusB (3)
METT *^	24	43	LPiC (40), MusD (8), AReW (5), PuSn (4), duck (3), crake? (3), ALiB (2), Coot? (1), PaBD (1); also other nests not counted.	5	0	AReW (1), SpCk (1), MusD (2), ALiB (1)
YELL	1	1	ChTl (1 brood), heron? (1 old nest).	6	12+	Duck (1), heron (1), BwSt (1), Swan (10+), Coot (2), YbSl (1), GyTl (2),
ESP1 ^	2	1	HhGb? (1), PaBD? (1), Coot? (1).	8	0	ChTl (1), Swan (1), BwSt (6)
SHAR ^	6	8	AReW (7), PuSn (2), ALiB (1), BbiD (1), SpCk (1), HhGb (1), Coot? (1).	13	Numer -ous	AReW / LiGd (1 + numerous), AReW (numerous), MusD (3), crake (1), PuSn (8)

* Surveyed twice in 2008-9. ^ Surveyed twice in 2009-10.

** Includes nests of unknown age (up to about 3 years old). See Appendix 4 for details. Data include unidentified s.

Similar data on numbers of nests pre-2008 are not available consistently for all wetlands so comparisons between recent and pre-2008 data are problematic. Also, nest searching in 2009-10 (and 2008-9) was not exhaustive at all wetlands (see Limitations, above). However, we consider the following waterbird breeding observations from 2008-10 to be noteworthy, bearing in mind that more nesting wa undoubtedly occurring in 2008-10 than was discovered:

- A substantial amount of breeding (at least 30 nests/broods) has occurred in recent years at two wetlands (METT 72 nests/broods, YARN 70).
- One wetland (DAVI 3) currently seems to be of low importance for breeding with respect to number of nests/broods.
- Wetlands with high numbers of nests and diversity of b eeding species (e.g. YARN) have diverse habitats including areas of dense sedges and trees/shrubs though these characteristics do not necessarily guarantee a large number of nests (cf. BOA1).
- Wetland area is not the critical factor. Small wetlands (e.g. SHAR) can have significant breeding activity both in terms of number of nests and number of breeding species.
- 20 breeding species were identified across the surveyed etlands.
- The most prolific waterbird breeding species were: Little Pied Cormorant (60 nests), Musk Duck (41), Purple Swamphen (39) and Australian Reed-Warbler (at least 30),
- Breeding by sensitive species comprised: Little Pied C rmorant (60 nests), Australian Little Bittern (9 nests), Australasian Bittern (4), Spotless Crake (2), unidentified crakes (12), Swamp Harrier (2), Blue-billed Duck (1), Yellow-billed Spoonbill (1) and unidentified heron (1).
- Swamp Harriers were recorded nesting on two occasions, at NINE and YARN. Its active nests have rarely been found within the project area and are therefore of considerable interest.
- More nests and breeding species were found at Yellilup in 2009-10 than in 2008-9 due to differences in the way this survey was conducted.

Other compositional differences

A number of differences in species composition with respect to occurrence and/or breeding are evident in the results of the 2008-9 and 2009-10 surveys. Salient points not already revealed in the above sections are as follows:

- Australasian Grebe was recorded at DAVI pre-2008, but not in 2008-9 nor in 2009-10. Perhaps this is related to the increasing salinity of DAVI (Lane *et al.* 2011; Davies 2010). This species commonly avoids saline waters.
- Small colonies of old cormorant nests, probably of Lit le Pied Cormorant, were recorded at YARN in 2008-9, possibly for the first time. Seven active Little Pied Cormorant nests were found in 2009-10. There is no obvious explanation for this change in breeding status, unless perhaps an abundance of freshwater crayfish had arisen locally, on-site or in nearby stocked farm dams.
- The 2008-9 surveys produced first records of Hoary-headed Grebe at PLEA, YARN, METT and ESP1 and first record of breeding by th species at YARN, ESP1 (?) and SHAR. In 2009-10, Hoary-headed Grebes were recorded only at DAVI and YARN and were recorded breeding only at YARN. These may be indicators of either a short term or long term influx of the species to the study area,

or due to increases in salinity of wetlands (DAVI, YARN, ESP1) though that trend has not occurred at all applicable sites (SHAR). In south-western Australia, Hoary-headed Grebe often breed in brackish (Goodsell 1990) and even saline (D. Cale, unpublished data) wetlands. During 1981-5, this species was reported breeding at 17 of 197 surveyed wetlands, 11 of these being above 3 parts per thousand (i.e. brackish or saline), however it was not recorded breeding at any of the 20 surveyed wetlands in the south coast and Muir-Unicup districts (see Jaensch *et al.* 1988).

- In January 2009, Hardhead were recorded breeding (2 nests) for the first time at PLEA; this species is known to commonly exploit flood conditions (RJ pers. obss.), so the result may be due to the unusually heavy rain a d local flooding in November-December 2008. No breeding by Hardhead was recorded during the 2009-10 surveys.
- Notable among the breeding species recorded at METT in 2008-9, all being new records, were extensive use of partially-inundated *Gahnia* tussocks for duck nests (especially Musk Duck) and several small colonies of L e Pied Cormorant (of varied antiquity, some active) in inundated live Yate and paperbark trees. In 2009-10, no nesting by Little Pied Cormorants was found and sk Duck were recorded nesting only in *B. articulata*. The *Gahnia* tussocks were dry in 2009-10.
- At YELL in 2008-9, there was a first record of nesting by Chestnut Teal (one brood). Noteworthy numbers of Australasian Shoveler (40) were present d spite elevated salinity. Many hundreds of the several thousand Austra an Shelducks at YELL were moulting. In 2009-10 Chestnut Teal and Shoveler were not recorded at YELL, however there were one thousand Shelduck, many flightless due to being in moult.
- The first record of Great Crested Grebe at Shark Lake occurred in 2008-9. They were recorded (2 birds) here again in 2009-10.

Numbers of waterbirds

Data on total numbers of all waterbird species were recorded in the 2008-9 and 2009-10 surveys but this was not a priority outcome because ou cus was on the occurrence of sensitive species and their habitats. For completeness and possible application in wetland management, summary information on total numbers and most-abundant species in 2009-10 is given in Table 9.

Apart from the omission of perhaps tens or (at larger swamps) possibly a few hundreds of the smaller secretive waterbirds (total numbers of ich are, in practice, impossible to determine in densely-vegetated swamps), these totals are considered in most nstances to reasonably reflect the actual total numbers present.

In 2009-10, highest numbers, by a substantial margin, were again at the highly saline (and large) Yellilup Lake. Numbers counted at the other wetlands, six being predominantly very fresh (<1 ppt), two being brackish (3<10ppt) and two being saline (10<50 ppt), were in the low (mainly) tens to c. 360 (at ESP1). In our collective experience this difference in numbers according to sal nity is common among wetlands in south-western Australia, especially on the south coast, although, in more than a few instances, fresh wetlands can hold large numbers of waterbirds and saline wetlands very few. Many other factors also influence waterbird numbers (Halse *et al.* 1993b), e.g. wetland area, bathymetry, nutrients, water clarity and pH, and factors external to the wetland, such as availability of food nearby (e.g. cer al grain in paddocks surrounding YELL attracts thousands of Shelduck to the area: Ian Peacock pers. comm.).

In 2009-10, the most abundant species across the surveyed wetlands ere some of those that tend to congregate in large numbers on open, shallow-margined lakes including saline lakes such as YELL: Australian Shelduck, Black-winged Stilt and Grey Teal. Among the fresh and low-salinity wetlands surveyed there was a diverse mix of species present in low numbers.

Table 9a. Total number of waterbirds counted at each wetland in September and/or November 2009 and the species that were most abundant

(BwSt = Black-winged Stilt; GyTl = Grey Teal; StSp = Sharp-tailed Sandpiper; PaBD = Pacific Black Duck; Swan = Black Swan)

Wetland	***Total number of waterbirds Sep 2009***	***Total number of waterbirds Nov 2010***	***The 3 most abundant species in Sep or Nov 2009*** *(5 or more individuals counted)*
ESP1	~360	203	BwSt (~200); GyTl (120); StSp (23)
SHAR	ns	80	PaBD (50); Swan (8)

ns = not surveyed.

Some less-conspicuous species were probably present in higher numbers than were counted but only the numbers seen/heard were recorded.

Table 9b. Total number of waterbirds counted at each wetland in Dec 2009 and/or Feb 2010 and the species that were most abundant

(AWhI = Australian White Ibis; HhGb = Hoary-headed Grebe; PuSn = Purple Swamphen; LPiC = Little Pied Cormorant; AReW = Australian Reed-Warbler; YbiS = Yellow-billed Spoonbill; PaBD = Pacific Black Duck; Swan = Black Swan; Shel = Australian Shelduck; BwSt = Black-winged Stilt)

Wetland	***Total number of waterbirds Dec 2009***	***Total number of waterbirds Feb 2010***	***The 3 most abundant species in Dec 2009 or Feb 2010*** *(5 or more individuals counted)*
NINE	20	ns	AWhI (8)
DAVI	25	ns	HhGb (13); PaBD (12)
YARN	37	numbers not recorded	LPiC (13); PuSn (6); AReW (5)
BOA1	24	1	MusD (12); Swan (8)
OWIN	8	2	
PLEA	24	ns	PuSn (6)
ALB2	16	6	AWhI (9)
METT	53	numbers not recorded	PaBD (24); YbiS (7)
YELL	1151+	ns	Shel (1000); BwSt (100+)
ESP1	ns	ns	
SHAR	49	ns	PaBD (20); Swan (8)

ns = not surveyed.

Numbers of AReW are a minimum: more were almost certainly present than were recorded. Some other species were also probably present in higher numbers than were counted but only the numbers seen/heard were recorded.

The low number of waterbirds counted at OWIN and ALB2 in 2009-10 is a reflection of survey focus, which was on searching for sensitive waterbirds, particularly bitterns. Many more birds were present at OWIN than the small numbers counted would suggest.

Importance of the wetlands

In our previous report (Jaensch *et al.* 2009), we assessed — using all data up to and including 2008-9 — the importance of six of the eleven wetlands of this project in terms of number of species, breeding species, threatened species, sensitive species and migratory species, number of individual birds, size of breeding effort and percentage of species' populations occurring at each.

NINE, YARN and YELL were omitted from the 2009 assessment because those wetlands had undergone substantial hydrological and vegetational c nge during the preceding 2-3 decades and, because of this, it was considered unsound to combine waterbird data from the 1980s – early 1990s with 2008-9 data to indicate the wetlands' current or former importance. OWIN and ALB2 were not part of the 2009 assessment since they were not added to the project until 2009-10.

The 2009 assessment is not updated here, because furth field survey work is being undertaken in 2010-11 and a consolidated assessment drawing on all data to 2011 is proposed.

Conclusions

Long term changes

In our previous report (Jaensch *et al.* 2009), we concluded that significant changes had occurred at five of the (then) nine surveyed wetlands in terms of habitat and/or waterbird use, from the early 1980s and/or early 1990s, to 2008-9. For the convenience of readers our descriptions of those changes are reproduced below. Each is then followed by a 2009-10 update.

- ***'Yarnup Lagoon*** *was formerly a significant breeding locality for Australian Little Bittern (the largest breeding aggregation in south-western Australia) and Spotless Crake and supported Australasian Bittern, but appears o have lost all of these sensitive species, as a consequence of major loss of dense emergent vegetation (tall sedgeland) and fringing vegetation (sedge-infused, live shrub thicket). This loss of habitat is predicted (R. Hearn pers. comm.) to pers st due to hydrological consequences of catchment clearing and it is not known if the changes an be reversed by intervention. Another possible indicator of change is the recent first recorded breeding by Hoary-headed Grebe, coinciding with increased salinity'.*

  In 2009-10, some regeneration of sedge-infused, live shrub thicket (*M. lateritia*) was apparent and some renewed nesting activity by Little Bitterns and Crakes was discovered. These are positive developments but it re ains to be seen whether they are persistent or short-lived. The cause(s) of these changes has not been determined but it is noteworthy that the pH of YARN's aters was closer to normal (pH ~ 6.5) in spring of 2009 than in the two preceding years (pH ~ 4; pH ~ 4.5).

- ***'Yellilup Lake*** *was formerly a fresh to brackish lake supporting herons, spoonbills, cormorants and ducks that breed in low salinity, periodically-inundated, live-wooded swamps, but has lost all live woodland habitat in its zone of seasonal inundation due to prolonged (multi-year) inundation and salinisation. Consequently these sensitive species no longer breed there, a suite of ot waterbird species no longer*

occurs and these changes are probably irreversible, at least in the short to medium term (decades)'.

In 2009-10, very limited (two nests) breeding by two sensitive species and limited breeding by several other species was found, but this as due to changes in the way this lake was surveyed, rather than any improvement in habitat or conditions for breeding.

- ***'Esperance 26410** has shown a recent minor loss of habitat for sensitive waterbirds and though this is not yet manifest in major changes to waterbird use, consistent with other live-wooded swamps in the surrounding catchments it is likely that further habitat loss may occur with perhaps eventual total los (as at the similar Coomalbidgup Swamp, 45 km to the east). It is not known if the changes can be reversed by intervention'.*

  In 2009-10, further deterioration in the health of some Yates and melaleucas was observed; some of these appeared to be dying.

- ***'Nine Mile Lake** has lost most of its open water but gained some dense vegetation that harbours sensitive species. Some waterbird species recorded in moderate numbers in the past probably do not use the wetland in its present condition, notably Great Cormorant (prefers deep open water; up to 29 counted in 1980s) and Red-capped Plover (occurs on beaches and drying open lake eds; up to 20 counted in 1980s). Changes are probably reversible by intervention, i.e. restoring former water depths, but impacts on sensitive species now using the main lake would need to be considered'.*

  In 2009-10, the habitat situation at NINE appeared unchanged. A sensitive breeding species, the Swamp Harrier, was recorded bree ing for the first time, its nest located in dense vegetation near the centre of the lake, an area that was once open water.

- ***'Lake Davies** There are some indications of possible loss of habita and loss of a sensitive species (Spotless Crake) and two breeding sp cies (Spotless Crake, Australasian Grebe)'.*

  In 2009-10, the habitat situation at DAVI appeared unchanged and there was no significant change in use by waterbirds.

- **Owingup Swamp** was surveyed for the first time in this project in 2009-10. Bulrush *Typha orientalis*, an introduced and invasive plant species, has expanded its occurrence at the southern end of the swamp since the early 1990s. This provides some additional nesting habitat, foraging habitat and shelter for both sensitive and non-sensitive species of waterbirds, though only non-sensitive species (Little Grassbird and Purple Swamphen) were found nesting in the *Typha* in 2009-10. Massive expansion of the *Typha* would have severe negative impacts on biodiversity values of the swamp and its areal extent should therefore be monitored.

- **Shark Lake** underwent some changes in habitat availability in 2009-10. Many melaleuca trees at the western end of the lake had died and fallen since 2008-9. This may be of some small, short-term benefit to certain non-sensitive waterbirds such as some ducks, but will be of concern if continues and regeneration does not occur.

In our previous report, we also concluded that: *'With respect to sensitive species, gains* [in 2008-9] *in terms of newly-listed species at BOA1, METT, ESP1 and SHAR and newly-listed breeding species at YARN, METT, and SHAR (Table 7) are considered to reflect survey methods and limitations rather than any real change over time'*. The same comment may be appropriately applied to the gains in s es at ALB2 and in breeding species at YARN, BOA1, OWIN (?), ALB2 and METT in 2009-10.

Action to recognise the importance of specific wetlands

In our previous report, we concluded that, based on all survey data up to and including 2008-9, three (BOA1, PLEA and METT) of the (then) nine surveyed wetlands *might* (depending upon the results of further surveys) be considered internationally important under Criterion 2 (threatened species and communities) of the Ramsar *Convention on Wetlands* because during the preceding 2-3 decades and including in 2008-9 they supported Australasian Bittern, a species listed as globally endangered. The surveys of 2009-10 have shown continuing use and breeding by Australasian Bitter at PLEA, but not at BOA1 and METT. Further surveys of these wetlan have been conducted in 2010-11 and the results are to be reported.

We also observed in our previous report that two of the surveyed wetlands (PLEA and SHAR) have supported at least 1% of the relevant (south-western Australian) populations of Australasian Bittern (1% = 5 birds) and Chestnut Teal (1% = 50 birds) on one or more occasions during the past 2-3 decades. We concluded that further surveys would be needed to establish continued and regular use at the =1% level and therefore did not propose nomination of either of these wetlands for listing under Criterion 6 of the Ramsar Convention at that time.

In 2009-10, four Australasian Bittern were recorded at PLEA and single individuals were found at OWIN and ALB2. No Chestnut Teal were recorde at SHAR; only 16 individuals were found at ESP1 and none were recorded at the other nine project wetlands. The results of the 2010-11 surveys have yet to be reported.

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Appendix 1. Scientific and English names of waterbird mentioned in this report.

Based on Christidis and Boles (2008).

FAMILY & SCIENTIFIC NAME	ENGLISH NAME
Anatidae	
Biziura lobata	Musk Duck
Stictonetta naevosa	Freckled Duck
Cygnus atratus	Black Swan
Tadorna tadornoides	Australian Shelduck
Chenonetta jubata	Australian Wood Duck
Malacorhynchus membranaceus	Pink-eared Duck
Anas rhynchotis	Australasian Shoveler
Anas gracilis	Grey Teal
Anas castanea	Chestnut Teal
Anas superciliosa	Pacific Black Duck
Aythya australis	Hardhead
Oxyura australis	Blue-billed Duck
Podicipedidae	
Tachybaptus novaehollandiae	Australasian Grebe
Poliocephalus poliocephalus	Hoary-headed Grebe
Podiceps cristatus	Great Crested Grebe
Phalacrocoracidae	
Microcarbo melanoleucos	Little Pied Cormorant
Phalacrocorax carbo	Great Cormorant
Phalacrocorax sulcirostris	Little Black Cormorant
Ardeidae	
Botaurus poiciloptilus	Australasian Bittern
Ixobrychus dubius	Australian Little Bittern
Ardea pacifica	White-necked Heron
Ardea modesta	Eastern Great Egret
Egretta novaehollandiae	White-faced Heron
Nycticorax caledonicus	Nankeen Night-Heron
Threskiornithidae	
Platalea flavipes	Yellow-billed Spoonbill
Accipitridae	
Circus approximans	Swamp Harrier
Rallidae	
Porphyrio porphyrio	Purple Swamphen
Gallirallus philippensis	Buff-banded Rail
Porzana pusilla	Baillon's Crake

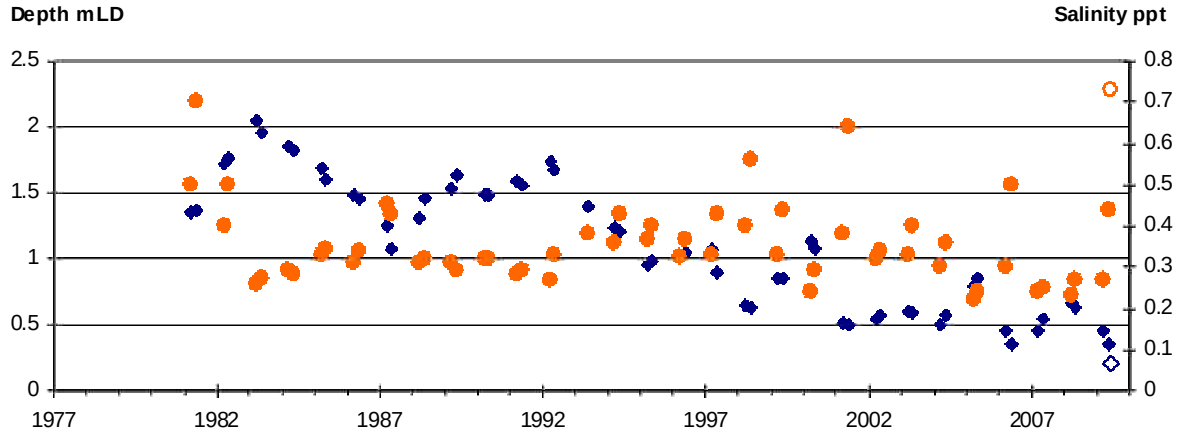
Appendix 1. Continued

FAMILY & SCIENTIFIC NAME	ENGLISH NAME
Porzana fluminea	Australian Spotted Crake
Porzana tabuensis	Spotless Crake
Gallinula tenebrosa	Dusky Moorhen
Fulica atra	Eurasian Coot
Charadriidae	
Charadrius ruficapillus	Red-capped Plover
Acrocephalidae	
Acrocephalus australis	Australian Reed-Warbler
Megaluridae	
Megalurus gramineus	Little Grassbird

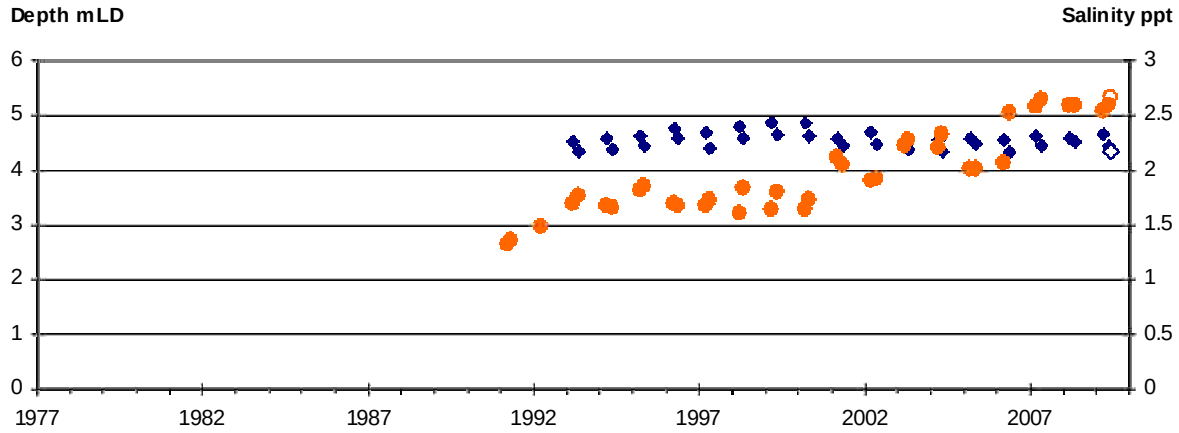
Appendix 2. Depths and salinities of the eleven selected wetlands over the entire period of monitoring by DEC

Blue diamonds = depth in metres, surveyed to deepest part of the wetland (mLD = metres Local Datum). Orange dots = salinity in parts per thousand.

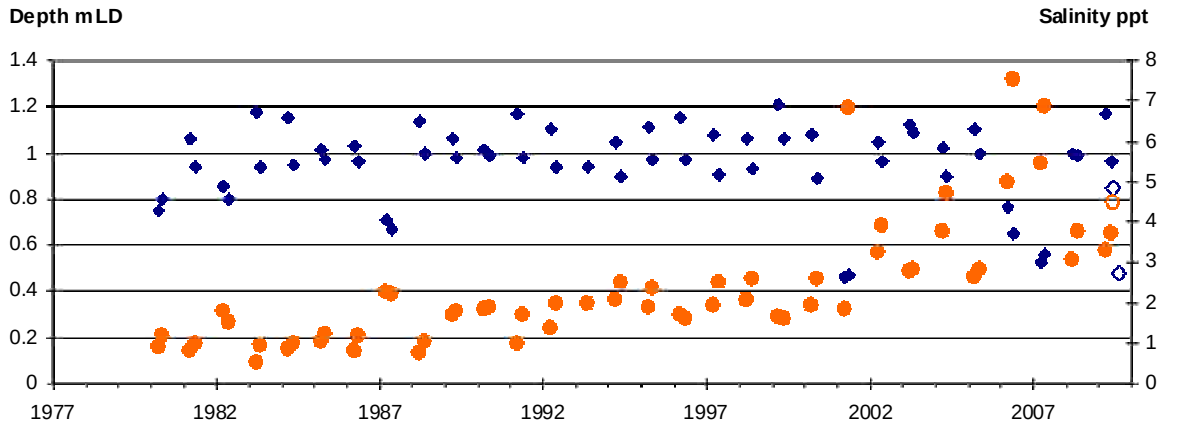
Nine Mile Lake (NINE)



Lake Davies (DAVI)

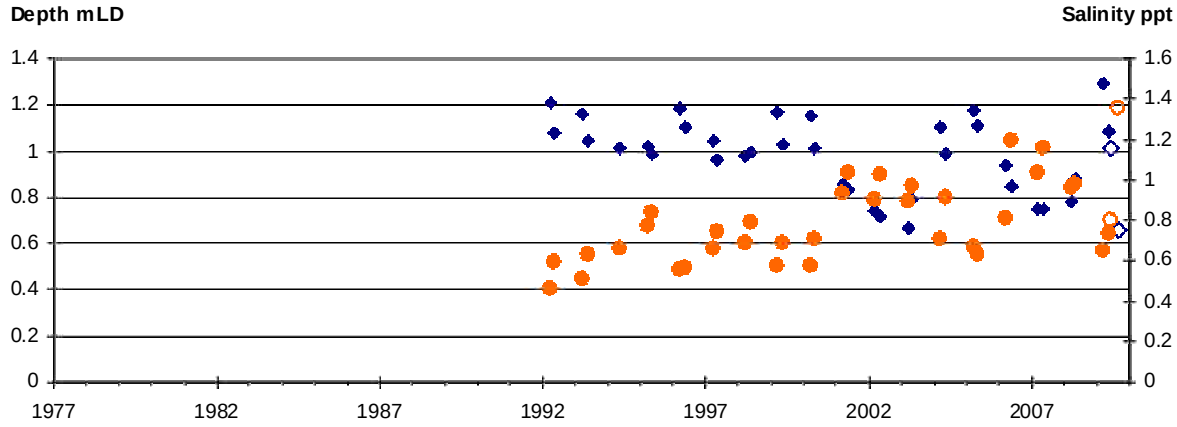


Yarnup Lagoon (YARN)

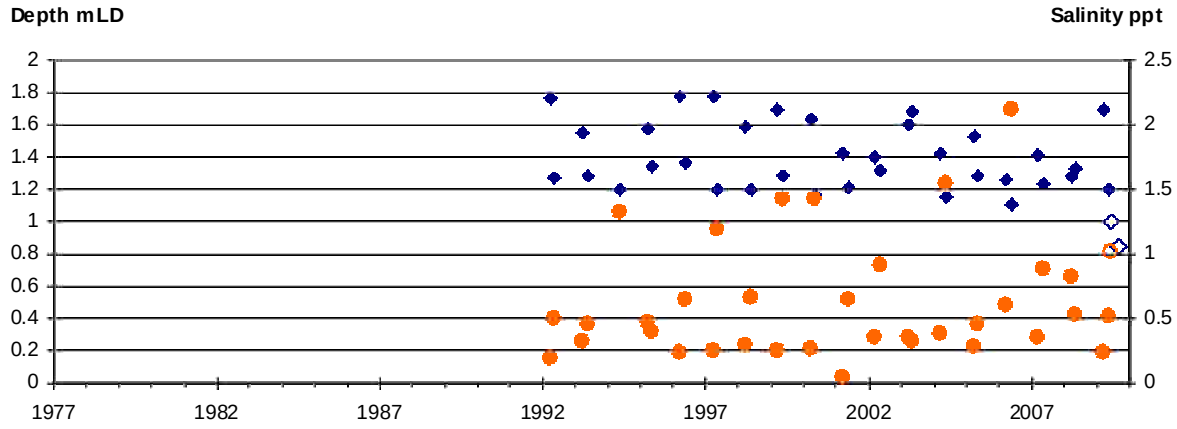


Appendix 2 continued

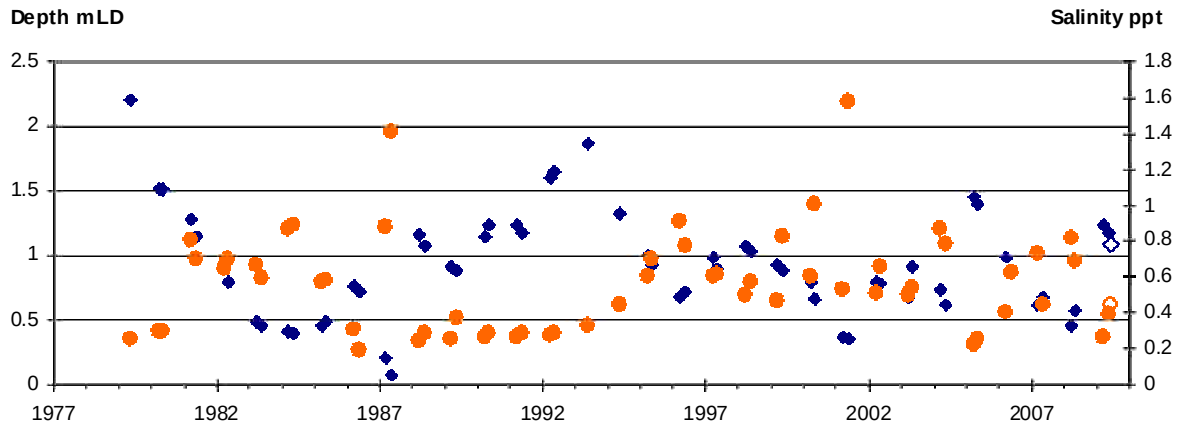
Boat Harbour Lake 1 (BOA1)



Owingup Swamp (OWIN)

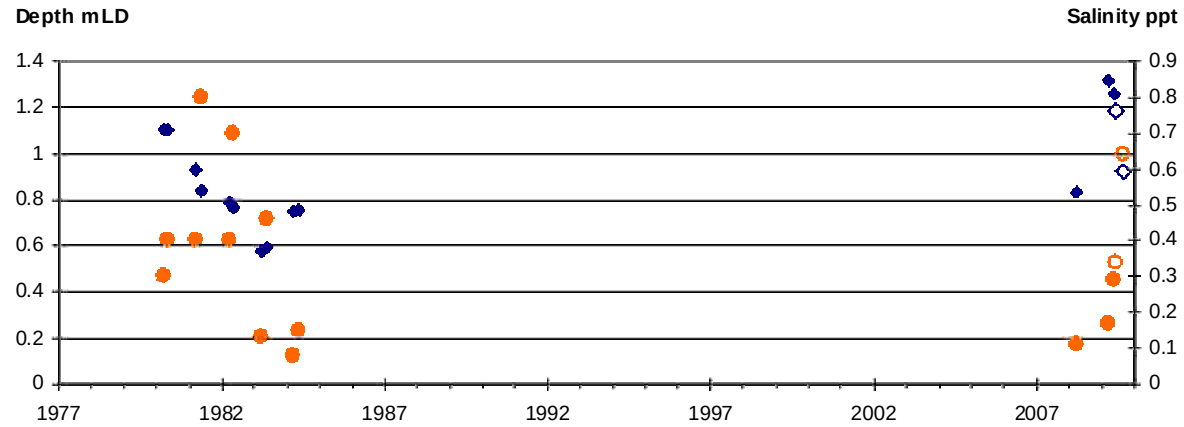


Lake Pleasant View (PLEA)

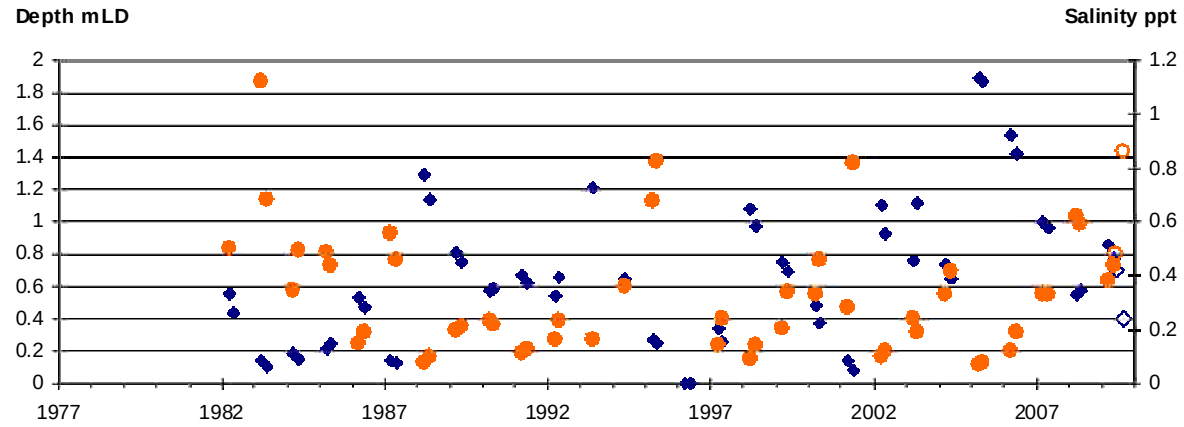


Appendix 2 continued

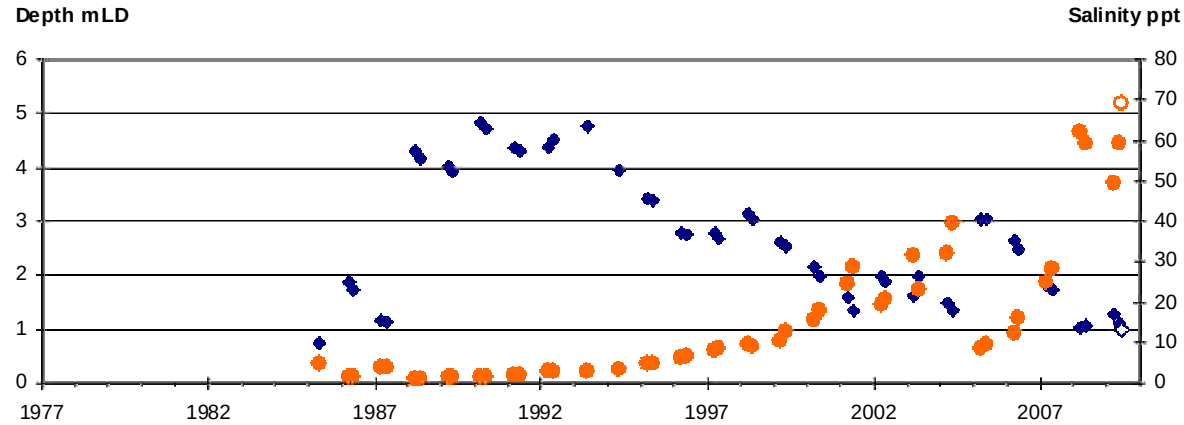
Albany 27157 (ALB2)



Mettler Swamp (METT)

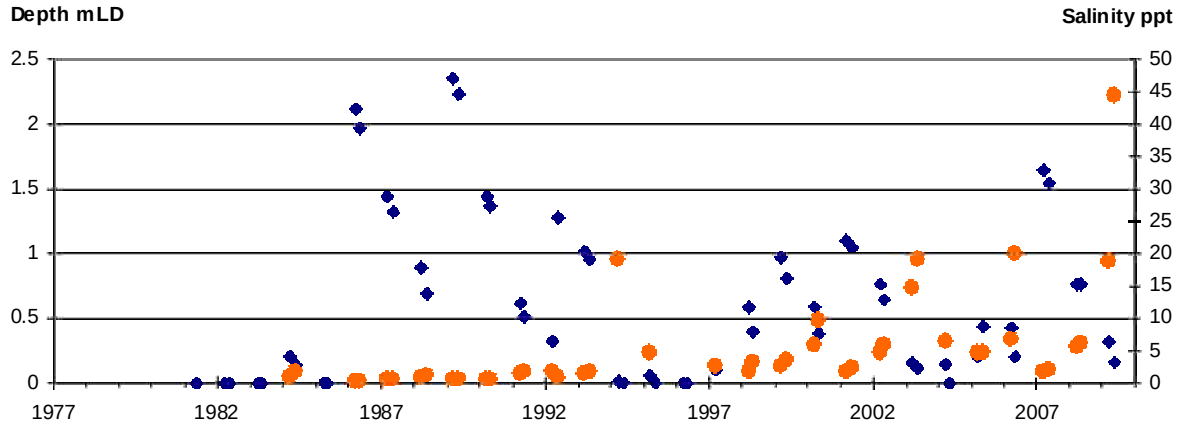


Yellilup Lake (YELL)

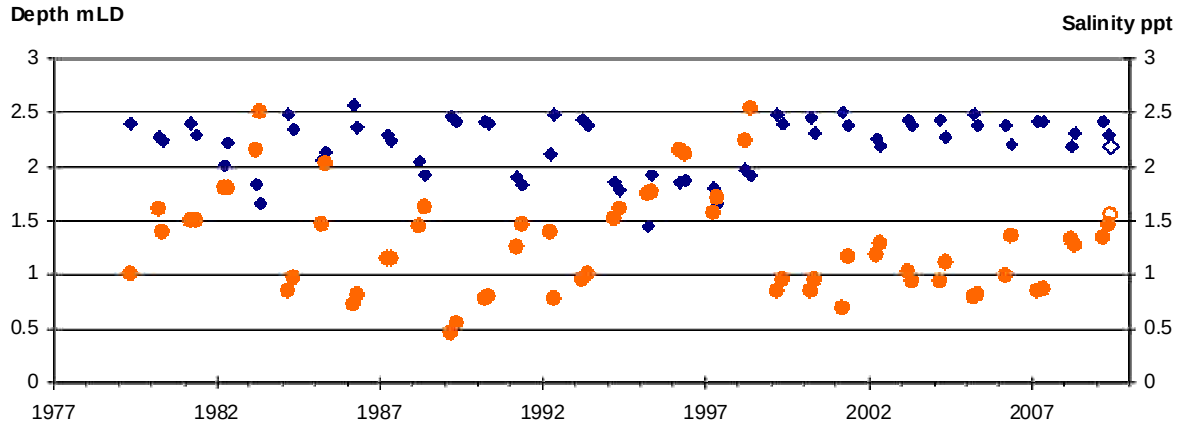


Appendix 2 continued

Esperance Reserve 26410 (ESP1)



Shark Lake (SHAR)



Appendix 3. Summary data sheets, maps and photographs of surveyed wetlands

Nine Mile Lake

Lake Davies

Yarnup Lagoon

Boat Harbour Lake 1

Owingup Swamp

Lake Pleasant View

Albany 27157

Mettler Swamp

Yellilup Lake

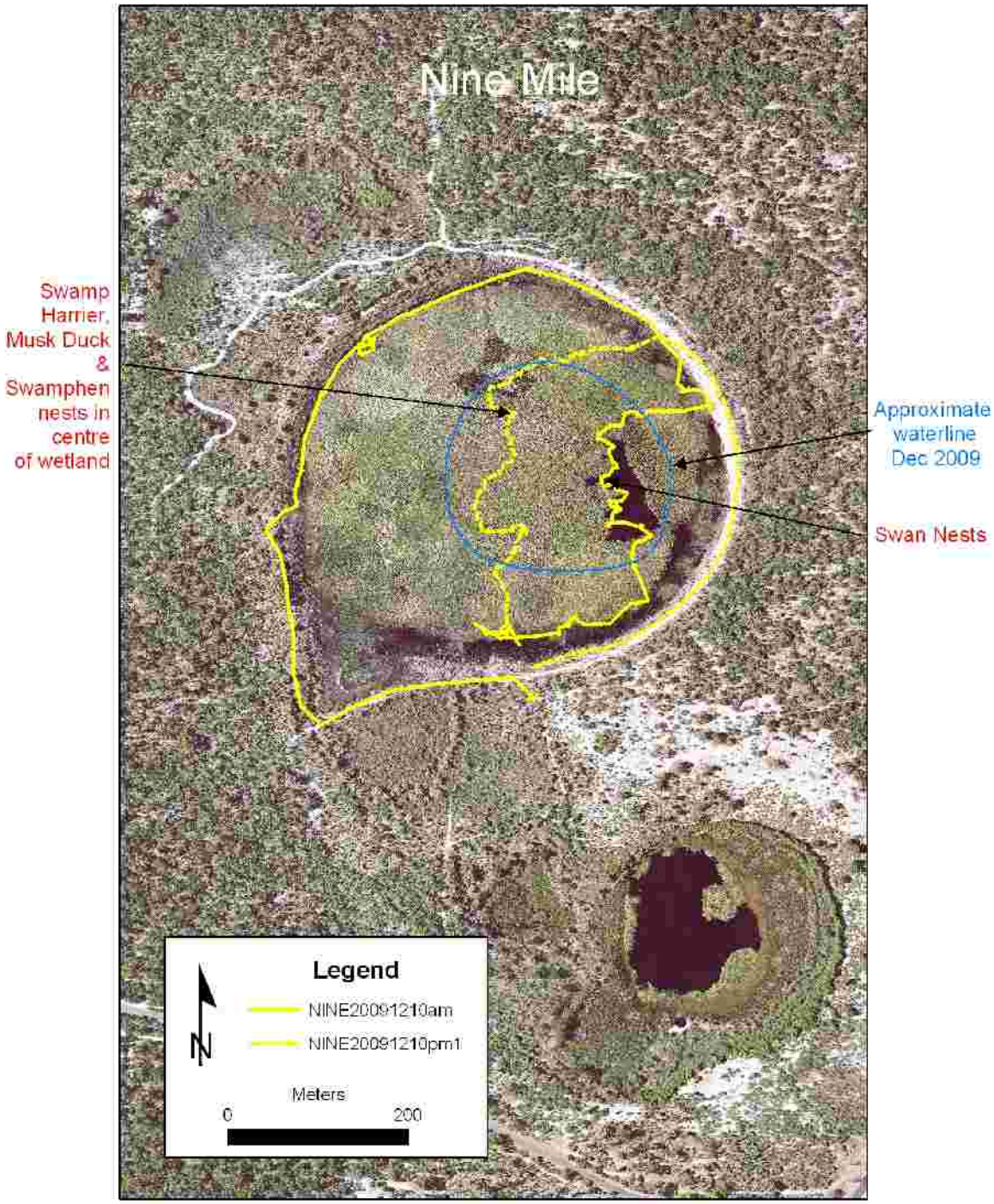
Esperance 26410

Shark Lake

Nine Mile Lake – survey (10 December 2009) data

	DATA	COMMENTS
Wetland name	Nine Mile Lake (NINE)	Within a nature reserve.
Observers	A Clarke (DEC), John Graff (volunteer).	
Date/s	10 December 2009	
Start & finish time/s (Day 1)	11:15 – 19:30	Two breaks of 1:45hrs and 1:30hrs
Start & finish time/s (Day 2)		
Total duration of survey	5.0 hours	Includes 1.0 hour listening at night
Weather (windy?)	Fine, hot and calm.	
% of wetland inundated	20 % (of main basin)	Both satellite swamps were dry.
% of inundated area surveyed	40 %	
Water depth at gauge	Dry at Gauge B	Only 20cm in open pool.
Survey methods used	Scan from shore; wading; intense nest-searching.	
Habitats searched for nests	Tall sedge; *Typha* beds; shrubs with sedge.	
Change since 1980s/1990s?	Open lake invaded by *Typha* up to 2.5m tall; less water depth than in 1980s. Satellite swamps apparently dry for many months.	
Other remarks	All species' counts likely to be the minimum number present. Lots of frogs *Litoria adelaidensis*. Evidence of pig feeding.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Spotless Crake	1 (heard only)	
Yellow-billed Spoonbill	1	
Purple Swamphen	1 (heard only)	
Little Grassbird	1 (heard only)	
Australian Reed-Warbler	2 (heard only)	Minimum count.
Swamp Harrier	3	Two adults chasing away a third.
Pacific Black Duck	3	
Aust. White Ibis	8	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Black Swan	On edge of open water pool, made of *Typha* (NINE09N1)	
Black Swan	On edge of open water pool, made of *Typha* (WPT 88)	
Australian Reed-Warbler ?	1 nest this year tall *Baumea articulata* clump and *Typha*. Nest made of shredded *Typha* (WPT 89)	
Swamp Harrier	This year's nest with down and fresh carcasses. Made of *Typha* and *Eucalyptus* sp. twigs.	
Musk Duck	This year, partial roof in thick *Typha* (NINE09N3)	
Australian Reed-Warbler ? x2	This year in tall dense *Typha*. Made of shredded *Typha* (WPT 92,93)	

Nine Mile Lake – survey (10 December 2009: AM & PM) map



Nine Mile Lake

Open water and *Typha* stand (RJ-WI, 25Nov08)

South-west edge (RJ-WI, 25 or 26 Nov 2008)

North-west edge (AC, 10Dec09)

Little Grassbird nest site (AC, 10Dec09)

Little Grassbird nest (AC, 10Dec09)

Swamp Harrier nest (AC, 10Dec09)

Nine Mile Lake — Continued

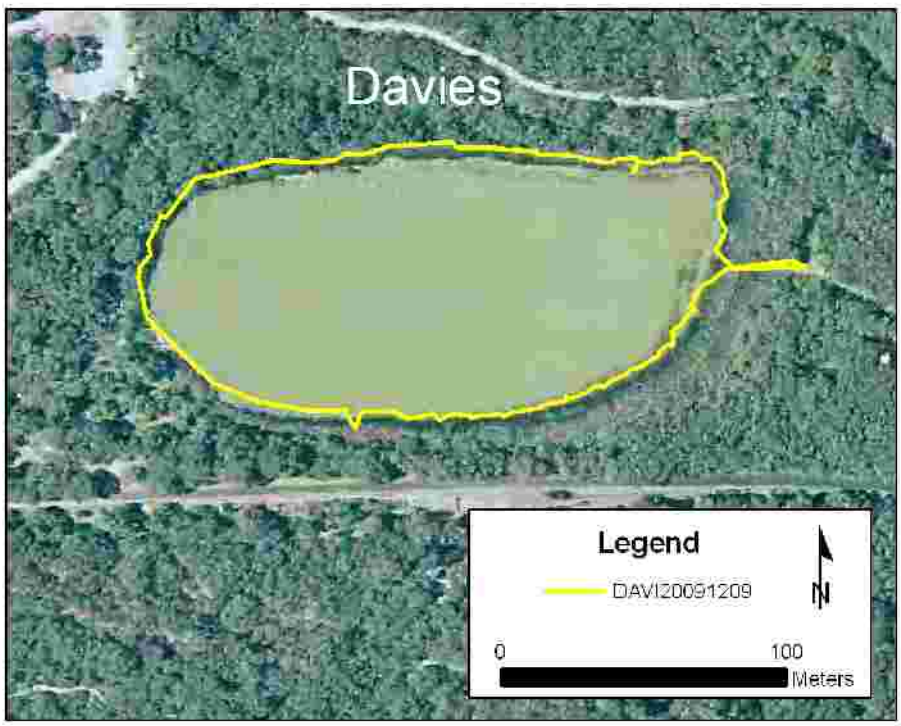
Swamp Harrier nest site (AC, 10Dec09)

Swan nest (AC, 10Dec09)

Lake Davies – survey (9 December 2009) data

	DATA	COMMENTS
Wetland name	Lake Davies (DAVI)	
Observers	A Clarke (DEC).	
Date/s	9 December 2009	
Start & finish time/s (Day 1)	15:15 – 16:30	
Total duration of survey	1.25 hours	
Weather (windy?)	Fine; light breeze.	
% of wetland inundated	At least 90%	
% of inundated area surveyed	Close to 100%	Missed very small areas of sedge.
Water depth at gauge	4.34 m	
Survey methods used	Scan from shore; wading (full circuit); intense nest-searching.	
Habitats searched for nests	Low sedge, along inundated and dry edges.	
Change since 1980s/1990s?	Low sedge was more continuous and seemed denser, lacking the separated tussock clumps noted at eastern end in Dec 91.	
Other remarks	Black Duck were in wing moult. Breeding had probably b en finished for sometime?	
Photos taken?	Yes: overview; habitat types.	
SPECIES	COUNT	COMMENTS
Hoary-headed Grebe	13	
Pacific Black Duck	12	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
N/A	No evidence of breeding this season was found.	

Lake Davies – survey (9 December 2009) map



Lake Davies

Northern side (AC-DEC, 3Dec08)

Dense low sedge on southern side (AC, 9Dec09)

North-western side and depth gauge (RJ-WI, 3Dec08)

South-eastern side (RJ-WI, 3Dec08)

Yarnup Lagoon – survey (8-9 December 2009) data

	DATA	COMMENTS
Wetland name	Yarnup Lagoon (YARN)	Within a nature reserve.
Observers	A Clarke (DEC), Ian Wheeler (DEC).	
Date/s	8 & 9 December 2009	
Start & finish time/s (Day 1)	14:00 – 19:40	40 minute break taken
Start & finish time/s (Day 2)	09:30 – 10:00	
Total duration of survey	5.40 hours	Includes 0.4 hour listening at dusk
Weather (windy?)	Calm; warm to hot.	
% of wetland inundated	80 %	Wetland full to outer limits of basin
% of inundated area surveyed	80 %	Lake scanned & thickets searched
Water depth at gauge	0.85 m	Water not overflowing across road.
Survey methods used	Scan from shore; wading; intense nest-searching; listening for calling bitterns at night.	
Habitats searched for nests	Shrub thickets; tall sedge; mixed shrubs and sedge.	
Change since 1980s/1990s?	*Melaleuca lateritia* thickets now dead or nearly leafless, throughout site but worst on south side. *Baumea articulata* beds now greatly reduced (>50%) in area. Some dead eucalypts in wetland at edge. Some regeneration of *Melaleuca lateritia* and thin sedge this year.	
Other remarks	Used highest species count from either day unless for new area. Most of the species counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types; habitat change; nests found.	
SPECIES	COUNT	COMMENTS
Purple Swamphen	2, plus 4 heard calling	
Musk Duck	2, plus 2 heard calling	
Swamp Harrier	1	Near-fledged juvenile.
Pacific Black Duck	3	
Australian Little Bittern	2 heard calling	Responded to voice call on dusk
Australian Reed-Warbler	1, plus 4 heard calling	
Eurasian Coot	1	
Aust. White Ibis	1	
Little Pied Cormorant	13	Roosting in *Melaleuca* sp.
Hoary-headed Grebe	1	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Hoary-headed Grebe	2 nests each with 3 warm eggs, and 2 grebe nests from last year, all at inner edge of southern shrub thicket (YARN09N18 N20, N15).	
Little Pied Cormorant	1 cluster of 7 nests, five used this year with egg shell and guano YARN06N. YARN04N from last year had new foliage. 1 nest 40m to west of colony with fresh guano and down. All in trees/shrubs, at edge of southern thicket.	

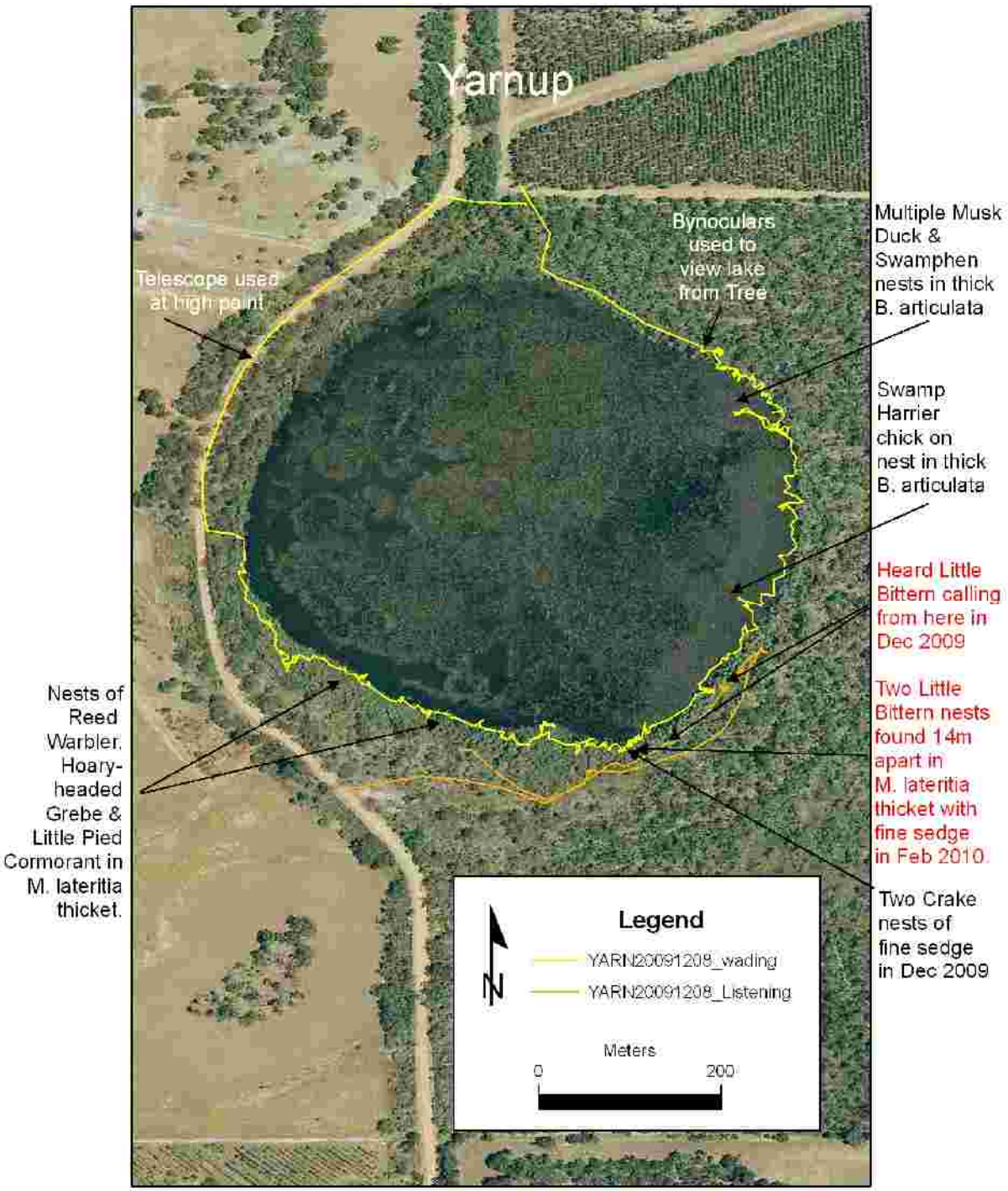
Yarnup Lagoon – survey (8-9 December 2009) data — Continued

NESTING SPECIES Contd.	NESTS, AGE & CONTENTS; HABITAT; GPS REF
Musk Duck	1 nest finished with down YARN09N1. 1 active? 50m from N1. 3 nests metres apart with 1 freshly predated egg YARN09N nest under construction YARN09N10. 1 nest with lots of down YARN09N19 with 2nd nest nearby under construction. 1 nest with lots of down 20m from YARN09N20. Nests in thick *Baumea* clumps & on edges shrub thicket with *Baumea*.
Purple Swamphen	4 nests at various stages of completion in tall *Baumea articulata* sedge, near north-eastern corner & east side (YARN09N8 *et al.*).
Australian Reed-Warbler	2 active nests 3m apart. 1 with 3 chicks YARN09N12. 1 ve nest with 3 eggs YARN09N17. 4 active nests 30m west of HhGb nest YARN09N18. Old nests adjacent to active nests. All in shrub thicket.
Swamp Harrier	Nest made *B. articulata* & *Eucalyptus* twigs in tall thick *Baumea articulata*. Diameter 500x800mm. Near-fledged chick (YARN09N9)
Crake	2 nests 3m apart. Used fine sedge for nest in *Melaleuca lateritia* thicket (YARN09N13).
Unidentified Duck	2 bowl-shaped nests suspended in *Melaleuca lateritia* thicket made of sword-sedge. (YARN09N13 & 14) pp420-428.
Unidentified	Fine sword-sedge platform, 20cm diameter near YARN09N14. pp436-437.
Unidentified Duck	Fine sedge platform suspended, 20cm diam.
Unidentified Duck	Unfinished duck? nest of fine sedge, 20cm diameter with white down.
Unidentified	Small platform not well formed, but contained whitish wn. Made of *Baumea articulata* in tall *Ba* clump. YARN09N7, pp367-369.

Yarnup Lagoon – survey (15 February 2010) data

	DATA	COMMENTS
Wetland name	Yarnup Lagoon (YARN)	Within a nature reserve.
Observers	A Clarke (DEC), Ian Wheeler (DEC).	
Date/s	15 February 2010	
Start & finish time/s	15:00 – 19:45	2.15 hour break taken
Total duration of survey	2.5 hours	Includes 0.5 hr listening at dusk
Weather (windy?)	Fine; warm; night breeze.	
% of wetland inundated	70 %	
% of inundated area surveyed	20 %	Lake scan & tall sedge searched.
Water depth at gauge	0.48m	
Survey methods used	Scan from shore; wading; intense nest-searching; listening for calling bitterns at dusk.	
Habitats searched for nests	Mainly the tall sedge beds and clumps and *Melaleuca lateritia* thicket.	
Change since 1980s/1990s?	See previous data sheet.	
Other remarks	Searching was specifically done in SE corner for Little Bittern nests. A general species count was not done.	
Photos taken?	Yes: nests found.	
SPECIES	COUNT	COMMENTS
Species not recorded		
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Australian Little Bittern	Two nests 14m apart in SE corner. Nests suspended in *Melaleuca lateritia*. Made of sword-sedge & lined with *Melaleuca* bark & 15cm diam. 2nd nest contained Little Bittern feathers. (YARN09LB1 & 2)	

Yarnup Lagoon – survey (8 December 2009) map



Yarnup Lagoon

Yarnup Lagoon (RJ-WI, 26Nov08)

Melaleuca thicket on S side (AC, 8Dec09)

Tall sedge from N side (RJ-WI, 27Nov08)

Melaleuca thicket on SE edge (AC, 8Dec09)

View across *Baumea articulata* tall sedge to paperbarks, N side (AC, 8Dec09)

View from SW side (AC, 8Dec09)

Yarnup Lagoon – Continued

Crake nest site (AC, 8Dec09)

Crake nest (AC, 8Dec09)

H-h Grebe nest with eggs covered (AC, 8Dec09)

Hoary-headed Grebe nest with eggs uncovered (AC, 8Dec09)

LP Cormorant nests (AC, 8Dec09)

Little Pied Cormorant nests (AC, 8Dec09)

Yarnup Lagoon — Continued

Reed-Warbler nest (AC, 8Dec09)

Reed-Warbler nest with young (AC, 8Dec09)

Reed-Warbler nest (AC, 8Dec09)

Reed-Warbler nest with eggs (AC, 8Dec09)

Swamp Harrier nest, Ian Wheeler (AC, 8Dec09)

Large juvenile Swamp Harrier 4-5m from its nest (AC, 8Dec09)

Yarnup Lagoon — Continued

Australian Little Bittern nest site (AC, 15Feb10)

Australian Little Bittern nest (AC, 15Feb10)

Musk Duck nest (AC, 8Dec09)

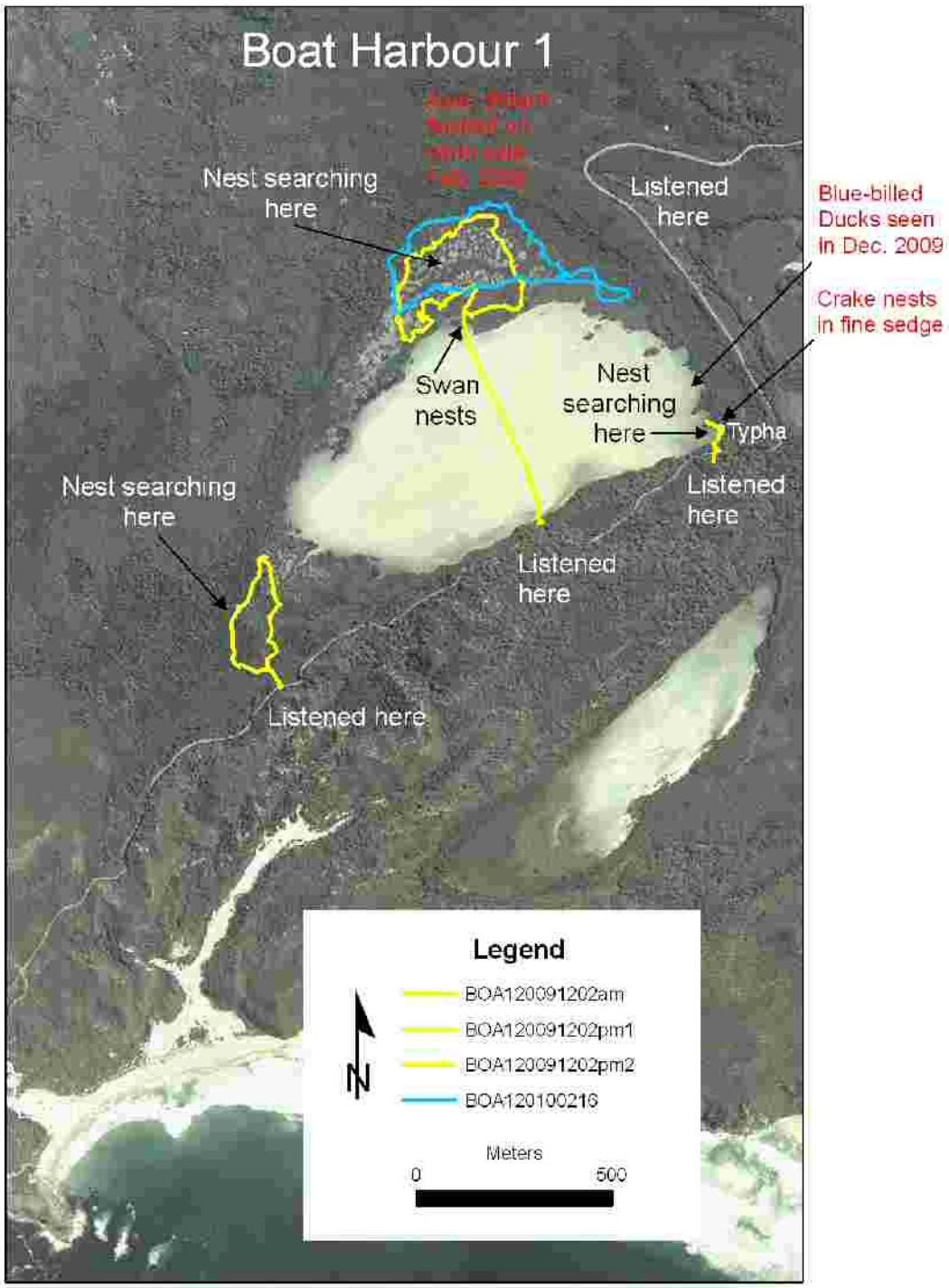
Boat Harbour Lake 1 – survey (2 December 2009) data

	DATA	COMMENTS
Wetland name	Boat Harbour Lake 1 (BOA1)	Within a nature reserve.
Observers	A Clarke (DEC), Janine Liddelow & Carol Ebbett (DEC).	
Date/s	2 December 2009	
Start & finish time/s (Day 1)	10:30 – 21:00	1st break of 2:45hrs, 2nd break 2hrs taken
Start & finish time/s (Day 2)		
Total duration of survey	4.8 hours	Includes 1.2 hour listening at night
Weather (windy?)	Overcast; strong south wind.	
% of wetland inundated	Probably close to 100 %	Some western edges not visited
% of inundated area surveyed	Approximately 70 %	Whole of open lake, part of swamp
Water depth at gauge	1.01 m	
Survey methods used	Scan from shore; wading; intense nest-searching; boating on lake to access north area; listening for calling bitterns at night.	
Habitats searched for nests	Mixed tall sedge, low sedge and *Gahnia* tussocks; *Melaleuca* shrub/tree thickets.	
Change since 1980s/1990s?	No change evident. *Typha* not noticeably more extensive. Areas of burnt (dead?) *Agonis* trees in far NE and SE corners of wetland.	
Other remarks	Most of the species counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Musk Duck	12	
Spotless Crake	4	Heard only, NE and *Typha* corner.
Black Swan	8	No juveniles seen.
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Black Swan	2 nests with fresh egg shell amongst Gahnia in NE sedgeland. BOAT09N1 & 5, pp1-2 & 27-30.	
Musk Duck	Nest in fine sedge tall tussock, under construction with roof. BOAT09N3, pp15-17.	
Crake sp.	Nest in fine sedge tussock in *Typha* corner. BOAT09N6, pp36-41.	
Musk Duck/Blue-billed Duck?	Small bowl shaped nest with roof, made of sword-sedge lined with shredded *Typha*. BOAT09N7, pp43-49.	
Purple Swamphen	Nest used earlier in the season of fine sedge in *B. articulata* in NE area. BOAT09N4, pp18-20.	
Unidentified	Situated inside tall clump of sword-sedge & other shrubs, lined with sword-sedge. BOAT09N2, pp12-14.	

Boat Harbour Lake 1 – survey (16 February 2010) data

	DATA	COMMENTS
Wetland name	Boat Harbour Lake 1 (BOA1)	Within a nature reserve.
Observers	A Clarke (DEC), Jackie Manning & Justin Ettridge (DEC Walpole).	
Date/s	16 February 2010	
Start & finish time/s	14:30 – 20:45	3 hour break taken
Total duration of survey	3.15 hours	Includes 45min listening at night
Weather (windy?)	Overcast; strong south wind.	Not ideal listening conditions.
% of wetland inundated	Presume 80 %	Outer limits not surveyed.
% of inundated area surveyed	Approximately 40 %	Whole of open lake, part of swamp
Water depth at gauge	0.66 m	Some open water area dry
Survey methods used	Scan from shore; wading; intense nest-searching; boating on lake and into sedgeland; listening for calling bitterns at ht.	
Habitats searched for nests	Mixed tall sedge, low sedge and *Gahnia* tussocks.	
Change since 1980s/1990s?	See previous datasheet.	
Other remarks	Survey emphasis was to determine bittern presence / absence. Other waterbird numbers were not recorded.	
Photos taken?	Yes: bittern habitat; nests found.	
SPECIES	COUNT	COMMENTS
Australasian Bittern	1	Flushed near wetland edge NE sedgeland area.
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Crake	Dead adult found on nest in fine sedge tussock in *Typha* corner. BOATDCRAKE	

Boat Harbour Lake 1 – surveys (2 December 2009 & 16 February 2010) map



Boat Harbour Lake 1

Gahnia tall tussocks, SW side (RJ-WI, 2-3Dec09)

Gahnia, and *Agonis* trees, E side (RJ-WI, 2-3Dec08)

Australasian Bittern flushing sites[1]: inundated *Gahnia* with low sedge (AC, 9Jan09)

Aust. Bittern flushing site: inundated *Gahnia* with low sedge (AC, 9Jan09)

Low *Melaleuca* & *Baumea* tall sedge (adjacent) southern swamp (RJ-WI, 2-3Dec08)

[1] Sites from which one or more Australasian Bitterns were flushed

Boat Harbour Lake 1 – Continued

Black Swan nest and survey punt (AC, 2Dec09)

Mixed tall and low sedge and *Gahnia* tussocks (RJ-WI, 2Dec08)

Crake nest site (AC, 2Dec09)

Crake nest (AC, 2Dec09)

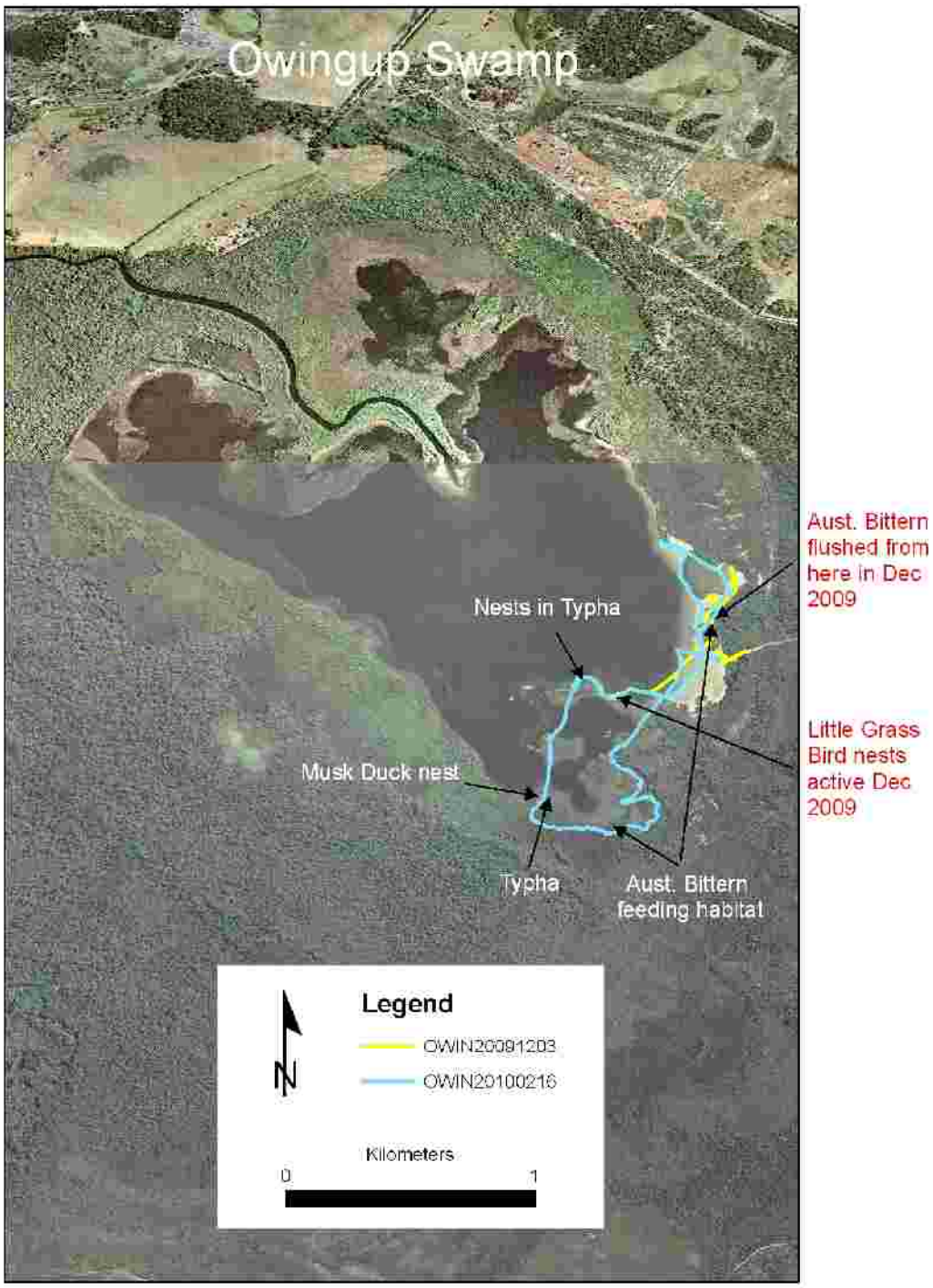
Owingup Swamp– survey (3 December 2009) data

	DATA	COMMENTS
Wetland name	Owingup Swamp (OWIN)	Within a nature reserve.
Observers	A Clarke (DEC).	
Date/s	3 December 2009	
Start & finish time/s	08:30 – 10:30	
Total duration of survey	2.0 hours	
Weather (windy?)	Fine; light breeze.	
% of wetland inundated	80 %	
% of inundated area surveyed	10%	
Water depth at gauge	Approx 1m	
Survey methods used	Flushing along shore north of gauge for 300m; wading; tense nest-searching.	
Habitats searched for nests	Tall sedge; mixed shrubs/trees and sedge.	
Change since1980s/1990s?	*Typha* has expanded and now large areas (two discrete beds) exist at the southern end of the swamp.	
Other remarks	Survey concentrated on recording Bitterns and nesting species only.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Blue-billed Duck	1	male
Little Grassbird	3	two heard calling
Unidentified Crake	2	calling from *Typha*
Australian Reed-Warbler	1	calling from *Typha*
Australasian Bittern	1	Flushed from north of gauge.
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Musk Duck	Finished nest with down in tall clump of *B. articulata*.	
Little Grassbird	Four nests in separate tall *B. articulate* clumps, two with three eggs each, one with three newly-hatched young and one finished with down and feathers.	
Little Bittern (Possible)	Rough small platform consistent with Little Bittern fo mation with slight bowl made of fine sedge in tall *B. articulata* near edge.	

Owingup Swamp– survey (16 February 2010) data

	DATA	COMMENTS
Wetland name	Owingup Swamp (OWIN)	Within a nature reserve.
Observers	A Clarke (DEC), Jackie Manning & Justin Ettridge (DEC Walpole).	
Date/s	16 February, 2010	
Start & finish time/s	10:30 – 12:50	
Total duration of survey	2.4 hours	
Weather (windy?) % of wetland inundated	Fine; 15knot SE wind. 60 %	
% of inundated area surveyed	20%	
Water depth at gauge	0.85m	
Survey methods used	Flushing along shore north of gauge for 300m & SE corner; investigating potential Bittern habitat, some nest-searching done.	
Habitats searched for nests Change since1980s/1990s?	Tall sedge; mixed shrubs/trees and sedge. *Typha* has expanded and now large areas (two discrete beds) exist at the southern end of the swamp.	
Other remarks	Survey concentrated on recording Bitterns and nesting species only.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Unidentified Crake	2	Heard calling in *Typha*
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Musk Duck	Finished nest with down in tall clump of *B. articulata*. SE area.	
Little Grassbird	Nest of shredded *Typha* in tall *Typha* stand, finished.	
Swamphen	Large raised structure with bowl formation resting on ke floor, made of *Typha* & containing egg shell.	

Owingup Swamp – surveys (3 December 2009 & 16 February 2010) map



Owingup Swamp

Typha stand on SE side (AC, 16Feb10)

Typha stand of SE islands (AC, 3Dec09)

Australasian Bittern flushing site on E side
(AC, 3Dec09)

Baumea at edge of island near E side
(AC, 16Feb10)

Mixed *Baumea* and *Gahnia* in SE area
(AC, 16Feb10)

Tall fine sedge in SE area
(AC, 16Feb10)

Owingup Swamp – Continued

Australian Little Bittern nest site (AC, 3Dec09)

Australian Little Bittern nest (AC, 3Dec09)

Little Grassbird nest site (AC, 3Dec09)

Little Grassbird nest with eggs (AC, 3Dec09)

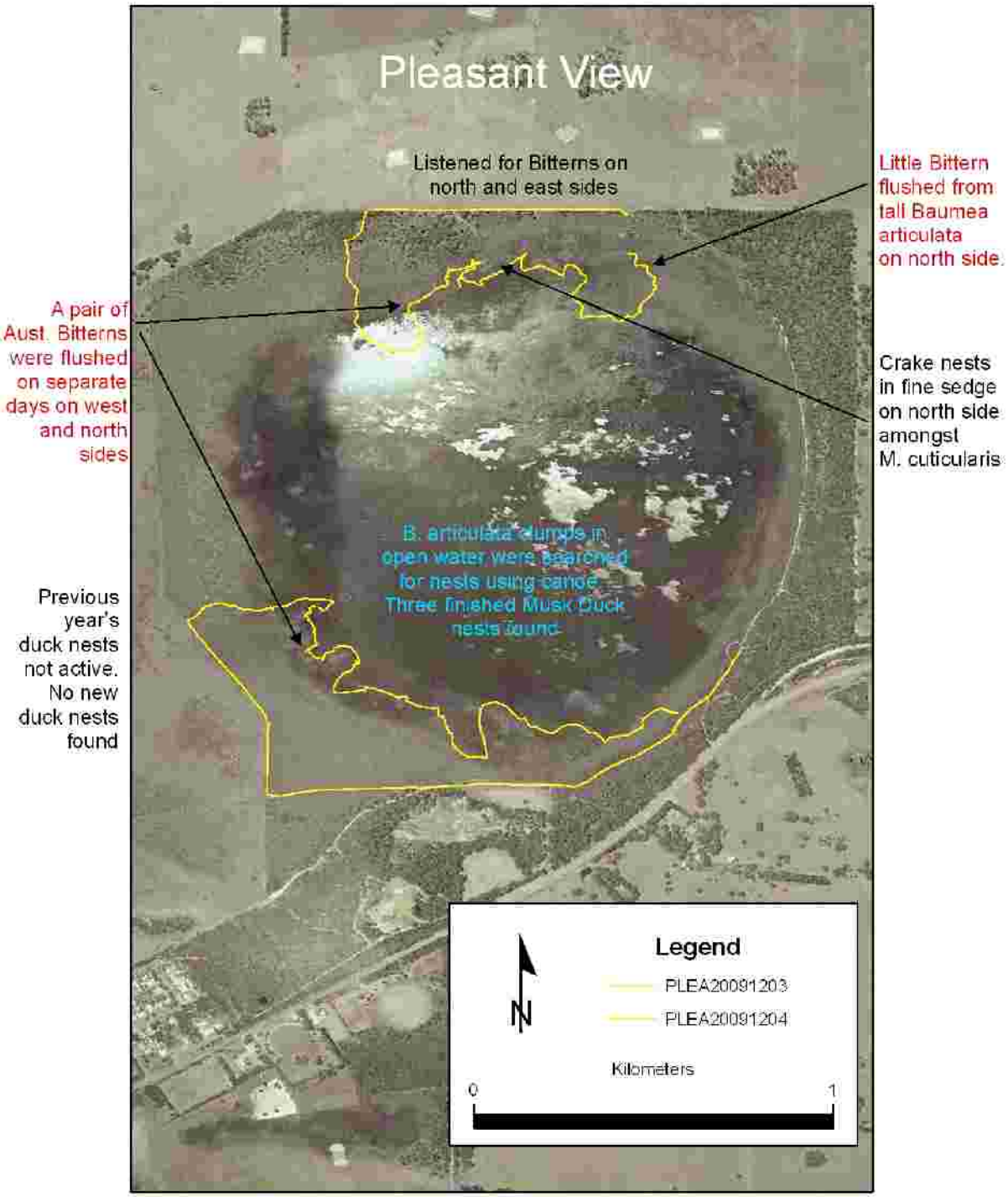
Musk Duck nest site (AC, 3Dec09)

Musk Duck nest (AC, 15Feb10)

Lake Pleasant View – survey (3-4 December 2009) data

	DATA	COMMENTS
Wetland name	Lake Pleasant View (PLEA)	Within a nature reserve.
Observers	A Clarke (DEC); Ian Wheeler (DEC Manjimup) &Tony Bush.	
Date/s	3 & 4 December 2009	
Start & finish time/s (Day 1)	15:00 – 21:50	2 hour break taken
Start & finish time/s (Day 2)	10:00 – 13:15	
Total duration of survey	8 hr 5 min	Includes 1:45 hrs listening at night
Weather (windy?)	Fine, warm; light wind.	Good listening conditions
% of wetland inundated	At least 90 %	
% of inundated area surveyed	Approximately 70 %	Parts of open lake, parts of swamp
Water depth at gauge	1.09 m	
Survey methods used	Scan from shore; wading; intense nest-searching; listening for calling bitterns at night.	
Habitats searched for nests	Mixed tall sedge and low sedge; *Melaleuca* thickets with tall and low sedge (northern side).	
Change since 1980s/1990s?	No change evident other than possible increase in exte of *Melaleuca* shrubs on outer N side. Some pampas (weed) clumps.	
Other remarks	Water level had peaked early and ducks had all finished nesting. Used highest species count from either day unless for new area. Most of the counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types, nests.	
SPECIES	COUNT	COMMENTS
Australasian Bittern	2 on 3rd Dec.	Flushed from same area on SW corner of lake as 2008.
Australasian Bittern	2 on 4th Dec.	Flushed from NW corner of lake 200m from nest.
Australian Little Bittern	1	Flushed from tall *Baumea articulata* on North side.
Purple Swamphen	6	
Little Grassbird	4	Heard calling around lake.
Musk Duck	4	
Spotless Crake	4	Heard calling around lake.
Little Pied Cormorant	1	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Musk Duck	Tony Bush found 3 finished nests in tall *B articulata* clumps in middle of lake.	
Little Grassbird	Nest with 3 eggs found by Tony Bush in *B articulata* clumps in middle of lake.	
Purple Swamphen	3 finished nests. 2 on west side & 1 on north side. PLEA09N3x2 & 7.	
Australian Reed-Warbler	2 nests 20m apart in tall fine sedge tussocks, finished. PLEA09N8.	
Australasian Bittern	Robust nest of fine sedge & *B articulata* attached to *Melaleuca cuticulata.* In tall *Ba*. Nest was 28 x 40cm and 18cm thick suspended above water with egg shell fragments. PLEA09N9	

Lake Pleasant View – survey (3-4 December 2009) map



Lake Pleasant View

Tall and low sedges (RJ-WI, 27Nov08)

Low sedge, NW side of lake (AC, 10Jan09)

Australasian Bittern flushing site (AC, 10Jan09)

Melaleuca in mixed sedge on N side (AC, 4Dec09)

Tall sedge on N side (AC, 4Dec09)

Tall *Baumea* and fine sedge (AC, 3Dec09)

Lake Pleasant View — Continued

Mixed sedge on N side (AC, 4Dec09)

Australasian Bittern flushing site (AC, 4Dec09)

Australasian Bittern flushing site (AC, 3Dec09)

Australasian Bittern flushing site (AC, 3Dec09)

Australasian Bittern nest (AC, 4Dec09)

Australasian Bittern nest with eggshells (AC, 4Dec09)

Lake Pleasant View — Continued

Reed-Warbler nest site (4Dec09)

Reed-Warbler nest (AC, 4Dec09)

Albany 27157 (Cheyne Road Nature Reserve) – survey (5 December 2009) data

	DATA	COMMENTS
Wetland name	Albany 27157 (ALB2)	Within nature reserve 27157.
Observers	A Clarke (DEC), Ian Wheeler (DEC Manjimup).	
Date/s	5 December 2009	
Start & finish time/s	10:30 – 13:10	
Total duration of survey	2 hr 40 min	
Weather (windy?)	Fine; light breeze.	
% of wetland inundated	90 %	
% of inundated area surveyed	30%	
Water depth at gauge	1.19 m	
Survey methods used	Scan from shore; wading; intense nest-searching. Circumnavigation of shore-line vegetation.	
Habitats searched for nests	Tall sedge; mixed shrubs/trees and sedge.	
Change since 1980s/1990s?	Comparison with 1979 photos showed little change.	
Other remarks	The species counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Purple Swamphen	1	
Musk Duck	1	Heard only
Pacific Black Duck	1	
Spotless Crake	2	Heard only
Swamp Harrier	1	
Australian White Ibis	9	
Australasian Bittern	1	Flushed from west shore.
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Musk Duck	Finished nest with down in tall clump of *B. articulata*, CHEY09N1.	
Swamphen	Finished nest with feathers, exposed position on island of *B. articulata.*	
Musk Duck	Finished nest made of fine sedge in *Melaleuca* shrub with lots of down, CHEY09N3.	
Unidentified	Small platform with slight bowl of fine sedge in fine edge clump. No roof to nest, diameter 15cm, CHEY09N4.	
Unidentified Duck	Finished nest made of fine sedge in *Melaleuca* shrub with lots of down, CHEY09N5	
Musk Duck	Finished nest made of fine sedge in fine sedge clump with lots of down, CHEY09N5	

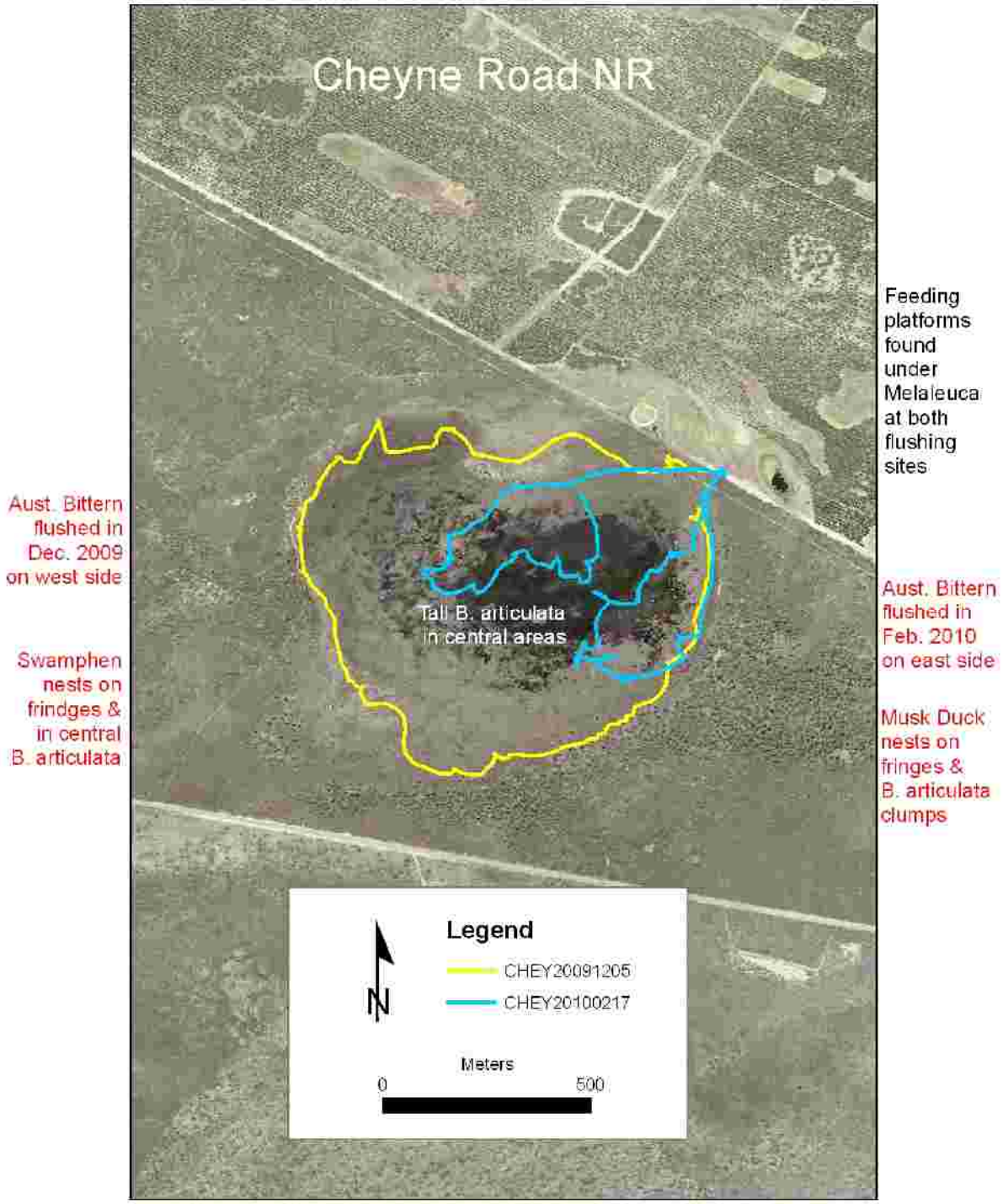
Albany 27157(Cheyne Road NR) – survey (5 December 2009) data — Continued

NESTING SPECIES Contd.	NESTS, AGE & CONTENTS; HABITAT; GPS REF
Musk Duck	Nest made of fine sedge in fine sedge clump, CHEY09N7
Musk Duck	Nest made of fine sedge in fine sedge clump with lots of down and egg shell, CHEY09N10
Swamphen	Finished nest in open position near CHEY09N10.
Musk Duck	Three nests of fine sedge in fine sedge clumps along e st shore with predated eggs.

Albany 27157 (Cheyne Road NR) – survey (17 February 2010) data

	DATA	COMMENTS
Wetland name	Albany 27157 (ALB2)	Within nature reserve 27157.
Observers	A Clarke (DEC), Sarah Comer (DEC Albany), Janet Newell (DEC Albany) & Anne Bondin (volunteer).	
Date/s	17 February 2010.	
Start & finish time/s Total duration of survey	09:30 – 13:15 3.45 hours	
Weather (windy?)	Light rain; moderate breeze.	
% of wetland inundated	80 %	
% of inundated area surveyed	60%	
Water depth at gauge	0.92 m	
Survey methods used	Scan from shore; wading; intense nest searching. Concentrated on tall *B. articulata* on central areas.	
Habitats searched for nests	Tall sedge.	
Change since 1980s/1990s?	Comparison with 1979 photos showed little change.	
Other remarks	The species counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Spotless Crake	1	Heard only
White-faced Heron	4	
Australasian Bittern	1	Flushed from east shore.
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Swamphen	Old nest of fine sedge slight bowl & suspended on edge of tall *B. articulata* clump. *Ba* growing through nest, CHEY10N1.	
Australasian Bittern	This year's nest in moderately open *B. articulata* near east shore. Nest made of fine sedge and *Ba* criss-crossed, 40cm diameter, 20cm thick & suspended.	
Australasian Bittern?	Roughly constructed nest only 15cm diameter, but 15cm thick mostly of fine sedge with *Ba* support pieces. No ramp attached in tall *Ba* clump, but open. Lots of Aust. Bittern feathers, CHEY10N3.	
Australasian Bittern (old)	Last year's nest with 40cm diameter in small open clump of *B. articulata*. Nest had slipped to 45 deg tilt & contained old Aust. Bittern feathers and Yabbie remains, CHEY10OLDAB.	
Swamphen	Last year's nest (*Ba* growing through nest) of fine sedge in oval shape suspended & 10cm thick in open *B. articulata*.	
Unidentified	Small nest, 10cm diameter & 10cm thick deep in large, dense *B. articulata* clump. Contained yabbie (*Cherax*) carcasses and white faeces.	
Swamphen	This year's nest of fine sedge in oval shape with Swamphen feathers in open *B. articulata*.	

Albany 27157 (Cheyne Rd NR) – survey (3-4 December 2009) map



Albany 27157 (Cheyne Road NR)

Extensive low sedge (AC, 5Dec09)

Tall sedge with Australasian Bittern nest in clump (AC, 17Feb10)

Tall and fine sedge (AC, 5Dec09)

Australasian Bittern flushing site on W side (AC, 5Dec09)

Australasian Bittern feeding pad in melaleuca and fine sedge (AC, 5Dec09)

Australasian Bittern flushing site in NW bay (AC, 5Dec09)

Albany 27157 (Cheyne Road NR) – Continued

Australasian Bittern nest site (AC, 17Feb10)

Australasian Bittern nest (AC, 17Feb10)

Crake nest site (AC, 5Dec09)

Crake nest (AC, 5Dec09)

Musk Duck nest site (AC, 5Dec09)

Musk Duck nest (AC, 5Dec09)

Albany 27157 (Cheyne Road NR) – Continued

Musk Duck nest site (AC, 5Dec09)

Musk Duck nest (AC, 5Dec09)

Purple Swamphen nest (AC,17Feb10)

Purple Swamphen nest (AC, 17Feb10)

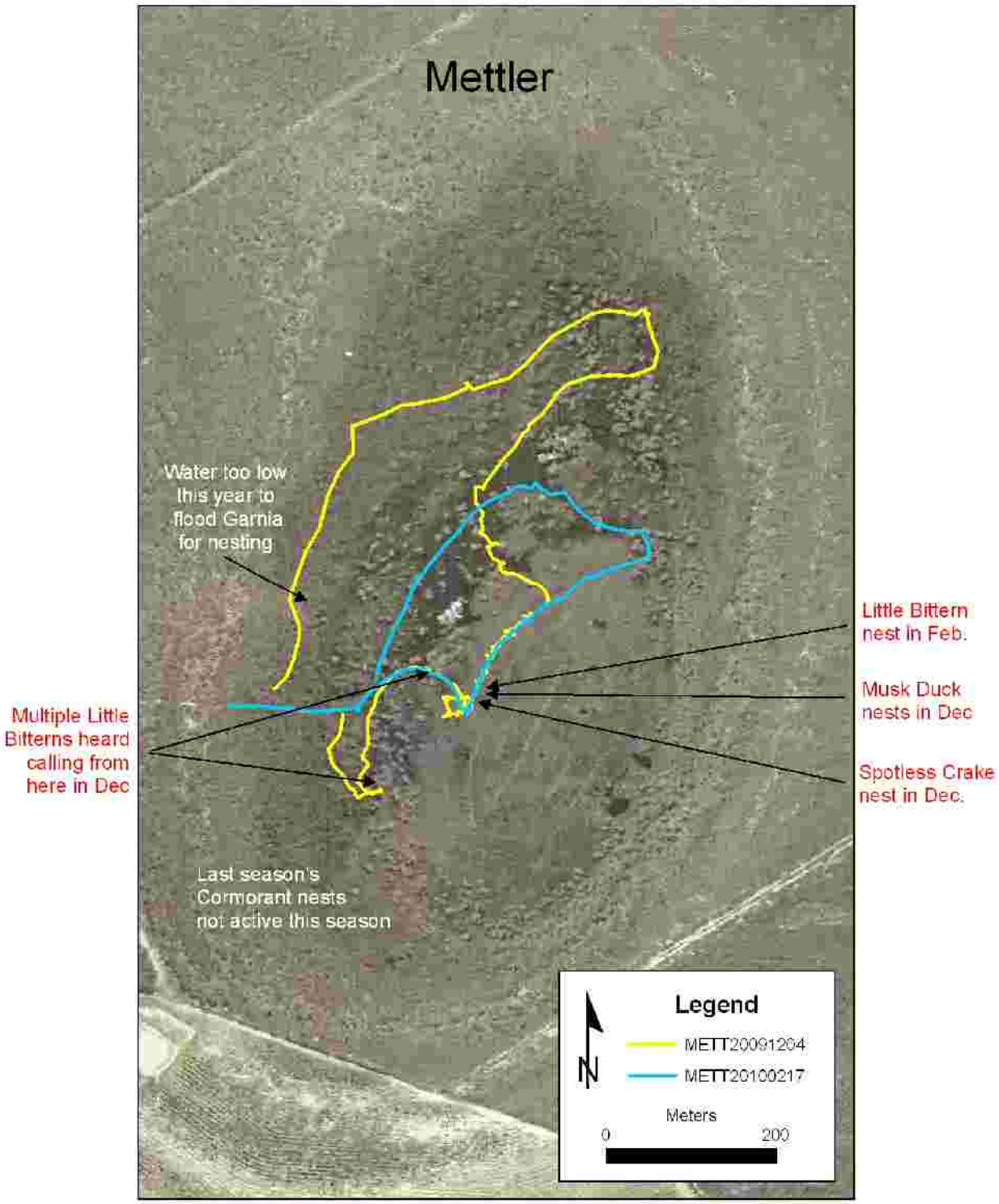
Mettler Swamp – survey (4 December 2009) data

	DATA	COMMENTS
Wetland name	Mettler Swamp (METT)	Within a nature reserve.
Observers	A Clarke (DEC), Ian Wheeler (DEC Manjimup).	
Date/s	4 December 2009	
Start & finish time/s	15:30 – 18:45	15 min break taken
Total duration of survey	3 hr 0 min	Includes 0.8 hr listening on dusk.
Weather (windy?)	Fine, moderate SE breeze	
% of wetland inundated	Close to 70 %	
% of inundated area surveyed	Approx. 50 %	All open water; part of dense veg.
Water depth at gauge	0.71 m	Water had been receding for some time.
Survey methods used	Wading; intense nest-searching; listening for bitterns at night.	
Habitats searched for nests	Wooded swamp; *Gahnia* tussocks-dry; tall sedge;	
Change since 1980s/1990s?	No change evident.	
Other remarks	Some of the species counts are the minimum number pres nt. Some trees of *Melaleuca cuticularis* in deepest water had sparse canopy foliage and black 'smut' on upper branchlets.	
Photos taken?	Yes: habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Purple Swamphen	4	
Musk Duck	1	Head calling
Swamp Harrier	1	
Pacific Black Duck	24	
Australian Little Bittern	2 heard	Calling on dusk
Spotless Crake	4, (3 heard, 1 seen).	
Grey Teal	2	
Hoary-headed Grebe	3	
Little Pied Cormorant	3	Both colonies active in 2008 were not active in 2009.
White-faced Heron	2	
Yellow-billed Spoonbill	7	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Australian Reed-Warbler	Nest in tall *Ba* near edge of open water at northern area of lake. No other details as Tiger Snake *Notechis scutatus* was on nest!	
Spotless Crake	Bird disturbed from nest in tall *Baumea articulata* 1st line, METT09N2.	
Musk Duck	1 egg in nest of *B. articulata* in tall *B. articulata* on 1st tall line, METT09N1. 2nd nest under construction with partial roof, METT09N9.	

Mettler Swamp – survey (17 February 2010) data

	DATA	COMMENTS
Wetland name	Mettler Swamp (METT)	Within a nature reserve.
Observers	A Clarke (DEC), Anne Bondin (volunteer).	
Date/s	17 February 2010	
Start & finish time/s (Day 1)	15:00 – 16:30	
Total duration of survey	1.5 hours	Listening not conducted
Weather (windy?)	Overcast; cool.	
% of wetland inundated	50 %	
% of inundated area surveyed	20 %	Main focus was 1st tall *Baumea articulata* line.
Water depth at gauge	0.40 m	
Survey methods used	Wading; intense nest-searching.	
Habitats searched for nests	Tall sedge.	
Change since 1980s/1990s?	See previous datasheet.	
Other remarks	The main focus was to search the 1st tall line of *Baumea articulata* for Little Bittern nests.	
Photos taken?	Yes: nests found.	
SPECIES	COUNT	COMMENTS
Species numbers not recorded.		
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Australian Little Bittern	New nest, made since December visit and now finished, in tall *Baumea articulata* with *Melaleuca* sapling shrubs, METT10NLB.	

Mettler Swamp – surveys (4 December 2009 & 17 February 2010) map



Mettler Swamp

Melaleuca and mixed sedges on E side
(RJ-WI, 28Nov08)

Live trees & shrubs over low sedge, NE side
(RJ-WI, 28Nov08)

Gahnia tussock under live Yates, W side
(RJ-WI, 28Nov08)

Low sedge and live Yates, inner NW side
(RJ-WI, 28Nov08)

Live Yates with *Baumea articulata* patch, inner N.
(RJ-WI, 28Nov08)

Paperbarks over *B. articulata*, inner NE
(RJ-WI, 28Nov08)

Mettler Swamp — Continued

Live paperbark showing sparse foliage, deep area, inner NE (RJ-WI, 28Nov08)

B. articulata with shrubs, south of centre (RJ-WI, 28Nov08)

Little Bittern nest site (AC, 17Feb10)

Little Bittern nest (AC, 17Feb10)

Crake nest (AC, 4Dec09)

Musk Duck nest with egg (AC, 4Dec09)

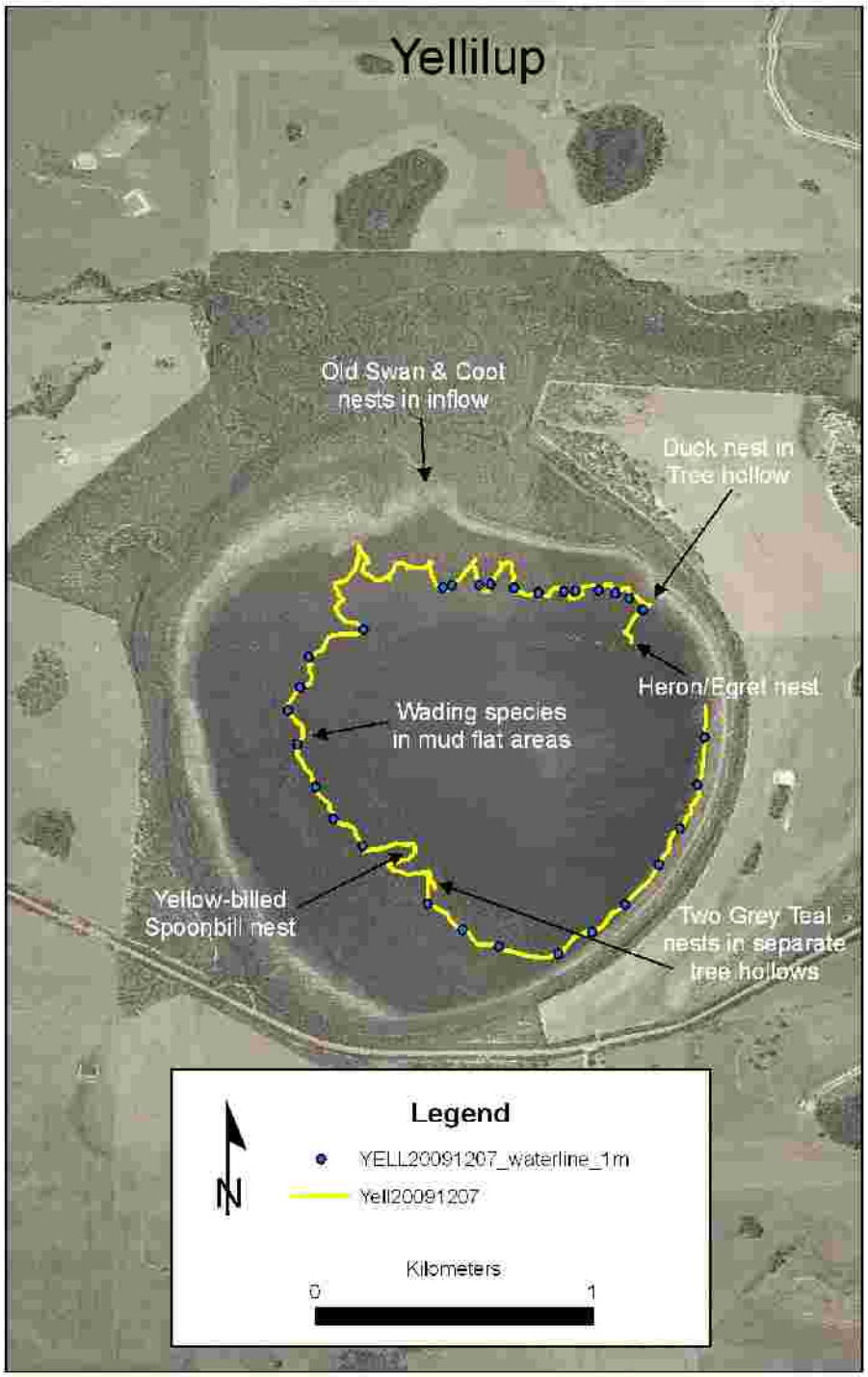
Yellilup Lake – survey (7 December 2009) data

	DATA	COMMENTS
Wetland name	Yellilup Lake (YELL)	On freehold land.
Observers	A Clarke (DEC), Ian Wheeler (DEC Manjimup).	
Date/s	7 December 2009	
Start & finish time/s	14:15 – 18:00	
Total duration of survey	3.45 hours	
Weather (windy?)	Overcast; moderate S wind	
% of wetland inundated	Probably 50 %	
% of inundated area surveyed	Approx. 80 %	Open lake, part of dead tree zone
Water depth at gauge	0.99 m	
Survey methods used	Scan from shore; wading/walking in dead tree zone.	
Habitats searched for nests	Open water; inundated dead trees (dead woodland).	
Change since 1980s/1990s?	Former live woodland of Yate and *Melaleuca* trees occupying extensive outer zone of lake bed, now all dead; live trees now only near high water mark (Depth > ~2.5m) apart from a few ve *Melaleuca* on E side just below ~2.5m; *Melaleuca* seedlings 2m high, above D=2.5m. Now samphire occurs on outer lake bed.	
Other remarks	Emphasis of survey was to investigate habitat for waterbirds and record any nesting activity in the dead timber zone.	
Photos taken?	Yes: overview; habitat types; nests.	
SPECIES	COUNT	COMMENTS
Grey Teal	30	
Australian Shelduck	1000	Many birds flightless due to moult.
Common Greenshank Little Pied Cormorant	6 2	
Black-winged Stilt	100+	
Red-kneed Dotterel	6	
Yellow-billed Spoonbill	5	2 adults & 3 near-fledged young.
Black-fronted Plover	1	
Wood Sandpiper	1	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Duck, unidentified	Tree hollow with down high in dead Yate *Eucalyptus occidentalis* with egg shell at base of tree, YELL09N2.	
[heron species?]	Nest in dead Yate with new material, active, YELL09N1.	
Black-winged Stilt	Nest on ground at water edge, not finished, abandoned, YELL09N3.	
Black Swan	At least 10 old (2+years) nests in the inflow area amongst the dead timber, YELL09N4.	

Yellilup Lake – survey (7 December 2009) data — Continued

NESTING SPECIES Contd.	NESTS, AGE & CONTENTS; HABITAT; GPS REF
Eurasian Coot	Two old (2+ years) nests in the inflow area amongst th dead timber, YELL09N4.
Yellow-billed Spoonbill	Nest in dead *Melaleuca* on west side with 3 near-fledged chicks, YELL01N.
Grey Teal	Two nests in separate dead Yate tree hollows 50m apart. Adult flushed from 1st nest. 2nd had lots of down, YELLN5 & 6.

Yellilup Lake – survey (7 December 2009) map



Yellilup Lake

Dead Yates and melaleucas on N side
(RJ-WI, 29Nov08)

Dead and fallen trees of NE inflow area
(RJ-W, 29Nov08)

Dead trees on N side (AC, 7Dec09)

Dead trees on E side (AC, 7Dec09)

Dead and fallen trees on N side (AC, 7Dec09)

Dead and fallen trees on S side (7Dec09)

Yellilup Lake – Continued

Duck nesting-hollow in dead tree on N side (AC, 7Dec09)

Yellow-billed Spoonbill nests in dead melaleuca on W side (AC, 7Dec09)

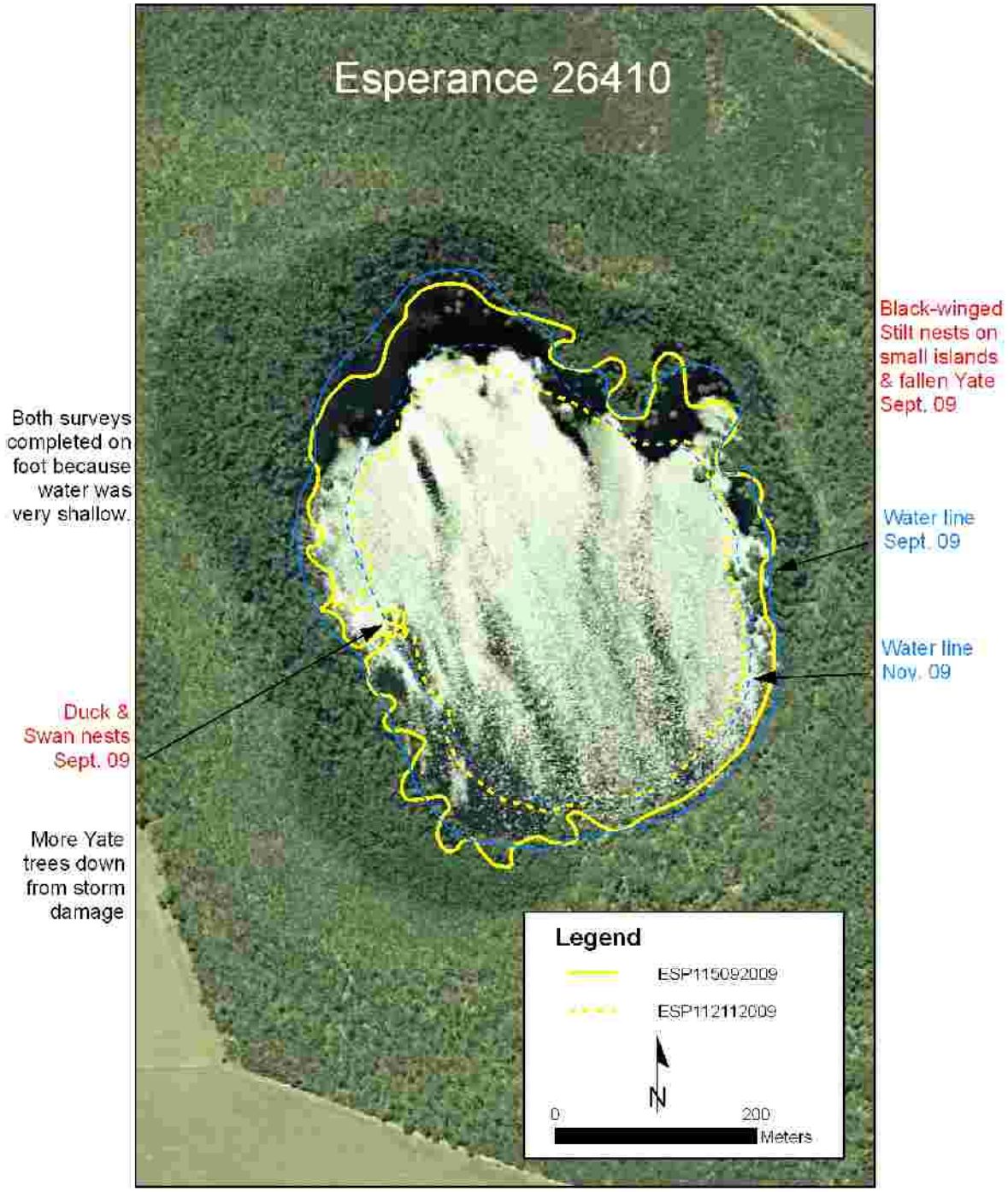
Esperance 26410 – survey (15 September 2009) data

	DATA	COMMENTS
Wetland name	Esperance 26410 (ESP1)	Within a nature reserve.
Observers	A Clarke (DEC).	
Date/s	15 September 2009	
Start & finish time/s	08:30 – 10:30	
Total duration of survey	2.0 hours	
Weather (windy?)	Fine, light breeze.	
% of wetland inundated	Approx. 60%	
% of inundated area surveyed	Almost 100 %	
Water depth at gauge	0.33 m	Large area of shallow water
Survey methods used	Scan from shore; wading; nest-searching.	
Habitats searched for nests	Wooded thickets; around fallen trees.	
Change since 1980s/1990s?	Zone of dead Yate trees now around edge of open water in NW to NE side of wetland, some still with fine twigs. Some Yate seedlings (to 2m) in NNE just above present water line; very small Yate seedlings under large live Yates near boat launch site on W side.	
Other remarks	Water clear with yellow tinge. Further storm damage (fallen limbs) to some live Yates at edge of open water. Small islands near shore used for nesting.	
Photos taken?	Yes: overview; habitat types; habitat change; nests found.	
SPECIES	COUNT	COMMENTS
Black-winged Stilt	~200	
Pacific Black Duck	10	
Grey Teal	120	
Chestnut Teal	16	All in pairs
Australasian Shoveler	3	
Black Swan	6	Including 4 cygnets.
White-faced Heron	5	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Chestnut Teal	Adult flushed from nest hollow in *Melaleuca* tree on west side. Eight eggs in down.	
Black Swan	Nest under fallen *Melaleuca* tree on west side containing egg shell.	
Black-winged Stilt	Four active nests each with four eggs, in shallows near fallen trees or on low islands near the shore. Two additional nests were under construction.	

Esperance 26410 – survey (12 November 2009) data

	DATA	COMMENTS
Wetland name	Esperance 26410 (ESP1)	Within a nature reserve.
Observers	A Clarke (DEC).	
Date/s	12 November 2009	
Start & finish time/s	08:30 – 10:30	
Total duration of survey	2.0 hours	
Weather (windy?)	Fine, warm, calm.	
% of wetland inundated	Approx. 40%	
% of inundated area surveyed	Almost 100 %	
Water depth at gauge	0.16 m	
Survey methods used	Scan from shore; wading; nest searching.	
Habitats searched for nests	Open water & islands.	
Change since 1980s/1990s?	Zone of dead Yate trees now around edge of open water in NW to NE side of wetland, some still with fine twigs. Some Yate seedlings (to 2m) in NNE just above present water line; very small Yate seedlings under large live Yate trees near boat launc site on west side.	
Other remarks	50% of wetland had <5cm of water. Many small islands n the shore.	
Photos taken?	Yes: overview; habitat types; habitat change; nests fo nd.	
SPECIES	COUNT	COMMENTS
Black-winged Stilt	144	Includes two juveniles.
Black Swan	6	Including 4 cygnets.
Chestnut Teal	3	males
Red-necked Avocet	2	
Sharp-tailed Sandpiper	23	
Curlew Sandpiper	1	
Greenshank	7	
Black-fronted Plover	8	
Red-kneed Dotterel	8	
Masked lapwing	1	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
No active nests seen.		

Esperance 26410 – surveys (15 September & 12 November 2009) map



Esperance 26410

Flooded melaleuca on N side (RJ-WI, 1Dec08)

Yate seedlings (RJ-WI, 1Dec08)

Live Yates with storm damage (RJ-WI, 1Dec08)

Dead Yates on edge of open water (RJ-WI, 1Dec08)

Dead and fallen trees on W side (AC, 15Sep09)

Dead and fallen Yates on edge of open water (AC, 15Sep09)

Esperance 26410 – Continued

Dead melaleuca near W side (AC, 15Sep09)

Black Swan nest (AC, 15Sep09)

Black-winged Stilt nest with eggs (AC, 15Sep09)

Black-winged Stilt nest with eggs (AC, 15Sep09)

Chestnut Teal nest site in melaleuca (AC, 15Sep09)

Chestnut Teal nest with eggs, in melaleuca tree hollow (AC, 15Sep09)

Shark Lake – survey (13 November 2009) data

	DATA	COMMENTS
Wetland name	Shark Lake (SHAR)	Within a nature reserve.
Observers	A Clarke (DEC).	
Date/s	13 November 2009	
Start & finish time/s	09:45 – 11:50	
Total duration of survey	2.0 hours	
Weather (windy?)	Fine; light breeze.	
% of wetland inundated	90 %	
% of inundated area surveyed	Over 60%	Open water 100%; sedge 50%
Water depth at gauge	2.29 m	
Survey methods used	Scan from shore; wading; intense nest-searching.	
Habitats searched for nests	Tall sedge; mixed shrubs/trees and sedge.	
Change since 2008 survey	Many of the well-established *Melaleuca* trees at the western end have died (due to excessive inundation?) and fallen.	
Other remarks	Some of the species counts are the minimum number pres Survey concentrated on North and west tall sedge areas.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Purple Swamphen	3	
Musk Duck	4	
Eurasian Coot	4	
Pacific Black Duck	50	
Grey Teal	2	
Blue-billed Duck	1	male
Black Swan	8	Includes 6 cygnets only days old.
Little Grassbird	1	Heard only, in tall sedge
Spotless Crake	4	Heard only, in tall sedge
Unidentified Crake	1	
Great Crested Grebe	2	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Musk Duck	1 active nest in tall *B. articulata* with one egg. Adult was flushed off the nest. 2nd nest on south side recently finished.	
Purple Swamphen	6 finished nests at east end in outflow area & north a west shores in tall *B. articulata* on edge of open water. 1 nest with 3 eggs.	
Australian Reed-Warbler/ Little Grassbird	Numerous old nests in tall, thick *B. articulata* along north shore.	

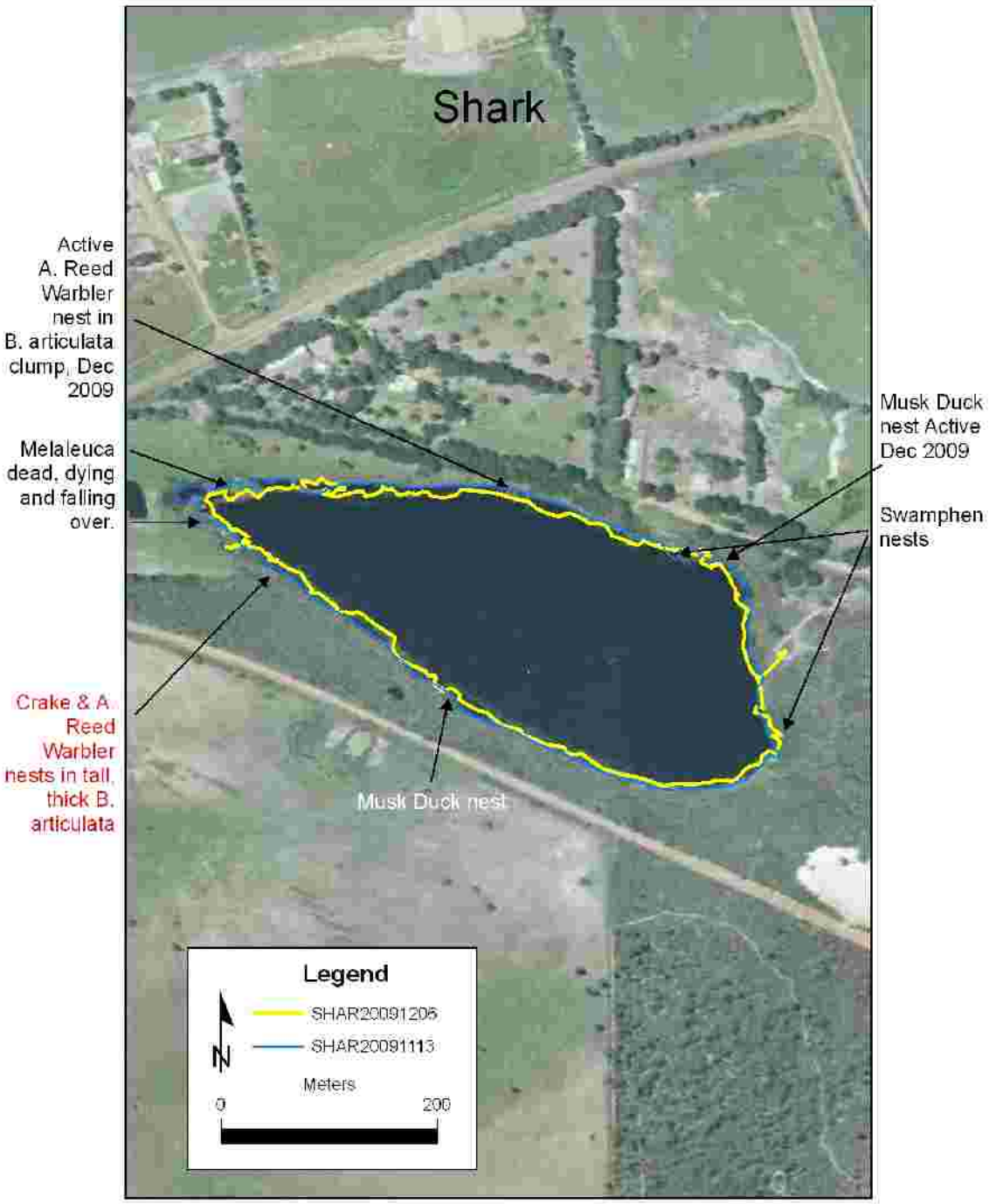
Shark Lake – survey (6 December 2009) data

	DATA	COMMENTS
Wetland name	Shark Lake (SHAR)	Within a nature reserve.
Observers	A Clarke (DEC), Steven Butler (DEC Esperance).	
Date/s	6 December 2009	
Start & finish time/s	14:35 – 18:30	0.5 hour break.
Total duration of survey	4.0 hours	Includes 0.5 hour listening on dusk
Weather (windy?)	Fine; light breeze.	
% of wetland inundated	90 %	
% of inundated area surveyed	Over 80%	Open water 100%; sedge 80%
Water depth at gauge	2.18 m	
Survey methods used	Scan from shore; wading; intense nest searching; liste ng for calling bitterns at dusk.	
Habitats searched for nests	Tall sedge; mixed shrubs/trees and sedge.	
Change since 2008 survey	Many of the well established *Melaleuca* trees at the western end had died and many of these have fallen over.	
Other remarks	Some of the species counts are the minimum number present.	
Photos taken?	Yes: overview; habitat types; nests found.	
SPECIES	COUNT	COMMENTS
Purple Swamphen	4	
Musk Duck	4	
Eurasian Coot	1	
Pacific Black Duck	20	
Australian Reed-Warbler	1	Heard only
Black Swan	8	Includes 6 cygnets only days old.
Little Black Cormorant	2	
Little Pied Cormorant	2	
Little Grassbird	1	Heard only, in tall sedge
Spotless Crake	2	Heard only, in tall sedge
Great Crested Grebe	1	
Nankeen Night Heron	3	
NESTING SPECIES	NESTS, AGE & CONTENTS; HABITAT; GPS REF	
Australian Reed-Warbler	Active nest with three eggs in isolated clump of *B. articulata* on north shore with old nest adjacent.	
Musk Duck	Nest in tall *B. articulata* clump lines with fine sedge on south side.	

Shark Lake – survey (6 December 2009) data — Continued

NESTING SPECIES Contd.	NESTS, AGE & CONTENTS; HABITAT; GPS REF
Crake	This year's nest with, in tall *B. articulata* infused with fine grass, near SSE edge of wetland, SHAR09N1.
Purple Swamphen	2 finished nests at east end in outflow area, 5 other ests, finished or under construction with feathers on north and west shores in tall *B. articulata* on edge of open water. 1 nest with 5 eggs and newly hatched young.
Australian Reed-Warbler	Numerous old nests in tall, thick *B. articulata* along north shore.
Australian Little Bittern ?	A new (not apparent in 2008 or Sept & Nov 2009 surveys) platform at water level in tall *B. articulata* on NNE side of lake 20m east of last year's nest, (SHAR02N)

Shark Lake – survey (6 December 2009) map



Shark Lake

Melaleuca thicket with tall sedge in 2009, in WNW corner (AC, 6Dec09)

Baumea stand on E side (AC, 30Nov08)

Melaleuca thicket with tall sedge in 2008 in WNW corner (RJ-WI, 30Nov08))

Dead and fallen melaleuca at W end (AC, 13Nov09)

Crake nest site (AC, 6Dec09)

Crake nest (AC, 6Dec09)

Shark Lake – Continued

Musk Duck nest site (AC, 6Dec09)

Musk Duck nest (AC, 6Dec09)

Reed-Warbler nest site (AC, 6Dec09)

Reed-Warbler nest with eggs (AC, 6Dec09)

Purple Swamphen nest site (AC, 13Nov09)

Purple Swamphen nest with eggs (AC, 6Dec09)

Appendix 4. GPS coordinates of nests located during the 2009-10 surveys

These GPS coordinates are retained by DEC and are not for gener l distribution, at least in the short term (several years at least), i der to give current nest sites a level of protection from possible unlawful disturbance.