



IDENTIFICATION OF SIGNIFICANT SHOREBIRD AREAS IN AUSTRALIA: MAPPING, THRESHOLDS AND CRITERIA

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IDENTIFYING SITES OF NATIONAL IMPORTANCE FOR SHOREBIRDS

SCOPE OF WORKS OF THE PROJECT:

- a) Identify areas of important habitat for each species of shorebird which occurs in Australia, where important habitat is defined as:
 - i. Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
 - ii. Habitat utilised by a migratory species which is at the limit of the species range, or
 - iii. Habitat within an area where the species is declining.

- b) Develop a geographic information system (GIS) which identifies areas of important habitat at international, national, state, regional, site complexes, sites, sub-sites and point scale for each species of migratory shorebird which visits Australia at all sites for which sufficient data exist. The GIS should provide for information on threatening processes impacting on the habitat to be captured and should be widely compatible with systems used by planners and decision makers and be able to be distributed easily.

The scope of this work falls under Objective 2 of the Wildlife Habitat Conservation Plan, including work related to Actions 2.1, 2.2, 2.3, 2.4, and 2.5.

MILESTONES OF THE PROJECT:

Progress report (submitted on July 27, 2007)

- Progress on submission of scientific paper on criteria testing to The Emu
- Progress on development of geographic information system

Final Report (included here, as submitted on July 28, 2008)

- A geographic information system which identifies areas of important habitat at international, national, state, regional, site complexes, sites, sub-sites and point scale for each species of migratory shorebird which visits Australia at all sites for which sufficient data exist.

EXECUTIVE SUMMARY

Shorebirds appear to be declining throughout the world, and their long-term survival will require the identification and protection of their habitat. Australia has signed several international conservation agreements, and the Environment Protection and Biodiversity Conservation Act 1999 recognises the importance of migratory shorebird conservation. To achieve the protection of migratory shorebirds, managers and planners first need to be able to identify the areas that are important for shorebirds. This report: 1) provides a brief overview of migratory shorebirds in Australia and the threats affecting their populations; 2) describes the methods used to create a GIS for important areas of shorebird habitat; 3) recommends criteria at the National, State and Regional levels to identify significant shorebird areas. The objective of this report and GIS is to explicitly identify important shorebird areas so that they can be more specifically considered in planning and management activities.

Shorebird habitat mapping conducted within a Geographic Information System (GIS) identified 234 'shorebird areas' known to be important for shorebirds in Australia. This list is based on current knowledge and is likely to change as more information becomes available. Within these shorebird areas, all habitats understood to provide important roosting and feeding resources have been identified (1405 areas of habitat have been mapped). The 234 shorebird areas were also divided into 'count areas' based on the areas covered during shorebird surveys submitted to Birds Australia. Where available, data on the number of birds observed within these 1850 count areas provides an indication of the importance of the habitat found there. Finally, within each count area, we have initiated the collection of data on potential threats and associated habitat characteristics. Ongoing work will be needed to encourage counters to collect this data.

The 234 shorebird areas mapped here have been classified, where applicable, as including habitat that is important at the International, National, State and Regional level. Existing Ramsar criteria have been used successfully in Australia to identify shorebird areas of International significance based on thresholds relating to: 1) the abundance of shorebirds in wetlands ($\geq 20,000$ regularly recorded birds); and, 2) the proportion of individual species flyway population in wetlands ($\geq 1\%$ of the population of one or more migrant species regularly recorded) (Watkins 1993). Criteria to identify areas of importance at the National level were explored and the following were identified as most appropriate: 1) a total abundance $\geq 2,000$ shorebirds; and, 2) $\geq 0.1\%$ of a migrant species flyway population. Shorebird areas where significant population declines in migratory shorebirds were greater than those observed nationally were identified as areas of State significance. Finally, some recommendations were made to identify shorebird areas, significant at the Regional level, that are important for those species not well represented in areas meeting the above criteria.

SUMMARY OF ACHIEVEMENTS IN THE MAPPING OF IMPORTANT HABITATS FOR SHOREBIRDS IN AUSTRALIA

- Continued adding to the GIS shapefiles identifying known important shorebird habitats in Australia. These shapefiles (n=3) now include 234 'shorebird areas', 1405 areas of feeding or roosting habitat, and 1850 'count areas' (including 330 randomly selected areas stratified geographically). A fourth shapefile is a point coverage of shorebird survey locations (n=1903) across Australia, and includes raw count data. All shapefiles except the point data layer will be made publically available.
- All polygon shapefiles have incorporated additional data sources from around the country to give a more complete representation of shorebird habitat in Australia. Commonly, these additional layers were of higher spatial resolution and have been based on aerial photography and ground-truthing.
- Added a number of attributes to each GIS shapefile providing information about all mapped areas. Attributes included details of: a) shorebird species recorded (summary indices and abundance values for 48 species individually); b) habitat characteristics; c) threatening processes; d) information source; e) level of habitat significance; and, f) number of shorebird surveys. Calculating many of these attributes required substantial work cleaning the National Shorebird Database.
- Developed metadata for each GIS shapefile that can be updated as required (Appendix B).
- Completed a draft manuscript of a scientific paper outlining the need for National criteria to identify important shorebird habitats in Australia (Appendix A).
- Drafted criteria to identify areas of State and Regional significance in order to highlight localised population declines, and bridge gaps in the identification of important habitat for key species.

RECOMMENDED CRITERIA TO IDENTIFY SIGNIFICANT HABITAT AT THE INTERNATIONAL, NATIONAL, STATE AND REGIONAL LEVELS

INTERNATIONAL CRITERIA (from East Asian-Australasian Shorebird Site Network)

A shorebird area is Internationally significant for shorebirds if it:

- Regularly supports $\geq 20,000$ shorebirds; or,
- Regularly supports $\geq 1\%$ of the flyway population estimate for at least one migratory shorebird species or sub-species.

NATIONAL CRITERIA

A shorebird area is Nationally significant for shorebirds if it:

- Regularly supports $\geq 2,000$ shorebirds; or,
- Regularly supports $\geq 0.1\%$ of the flyway population estimate for at least one migratory shorebird species or sub-species.

For the purposes of applying International and National criteria, a shorebird area is considered to 'regularly support' a population of a given size if:

- a) the requisite number of birds has been recorded in two-thirds of the years for which adequate data are available (for ephemeral wetlands years when the wetland is dry were not considered), the total number of years being not less than three and with no less than five surveys; or
- b) the average maximum annual count, taken over at least years, meets the required level.

STATE CRITERIA

A shorebird area is significant at the State level for shorebirds if it is Nationally significant, and:

- Exhibits significant decline in: a) the total number of shorebirds; or b) populations of any species, not known to be experiencing declines more broadly; or,
- Supports threatened or endangered shorebird species; or,
- Supports $\geq 1\%$ of the population of any resident Australian shorebird species.

For the purposes of applying State criteria, 'significant declines' include any declines significant at the $p < 0.05$ level, as reported in the literature or identified in analyses undertaken on data contained in the National Shorebird Database.

Shorebird areas of ‘**possible**’ State significance have been identified if the associated count data indicates:

- Significant population declines for any species for which widespread trends are not known; or,
- Population declines for any species not showing widespread population declines; or,
- The total number of shorebirds observed has experienced one of the following declines: a) >30% in ≥ 10 years; b) >50% in 5 years; or, c) >80% in 1 year.

REGIONAL CRITERIA

A shorebird area is significant at the Regional level for shorebirds if it:

- Has associated records of ≥ 15 species of migratory shorebirds; or,
- Has associated records of ≥ 20 species of migratory and resident shorebirds; or,
- Forms one of three most abundant shorebird areas, within each NRM boundary, for any of the following species: Latham’s Snipe, Little Curlew, Oriental Plover, Oriental Pratincole, and Australian Pratincole.

These five species were selected on the basis of being poorly captured by National criteria (i.e. too dispersed and/or found in poorly sampled habitats such as grasslands or small freshwater wetlands). All have >30% of their flyway population estimates regularly recorded in Australia (Table 1).

- Areas that support threatened or endangered shorebirds
- Areas that support greater than 1% of the Australian population of any resident shorebird species.

Each of these criteria, and their associated thresholds, are discussed in greater detail below

Table 1. Thirty eight species of migratory shorebirds recorded regularly in Australia. Population estimates are shown for each, as is their degree of site fidelity and whether they are listed under the Japan-Australia Migratory Birds Agreement (JAMBA) and the China-Australia Migratory Birds Agreement (CAMBA).

Common Name	Scientific Name	Min Flyway Population Estimate	National Population Estimate	% of Population in Australia	Fidelity*	JAMBA	CAMBA
Asian Dowitcher [^]	<i>Limnodromus semipalmatus</i>	24,000	insufficient data	insufficient data	High		listed
Australian Pratincole [^]	<i>Stiltia isabella</i>	60,000	60,000	100	Low	listed	listed
Bar-tailed Godwit	<i>Limosa lapponica</i>	325,000	180,000	55	High	listed	listed
Black-tailed Godwit	<i>Limosa limosa</i>	160,000	70,000	44	High	listed	listed
Broad-billed Sandpiper [^]	<i>Limicola falcinellus</i>	25,000	10,000	40	High	listed	listed
Common Greenshank	<i>Tringa nebularia</i>	60,000	18,000	30	Low	listed	listed
Common Redshank [^]	<i>Tringa totanus</i>	75,000	insufficient data	insufficient data	High		listed
Common Sandpiper [^]	<i>Actitis hypoleucos</i>	25,000 - 100,000	3,000	3 - 12	High		listed
Curlew Sandpiper	<i>Calidris ferruginea</i>	180,000	115,000	64	High	listed	listed
Double-banded Plover	<i>Charadrius bicinctus</i>	50,000	30,000	60	High	listed	listed
Eastern Curlew	<i>Numenius madagascariensis</i>	38,000	28,000	74	High	listed	listed
Great Knot	<i>Calidris tenuirostris</i>	375,000	360,000	96	High	listed	listed
Greater Sand Plover	<i>Charadrius leschenaultii</i>	110,000	73,000	66	High	listed	listed
Grey Plover	<i>Pluvialis squatarola</i>	125,000	12,000	10	High	listed	listed
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	50,000	40,000	80	Mod	listed	listed
Latham's Snipe [^]	<i>Gallinago hardwickii</i>	36,000	36,000	100	High	listed	listed
Lesser Sand Plover	<i>Charadrius mongolus</i>	140,000	24,000	17	Low	listed	listed
Little Curlew [^]	<i>Numenius minutus</i>	180,000	175,000	97	Low	listed	listed
Little Ringed Plover [^]	<i>Charadrius dubius</i>	25,000	50	0	Low		listed
Long-toed Stint [^]	<i>Calidris subminuta</i>	25,000	1,000	4	High	listed	listed
Marsh Sandpiper [^]	<i>Tringa stagnatilis</i>	100,000 - 1,000,000	9,000	1 - 9	Low	listed	listed
Oriental Plover [^]	<i>Charadrius veredus</i>	70,000	70,000	100	Low	listed	listed
Oriental Pratincole [^]	<i>Glareola maldivarum</i>	2,880,000	2,880,000	100	High	listed	listed
Pacific Golden Plover	<i>Pluvialis fulva</i>	100,000	9,000	9	Low	listed	listed
Pectoral Sandpiper [^]	<i>Calidris melanotos</i>	insufficient data	insufficient data	insufficient data	High	listed	
Pin-tailed Snipe [^]	<i>Gallinago stenura</i>	25,000 - 1,000,000	insufficient data	insufficient data	Mod	listed	listed
Red Knot	<i>Calidris canutus</i>	220,000	135,000	61	Low	listed	listed
Red-necked Phalarope [^]	<i>Phalaropus lobatus</i>	100,000 - 1,000,000	insufficient data	insufficient data	Low	listed	listed
Red-necked Stint	<i>Calidris ruficollis</i>	325,000	260,000	80	High	listed	listed
Ruddy Turnstone	<i>Arenaria interpres</i>	35,000	17,000	49	High	listed	listed
Ruff [^]	<i>Philomachus pugnax</i>	insufficient data	insufficient data	insufficient data	Low	listed	listed
Sanderling	<i>Calidris alba</i>	22,000	10,000	45	High	listed	listed
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	160,000	141,000	88	Low	listed	listed
Swinhoe's Snipe [^]	<i>Gallinago megala</i>	25,000 - 100,000	insufficient data	insufficient data	Mod		listed
Terek Sandpiper	<i>Xenus cinereus</i>	60,000	22,000	37	High	listed	listed
Wandering Tattler [^]	<i>Heteroscelus incanus</i>	insufficient data	insufficient data	insufficient data	Mod	listed	listed
Whimbrel	<i>Numenius phaeopus</i>	100,000	30,000	30	High	listed	listed
Wood Sandpiper [^]	<i>Tringa glareola</i>	100,000 - 1,000,000	6,000	0 - 6	Low	listed	listed

All species are listed under the Environment Protection and Biodiversity Conservation Act 1999 and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

[^] Species poorly represented in the National Shorebird Database

* The relative probability that a species will return to the same area in consecutive years (Bamford et al. 2008).

INTRODUCTION

The tidal flats, other coastal habitats, and many inland wetlands in Australia support a wide variety of shorebirds (Marchant and Higgins 1993; Marchant, Higgins et al. 1996). Shorebirds (also known as “waders”) include sandpipers, plovers, oystercatchers, stilts, and pratincoles. All shorebirds are characterised by their long bills, legs, and toes which are useful for wading to forage in wetlands. Here in Australia, shorebirds can be broken into two categories: migratory and resident. Migratory shorebirds come to Australia for the non-breeding season from as far as 13,000 kilometres to the north. Resident shorebirds breed in Australia and remain here year round, with the exception of the migratory Australian Pratincole which breeds in Australia and migrates north.

Having long recognised that the long-term conservation of viable wildlife populations requires the identification, protection and management of their habitat, governments throughout the world have initiated conservation measures and signed international conservation agreements. International agreements that pertain to Australia’s shorebirds include: the Ramsar Convention, the World Heritage Convention, the Bonn Convention, the Convention of Biological Diversity, the Asia-Pacific Migratory Waterbird Conservation Strategy, the East Asia-Australasia Shorebird Reserve Network, the China-Australia Migratory Birds Agreement (CAMBA), and the Japan-Australia Migratory Birds Agreement (JAMBA) (Silcocks and Weston 2004). As migratory shorebirds can travel up to 26,000 kilometres a year during their migration, it is clear that the long-term survival of these species demands such international cooperation. Without it, the highly productive habitats needed to meet the high-energy requirements of migratory shorebirds will continue to be lost (Myers, Morrison et al. 1987). In Australia, the Environment Protection and Biodiversity Conservation Act 1999 also recognises the importance of migratory shorebird conservation, treating these birds as a matter of National Environmental Significance. All of these agreements require the identification and protection of significant habitat for conservation.

Shorebird habitat must provide for a diversity of resource requirements if populations of these birds are to be conserved in the long-term. All shorebird habitats must provide a combination of feeding areas rich in food and nearby roosting areas that allow shorebirds to rest without losing too much energy to disturbance (van de Kam, Ens et al. 2004). Further, optimal shorebird habitat must be sufficiently open in order to allow shorebirds to detect and avoid predation. It is clear that, before these important components of shorebird habitat can be conserved, they must be well identified. The identification of important shorebird habitats is especially critical for migratory shorebirds as many of these species are declining throughout the world (Howe, Geissler et al. 1989; Morrison, Downes et al. 1994; Morrison, Aubry et al. 2001; (IWSG) 2003; van de Kam, Ens et al. 2004) and in Australia (Creed and Bailey 1998; Wilson 2001; Olsen, Weston et al. 2003; Reid and Park 2003; Gosbell and Clemens 2006; Nebel, Porter et al. 2008).

There is a clear need for information to ensure that planners and managers know how best to avoid impacting on important shorebird habitats. While understanding the spatial boundaries of any habitats used by shorebirds will assist management, the

maintenance of viable shorebird populations will require threats to shorebird habitat be minimised within, and outside, existing protected areas. The objective of this report, and the associated GIS shapefiles, is to map the distribution and extent of shorebird habitat in Australia, and to summarise the relevant available information for each area.

THREATS TO SHOREBIRDS IN AUSTRALIA

Threats to shorebird populations, and their habitats, in Australia include habitat loss/degradation, disturbance pressures, invasive species, pollution, and human-induced mortality or breeding failure (for residents). The severity of these threats depends on the scale and aggregate effect of human actions throughout the area, and the degree to which shorebird populations are currently limited in the area. However, there has been little effort to quantify the effects of past human actions on shorebird populations throughout Australia. Nevertheless, there is growing evidence from around the globe of the impacts that these kinds of threatening processes can have on shorebird populations (Howe, Bart et al. 2000; van de Kam, Ens et al. 2004; Geering, Agnew et al. 2007).

Habitat loss can be particularly problematic for migratory shorebird populations as they often congregate in high numbers in productive habitats to fuel their energetically demanding migration. Loss or degradation of habitats that hold large numbers of shorebirds appear to cause disproportionate declines in shorebird populations (Myers, Morrison et al. 1987; Morrison, Ross et al. 2004; van de Kam, Ens et al. 2004; van Gils, Piersma et al. 2006). For example, commercial shellfish dredging in the Dutch Wadden Sea reduced both the quality and quantity of food resources for Red Knot, causing drastic population declines in this species (van Gils, Piersma et al. 2006). In USA, habitat degradation associated with the invasion of exotic *Spartina anglica* is widely understood to result in the loss of both roosting and important foraging habitats for shorebirds (Stralberg, Toniolo et al. 2004). In other areas, it has been shown that habitats subject to continuous disturbances can be permanently lost to shorebirds, and even infrequent disturbance can incur an energetic cost that has been shown to result in decreased breeding success in migratory Pink-footed Geese (van de Kam, Ens et al. 2004). While the impacts of disturbance on shorebirds vary, and have been difficult to quantify, there is growing evidence that disturbance affects shorebird behaviour and energetic fitness (Davidson and Rothwell 1993; Fitzpatrick and Bouchez 1998; Collins, Jessop et al. 2000; Paton, Ziemnicki et al. 2000; James, Rodgers Jr. et al. 2003; Burger, Jeitner et al. 2004) (Table 2).

In Australia, the impact of threatening processes on shorebird populations has not been quantified but suggestive evidence is growing. For example, recent analyses in Botany Bay revealed significant population declines of migratory shorebirds which appear to be related to widespread habitat loss in the area (Straw pers. comm.). In Anderson Inlet, invasive *Spartina anglica* and disturbance are considered responsible for unusual roost selection in Red-necked Stint (Minton and Whitelaw 2000) and there is growing evidence that the number of some species using this shorebird area is declining. The evidence of widespread population declines in Australia (Creed and Bailey 1998; Gosbell and Clemens 2006; Rogers and Gosbell 2007), and of independent declines in some areas (reported below), suggest that understanding the

impacts of these threatening processes on shorebird populations will be critical to their successful conservation. This report outlines the recommended ways in which we hope to improve tracking of these threats over time.

Table 2. Brief description of the results of selected studies investigating the impact of disturbance pressures on shorebirds.

Source	Summary description of findings
Paton et al. (2000)	Found that human activity disturbed shorebirds at distances from 25m to 204m, and that walking with a dog, or using jet skis were the most disturbing forms of human activity.
Davidson and Rothwell (1993)	A collection of papers including reviews of what is known regarding human caused disturbances and how they relate to things like feeding, dispersion, competition, and behaviour in shorebirds.
Collins et al. (2000)	Review of potential impacts to waterbirds from hovercraft and jet-skis.
Burger et al. (2004)	Demonstrate the success of managing visiting people to limit disturbance to shorebirds.
Fitzpatrick and Bouchez. (1998)	Measure how human activity changes shorebird behaviour in three species.
James et al. (2003)	Compared the distance that various bird species flushed by passing outboard-powered boats and airboats. Larger species generally exhibited greater average flush distances. Recommended buffer zones that would minimize disturbance of waterbirds from 165m to 255m.

THE USE OF CRITERIA TO IDENTIFY SIGNIFICANT SHOREBIRD HABITATS

Sites of International significance have been identified in Australia using criteria adopted under the Ramsar Convention (Watkins 1993). Similar criteria are used throughout the world by other major conservation organisations and initiatives, including the Ramsar Convention, Important Bird Areas (BirdLife International), Key Biodiversity Sites, and the East Asian – Australasian Shorebird Site Network (Morrison, Davidson et al. 2005). Surprisingly, little investigation has been conducted to quantify the performance of these criteria. Most who have adopted these criteria, however, do recognise that they are successful in identifying known important shorebird areas (Atkinson-Willes, Scott et al. 1982). For example, a study quantifying the effectiveness of criteria found that over 95% of the individuals from 13 shorebird species were identified within wetlands that met the “1% of individuals in a population” criterion (Page, Stenzel et al. 1999).

Watkins (1993) demonstrated, however, that in Australia lowering the threshold at which sites were flagged as significant by a relatively small amount resulted in the identification of additional areas used by large numbers of shorebirds. He suggested that the sites identified by lower thresholds should be flagged as being significant at the National level. The fact that international criteria did not identify all areas used by relatively large numbers of shorebirds suggests that migratory shorebirds may be more dispersed in Australia than other areas. Unpredictable climatic conditions, for

example, throughout much of Australia create many ephemeral wetlands, uncommon in other flyways (Olsen and Weston 2004), which lead to more dispersed distributions of shorebirds (Warnock, Haig et al. 1998). As a result, additional criteria to identify significant shorebird habitats, at the National level, are necessary.

While such criteria are relatively arbitrary in nature, they are the most effective and consistent way to identify important shorebird areas. This report recommends criteria to identify habitat that is significant for shorebirds at the National, State, and Regional level. Shorebird areas classified by these criteria, as well as the existing International criteria, are identified in the GIS shapefile for shorebird areas.

MAPPING OF SIGNIFICANT SHOREBIRD HABITAT

METHODS AND RESULTS

STUDY AREA

The study area included any area in Australia (mainland and offshore islands) where sufficient data existed to facilitate mapping, or for which pre-existing GIS layers were available (Figure 1). Every effort was made to incorporate existing shorebird habitat mapping, most notably that created by Wetlands International, as well as the Queensland Wader Study Group, the New South Wales Wader Study Group, and WWF Australia.

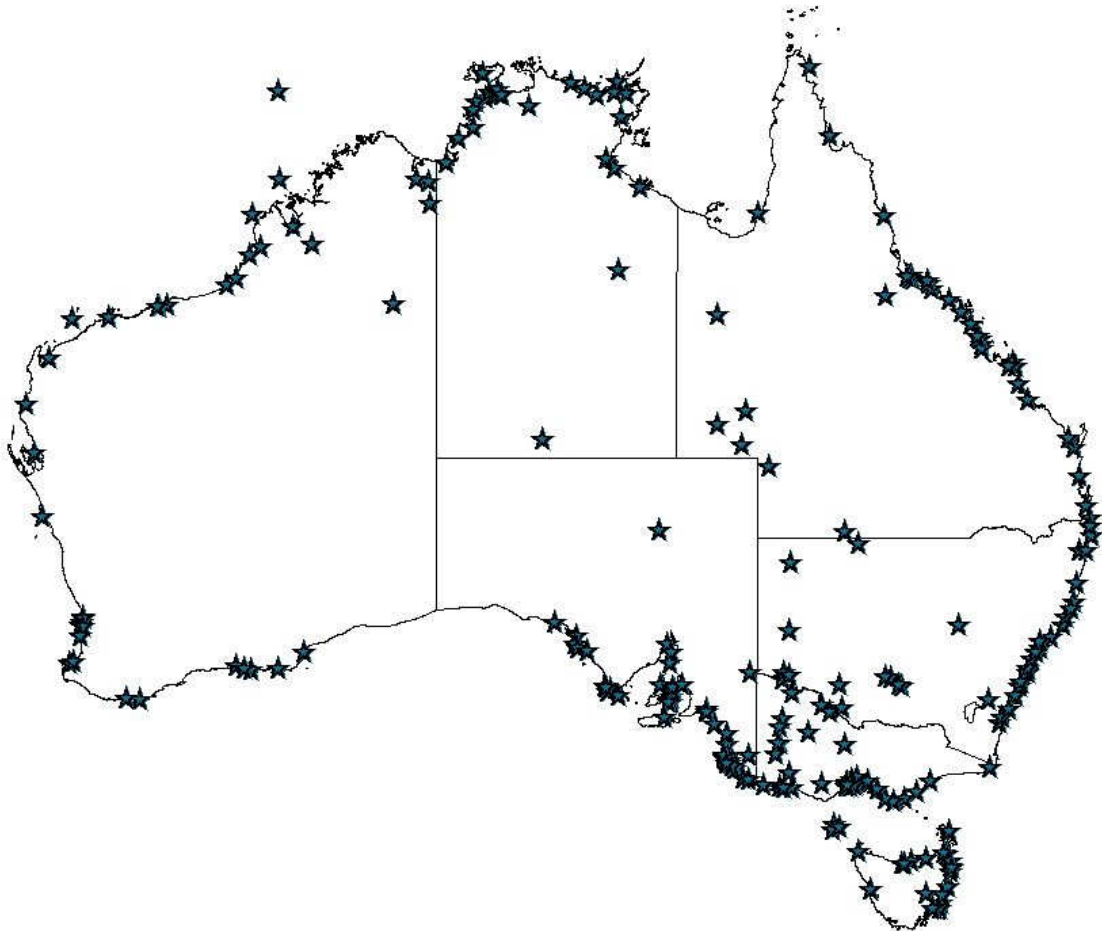


Figure 1. Location of all 234 shorebird areas in Australia.

DATA SOURCES

A large amount of spatial data was incorporated from other field-based projects/organisations. Generally each of these projects had access to high resolution imagery on which mapping was based. Further, associated polygon boundaries were often refined by ground-truthing with a GPS. This resulted in much more accurate mapping of the habitats in these areas (see Appendix B).

The remaining mapping involved substantial consultation with shorebird experts from around the country. This was done by supplying each expert with 1:100,000 topographic maps with known shorebird areas overlaid. Local experts then revised and added new boundaries directly onto these paper maps. Each expert was instructed to identify the full extent of each shorebird area. Where available, historic mud-maps from old data sheets were also interpreted for some of the shorebird areas represented in the GIS shapefiles. Where possible, count data was used to verify movements between adjacent habitats thought to be part of the same shorebird area. Within each shorebird area, experts were also asked to identify the boundary of all areas in which shorebird surveys are conducted ('count areas) and the location of habitats used by shorebirds for feeding and roosting. Further, experts were asked to describe the habitat, threats, and shorebird usage of the area. The areas mapped reflected those areas surveyed in the 2008 field survey, and those areas covered historically by shorebird experts.

MAPPING TECHNIQUE

Most polygon boundaries were digitised on screen-displayed 1:100,000 topographic maps (except in Tasmania where only 1:250,000 maps were available) in ArcView 3.2 and ArcMap 9.1. These boundaries were based on hand drawings made by shorebird experts using the same topographic maps. Additional polygons were imported from other GIS shapefiles, or digitised from a variety of sources (e.g. historic reports, mud-maps, aerial photos, Google Earth imagery). As a result, the mapping of shorebird habitats encompasses a diversity of spatial accuracy and resolution.

We focused primarily on areas represented in the National Shorebird Database, or known to volunteer shorebird counters throughout the country. Time did not permit additional data sources, past those already identified, to be investigated. The resulting mapping reflects a tendency for less data to be collected in remote areas and non-wetland habitats such as grasslands. As a result, insufficient data was available to allow adequate mapping of many of the often-ephemeral wetlands of inland Australia. Therefore, it is expected that mapping in some areas will need to be refined, and additional areas added. Nevertheless, all shapefiles represent the best available knowledge on important habitats used by shorebirds in Australia.

GIS SHAPEFILES

Four GIS shapefiles (three polygon, and one point coverage) were created to represent important shorebird habitats in Australia. All polygon layers will be publically available, but the point coverage has been generated for internal use by the Government and partner organisations. A shapefile identifying historic count areas has also been initiated, in the hope of identifying changes in shorebird area use

The 'shorebird area' shapefile reflects the boundary of all habitats used by shorebird populations in the non-breeding season. Shorebird areas are defined as all contiguous and non-contiguous habitat known to be used by the same population of shorebirds – effectively, the non-breeding home range for each population. Non-contiguous habitats were only included as part of the same shorebird area if there was evidence of regular bird movement between them. Contiguous habitats known not to be used by

shorebirds were not included within shorebird area boundaries. Shorebird area boundaries are generally more precise in areas with more data (> 10 years) and in areas where on-ground habitat mapping has been conducted, a preliminary attempt to score the completeness of the mapped boundaries has been included as an attribute within the GIS.

A total of 234 shorebird areas have been identified and mapped in the shorebird area shapefile. The size of these areas ranged from over just over 1 ha to over 100,000 ha. Ten areas were larger than 50,000 ha while seven were less than ten ha. Single shorebird areas included up to 19 adjacent wetlands but the majority of shorebird areas fell within one area of contiguous habitat. Examples of identified shorebird area boundaries are included in Appendix C.

The 'feeding and roosting' habitat shapefile identifies all habitats known to be used by shorebirds for either feeding or roosting. These areas vary in accuracy and resolution depending on the data source. Some roosting habitats have been mapped by buffering a point location (i.e. lat-long coordinate) reported during a high tide roost survey. In such cases, the important roosting habitat may not be fully contained within the polygon boundary. In total, 1405 areas have been identified, and mapped, as shorebird feeding and/or roosting habitat. The vast majority of these areas represent high-tide roosts as this is the time when shorebird surveys in tidal areas are often conducted. Thus, they do not constitute comprehensive mapping of important roost areas. Even within shorebird areas where on-ground mapping and high resolution imagery has been used, little work has been done to identify neap tide roosts, or night time roosts. Further, the mapping of feeding areas has been less comprehensive as very few low-tide surveys have been conducted. In shorebird areas known to hold large number of shorebirds, potential feeding areas were mapped if there was extensive mud-flats available for foraging. More work is needed to map the extent and use of tidal flats in these areas as use varies with the tides and the shifting distribution of both the benthic fauna and the tidal flats. Therefore, it is important to emphasise that areas where water is sufficiently shallow, or flats are exposed, have been mapped as feeding habitats. Considerable work is needed to develop this understanding further: currently, feeding area boundaries represent the limit of areas that are known to be important. Examples of type mapping identifying feeding and roosting habitats are presented in Appendix D.

The 'count area' shapefile identifies the extent of the areas counted during shorebird surveys. Most shorebird areas comprise multiple count areas. These count areas are often aligned with high-tide roost locations and reflect the areas that counters anticipate being able to cover consistently in ongoing monitoring efforts. Despite considerable consultation with shorebird counters, there is no guarantee that historic counts were undertaken in the same location as the count areas mapped in this shapefile. Even so, many count areas have been defined based on historic counter methodology and count areas with over ten years of data often have more consistent boundaries. In total, 1850 count area polygons have been mapped, including 330 random sampling locations (see below). As with the other shapefiles already described, it is likely that count area boundaries will continue to be refined as our understanding of shorebird surveys increases. Examples of count area mapping can be found in Appendix C.

The point layer created here is based on lat-long coordinates reported for shorebird surveys included in the National Shorebird Database. The majority of these count locations correspond with information contained in the other shapefiles. For example, many counts have been undertaken in count areas and/or shorebird areas. Many also are associated with roosting habitats.

RANDOM SELECTION OF ADDITIONAL COUNT AREAS

The lack of random sampling in the historic shorebird counts has made it more difficult to draw inferences from the data collected (Clemens, Weston et al. 2007). Therefore, we have randomly identified an additional set of 330 count areas for shorebird sampling. These areas are not located within existing shorebird areas and their selection has been stratified geographically. In order to break up Australia into geographic sampling regions, the full number of 85 bioregions (IBRAs - Interim Biogeographic Regionalisation for Australia) were dissolved into 11, larger bioregions. In doing so, we combined IBRAs that held similar types of shorebird habitats. Further, we combined more areas in remote inland Australia where shorebirds, and wetlands are more scarce and combined areas less in parts of country where large numbers of shorebirds are known to occur but which have not been sampled well historically (i.e. far northern Australia).

Due to the highly ephemeral nature of many of Australia's inland wetlands, and a lack of resources, half the randomly selected areas included areas where shorebirds have been recorded (from ATLAS or shorebird count records). The remaining half were selected at random from within areas known to hold water (based on the 250k Australian water GIS coverage). Randomly selected areas were at least 10 km away from existing shorebird areas and at least 20km from any other randomly selected point. Finally, to allow for survey standardisation across very diverse habitats, each randomly selected area was buffered with a 5km radius circle which represents the recommended survey area. A combination of buffered, clipped, and intersected polygons were used to ensure these rules were followed, and points were reselected if any of the selection criteria were broken. This process resulted in the identification of 330 additional count areas, each covering an area of 5 km radius, all of which have been included in the count area shapefile. Random site selection was undertaken using the Sampling Tool extension in conjunction with Arcview 3.2a.

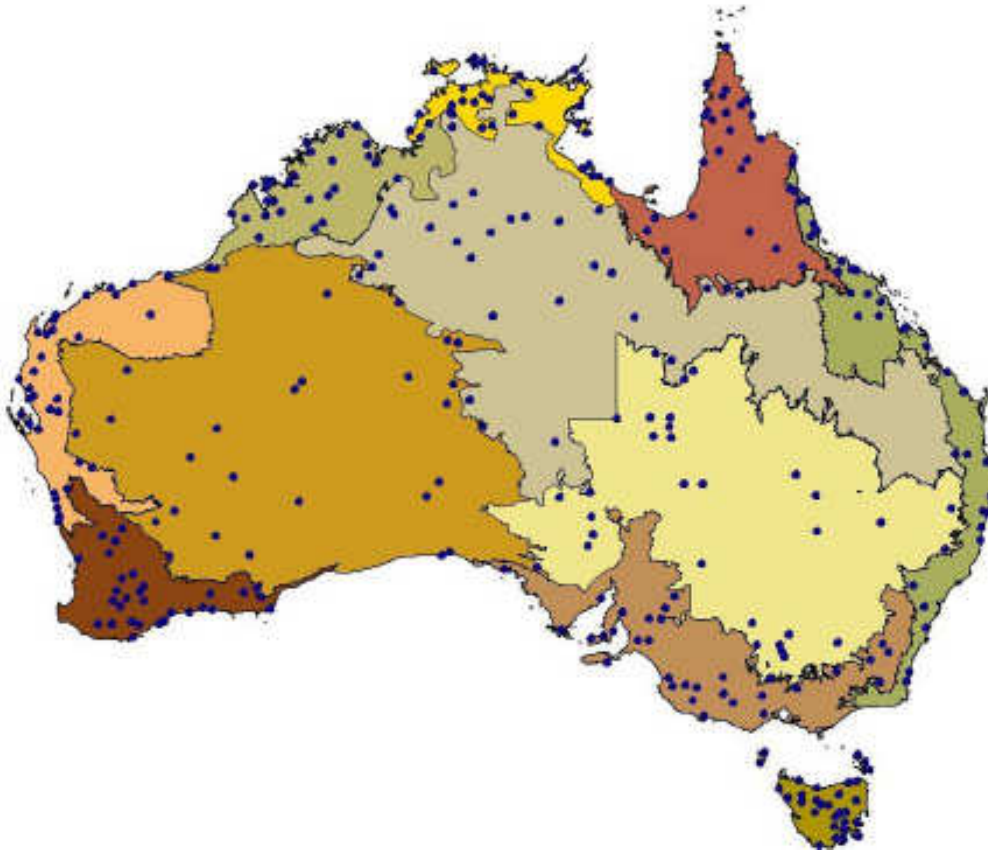


Figure 2. Location of 330 randomly selected count areas stratified across 11 bioregions in Australia.

SPECIES INCLUDED IN GIS

This report and GIS focuses on 38 species of migratory shorebird that regularly visit Australia (Table 1). Previous reports have identified 36 species of regular migrants with some variation in which species were included. The Australian Pratincole (*Stiltia isabella*), Pin-tailed Snipe (*Gallinago stenura*), and the Little Ringed Plover (*Charadrius dubius*) are the three species that appear in some lists and not in others. Including all of them here will have little impact, as there are very few records in the national shorebird count database for any of these species. The Pin-tailed Snipe and the Little Ringed Plover were probably not always included in lists because they visit Australia in very low numbers and may at times be considered vagrants rather than regular migrants. The Australian Pratincole is the only shorebird species that breeds in Australia and migrates north, and so while it is a migratory shorebird it has different habitat requirements compared with other migratory shorebirds. The Double-banded Plover (*Charadrius bicinctus*) is also different from most migratory shorebirds that visit Australia, as it visits in the Australian winter after having bred in New Zealand. Habitat used by five species that visit Australia were not well represented in the national count database or the GIS created. These species included Latham's Snipe, Oriental Plover, Little Curlew, Oriental Pratincole, and Australian Pratincole. These species occur in habitats (such as grasslands or freshwater marshes) that were not well represented in data or known sampling, and some of these species

are too dispersed in these habitats to suggest that future habitat mapping would be easy.

DATA INCLUDED IN THE ATTRIBUTE TABLES OF GIS SHAPEFILES

A range of different information ('attributes') about each polygon/point mapped in the GIS shapefiles is included in the associated attribute tables. The XTools extension was used to generate the centroid, area (ha), and perimeter (m) for all mapped polygons. Other attributes were either brought in directly from the National Shorebird Database (see below), or input directly based on observer responses to information requests. See acknowledgements and Appendix B for further details on contributors, sources, and specifications of spatial data.

In 1980, Birds Australia (formerly the Royal Australasian Ornithologists Union) formed a specialist sub-group (a special interest group) called the Australasian Wader Study Group (AWSG) to improve the understanding of shorebird populations in Australia. The AWSG has collected shorebird data over the last 25 years, resulting in a substantial database (the National Shorebird Database) that is housed at the Birds Australia National Office. This database contains count data collected by up to 700 volunteers in any one year at shorebird areas throughout Australia. These data can be categorised into three main groups:

- Population Monitoring data, collected since 1981, which constitutes about 30 regularly visited shorebird areas that are generally counted twice a year (once in the summer and once in the winter). Relatively complete data sets are available for 20 shorebird areas;
- The Regular Counts project, 1981-1990, which collected data from 118 shorebird areas around Australia on a monthly basis. Few of these shorebird areas have complete data sets; and,
- Opportunistic counts, from 1981 onwards, where wader counters visited shorebird areas on a one-off basis and conducted a shorebird count at the area.

The raw data is not publically available, but may be made available upon request. For all shorebird areas, and many count areas, the maximum and average annual count of each of 48 shorebird species is provided. A summary of the maximum counts reported for each shorebird area for the more common species is included in Appendix E.

IDENTIFICATION OF THREATS AFFECTING SHOREBIRD HABITATS

A literature review identified five key threatening processes that are likely to impact on shorebird populations in Australia. They include: 1) human-induced habitat loss/degradation; 2) human-induced disturbance; 3) invasive species (plant or animal); 4) pollution (e.g. oil spills, runoff), and; 5) accidental mortality of birds through factors such as nest trampling. The Western Hemisphere Shorebird Reserve Network (WHSRN) has created a relatively straightforward way to assess the likely impact of each of these threats on shorebird areas (Table 3). Each category of threat is scored in

three different ways based on the timing, scope and severity of the threat. These three values are then summed to give one score that represents the overall impact, of each type of threat, on shorebird areas. While this method is subjective, it does allow for comparisons between potential impacts, of different threats, on shorebirds in shorebird areas.

Table 3. System of scoring key threats known to impact on shorebird populations (adapted from methods developed by the WHSRN).

Characteristic of threat	Description of threat impact	Score
Timing	Occurring now	3
	Likely to occur within 3 yrs	2
	Likely to occur in > 3 yrs	1
	No occurring, not likely to occur in future	0
Scope	> 90% reduction in shorebird population	3
	50 – 90% reduction in shorebird population	2
	10 – 49% reduction in shorebird population	1
	< 10% reduction in shorebird population	0
Severity	Severe deterioration (will persist for 10+ yrs)	3
	Moderate to high (will persist for next 3 yrs)	2
	Small to moderate (unlikely to persist for 3 yrs)	1
	No/imperceptible deterioration	0
Overall impact of threat when scores combined	High	8-9
	Medium	6-7
	Low	2-5
	Negligible	0-1

Threat scores for each shorebird area and count area have been requested from counters across the country. To date, this information has been received for only 71, out of the total 1500, identified count areas. An additional 103 count areas have been scored as part of a separate project in Gippsland, Victoria (Clemens, D. et al. 2007). Given the small percentage of count areas that have been scored, these results are not included in the attribute table of the count area shapefile. However, where available, threat scores for shorebird areas have been included in the shorebird area shapefile (Appendix F). Telephone surveys were conducted to establish these threat scores for 48 shorebird areas. Ideally, this information will be collected annually for each shorebird/count area visited and will be incorporated into the GIS shapefiles as it becomes available. New data sheets created for the 2008 winter shorebird count appear to be yielding more threat score information, but this data has yet to be entered into the database.

The potential value of incorporating these threat scores into a GIS were illustrated in the West Gippsland Habitat Mapping Project (Clemens et al. 2007), and examples are presented in Appendix G. These figures show how spatially explicit threat scores can be presented to give relative comparisons that are useful in setting management and planning priorities.

DISCUSSION OF MAPPING

MAPPING OF SHOREBIRD HABITATS

The mapping of shorebird habitats reported here has greatly enhanced previous knowledge of the areas that are important for shorebirds in Australia. Further, this mapping has enhanced the understanding of the spatial extent of shorebird areas that have been surveyed over the last 28 years. Specifically, mapping done by shorebird experts throughout Australia has refined the boundaries of known shorebird areas and identified the key habitats within those areas. Further, by incorporating spatial datasets collected with more rigorous techniques, this mapping represents the best available information on important shorebird habitats throughout Australia. The recent reinvigoration of shorebird population monitoring has also led to the identification of new areas that are important for shorebirds.

Nevertheless, the complete identification of all important shorebird habitats in Australia in the near future is unlikely. This is because considerable work is needed to identify the full range of habitat components that contribute to shorebird fitness. There are also limitations to our understanding of the areas, especially in inland Australia, that are being used by shorebirds. Gaps are most evident in the mapping of feeding areas, non-wetland habitats, small inland freshwater wetlands, near tide roosts, nocturnal roosts, resident shorebird habitats, and many of the inland areas previously reported as important for shorebirds (Watkins 1993; Kingsford 1999; Nebel, Porter et al. 2008). Lastly, in many cases, the only information representing specific habitat characteristics related to the extent of tidal flats or wetlands.

The way 'shorebird areas' have been defined here is central to calculating the number of birds recorded in the area, and therefore also affects its assigned significance level. In turn, understanding of the way shorebirds use each area is critical to defining shorebird area boundaries. The data contained in the National Shorebird Database has contributed substantially to this understanding. As the amount of shorebird data available increases and we learn more about how shorebirds use different areas, the location of shorebird area boundaries will become accurate. Nevertheless, some shorebird areas mapped here have been surveyed regularly for over 25 years. For these areas, we have a relatively comprehensive understanding of the position of shorebird area, count area, and spring tide roost boundaries, as well as the number of shorebirds using the area. Shorebird areas with relatively few counts (< 5), that hold non-aggregating species or species that use grassland or small freshwater habitats, are not well represented by the boundaries identified here.

POSITIONAL ACCURACY OF MAPPING

Accuracy of this mapping was not fully assessed as the resources required to conduct ground-truthing throughout the country were not available. Generally, the topographic maps that formed the basis of most mapping contain positional errors of

up to 100m depending on the feature mapped. For example, the extent of mudflat is likely to be less accurate than the position of roads. In another project where ground-truthing was conducted, positional accuracy was found to be between 15 m and 400 m (Clemens, D. et al. 2007). While many of the features that define the boundaries of shorebird areas are relatively fixed, some are dynamic habitat features that may shift dramatically. Further, many inland shorebird areas vary in habitat suitability due to drying and flooding cycles, as well as shifts in water quality and salinity (Taylor 2003). Despite these considerations, the shorebird area boundaries presented here are considered coarse enough to capture such shifts.

For planners and managers requiring greater spatial resolution, some generalisations may assist in the interpretation of important shorebird habitat boundaries. In general, areas near the mouths of estuaries will be subject to greatest spatial inaccuracy. Boundaries of feeding areas can also be dynamic, with positional changes associated with altered channel locations and movement of benthic organisms. Boundaries of discrete wetlands are less likely to vary widely. Habitats associated with sewerage farms, lakes, and salt-works were clearly demarcated. Boundaries adjacent to fixed features will likely be accurate to between 5 m – 100 m and those derived from field-based projects will also be relatively accurate (Appendix B). Finally, the boundary of some habitat features (e.g. salt marshes) used by shorebirds are not visible on 1:100,000 topographic maps: for these features, high resolution imagery will be required for more precise mapping.

ACCURACY OF SPECIES RECORDS IN ATTRIBUTE TABLES

The number of shorebirds recorded in each shorebird area or count area varies in accuracy depending on the number of counts undertaken in the area, and how recently the area has been surveyed. Generally, the maximum and average number of shorebirds recorded annually in each shorebird area/count area will be relatively accurate for areas with ten or more years of data. However, due to the difficulty of counting all birds in each area, it is likely that reported values slightly underestimate the actual number of shorebirds using the area. It is unclear how many visits are required to accurately represent the number of shorebirds using an area, but multiple visits throughout the year are required in order to capture the full number of species using an area, and to increase the accuracy of maximum abundance estimates (Alcorn, Alcorn et al. 1994).

DISCUSSION OF RECOMMENDED CRITERIA TO IDENTIFY SIGNIFICANT HABITAT AT THE INTERNATIONAL, NATIONAL, STATE AND REGIONAL LEVELS

In early discussions about how to identify significant shorebird habitat, it was suggested that shorebird areas at the limit of a migratory species range might provide the basis for effective criteria. In theory, these areas may be among the first to exhibit declines in species' populations. Initial investigations involved mapping all shorebird survey locations (from the National Shorebird Database and Birds Australia ATLAS records; Appendix I). However, the resultant maps resembled coarse range maps with subjective judgements being required to define the limit of species' ranges. Further, while the range of one species may extend into New South Wales, other species occurring in the same habitat may extend further south. In other words, many of the

areas being used by shorebirds at the limit of their range are identified as being significant habitat for other shorebird species. It remains unclear if shorebird areas supporting small numbers of shorebirds at the edge of their range are more important than areas holding similar numbers of individuals in the middle of their range.

NATIONAL AND INTERNATIONAL CRITERIA

International criteria have been successfully used to identify significant habitat for shorebirds throughout the world in a transparent and consistent way. Here in Australia, it is evident that the distribution of shorebirds is more dispersed than in other countries (Marchant and Higgins 1993; Marchant, Higgins et al. 1996; Page, Stenzel et al. 1999; Geering, Agnew et al. 2007). As a result, shorebird areas identified by existing international criteria contain a smaller proportion of shorebird populations than when applied in other parts of the world (Appendix A). Comparable proportions of the flyway populations of some migratory species were only captured by the network of 'significant' shorebird areas when thresholds are revised downward (Appendix A). Therefore, lower threshold values are required to ensure that criteria identifying significant shorebird habitats in Australia perform in a similar manner to those employed overseas. Appendix A includes a more detailed discussion of the criteria recommended to identify shorebird areas of International and National significance in Australia.

These criteria do not perform equally across shorebird species. For example, some species are too dispersed, or occur in infrequently surveyed habitats (e.g. grasslands), to be adequately represented in shorebird areas identified as significant at the International and National level. Therefore, a different approach is needed to identify and conserve habitat important for these species. Two additional criteria levels (State and Regional) have been recommended and are described below.

STATE CRITERIA

For successful conservation of migratory shorebirds in Australia, it is critical that shorebird areas experiencing localised population declines are identified. To this end, the criteria recommended to identify significant shorebird areas at the State level are based around shorebird population declines. The thresholds suggested here are fairly conservative and rely strongly on the availability of sufficient data to identify population declines at the level of individual shorebird areas (Table 4). However, in doing so, they guard against the identification of localised trends that might reflect more widespread trends. Unfortunately, these criteria are not sensitive enough to detect population trends in a shorebird area until there has been a substantial reduction in the shorebird populations recorded there.

We are hopeful that more consistent annual count coverage in the future will increase our ability to detect localised population trends. As more consistent data becomes available, it is hoped that declines currently suggested by inconclusive evidence will become more apparent. This is important in order to ensure that population declines are noticed with sufficient time to allow the associated causes to be limited.

The State criteria recommended here provide an initial warning of possible localised population declines for some species within shorebird areas. We suggest that managers of any shorebird area listed as significant, or possibly significant, at the State level take steps to that confirm population declines are occurring, discover what is driving them, and act to reduce or mitigate any associated threats.

Table 4. Shorebird areas of State significance and associated justification for assigning significance at this level.

Shorebird Area	State	Significant?	Source
Botany Bay	NSW	Yes	Significant declines in Red-necked Stint (Gosbell and Clemens 2006)
Cairns area	QLD	Yes	Significant declines ($p < 0.01$) in Red-necked Stint/Bar-tailed Godwit in recent analyses (2008)*
Cape Portland	TAS	Yes	Significant declines in Red-necked Stint (Gosbell and Clemens 2006)
Coorong	SA	Yes	Red-necked Stint >50% decline evident, possible declines in Sanderling (Gosbell and Christie 2007)
Derwent	TAS	Yes	Evidence of declines (Olsen and Weston 2003). Significant declines ($p < 0.01$) in Red-necked Stint, Common Greenshank, Bar-tailed Godwit in recent analyses (2008)
Hunter Estuary	NSW	Yes	Significant declines in Red-necked Stint (Gosbell and Clemens 2006)
Shoalhaven Estuary	NSW	Yes	Significant declines in Red-necked Stint (Gosbell and Clemens 2006)
Swan River & Rottnest Is.	WA	Yes	Significant declines in Bar-tailed Godwit, Red-necked Stint, Curlew Sandpiper, Sharp-tailed Sandpiper, and Grey Plover (Creed & Bailey 1998)
Anderson Inlet	VIC	Possible	Evidence (using initial and final predicted values from regressions) of 50% decline in Sharp-tailed Sandpiper
Clarence River	NSW	Possible	Far fewer Red-necked Stint seen in recent years than historically >300% decline (data insufficient to confirm significance)
George Town Reserve	TAS	Possible	Significant declines in the total abundance of all species, and of Ruddy Turnstone from recent analysis $p < 0.01$ (2008)
Laverton/Altona	VIC	Possible	Significant declines in Sharp-tailed Sandpiper from recent analysis $p < 0.01$ (2008)
Moolap Saltworks	VIC	Possible	Significant declines in Pacific Golden Plover from recent analysis $p < 0.01$ (2008)
Swan Bay & Mud Islands	VIC	Possible	Significant declines in Great Knot from recent analysis $p < 0.01$ (2008)
Wilson Inlet	WA	Possible	90% reduction in total number of shorebirds observed from 2007 to 2008
Kerang Lakes	VIC	Possible	Evidence of over 70% declines in the numbers of Red-necked Stints and the total number of all shorebirds since the 1980's

* Analyses undertaken in 2008 incorporated data from the National Shorebird Database and followed methods described in Gosbell and Clemens (2006).

REGIONAL CRITERIA

Criteria for identifying significant shorebird areas at the Regional level are recommended with the intention of identifying areas used by species inadequately captured by International and National criteria. To do this we identified, for each NRM region across Australia, the three shorebird areas in which five key species were recorded at highest abundance. These species (Latham's Snipe, Little Curlew, Australian Pratincole, Oriental Pratincole and Oriental Plover) were selected on the basis of being highly dispersed and/or occurring in habitats not regularly surveyed for shorebirds (e.g. grasslands).

The use of additional, Regional criteria based on species richness values ensures that wetlands providing a diverse range of habitat resources are identified, even if the abundance of shorebirds recorded in them is low. The value of wetlands that support rich shorebird assemblages has yet to be assessed, but it is assumed that habitats supporting more species are likely to be more diverse than those supporting fewer species.

Additional work is needed to refine regional criteria so that habitats important for shorebird conservation can more fully be identified. For example, more data is needed to identify enough shorebird areas to capture 30% of the flyway population of Latham's Snipe. This is recommended if the habitat identified for Latham's Snipe is to be comparable, in terms of the proportion of flyway population captured, to species well represented in the National Shorebird Database.

OVERALL CONCLUSIONS

The mapping of shorebird areas and associated information contained in GIS shapefiles is impressive in scope and completeness given the spatial coverage of the dataset, and the enormous volunteer effort required to gather the data. Without these data, mapping and identifying important habitats for shorebirds in Australia would not have been possible. These GIS shapefiles provide a valuable tool to those charged with conserving migratory shorebirds. Nevertheless, there is a critical need to continue refining our knowledge of shorebird conservation given the population declines already identified and the growing threats to shorebirds throughout the flyway. This should include the continued refinement of the boundaries of shorebird areas, and the habitats used by shorebirds in Australia.

We strongly recommend that the criteria suggested here be adopted to help reduce future losses of important shorebird habitat. Further, we recommend that, in the case of ephemeral inland wetlands, the requirement of 'regularly supporting' a given number of birds should be removed from criteria thresholds. These habitats are infrequently inundated with water, and only sporadically surveyed: the requirement of regular data in remote ephemeral habitats is impractical.

The following is a list of future work recommended to further enhance our understanding of the habitats required to ensure the long-term conservation of migratory shorebirds.

FUTURE WORK NEEDED

- Incorporate more external datasets into the current GIS shapefiles
- Continue to map shorebird habitat using high resolution imagery and ground-truth these areas with GPS locations. Efforts should focus on areas considered highly threatened or poorly mapped in the current shapefiles. Following this, efforts should be made to spatially define other important habitats to guard against their loss. Key habitats include: feeding areas, non-wetland habitats

used by shorebirds, small inland freshwater wetlands, neap tide roosts, nocturnal roosts, and resident shorebird habitat.

- Employ GAP analysis to ensure sufficient habitat is identified to meet the conservation goals for all migratory species.
- If gaps are identified, adjust criteria to ensure conservation goals can be met.
- Ensure that existing layers continue to be updated and refined so that the count data being collected is more useful.

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APPENDIX A. METADATA FOR 4 GIS LAYERS PRODUCED ON IMPORTANT SHOREBIRD AREAS AND HABITAT.

Metadata for the Shorebird Areas Australia GIS Shapefile

Title: National Shorebird Areas - 1:100,000 scale

Dataset name: Aust shorebird areas

Abstract: This dataset is a polygon representation of areas, termed 'shorebird areas' known to be used regularly by migratory shorebirds in Australia. The significance of each of these areas is identified, and the available count data is summarised for migratory shorebirds, and selected resident shorebirds. Each shorebird area represents, as best as possible, the total area used by closed shorebird populations (the suspected home range of migratory shorebird populations in the non-breeding season). These shorebird areas have been digitised from 1:100,000 Australian Surveying and Land Information Group (AUSLIG) topographic maps in consultation with local shorebird experts. These areas differ widely in terms of the number of annual shorebird counts undertaken in each, and the degree to which the habitat within each boundary is understood. This data is intended to be an aid to planning and management decisions and assist in the maintenance and monitoring of known important shorebird areas.

Search word(s): Resident Shorebirds, Migratory Shorebirds

Dataset topic: Category: Biota

Dataset language: English

Dataset status: Current as at completion date

Date of completion: 24 July 2008

Maintenance/Update: On-going maintenance, up-dates recommended every five years

Access constraints: None

Use constraints: None

Dataset format: ESRI ArcMap Shapefile

Data type: Vector

Coordinate system: Geocentric Datum of Australia 1994 (GDA94)

Geographic extent: Australia (excluding external territories)

Data Quality Information:

Positional Accuracy Precision

<25 m – 500 m

Determination of Accuracy

Previous work suggests that AUSLIG maps at 1:100,000 are accurate to <100 m. Additional inaccuracy may be introduced by the dynamic nature of shorebird habitats (e.g. through the erosion and deposition of sediments). For example, ground-truthing of areas in SE Australia has identified positional shifts of up to 500 m in polygon boundaries

over just seven years. Further positional changes may be expected following changes to the distribution of vegetation. Periodic re-surveys are recommended.

Collection Method

The location of all shorebird areas was initially digitised using 1:100,000 topographic maps. The positional accuracy of these areas was then verified by shorebird experts around Australia. The location of shorebird areas was updated, where necessary, following this process. Shorebird areas encompass all areas of habitat between which regular shorebird movements are known to occur. Thus, each shorebird area is seen to be used collectively by the same shorebird population.

Attribute Accuracy

Due to logistical constraints, limited ground-truthing of the dataset has been undertaken. Nevertheless, as attribute information has been based on consultation with local shorebird experts from around the country, it is considered as accurate as possible given the broad spatial coverage of the dataset.

Logical Consistency

All polygons are labelled, but the dataset has not been ‘cleaned’ (i.e. dangling nodes/sliver polygons removed). This process is recommended.

Completeness

This dataset contains all shorebird areas to be surveyed regularly as part of the ongoing, Australia-wide Population Monitoring Program for shorebirds. It also contains a number of additional areas known to be important for resident and migratory shorebird species in Australia.

Attribute Information:

ID	Unique ID number for each shorebird area (matches that in National Shorebird Database maintained by Birds Australia)
SBIRD_AREA	Name of shorebird area
NAME_BAMFO	Name of the internationally important sites identified in (Bamford et al. 2008), the boundaries of sites do not always match the boundaries identified here, but future work should allow them to match up.
BOUNDARY_C	A subjective score on how well the mapped shorebird area boundary is known to capture the shorebird habitat found there. 5 = major spring tide roosts have been mapped, along with some other habitats used, and the outer boundary is known to capture the important shorebird habitat, 4 = confident that outer boundary captures shorebird habitat, some identification of habitat within the area, and areas counted, 3 = Outer boundary may need some adjustment, but core of shorebird habitat is thought to have been captured within, 2 = from the count data (which might be ascribed to only a point location, identified the extent of the habitat which occurs in the area), 1 = extent of area used by shorebirds and boundary of available habitat not certain.
STATE	State in which the shorebird area is located
LONGITUDE	Longitude in decimal degrees
LATITUDE	Latitude in decimal degrees
AREA_HA	Area (ha) of shorebird area
PERIM_M	Perimeter (m) of shorebird area
SOURCE	Source of information regarding shorebird area location and boundary position, often these include the individual shorebird experts consulted
HABITAT	Brief description of the habitat/s found in the shorebird area
COMMENTS	Any additional information regarding the shorebird area
INT_SIG	Identifies whether the shorebird area is classified as Internationally Significant for shorebirds based on data held at Birds Australia National Office Melbourne (see Appendix 1)
IN_SIG_BAM	Areas identified by any known data signifying an area is internationally significant (Bamford et al 2008)
NAT_SIG	Identifies whether the shorebird area is classified as Nationally Significant for shorebirds
STATE_SIG	Identifies whether the shorebird area is classified as Significant for shorebirds at the State level
REG_SIG	Identifies whether the shorebird area is classified as Regionally Significant
HAB_LOSS	Describes the scale of habitat loss affecting the shorebird area (see Appendix 2)
HUM_DIST	Describes the level of human disturbance affecting the shorebird area
INV_SP	Describes the impact of invasive species on the shorebird area
POLLUTION	Describes the level of pollution in the shorebird area
ACC_MORT	Describes the potential for accidental mortality of birds in the shorebird area
THREAT	Additional comments regarding any threats affecting the shorebird area
YEARS_DATA	Number of years of count data collected in the shorebird area

TOTAL_RICH	Total number of all shorebird species recorded in the shorebird area
MIG_RICH	Total number of migrant species recorded in the shorebird area
MAX_AB_SP	Maximum annual abundance of all shorebird species in the shorebird area
AVG_AB_SP	Mean annual abundance of all shorebird species in the shorebird area
MAX_AB_MIG	Maximum annual abundance of migrant species in the shorebird area
AVG_AB_MIG	Mean annual abundance of all migrant species in the shorebird area

Where data is available, maximum (_MAX) and mean (_AVG) annual counts recorded in the shorebird area is listed for the following species:

- Asian Dowitcher (ASDO)
- Australian Pratincole (AUPR)
- Bar-tailed Godwit (BAGO)
- Banded Stilt (BAST)
- Black-fronted Dotterel (BLDO)
- Black-tailed Godwit (BLGO)
- Black-winged Stilt (BLST)
- Broad-billed Sandpiper (BRSA)
- Common Greenshank (COGR)
- Common Redshank (CORE)
- Common Sandpiper (COSA)
- Curlew Sandpiper (CUSA)
- Double-banded Plover (DOPL)
- Eastern Curlew (EACU)
- Great Knot (GRKN)
- Grey Plover (GRPL)
- Greater Sand Plover (GRSA)
- Grey-tailed Tattler (GRTA)
- Hooded Plover (HOPL)
- Latham's Snipe (LASN)
- Lesser Sand Plover (LESA)
- Little Curlew (LICU)
- Little Ringed Plover (LIPL)
- Long-toed Stint (LOST)
- Masked Lapwing (MALA)
- Marsh Sandpiper (MASA)
- Oriental Plover (ORPL)
- Oriental Pratincole (ORPR)
- Pacific Golden Plover (PAPL)
- Pectoral Sandpiper (PESA)
- Pied Oystercatcher (PIOY)
- Pin-tailed Snipe (PISN)
- Red-necked Avocet (REAV)
- Red-kneed Dotterel (REDO)
- Red Knot (REKN)
- Red-necked Phalarope (REPH)
- Red-capped Plover (REPL)
- Red-necked Stint (REST)
- Ruff (RUFF)
- Ruddy Turnstone (RUTU)
- Sanderling (SAND)
- Sharp-tailed Sandpiper (SHSA)
- Sooty Oystercatcher (SOOY)
- Swinhoe's Snipe (SWSN)
- Terek Sandpiper (TESA)
- Wandering Tattler (WATA)
- Whimbrel (WHIM)
- Wood Sandpiper (WOSA)

Base layer data source:

National Dataset Birds Australia

1:100,000 AUSLIG topographic maps

Important Australian Shorebird Areas (Wetland International, Watkins and Jaensch)

Custodian Organisation: Australian Government Department of the Environment and Heritage

Contact's position: Species Data Manager

Contact information: Phone: (02) 6274 1111

Address: GPO Box 787

City: Canberra ACT 2601

Australia species.metadata@deh.gov.au

Online Location: <http://www.deh.gov.au/>

Themes or categories of the resource: biota

Theme keywords: FAUNA Vertebrates_Distribution

Dataset language: English

Dataset character set: utf8 - 8 bit UCS Transfer Format

Update Status: completed

Update frequency: irregular

Yet to be determined, currently the Australian Government, Department of the Environment and Heritage internal use. Some boundaries are based on AUSLIG 1:100,000 and 1:250,000 coverages and Ramsar dataset boundaries, therefore the access condition of those datasets will apply..

Spatial representation type: vector

Format name: Shapefile

Scale denominator: 100000

Resource's bounding rectangle:

Extent type: Full extent in decimal degrees

West longitude: 113.321629

East longitude: 153.588527

North latitude: -10.570227

South latitude: -43.633873

Dataset Point of contact:

Organisation: Australian Government Department of the Environment and Heritage

Contact's position: Species Data Manager

Contact information: Voice: (02) 6274 1111

Address:

Delivery point: GPO Box 787

City: CANBERRA, ACT , 2601

Country: Australia species.metadata@deh.gov.au

Online Location: <http://www.deh.gov.au/>

Value: GCS_Assumed_Geographic_1

Data Quality Information:

Lineage: Where appropriate digital boundaries from Ramsar and important wetlands datasets were utilised. Newly digitised sites were digitised from the AUSLIG 1:100,000 coastline and 1:250,000 raster coverages.

Source data acknowledgements:

Roger Jaensch and Doug Watkins of Wetlands International - Oceania delineated the shorebird area boundaries and identified recent updates, mainly from Australasian Wader Studies Group data.

Karl Bossard and Simon Bennett of Environment Australia digitised and mapped the area boundaries.

Jim Wilson of the Australasian Wader Studies Group provided recent updates to the dataset for parts of South Australia.

Some polygon boundaries were derived the AUSLIG's 1:100,000 and 1:250,000 digital datasets which are copyright Commonwealth of Australia, AUSLIG, Australia's national mapping agency, 1990, 1997.

For more information contact Wetlands International Australia

Birds Australia [Important Bird Areas]

Polygons were taken from areas that have reported significant (often internally significant) numbers of shorebirds, but significance has not been fully assessed. Most attributes have not been added for these polygons.

Further maps, data summaries, and area descriptions available online.

<http://www.birdsaustralia.com.au/our-projects/iba-maps.html>

Dataset and metadata point of contact:

Organisation:	Birds Australia
Contact's position:	Shorebirds 2020 Technical Manager
Contact person:	Rob Clemens
Phone:	03 9347 0757
Fax:	03 9347 9323
Address:	Suite 2-05 60 Leicester St Carlton VIC 3053 Australia
e-mail:	r.clemens@birdsaustralia.com.au
Website:	www.birdsaustralia.com.au
Metadata date:	24 July 2008

Appendix 1

Listed below are the criteria used to identify shorebird areas providing significantly important habitat for shorebirds. Four levels of significance are employed: International, National, State and Regional. Shorebird areas are considered significant at a given level if they meet any of the thresholds associated with that level.

- International:*
- a) Shorebird areas containing $\geq 1\%$ of the flyway population estimate of any migrant species (see Watkins 1993, Bamford *et al.* 2008 for flyway population estimates).
 - b) Shorebird areas containing $\geq 20,000$ total abundance of shorebirds (resident and migrant species combined: calculated based on maximum count averaged across years for which data is available)
- National:*
- a) Shorebird areas containing $\geq 0.1\%$ of the flyway population estimate for migrant species
 - b) Shorebird areas containing $\geq 2,000$ total abundance of shorebirds (resident and migrant species combined: calculated based on maximum count averaged across years for which data is available)
- State:*
- a) Shorebird areas identified in the literature as showing significant declines in shorebirds known not to be declining throughout Australia. (i.e. Red-necked Stint numbers)
 - b) Shorebird areas in which evidence suggests species are showing greater declines than have been identified in other areas.
- Regional:*
- a) ≥ 15 migrant species recorded in the shorebird area
 - b) ≥ 20 resident and migrant species recorded in the shorebird area
 - c) The three shorebird areas with the highest abundance of any of five species in each NRM region across Australia. Species included were: Little Curlew, Australian Pratincole, Oriental Pratincole, Oriental Plover and Latham's Snipe (abundance calculated by taking the maximum count of each species, averaged across years for which data was available).

Appendix 2

For each shorebird area, five threats were scored on a scale between 0-9 to reflect the timing, scope and severity of each. Threats included habitat loss, human disturbance, invasive species, pollution and accidental mortality. A score of 0-1 indicates that the threat has a negligible affect on shorebirds in the area; 2-5 = low impact, 6-7 = medium impact and 8-9 = high impact.

References

Bamford, M. J., D. G. Watkins, W. Bancroft, G. Tischler, and J. Wahl. 2008. Migratory Shorebirds of the East Asian-Australasian Flyway; Population Estimates and Important Sites. *in*. Wetlands International, Oceania.

Watkins, D. 1993. A national plan for shorebird conservation in Australia. RAOU Report No. 90, Australasian Wader Study Group, Melbourne, Australia.

Metadata for the Shorebird Count Areas Australia GIS Shapefile

Title: National Shorebird Count Areas - 1:100,000 scale

Dataset name: Aust shorebird count areas

Abstract: This dataset is a polygon representation of specific survey locations, termed 'count areas', for monitoring of resident and migratory shorebird numbers in Australia. Each count area falls into one of three categories: those contained within known 'shorebird areas', those located outside of shorebird areas, and those that have been randomly selected to increase the geographic coverage of shorebird surveys. The count data collected during these surveys will contribute to the ongoing, Australia-wide Population Monitoring Program for shorebirds. These count areas form the smallest sampling unit by which important shorebird areas in Australia will be monitored and may be aggregated with other count areas to form larger 'shorebird areas'. Thus, count areas form the basis for the systematic sampling of important shorebird habitats in Australia, and describe the required coverage for any shorebird count to be considered complete. In shorebird areas with many years of historic data count areas represent the historic coverage for those counts, but for area with little data, count areas are often reflect the areas that will be surveyed in future, and some of the data ascribed to those areas may have been collected beyond the mapped boundaries.

Seven data sources have contributed to this dataset: one national (digitised at Birds Australia national office, based on expert advice and mapping from throughout the country), and six regional. The regional datasets relate to West Gippsland (Vic), Great Sandy Strait (Qld), Moreton Bay (Qld), the Burnett Mary region of Queensland, Shoalwater (Qld), and much of the coast of NSW. For the national dataset, count areas have been digitised from 1:100,000 AUSLIG (Australian Surveying and Land Information Group) topographic maps in consultation with shorebird experts in Australia. For the regional datasets, roost and feeding habitat boundaries have been generalised from more detailed mapping done often with ground truthing and high resolution airphotos

These count areas differ widely in terms of the number of annual shorebird counts undertaken in each. Available data for a range of resident and migratory species is summarised. This data is intended to increase standardisation of shorebird population monitoring and to aid planning and management decisions by providing attributes for each area.

Search word(s): Resident Shorebirds, Migratory Shorebirds

Dataset topic: Category: Biota

Dataset language: English

Dataset status: Current as at completion date

Date of completion: 24 July 2008

Maintenance/Update: On-going maintenance, up-dates recommended every five years
Access constraints: None
Use constraints: None

Dataset format: ESRI ArcMap Shapefile
Data type: Vector
Coordinate system: Geocentric Datum of Australia 1994 (GDA94)

Geographic extent: Australia (excluding external territories)

Data Quality Information:

Positional Accuracy Precision

<25 m – 500 m

Determination of Accuracy

Previous work suggests that AUSLIG maps at 1:100,000 are accurate to <100 m. Additional inaccuracy may be introduced by the dynamic nature of shorebird habitats (e.g. through the erosion and deposition of sediments). For example, ground-truthing of areas in SE Australia has identified positional shifts of up to 500 m in polygon boundaries over just seven years. Further positional changes may be expected following changes to the distribution of vegetation. Periodic re-surveys are recommended.

Collection Method

The location of shorebird count areas has been derived from a number of sources. Most have been digitised using 1:100,000 topographic maps. These count areas have been identified to ensure that all shorebird roosting and feeding habitats, both within and outside established shorebird areas, are adequately sampled. Where possible, the location and boundary position of these count areas have been verified by shorebird experts around Australia. Priority has given to mapping areas where shorebirds have been surveyed at least five times within any three-year period since 1980.

Some existing datasets contain more detailed information on the location of count areas in select regions/shorebird areas. Where possible, these have been incorporated into this dataset. These areas include: West Gippsland (Vic), Moreton Bay (Qld), Great Sandy Strait (Qld), and Shoalwater (Qld).

West Gippsland dataset

Screen digitising of aerial photographs (1:25,000) in addition to collection of Ground Control Points, and polygon location points (for areas poorly defined in photos) using a GPS.

Great Sandy Strait dataset

All known high-tide roosts in Great Sandy Strait were mapped on location in 2005 by marking the GPS coordinates of roost boundaries onto aerial photographs.

Moreton Bay dataset

A combination of high resolution mapping with air photos and ground truthing, more general polygons, and buffered point locations.

Shoalwater dataset

High resolution mapping based on ground and air surveys

Burnett Mary dataset

High resolution mapping based on ground-truthing and airphotos.

New South Wales Wader Study Group dataset

Based primarily on 1:25,000 topo maps.

Attribute Accuracy

Due to logistical constraints, limited ground-truthing of the dataset has been undertaken (except in the case of regional datasets). Nevertheless, attribute information has been based on consultation with local shorebird experts from around the country.

Logical Consistency

All polygons are labelled, but the dataset has not been 'cleaned' (i.e. dangling nodes/sliver polygons removed). This process is recommended.

Completeness

This dataset contains all count areas that will be regularly surveyed as part of the ongoing, Australia-wide Population Monitoring Program for shorebirds. Further, it also identifies a large number of additional, randomly-selected additional areas to be surveyed less frequently.

Attribute Information:

ID	Unique ID number for each count area (matches that in National Shorebird Database maintained by Birds Australia)
STATE	State in which the count area is located
SBIRD_AREA	Name of shorebird area in which the count area is located
COUNT_AREA	Name of count area
CODE	Unique code used to identify the count area
HABITAT	Brief description of the habitat/s found in the count area
COMMENTS	Any additional information regarding the count area
SOURCE	Source of information regarding count area location and boundary position
PERIMETER_	Perimeter (m) of count area
HECTARES_	Area (ha) of count area
LONGITUDE	Longitude in decimal degrees
LATITUDE	Latitude in decimal degrees
TOTAL_RICH	Total number of all shorebird species recorded in the count area
MIG_RICH	Total number of migrant species recorded in the count area
NUMB_VISIT	Number of counts ascribed to each count area
NUMB_YEARS	Number of years in which a count was submitted for each count area
MAX_AB_ALL	Maximum annual abundance of all shorebird species in the count area
AVG_AB_ALL	Mean annual abundance of all shorebird species in the count area
MAX_AB_MIG	Maximum annual abundance of migrant species in the count area
AVG_AB_MIG	Mean annual abundance of all migrant species in the count area

Where data is available, the maximum (_MAX) and mean (_AVG) annual count recorded in the count area is listed for the following species:

Asian Dowitcher (ASDO)
 Australian Pratincole (AUPR)
 Bar-tailed Godwit (BAGO)
 Banded Stilt (BAST)
 Black-fronted Dotterel (BLDO)
 Black-tailed Godwit (BLGO)
 Black-winged Stilt (BLST)
 Broad-billed Sandpiper (BRSA)
 Common Greenshank (COGR)
 Common Redshank (CORE)
 Common Sandpiper (COSA)
 Curlew Sandpiper (CUSA)
 Double-banded Plover (DOPL)
 Eastern Curlew (EACU)
 Great Knot (GRKN)
 Grey Plover (GRPL)
 Greater Sand Plover (GRSA)
 Grey-tailed Tattler (GRTA)
 Hooded Plover (HOPL)
 Latham's Snipe (LASN)
 Lesser Sand Plover (LESA)
 Little Curlew (LICU)
 Little Ringed Plover (LIPL)
 Long-toed Stint (LOST)
 Masked Lapwing (MALA)
 Marsh Sandpiper (MASA)
 Oriental Plover (ORPL)
 Oriental Pratincole (ORPR)
 Pacific Golden Plover (PAPL)
 Pectoral Sandpiper (PESA)
 Pied Oystercatcher (PIOY)
 Pin-tailed Snipe (PISN)
 Red-necked Avocet (REAV)
 Red-kneed Dotterel (REDO)
 Red Knot (REKN)
 Red-necked Phalarope (REPH)
 Red-capped Plover (REPL)
 Red-necked Stint (REST)
 Ruff (RUFF)
 Ruddy Turnstone (RUTU)
 Sanderling (SAND)
 Sharp-tailed Sandpiper (SHSA)
 Sooty Oystercatcher (SOOY)
 Swinhoe's Snipe (SWSN)
 Terek Sandpiper (TESA)
 Wandering Tattler (WATA)
 Whimbrel (WHIM)
 Wood Sandpiper (WOSA)

Base layer data source:

National dataset

1:100,000 AUSLIG topographic maps

West Gippsland dataset

Aerial photographs taken in 2000

Victoria, Department of Sustainability and Environment

Digital Base Layer Format: 2 Ortho-photos ECW format

Name: 652_WellingtonShire_GDA94_Final.ers
 Version: 6.3
 Last Updated: Mon Sep 05 04:51:33 GMT 2005
 Data File: 652_WellingtonShire_GDA94_Final.ecw
 Data Set Type: Translated
 Data Type: Raster
 Coordinate Space Begin:
 Datum: WGS84

Projection: SUTM55
Rotation = 0:0:0.0
Eastings: 435612.22600000002
Northings: 5836933.7790000001

Name:
652_SouthGipplislandShire_GDA94_Final.ers
Version: 7.0
Last Updated: Thu Sep 01 04:14:05 GMT 2005
Data File:
652_SouthGipplislandShire_GDA94_Final.ecw
Data Set Type: Translated
Data Type: Raster
Coordinate Space Begin:
Datum: GDA94
Projection: SUTM55
Rotation: 0:0:0.0
Eastings: 374186.12585647742
Northings: 5772808.898

Great Sandy Strait dataset

Aerial photographs taken in 2004, Contact Queensland Wader Study Group for Metadata

Moreton Bay dataset

Various sources, contact Queensland Water Study Group for Metadata

Burnett Mary dataset

Aerial photographs, Contact Queensland Wader Study Group for Metadata

New South Wales Wader Study Group dataset

1:25,000 topo maps, contact NSW Wader Study Group for details

Shoalwater dataset

Google Earth imagery, and other sources, contact Wetlands International for metadata
(Roger Jaensch)

Dataset and metadata point of contact:

Organisation: Birds Australia
Contact's position: Shorebirds 2020 Technical Manager
Contact person: Rob Clemens
Phone: 03 9347 0757
Fax: 03 9347 9323
Address: Suite 2-05
60 Leicester St
Carlton VIC 3053
Australia
e-mail: r.clemens@birdsaustralia.com.au
Website: <http://www.birdsaustralia.com.au/>
Metadata date: 24 July 2008

Metadata for Shorebird Habitat, Feeding and Roosting Areas GIS shapefile

Title: National Shorebird Feeding and Roosting Areas - 1:100,000 scale

Dataset name: aus shorebird feed and roost habitat

Abstract: This dataset is a polygon representation of known important areas in which migratory and resident shorebirds congregate to feed and roost in Australia. Six data sources have contributed to this dataset: one national and five regional. The regional datasets relate to West Gippsland (Vic), Great Sandy Strait, Moreton Bay, Burnett Mary, and Shoalwater (all Qld). For the national dataset, feeding and roosting areas were digitised from 1:100,000 Australian Surveying and Land Information Group (AUSLIG) topographic maps in consultation with shorebird experts. For the regional datasets, feeding and roosting areas were often digitised using recent airphotos and their positional accuracy was subsequently ground-truthed. This data is intended to aid planning and management decisions, and assist in the maintenance and monitoring, of known important shorebird habitats in Australia.

Search Word(s): Resident Shorebirds, Migratory Shorebirds, Roost site, Feeding Area

Dataset topic: Category: Biota

Dataset language: English

Dataset status: Current as at completion date

Date of completion: 24 July 2008

Maintenance/Update: On-going maintenance, up-dates recommended every five years

Access constraints: None

Use constraints: None

Dataset format: ESRI ArcMap Shapefile

Data type: Vector

Coordinate system: Geocentric Datum of Australia 1994 (GDA94)

Geographic extent: Australia (excluding external territories)

Data Quality Information:

Positional Accuracy Precision

<25 m – 500 m

Determination of Accuracy

Previous work suggests that AUSLIG maps at 1:100,000 are accurate to <100 m. Additional inaccuracy may be introduced by the dynamic nature of shorebird habitats (e.g. through the erosion and deposition of sediments). For example, ground-truthing of areas in SE Australia has identified positional shifts of up to 500 m in polygon boundaries over just seven years. Further positional changes may be expected following changes to the distribution of vegetation. Periodic re-surveys are recommended.

Collection Method (*National dataset*)

The location of important feeding and roosting areas were mapped on 1:100,000 topographic maps in consultation with shorebird experts around Australia. These areas were then digitised using digital versions of the same topographic maps. Priority was given to mapping areas that have been surveyed at least five times within any three-year period since 1980.

Collection Method (*West Gippsland dataset*)

Screen digitising of aerial photographs (1:25,000) in addition to collection of Ground Control Points, and polygon location points (for areas poorly defined in photos) using a GPS. Where appropriate, previous digital shorebird area boundaries from Birds Australia were used as was historic roost location data (see historic data source).

Collection Method (*Great Sandy Strait dataset*)

All known high-tide roosts in Great Sandy Strait were mapped on location in 2005 by marking the GPS coordinates of roost boundaries onto aerial photographs.

Collection Method (*Burnett Mary dataset*)

Feeding and roosting habitats were mapped using GPS locations collected in the field, together with information gathered from shorebird experts and aerial and sea surveys.

Collection Method (*Moreton Bay dataset*)

A combination of high resolution mapping with air photos and ground truthing, more general polygons, and buffered point locations.

Collection Method (*Shoalwater dataset*)

High resolution mapping based on ground and air surveys

Collection Method (*New South Wales Wader Study Group dataset*)

Based primarily on 1:25,000 topo maps.

Attribute Accuracy

For regional datasets, ground-truthing was undertaken to verify attribute information. Further, historic data and a literature review (Clemens, R. and D. Rogers. 2007. Shorebird Habitat Mapping Project: West Gippsland. *Unpublished Report*. Birds Australia, Carlton, Victoria) were also used to verify accuracy of West Gippsland mapping. Due to logistical constraints, limited ground-truthing of the national dataset has been undertaken. Nevertheless, attribute information has been based on consultation with local shorebird experts from around the country.

Logical Consistency

All polygons are labelled, but the dataset has not been 'cleaned' (to remove dangling nodes/ sliver polygons). This process is recommended.

Completeness

Major feeding and roosting areas used frequently by shorebirds within regions in which regular shorebird surveys are undertaken are likely to be mapped in this dataset. Mapping of feeding and roosting areas is most comprehensive for areas covered by the regional datasets incorporated than for other regions in Australia.

Attribute Information:

ID	Unique ID number of all polygons
AREA_TYPE	Identifies whether the habitat is used by shorebirds for feeding, roosting, or both
SBIRD_AREA	Name of shorebird area in which the feeding and/or roosting habitat is located
STATE	Australian State in which the feeding and/or roosting habitat is located
SOURCE_GIS	Note from which data set the polygon came from, national or one of regional
SOURCE	Source of information regarding habitat type, location and boundary position
THREATS	Brief overview of known or potential threats
HABITAT	Brief description of the associated habitat type/s

COMMENTS	Any additional information regarding the feeding and/or roosting habitat
PERIMETER_	Perimeter (m) of feeding and/or roosting habitat
HECTARES	Area (ha) of feeding and/or roosting
LONGITUDE	Longitude in decimal degrees
LATITUDE	Latitude in decimal degrees

Base layer data source:

National dataset

1:100,000 AUSLIG topographic maps

West Gippsland dataset

Aerial photographs taken in 2000
 Victoria, Department of Sustainability and Environment
 Digital Base Layer Format: 2 Ortho-photos ECW format

Name: 652_WellingtonShire_GDA94_Final.ers
 Version: 6.3
 Last Updated: Mon Sep 05 04:51:33 GMT 2005
 Data File: 652_WellingtonShire_GDA94_Final.ecw
 Data Set Type: Translated
 Data Type: Raster
 Coordinate Space Begin:
 Datum: WGS84
 Projection: SUTM55
 Rotation: 0:0:0.0
 Eastings: 435612.22600000002
 Northings: 5836933.77900000001

Name:
 652_SouthGippslandShire_GDA94_Final.ers
 Version: 7.0
 Last Updated: Thu Sep 01 04:14:05 GMT 2005
 Data File:
 652_SouthGippslandShire_GDA94_Final.ecw
 Data Set Type: Translated
 Data Type: Raster
 Coordinate Space Begin:
 Datum: GDA94
 Projection: SUTM55
 Rotation: 0:0:0.0
 Eastings: 374186.12585647742
 Northings: 5772808.898

Great Sandy Strait dataset

Aerial photographs taken in 2004, contact Queensland Wader Study Group

Burnett Mary dataset

Queensland Wader Study Group
 Geographic extent:
 -23.861857dd
 -25.268906
 152.809350
 151.302072

Moreton Bay dataset

Various sources, contact Queensland Water Study Group for Metadata

New South Wales Wader Study Group dataset

1:25,000 topo maps, contact NSW Wader Study Group for details

Shoalwater dataset

Google Earth imagery, and other sources, contact Wetlands International for metadata (Roger Jaensch)

Historic data source:

West Gippsland dataset only

Martindale, J. 1982. A study of wading birds in Corner Inlet: Technical Report No. 4. Arthur Rylah Institute for Environmental Research Technical Report Series, Ministry for Conservation Fisheries and Wildlife Division, 55pp.
(Polygons based on general circles overlaid on historic 1:50,000 aerial photos)

Dataset and metadata point of contact:

Organisation: Birds Australia
Contact's position: Shorebirds 2020 Technical Manager
Contact person: Rob Clemens
Phone: 03 9347 0757
Fax: 03 9347 9323
Address: Suite 2-05
60 Leicester St
Carlton VIC 3053
Australia
e-mail: r.clemens@birdsaustralia.com.au
Website: <http://www.birdsaustralia.com.au/>
Metadata date: 24 July 2008

Metadata for the National Shorebird Survey Point Data GIS Shapefile

Title: National Shorebird Survey Locations

Dataset name: Aust shorebird survey locations

Abstract: This dataset is a point representation of locations at which shorebird surveys contributing to the National Shorebird Dataset have been undertaken. Survey locations are classified, where applicable, by count area and shorebird area (see associated GIS shapefiles: Aus Shorebird area / Aus shorebird count areas. Raw count data for all species recorded during each survey is also included. This data provides an indication as to the occurrence and abundance of shorebird species in different locations around Australia.

Search word(s): Resident Shorebirds, Migratory Shorebirds

Dataset topic: Category: Biota

Dataset language: English

Dataset status: Current as at completion date

Date of completion: 24 July 2008

Maintenance/Update: On-going maintenance, up-dates recommended every five years

Access constraints: None

Use constraints: None

Dataset format: ESRI ArcMap Shapefile

Data type: Vector

Coordinate system: Geocentric Datum of Australia 1994 (GDA94)

Geographic extent: Australia (excluding external territories)

Data Quality Information:

Positional Accuracy Precision

<25 m – 20+ km (the latter precision estimate is based on the potential error associated with locations assigned arbitrarily using the centroid of count area polygons)

Determination of Accuracy

Where positional information collected during the count itself is available, accuracy will reflect the method used to collect this information (e.g. GPS unit). Accuracy may be considerably lower in situations where spatial location is ascribed based on the centroid of the associated count area or shorebird area.

Collection Method

Where available, positional data (i.e. latitude/longitude) collected at the time of the shorebird count is included. Where this spatial information is missing, it has been estimated by other information associated with the count. For example, if the count area in which the survey was undertaken is known, then the centroid of the count area is used to represent the location of the count.

Attribute Accuracy

The National Shorebird Database has undergone extensive 'cleaning' of count data collected during shorebird surveys. Thus, raw count data associated with each survey is

considered as accurate as possible given the limitations associated with maintaining a nation-wide, volunteer-based dataset.

Logical Consistency

The spatial consistency between the location of point data and the boundaries of polygons representing count areas and shorebird areas has been verified and corrected where necessary.

Completeness

This dataset contains the position of all shorebird survey locations contained in the National Shorebird Database that include spatial information.

Attribute Information:

BACOMNAME	Common name of each bird counted
NUMBEROFBI	Count of each species, zero counts recorded for migratory shorebirds
STARTDATE	Date on which shorebird survey was undertaken
SHOREBIRD	Name of shorebird area in which the shorebird survey was undertaken
GIS_COUNT_	Name of the count area in which the shorebird survey was undertaken
AREA_CODE	Unique code used to identify the count area
SITENAME	Name of location from database (before count areas had been identified)
LATITUDE	Latitude in decimal degrees
LONGITUDE	Longitude in decimal degrees
STATE	State in which the shorebird survey was undertaken
VISIT_PKID	Unique ID number for each shorebird survey (matches that in National Shorebird Database maintained by Birds Australia)

Dataset and metadata point of contact:

Organisation:	Birds Australia
Contact's position:	Shorebirds 2020 Technical Manager
Contact person:	Rob Clemens
Phone:	03 9347 0757
Fax:	03 9347 9323
Address:	Suite 2-05 60 Leicester St Carlton VIC 3053 Australia
e-mail:	r.clemens@birdsaustralia.com.au
Website:	www.birdsaustralia.com.au
Metadata date:	24 July 2008

APPENDIX D. SUMMARY OF COUNT DATA (Table 1. significance levels of Shorebird areas (234 known))

Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE
80 Mile Beach	WA	Yes	Yes	Yes	No evidence	Yes	121.14063	-19.51075	38087.404	Watkins GIS
Adelaide River Floodplain			Yes							
Albany	WA	No	Yes	Yes	No evidence	Yes	117.91436	-35.01273	2701.516	
Alva Beach	QLD	No		Yes	No evidence	Yes	147.49016	-19.45906	473.869	DEH (Watkins)
Anderson Inlet	VIC	Yes		Yes	Possible	Yes	145.82479	-38.72127	3436.312	Whitelaw
Anna Plains			Yes							
Anson Bay, Daly & Reynolds River Floodplains IBA	NT		Yes							
Armstrong Beach	QLD	No		Yes	No evidence	Yes	149.29334	-21.44689	192.188	
Ashmore Reef IBA	WA						123.07625	-12.24861	69219.060	Chris Hassell
Astrelba Downs			Yes							Watkins GIS
Baird Bay	SA	No		Yes	No evidence	No	134.31527	-33.10767	5353.929	DEH (Watkins)
Barren Box Swamp	NSW	No		No	No evidence	Yes	145.83477	-34.15460	3429.780	AWSG
Barrow Island			Yes							
Batemans Bay	NSW	No		No	No evidence	No	150.19281	-35.71084	184.115	AMSA, NPWS
Beachport NP			Yes							
Begola (Bellarine Peninsula)	VIC	No		No	No evidence	Yes	144.53587	-38.26826	1.576	John Newman
Bellambi Point	NSW	No		Yes	No evidence	No	150.93070	-34.36910	7.561	AMSA, NPWS
Belmont Common (Bellarine Peninsula)	VIC	No		No	No evidence	Yes	144.35901	-38.17511	27.610	Mariilyn Hewish
Bendigo Sewage Farm	VIC	No		No	No evidence	Yes	144.30345	-36.69292	209.785	
BHP Saltfields	SA	No		Yes	No evidence	Yes	137.65434	-32.95801	3759.893	AWSG
Black Point (Yorke)	SA	No		No	No evidence	No	137.91523	-34.61628	208.871	David Close
Black Rocks / Breamlea (Bellarine Peninsula)	VIC	No		No	No evidence	No	144.38435	-38.29654	54.299	Marilyn Hewish
Blakeys Crossing	QLD	No		No	No evidence	Yes	146.75406	-19.25747	51.686	AWSG 1985
Blue Mud Bay	NT		Yes							
Bool lagoon	SA	No		Yes	No evidence	Yes	140.69328	-37.12189	3366.243	RAMSAR
Botany Bay	NSW	Yes		Yes	Yes	Yes	151.16572	-34.01790	1487.822	AWSG 1983
Boucat Bay	NT		Yes							IBA & Watkins
Bowen	QLD	No		Yes	No evidence	Yes	148.23473	-20.03488	623.360	QWSG
Brisbane Water	NSW	No		No	No evidence	No	151.35158	-33.49754	1128.906	AMSA, NPWS
Broadwater (Busselton)	WA	No		No	No evidence	No	115.28334	-33.67067	60.094	Rob Breeden
Brunswick River estuary	NSW	No		No	No evidence	No	153.53789	-28.53102	94.013	
Buckingham Bay IBA	NT		Yes							
Burdekin River delta			Yes							
Bushland Beach	QLD	No		No	No evidence	No	146.67602	-19.18240	641.166	DEH (Watkins)

Bynoe Harbour Cairns area		QLD	No	Yes	Yes	Yes	Yes	145.77934	-16.88149	2057.646	AWSG
Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE	
Camballin			Yes								
Camden Haven	NSW	No		No	No evidence	No	152.81755	-31.64491	242.057	AMSA, NPWS	
Camila Beach	QLD	No		No	No evidence	No	149.46294	-21.88382	460.094	AWSG	
Canunda National Park	SA	No	Yes	Yes	No evidence	No	140.20270	-37.64274	328.908	Maureen Christie	
Cape Bowling Green			Yes								
Cape Gordon to Cape Villaret	WA	No		No	No evidence	No	122.02852	-18.36600	893.830	Chris Hassell	
Cape Portland	TAS	No	Yes	Yes	Yes	Yes	148.00846	-40.76210	3474.707	Ralph Cooper	
Carpenter Rocks	SA	Yes	Yes	Yes	No evidence	No	140.49402	-37.96560	435.920	Maureen Christie	
Chambers Bay			Yes								
Clarence River	NSW	No		Yes	Possible	Yes	153.35249	-29.43269	1457.126	AMSA, NPWS	
Coobowie Inlet (Yorke Peninsula)	SA	No		No	No evidence	No	137.71841	-35.05843	161.973	David Close	
Cooke Point	WA	No		Yes	No evidence	Yes	118.64106	-20.30046	10.106	AWSG - Watkins	
Coorong	SA	Yes	Yes	Yes	Yes	Yes	139.45523	-35.93150	26805.996	Ken Gosbell	
Corner Inlet	VIC	Yes		Yes	No evidence	Yes	146.55982	-38.74990	69690.963	Clive Minton	
Currie Harbour	TAS	No	Yes	Yes	No evidence	No	143.84222	-39.92614	54.771	AWSG 1984	
Dampier Saltworks	WA	No		Yes	No evidence	Yes	116.73611	-20.71922	6783.864		
Darwin Harbour	NT	No		No	No evidence	No	130.88382	-12.46086	1792.167	Tony Hertog	
Derby Sewage Ponds			Yes								
Derwent	TAS	No	Yes	Yes	Yes	Yes	147.60281	-42.83225	5254.847	Woehler / Park	
Diamantina Floodplain	QLD		Yes							IBA	
Discovery Bay to Glenelg River	VIC	No		Yes	No evidence	Yes	141.29774	-38.22229	2112.117	Rob Farnes	
Douglas area (Wimmera)	VIC	No		Yes	No evidence	No	141.74579	-37.05450	1046.286	Richard Alcorn	
Dubbo Sewage Ponds	NSW	No		No	No evidence	Yes	148.59886	-32.22894	2.407	AWSG	
East Port Phillip	VIC	No	Yes	Yes	No evidence	Yes	145.16721	-38.05521	866.790	Andrew Silcocks	
Elcho Island			Yes								
Esperance	WA	No	Yes	No	No evidence	No	122.07644	-33.90434	4375.080		
Exmouth Gulf Mangroves IBA											
Farquhar Inlet	NSW	No		No	No evidence	No	152.59974	-31.94906	198.504	AMSA, NPWS	
Finucane Island	WA	No		No	No evidence	Yes	118.55903	-20.30839	93.749	AWSG - Watkins	
Fitzroy River Mouth	VIC	No		No	No evidence	No	141.86528	-38.26436	476.964	Rob Farnes	
Fivebough Swamp	NSW	No		Yes	No evidence	Yes	146.43105	-34.53020	330.162	AWSG	
Fletcher Lake	NSW	No		Yes	No evidence	No	142.02413	-34.03345	867.384	Phil Straw	
Flinders Island Lagoons IBA	TAS		Yes							IBA & Watkins	
Fog Bay	NT		Yes								
Fox and Pub Lakes	SA	No		No	No evidence	Yes	139.78034	-37.16828	7.507	Maureen Christie	
Garden Island	WA	No		Yes	No evidence	Yes	115.69189	-32.24437	7.966	AWSG	

George Town Reserve	TAS	No		Yes	Possible	No	146.81232	-41.09438	52.086	Woehler / Park
Georges Bay	TAS	No	Yes	Yes	No evidence	Yes	148.28257	-41.29873	1488.935	Woehler / Park / Britton
Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE
Gippsland Lakes	VIC	No	Yes	No	No evidence	No	147.58016	-38.05464	0.000	Duncan Fraser
Gladstone	QLD	No		Yes	No evidence	Yes	151.19374	-23.81964	8351.958	QWSG
Goldsmith Beach to Wattle Pt (Yorke)	SA	No		No	No evidence	No	137.70225	-35.14190	429.471	David Close
Great Musselroe Bay	TAS	No		No	No evidence	No	148.15438	-40.82675	439.491	Woehler / Park
Great Sandy Straight	QLD	Yes	Yes	Yes	No evidence	Yes	152.91938	-25.60393	83228.522	QWSG
Guichen Bay	SA	No		No	No evidence	No	139.79106	-37.12140	484.610	
Gulf of St Vincent	SA	Yes	Yes	Yes	No evidence	Yes	138.25116	-34.45474	27654.757	David Close
Gunyah Beach	SA	Yes	Yes	Yes	No evidence	No	135.43499	-34.71684	337.924	DEH (Watkins)
Hamilton	VIC	Yes		Yes	No evidence	No	142.22222	-37.75474	1072.935	
Hastings River	NSW	No		Yes	No evidence	No	152.88578	-31.38603	403.487	AMSA, NPWS
Hattah Lake	VIC						142.34651	-34.75645	53.785	
Herdsman Lake	WA	No		No	No evidence	No	115.80609	-31.91943	498.511	AWSG - WA
Horse Peninsula	SA	No	Yes	Yes	No evidence	No	135.39566	-34.55373	292.900	AWSG
Hunter Estuary	NSW	Yes		Yes	Yes	Yes	151.77642	-32.84164	2780.757	Liz Herbert
Hutt Lagoon	WA	No		Yes	No evidence	No	114.23824	-28.15330	4119.274	AWSG
Hyland Bay & Moyle Floodplain IBA	NT									IBA
Ince Bay	QLD						149.38785	-21.53442	1680.010	AWSG
Island Head	QLD						150.64188	-22.39422	3490.456	
Islands off False Orford Ness			Yes							
Jack Smith Lake (Gippsland Lakes)	VIC	No	Yes	Yes	No evidence	Yes	147.00725	-38.49776	1198.165	Duncan Fraser
Joseph Bonaparte Bay (Turtle Pt)			Yes							
Kakadu National Park	NT		Yes							Watkins & IBA
Kangaroo Island	SA	No	Yes	Yes	No evidence	No	137.77931	-35.81426	1769.567	Watkins
Karinga Creek System IBA										
Kelldie Bay	SA	No	Yes	No	No evidence	No	135.51395	-34.60186	68.882	AWSG
Kelso, Tamar Estuary	TAS	No		No	No evidence	No	146.79182	-41.09530	76.324	Woehler / Park
Kerang Lakes	VIC	No	Yes	Yes	Possible	Yes	143.75207	-35.51456	3517.611	Chris Coleborn
Kinka Beach	QLD	No		No	No evidence	Yes	150.80006	-23.21504	157.578	AWSG
Kununurra irrigation area			Yes							
Lacepede Islands IBA	WA	Yes		Yes	No evidence	Yes	122.16335	-16.87798	3334.660	Chris Hassell IBA
Lades Beach	TAS	No		Yes	No evidence	No	147.35687	-40.96216	293.794	Duckworth
Lake Albacutya (Wimmera)	VIC	No		Yes	No evidence	Yes	141.97134	-35.75070	5755.983	AWSG 1980's
Lake Alexandrina & Lake Albert	SA									IBA
Lake Argyle IBA	WA									IBA
Lake Bathurst	NSW	No		Yes	No evidence	Yes	149.68946	-35.04982	1441.721	AWSG
Lake Buloke (Wimmera)	VIC	Yes	Yes	Yes	No evidence	Yes	142.96019	-36.24923	5944.167	AWSG 1980's
Lake Connewarre area	VIC	Yes	Yes	Yes	No evidence	Yes	144.44660	-38.23818	4339.861	Marilyn Hewish
Lake Corangamite area	VIC	No	Yes	Yes	No evidence	No	143.45959	-38.16644	37830.356	AWSG

Lake Dulverton	TAS	No		No	No evidence	No	147.38417	-42.30931	249.733	Woehler / Park
Lake Eliza	SA	No		Yes	No evidence	No	139.85666	-37.24510	4099.700	Maureen Christie
Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE
Lake Eyre	SA		Yes							Watkins & IBA
Lake Finnis			Yes							
Lake George	SA	Yes	Yes	Yes	No evidence	No	139.98618	-37.41710	5816.919	Maureen Christie
Lake Gol Gol			Yes							
Lake Gore	WA	No		Yes	No evidence	No	121.52038	-33.77425	1115.039	AWSG
Lake Gregory			Yes							
Lake Hawdon	SA	Yes	Yes	Yes	No evidence	Yes	139.94601	-37.16877	11359.335	Maureen Christie
Lake Hindmarsh (Wimmera)	VIC	No	Yes	Yes	No evidence	No	141.90790	-36.04017	13527.085	Richard Alcorn
Lake Illawarra	NSW	No		No	No evidence	No	150.86964	-34.53990	187.025	AMSA, NPWS
Lake Lorne (Bellarine Peninsula)	VIC	No		No	No evidence	No	144.55603	-38.18192	3.933	John Newman
Lake Machattie	QLD		Yes							IBA & Watkins
Lake MacLeod	WA	Yes		Yes	No evidence	Yes	113.66998	-23.93930	62791.858	Watkins - DEWR
Lake MacQuarie entrance	NSW	No		No	No evidence	No	151.63953	-33.07740	380.681	
Lake Merreti	SA	No		No	No evidence	No	140.75849	-34.01259	410.141	AWSG
Lake Moondarra	QLD	No		No	No evidence	Yes	139.54354	-20.60082	1765.944	AWSG
Lake Numalla			Yes							
Lake Robe	SA	No		Yes	No evidence	No	139.79885	-37.21266	269.792	Maureen Christie
Lake St Clair	SA	No		No	No evidence	No	139.91352	-37.32706	2474.200	Maureen Christie
Lake Sylvester			Yes							
Lake Wyn Wyn area (Wimmera)	VIC	No		Yes	No evidence	No	141.90353	-36.66346	756.620	AWSG 1980's
Lake Yamma Yamma	QLD		Yes							Watkins & IBA
Laverton/Altona	VIC	Yes	Yes	Yes	Possible	Yes	144.78679	-37.90817	1076.388	Ken Gosbell
Legoes Swamp	SA						140.00043	-37.32672	430.391	
Limmen River mouth			Yes							
Little Swanport	TAS	No		No	No evidence	No	147.97478	-42.33156	640.564	Woehler / Park
Long Nose	SA	No	Yes	Yes	No evidence	No	135.35061	-34.52305	139.780	AWSG
Low Island, Arnhem Bay			Yes							
Lowbidgee Floodplain	NSW		Yes							
Mackay	QLD	No		Yes	No evidence	Yes	149.03468	-20.98127	7092.875	QWSG
Magnetic Island	QLD	No		No	No evidence	No	146.80872	-19.16318	475.830	AWSG 1983
Mallacoota	VIC	No		No	No evidence	No	149.74336	-37.58259	470.302	Bob Semmens
Marion Bay & Blackmans Bay	TAS	No		Yes	No evidence	No	147.86445	-42.83444	500.284	Woehler / Park
Maroochy River	QLD	No		No	No evidence	No	153.08806	-26.64402	322.909	
Maurouard Beach	TAS	No		No	No evidence	No	148.31855	-41.33027	302.913	Woehler / Park
Menindee Lakes	NSW		Yes							
Mildura	VIC	No		Yes	No evidence	Yes	141.98471	-34.25955	683.705	AWSG
Milingimbi coast	NT		Yes							
Moolap Saltworks	VIC	No	Yes	Yes	Possible	Yes	144.42627	-38.14525	734.039	Mariilyn Hewish

Moorland Point	TAS	No		Yes	No evidence	Yes	146.44903	-41.16043	2.872	Woehler/Park/Britton
Moreton Bay	QLD	Yes		Yes	No evidence	Yes	153.38073	-27.76928	59452.237	DEH (Watkins)
Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE
Moruya Estuary	NSW	No		No	No evidence	No	150.10735	-35.90366	435.082	AMSA, NPWS
Moulting Lagoon	TAS	No		No	No evidence	No	148.17751	-42.04181	4087.121	Woehler / Park
Mullins Swamp	SA	No		Yes	No evidence	No	140.14835	-37.51053	53.806	AWSG data
Munderoo Bay to Tickera Bay	SA	No		Yes	No evidence	No	137.78582	-33.67365	7115.873	DEH (Watkins)
Nadzab Lagoon	SA	No		Yes	No evidence	No	139.88178	-36.70442	559.062	Maureen Christie
Nambucca River	NSW	No		No	No evidence	No	152.98698	-30.66640	638.353	AMSA, NPWS
Narantapu National Park	TAS	No		No	No evidence	No	146.57656	-41.16141	39.766	Woehler/Park/Britton
Nericon Swamp	NSW	No		Yes	No evidence	No	146.04058	-34.21967	44.631	AWSG
North Darwin	NT	No	Yes	Yes	No evidence	Yes	131.01796	-12.28869	6012.132	Tony Hertog, Keats
Nungbalgarri Creek			Yes							
Nuytsland Nature Reserve	WA	No		No	No evidence	Yes	124.03655	-33.25389	80855.132	AWSG
Ocean Beach	TAS	Yes	Yes	Yes	No evidence	No	145.26402	-42.11875	414.350	AWSG
Parramatta River	NSW	No		No	No evidence	Yes	151.17443	-33.84580	1932.226	DEH (Watkins)
Parry floodplain, Wyndham			Yes							
Peel & Yalgorup Lakes	WA	No	Yes	Yes	No evidence	Yes	115.68112	-32.65401	15972.652	Bill Russel - Colin Davis
Pelican Island and nearby islands			Yes							
Pine Point (Yorke)	SA	No		No	No evidence	No	137.88526	-34.56724	63.099	David Close
Point Richards (Bellarine Peninsula)	VIC	No		No	No evidence	No	144.64302	-38.10985	26.182	John Newman
Policeman's Point	TAS	No		No	No evidence	No	148.28866	-41.05763	45.824	Woehler / Park
Port Clinton	QLD						150.72872	-22.55248	10195.184	
Port Fairy	VIC	Yes	Yes	Yes	No evidence	Yes	142.35242	-38.35275	1399.796	George Appleby
Port Fairy West	VIC	No		Yes	No evidence	Yes	142.04884	-38.33364	472.326	Rob Farnes
Port Hedland	WA	No	Yes	Yes	No evidence	Yes	118.92251	-20.24077	12965.146	AWSG - Watkins
Port MacDonnell	SA	Yes	Yes	Yes	No evidence	Yes	140.70780	-38.05275	356.379	Maureen Christie
Port McArthur Tidal Wetlands System IBA	NT		Yes							IBA Watkins
Port Pirie coast			Yes							
Port Stephens	NSW	Yes		Yes	No evidence	Yes	152.05749	-32.70672	13674.229	AMSA, NPWS
Port Victoria	SA	No		Yes	No evidence	Yes	137.40870	-34.45738	1514.111	DEH (Watkins)
Reeves Lake	QLD	No		No	No evidence	Yes	145.83615	-19.88322	119.470	AWSG
Repulse Bay	QLD						148.70206	-20.52706	1527.866	QWSG
Richmond River estuary	NSW	No		Yes	No evidence	Yes	153.54620	-28.87504	1629.728	AMSA, NPWS
Rivoli Bay	SA	No		Yes	No evidence	No	140.10260	-37.52258	1378.906	
Robbins Passage/Boullanger Bay	TAS	Yes	Yes	Yes	No evidence	Yes	144.82294	-40.70637	22537.880	Woehler / Park
Roebuck Bay	WA	Yes	Yes	Yes	No evidence	Yes	122.44047	-18.06252	110658.396	Chris Hassell
Roper River area			Yes							
Sandspit Point	TAS	No		No	No evidence	No	147.94884	-42.65396	183.523	AWSG 1984
Scamander		No		No	No evidence	No	148.26507	-41.46074	15.651	

Sceale Bay	SA	No		Yes	No evidence	No	134.20971	-32.96491	700.190	DEH (Watkins)
SE Gulf of Carpentaria	QLD	Yes		Yes	No evidence	Yes	141.07903	-16.82435	72890.646	
Shorebird Area	STATE	INT_SIG	IN_SIG_BAM	NAT_SIG	STATE_SIG	REG_SIG	LONGITUDE	LATITUDE	AREA_HA	SOURCE
Sea Elephant	TAS	No	Yes	Yes	No evidence	Yes	144.11176	-39.80601	235.558	AWSG 1984
Shallow Inlet	VIC	No	Yes	Yes	No evidence	Yes	146.15672	-38.83262	2447.612	Danny Rogers Wetlands Directory 2000
Shark Bay	WA	No		No	No evidence	Yes	113.93056	-25.80373	607039.360	
Shoalhaven Estuary	NSW	No		Yes	Yes	Yes	150.71179	-34.89498	3791.452	
Shoalwater	QLD		Yes				150.48104	-22.53941	33830.429	Watkins
Sleaford Bay	SA	No		No	No evidence	No	135.82748	-34.87284	300.125	
St. Leonards Salt Lake (Bellarine Peninsula)	VIC	No		No	No evidence	No	144.70996	-38.15607	65.018	AWSG data
Stansbury / Oyster Point (Yorke)	SA	No		No	No evidence	No	137.79947	-34.92032	135.416	David Close
Streaky Bay	SA	No		Yes	No evidence	Yes	134.27905	-32.62488	3083.457	DEH (Watkins)
Swan Bay & Mud Islands	VIC	Yes	Yes	Yes	Possible	Yes	144.66311	-38.23193	2996.252	Roz Jessop
Swan Coastal Plain Lakes	WA	No	Yes	Yes	No evidence	No	115.78654	-32.29724	1374.871	BAWA
Swan Hill	VIC	No		Yes	No evidence	No	143.43739	-35.22244	822.201	Chris Coleborn
Swan River & Rottnest Island	WA	No	Yes	Yes	Yes	Yes	115.79421	-32.00930	3471.114	BAWA
Telfer's Swamp	VIC	No		Yes	No evidence	No	141.84184	-36.67138	125.496	AWSG 1983
The Broadwater (NSW)	NSW	No		No	No evidence	Yes	153.12734	-29.42689	3359.879	AMSA, NPWS
Tiwi Islands IBA	NT									IBA
Tolderol	SA	No		No	No evidence	No	139.14895	-35.36854	30.763	Paul Wainwright
Toogoom to Point Vernon	QLD	No		No	No evidence	Yes	152.68787	-25.24893	1636.433	QWSG
Tourville Bay	SA	No		No	No evidence	No	133.47020	-32.14822	7889.072	
Townsville (Ross River area)	QLD	No		Yes	No evidence	Yes	146.85226	-19.27625	246.011	DEH (Watkins)
Troubridge Island / Shoal (Yorke)	SA	No		No	No evidence	No	137.80504	-35.12686	931.887	David Close
Tuckerbil Swamp			Yes							
Tuggerah Lakes	NSW	No		Yes	No evidence	Yes	151.46539	-33.32826	1173.747	AWSG 1985
Tullakool Saltworks	NSW	No	Yes	Yes	No evidence	Yes	144.19614	-35.35996	566.310	Phil Straw
Tweeds Estuary	NSW	No		Yes	No evidence	Yes	153.51977	-28.21831	2262.416	AMSA, AWSG
Ulladulla	NSW	No		No	No evidence	No	150.44627	-35.38683	65.014	
Vasse-Wonnerup Estuary	WA	No		Yes	No evidence	No	115.43785	-33.61899	1575.321	Rob Breeden
Venus Bay	SA	No		No	No evidence	No	134.67603	-33.18784	8226.963	
Wallis Lake (Pelican Island)	NSW	No		Yes	No evidence	No	152.50053	-32.25519	115.607	AWSG 1985
Warden Lakes (Esperance)	WA	No		Yes	No evidence	No	121.82526	-33.84087	2378.191	AWSG
WaterValley Wetlands IBA	SA									IBA
Werribee / Avalon	VIC	Yes	Yes	Yes	No evidence	Yes	144.56717	-38.02150	6517.518	Danny Rogers
Western Port Bay	VIC	Yes	Yes	Yes	No evidence	Yes	145.51554	-38.36281	54647.710	BOCA
Wilson Inlet	WA	No		Yes	Possible	Yes	117.40397	-34.99882	6046.104	Anne Bondin
Woodman Point	WA	No		No	No evidence	No	115.75236	-32.13181	51.578	AWSG
Yantabulla Swamp			Yes							
Yantara Lake			Yes							
Yarrowonga Point	QLD	No	Yes	No	No evidence	Yes	149.45014	-21.74038	455.853	AWSG

Yellow Rock Beach	TAS	No	Yes	Yes	No evidence	No	143.90185	-39.68858	176.471	AWSG 1984
Yokinup	WA	No	Yes	No	No evidence	No	123.10659	-33.88726	635.529	

Table 2. Shorebird areas (172 Birds Australia has data on) reported richness and abundance.

Shorebird Area	YEARS_DATA	TOTAL_RICH	MIG_RICH	MAX_AB_ALL	MAX_AB_MIG	BAGO_MAX	BLGO_MAX	COGR_MAX	CUSA_MAX	DOPL_MAX	EACU_MAX
80 Mile Beach	18	34	28	465436	461991	93818	600	3160	11867	0	540
Coorong	13	33	23	234551	144371	116	210	718	30612	27	29
Roebuck Bay	20	34	28	93022	92024	32045	13560	500	6000	130	910
Lake MacLeod	7	32	25	161149	80698	386	66	300	55000	0	1
Gulf of St Vincent	25	40	31	78628	50351	5000	158	963	9809	100	164
SE Gulf of Carpentaria	4	26	21	49112	49001	6	48930	69	347	0	43
Corner Inlet	28	33	23	44073	42811	13139	1073	468	10540	1579	1971
Moreton Bay	28	40	30	37936	35820	13233	1414	408	5229	384	3500
Townsville (Ross River area)	18	33	26	31693	30867	1806	361	89	49	0	867
Werribee / Avalon	27	36	27	24794	23877	61	44	168	13323	955	25
Robbins Passage/Boullanger Bay	23	29	22	23159	21845	500	21	125	3400	1721	292
Western Port Bay	27	31	22	22100	20837	890	0	435	7056	1000	2251
Laverton/Altona	27	32	23	21561	20198	4	4	122	8416	631	2
Dampier Saltworks	8	32	27	21931	17757	386	200	200	1611	0	50
Wilson Inlet	26	31	22	21067	16200	250	34	568	732	0	0
Swan Bay & Mud Islands	28	34	24	15702	15120	2500	18	311	3679	660	808
Lake Connewarre area	28	32	23	15255	14131	43	12	331	3184	101	19
Peel & Yalgorup Lakes	9	33	25	33891	12735	65	4	159	631	0	12
North Darwin	20	39	32	12750	12686	2002	2000	74	38	0	41
Bowen	16	28	20	17022	12659	526	63	300	3333	0	224
Great Sandy Straight	12	32	24	12524	12439	7451	84	85	170	92	1853
Lake Buloke (Wimmera)	5	13	7	13363	12122	0	0	18	120	30	0
Lake George	14	21	12	71536	11738	0	0	251	3582	39	0
Lake Corangamite area	7	18	11	17511	11116	0	0	4	3000	278	0
Moolap Saltworks	28	28	20	11555	11032	21	2	232	4981	230	6
Port Hedland	3	27	22	11104	11003	180	0	36	400	0	2
Anderson Inlet	16	25	19	8686	8608	60	2	395	650	550	450
Shallow Inlet	13	24	19	8237	8059	72	0	154	3500	597	622
Lake Hawdon	7	14	8	8251	6995	0	0	150	10	0	0
Kerang Lakes	6	19	12	9485	6926	1	6	22	1119	46	0
Hunter Estuary	24	31	23	8301	6788	2400	800	550	2600	60	653

Munderoo Bay to Tickera Bay	8	19	11	9205	6728	355	0	262	359	0	30
Derwent	36	32	23	7326	6353	165	113	115	1735	388	243
Shorebird Area	YEARS_DATA	TOTAL_RICH	MIG_RICH	MAX_AB_ALL	MAX_AB_MIG	BAGO_MAX	BLGO_MAX	COGR_MAX	CUSA_MAX	DOPL_MAX	EACU_MAX
Swan Coastal Plain Lakes	15	23	15	9836	5622	1	12	185	700	0	0
Gippsland Lakes	7	8	5	5397	5397	0	0	203	24	0	0
Tuggerah Lakes	17	28	21	5533	5291	397	1	72	1315	39	40
Port MacDonnell	27	30	22	5444	5234	12	1	37	1006	212	6
Tourville Bay	3	23	17	5846	5143	420	0	301	212	0	13
East Port Phillip	27	21	14	5023	5023	0	1	18	80	40	2
Lacepede Islands IBA	3	24	21	5092	5018	614	2	19	365	0	32
Hamilton	3	8	2	5082	5000	0	0	0	0	0	0
Lake Hindmarsh (Wimmera)	6	14	7	7286	4944	0	2	5	908	22	0
Gladstone	6	25	18	5168	4900	1509	0	198	293	0	515
Jack Smith Lake (Gippsland Lakes)	6	14	10	4966	4686	0	0	24	350	250	0
BHP Saltfields	6	22	15	8582	4579	38	0	63	1690	0	3
Swan River & Rottnest Island	25	31	23	13420	4272	28	7	86	1078	4	0
Port Fairy	7	25	15	4377	3907	0	0	78	40	156	0
Tolderol	2	15	11	4024	3831	0	120	10	250	0	0
Carpenter Rocks	27	26	18	3832	3727	12	11	118	661	57	9
Mackay	24	34	26	3742	3636	1614	350	81	80	10	502
Albany	24	32	22	4839	3626	74	6	176	237	1	3
Troubridge Island / Shoal (Yorke)	3	14	11	3784	3612	55	0	10	150	0	0
Port Victoria	4	19	13	4172	3597	210	0	25	340	0	5
Armstrong Beach	8	22	16	3631	3551	1194	110	29	12	0	225
Baird Bay	10	22	15	3810	3533	174	0	56	268	24	8
Sceale Bay	9	20	10	3651	3199	0	0	16	198	0	1
Alva Beach	5	27	22	3126	3061	104	6	11	299	40	14
Cape Portland	28	23	17	3160	3030	15	0	10	709	500	3
Clarence River	24	31	23	3150	3010	950	258	47	190	45	173
Streaky Bay	17	27	20	2995	2847	126	0	153	266	33	15
Vasse-Wonnerup Estuary	8	17	10	17760	2805	11	0	136	400	22	0
Port Stephens	13	29	20	2869	2759	1056	96	26	30	67	964
Shoalhaven Estuary	30	34	25	2796	2384	1228	133	30	77	224	414
Lake Robe	9	11	5	3883	2308	0	0	2	6	0	0
Lake Eliza	9	13	6	32584	2210	0	0	0	0	0	0
Long Nose	5	21	15	2443	2168	120	0	19	100	0	20
Tullakool Saltworks	4	16	9	3936	2166	0	4	135	158	0	0
Cairns area	30	35	27	2122	2099	280	119	62	185	7	80
Botany Bay	28	32	24	2115	2068	1067	999	14	610	174	378
Mullins Swamp	5	15	8	2337	2012	0	0	115	680	0	0
Kangaroo Island	4	18	10	2753	1989	25	0	40	266	55	30

Marion Bay & Blackmans Bay	28	18	12	2002	1932	89	0	18	63	200	12
Coobowie Inlet (Yorke Peninsula)	2	12	9	1906	1764	0	0	59	237	0	5
Shorebird Area	YEARS_DATA	TOTAL_RICH	MIG_RICH	MAX_AB_ALL	MAX_AB_MIG	BAGO_MAX	BLGO_MAX	COGR_MAX	CUSA_MAX	DOPL_MAX	EACU_MAX
Richmond River estuary	23	39	30	1908	1712	306	65	64	217	60	111
Black Point (Yorke)	2	11	8	1519	1465	0	0	22	350	4	0
Parramatta River	26	29	22	1901	1380	525	145	72	860	5	2
Herdsman Lake	5	17	12	1354	1311	7	0	3	60	0	0
Georges Bay	11	18	12	1577	1270	47	0	8	1	51	20
Lake Albacutya (Wimmera)	5	14	7	2792	1252	0	1	5	87	0	0
Swan Hill	5	14	7	2246	1184	0	2	21	412	0	0
Lake Bathurst	6	21	14	1888	1176	0	0	10	450	125	1
Black Rocks / Breamlea (Bellarine Peninsula)	28	17	10	1202	1165	0	0	24	42	80	0
Lake Gore	4	12	7	11229	1131	0	0	19	1000	0	0
Fletcher Lake	4	11	4	1809	1112	0	0	16	9	0	0
Shark Bay	4	24	17	1179	1105	248	1	48	21	0	29
Venus Bay	5	16	11	1612	1098	27	0	44	4	0	0
Fivebough Swamp	10	25	18	1466	1069	1	4	37	13	8	0
Bool lagoon	5	17	10	3777	1068	0	0	53	10	6	0
George Town Reserve	26	20	16	1084	1061	67	0	43	249	53	98
Ocean Beach	5	10	6	1100	1050	0	0	0	1	197	0
Telfer's Swamp	4	7	3	1447	930	0	0	0	0	0	0
Yarrawonga Point	8	22	17	941	926	92	8	27	0	0	53
Mildura	5	17	10	2770	896	0	2	60	73	2	0
Tweeds Estuary	19	30	20	2312	883	485	21	98	40	44	216
Warden Lakes (Esperance)	5	19	10	3042	859	2	0	91	123	300	2
Port Fairy West	7	19	11	964	851	1	0	6	0	52	0
Wallis Lake (Pelican Island)	7	20	14	913	849	555	0	3	1	76	112
Bushland Beach	6	20	17	870	848	170	0	18	0	10	50
Hastings River	9	17	13	863	820	316	0	11	0	63	116
Lake Wyn Wyn area (Wimmera)	6	13	6	24719	771	0	0	1	21	8	0
Stansbury / Oyster Point (Yorke)	2	6	5	705	697	0	0	87	34	0	0
Cooke Point	4	26	21	735	687	1	0	20	80	0	0
St. Leonards Salt Lake (Bellarine Peninsula)	28	15	7	885	686	0	0	110	370	0	0
Lake MacQuarie entrance	4	22	16	720	683	178	0	30	146	31	18
Sea Elephant	3	13	8	681	631	0	0	11	0	8	0
Discovery Bay to Glenelg River	7	18	12	745	577	3	0	33	50	100	0
Farquhar Inlet	6	13	11	641	575	134	21	1	2	32	33
Broadwater (Busselton)	2	12	7	1293	568	0	0	35	67	0	0
Great Musselroe Bay	3	16	11	649	559	7	3	16	19	1	19

Goldsmith Beach to Wattle Pt (Yorke)	3	10	8	686	534	0	0	6	132	0	0
Rivoli Bay	9	10	6	562	521	0	0	0	26	17	0
Shorebird Area	YEARS_DATA	TOTAL_RICH	MIG_RICH	MAX_AB_ALL	MAX_AB_MIG	BAGO_MAX	BLGO_MAX	COGR_MAX	CUSA_MAX	DOPL_MAX	EACU_MAX
Hutt Lagoon	3	19	13	782	501	0	0	2	132	0	1
Lake St Clair	7	10	6	576	499	0	0	2	63	0	0
Reeves Lake	7	21	14	851	494	19	19	14	18	0	0
Nericon Swamp	4	15	9	602	490	0	8	9	7	4	0
Nadzab Lagoon	4	8	4	5080	485	0	0	0	20	0	0
Nuytsland Nature Reserve	14	34	24	565	482	20	1	10	14	11	1
Guichen Bay	3	11	7	530	475	0	0	0	3	0	0
Horse Peninsula	4	15	12	522	461	5	0	5	14	1	0
Yellow Rock Beach	3	14	9	472	461	0	0	1	87	285	0
Blakeys Crossing	7	30	23	808	450	40	60	13	30	0	12
Kellidie Bay	4	10	5	475	441	0	0	6	2	0	0
Garden Island	5	15	12	479	433	7	0	0	0	0	0
Currie Harbour	3	9	5	440	423	0	0	0	15	86	0
Camila Beach	8	17	14	423	410	120	2	11	0	0	53
Lake Moondarra	6	23	17	444	407	4	80	2	8	0	0
Moulting Lagoon	3	12	7	438	394	0	0	70	144	35	13
Gunyah Beach	5	7	3	454	380	0	0	0	0	0	0
Toogoom to Point Vernon	5	20	17	414	378	200	100	6	1	6	12
Lake Illawarra	10	25	20	503	375	206	17	32	78	54	29
Canunda National Park	6	8	4	383	368	0	0	0	0	60	0
Point Richards (Bellarine Peninsula)	27	10	5	391	366	0	0	1	22	0	0
Lades Beach	5	9	4	413	349	1	0	0	0	54	0
Douglas area (Wimmera)	11	12	5	18251	326	0	0	1	50	0	0
Kelso, Tamar Estuary	9	16	11	443	320	19	0	3	100	63	3
Darwin Harbour	6	18	17	276	276	21	0	3	17	0	18
Fox and Pub Lakes	5	10	6	271	255	0	0	23	0	0	0
Sandspit Point	4	9	4	366	251	0	0	0	1	25	2
Narantapu National Park	15	18	11	437	247	6	0	1	1	152	69
Lake Merreti	6	16	8	1252	241	0	0	19	14	0	0
Kinka Beach	8	30	21	437	233	64	38	60	2	3	27
Sleaford Bay	2	6	2	243	220	0	0	0	0	0	0
Finucane Island	3	21	18	237	217	27	1	32	5	0	5
Dubbo Sewage Ponds	9	12	7	327	212	0	0	0	1	0	0
Mallacoota	7	16	11	296	198	162	0	0	0	15	54
Pine Point (Yorke)	2	7	4	211	192	0	0	32	92	0	0
Moorland Point	6	12	6	337	190	0	0	0	0	95	0
Barren Box Swamp	4	12	6	245	175	0	0	62	0	0	0
The Broadwater (NSW)	3	12	6	248	167	7	0	0	0	12	0

Bendigo Sewage Farm	4	14	8	609	156	1	0	0	1	1	0
Woodman Point	8	23	17	189	147	2	0	1	1	0	0
Shorebird Area	YEARS_DATA	TOTAL_RICH	MIG_RICH	MAX_AB_ALL	MAX_AB_MIG	BAGO_MAX	BLGO_MAX	COGR_MAX	CUSA_MAX	DOPL_MAX	EACU_MAX
Magnetic Island	5	16	11	162	143	58	0	17	0	0	24
Nambucca River	5	16	10	276	139	36	0	1	0	23	24
Moruya Estuary	5	10	5	129	125	60	0	0	0	15	40
Policeman's Point	1	7	3	232	117	0	0	0	0	0	0
Esperance	4	10	6	168	102	0	0	0	0	0	0
Brisbane Water	7	10	6	143	100	35	0	0	0	3	56
Maroochy River	3	9	7	128	99	6	0	2	0	0	6
Camden Haven	4	5	3	112	99	66	0	0	0	0	32
Maurouard Beach	8	10	5	149	91	0	0	0	0	17	0
Belmont Common (Bellarine Peninsula)	28	4	1	134	88	0	0	0	0	0	0
Begola (Bellarine Peninsula)	28	7	3	63	57	0	0	0	0	0	0
Fitzroy River Mouth	5	6	2	89	44	0	0	0	0	44	0
Batemans Bay	4	7	4	49	41	16	0	0	0	5	25
Brunswick River estuary	5	11	7	48	40	19	0	2	0	0	7
Bellambi Point	3	8	5	46	38	1	0	0	0	7	0
Little Swanport	2	7	2	69	26	0	0	0	0	4	0
Lake Lorne (Bellarine Peninsula)	27	6	1	97	24	0	0	0	0	0	0
Scamander	3	6	2	41	21	0	0	0	0	1	0
Ulladulla	2	8	3	36	9	2	0	0	0	8	1
Lake Dulverton	3	1	0	365	0	0	0	0	0	0	0
Yokinup	1	4	0	13	0	0	0	0	0	0	0

Table 2. Shorebird areas (172 Birds Australia has data on) reported richness and abundance (Cont).

Shorebird Area	GRKN_MAX	GRPL_MAX	GRTA_MAX	PAPL_MAX	REKN_MAX	REPL_MAX	REST_MAX	RUTU_MAX	SAND_MAX	SHSA_MAX
80 Mile Beach	167353	1521	14632	423	28848	4812	67221	1613	2996	193
Coorong	4	12	0	289	80	5446	63800	3	929	55781
Roebuck Bay	30190	1000	3380	45	5000	2330	9520	2000	1754	500
Lake MacLeod	260	60	13	5	668	3125	25000	50	5	850
Gulf of St Vincent	1908	930	56	47	2003	3474	29000	451	30	16864
SE Gulf of Carpentaria	873	30	6	5	359	230	225	1	0	65
Corner Inlet	950	1120	71	49	7110	117	24355	162	300	500
Moreton Bay	1975	191	3188	2163	268	3030	7488	296	50	3568
Townsville (Ross River area)	18702	7	607	81	223	683	5429	5	2	1062
Werribee / Avalon	160	22	6	120	170	318	13642	35	0	6052
Robbins Passage/Boullanger Bay	26	308	180	521	1920	524	15726	2450	29	154
Western Port Bay	6	5	29	162	571	235	13902	211	0	1856
Laverton/Altona	1	1	1	178	65	553	8995	2	0	2673

Dampier Saltworks	430	42	70	15	250	3845	10594	34	4	4204
Shorebird Area	GRKN_MAX	GRPL_MAX	GRTA_MAX	PAPL_MAX	REKN_MAX	REPL_MAX	REST_MAX	RUTU_MAX	SAND_MAX	SHSA_MAX
Wilson Inlet	135	27	0	28	76	1053	15252	2	1	1059
Swan Bay & Mud Islands	1313	743	43	255	1295	301	9069	328	2	2174
Lake Connewarre area	10	1	2	86	44	169	7430	2	10	4775
Peel & Yalgorup Lakes	160	41	5	35	265	1208	12285	1	5	2400
North Darwin	8221	302	71	74	900	100	558	193	200	88
Bowen	185	12	49	83	8	2069	2394	49	5	2997
Great Sandy Straight	402	260	3400	46	124	98	1322	63	5	41
Lake Buloke (Wimmera)	0	0	0	0	0	3530	175	0	0	12000
Lake George	4	1	0	6	86	570	9000	5	68	4500
Lake Corangamite area	0	0	0	20	6	125	8799	1	0	4500
Moolap Saltworks	0	13	0	122	35	544	4859	4	0	3811
Port Hedland	1	4	3	4	0	38	2937	10	0	312
Anderson Inlet	120	0	0	322	10	72	6390	2	0	2530
Shallow Inlet	1	1	3	400	11	85	5421	7	533	212
Lake Hawdon	0	0	0	0	0	87	660	0	0	6440
Kerang Lakes	0	0	0	0	0	860	1410	0	0	4653
Hunter Estuary	32	0	96	800	270	110	450	50	0	1201
Munderoo Bay to Tickera Bay	0	440	0	12	275	68	3386	2	0	1706
Derwent	2	3	17	319	26	285	4622	2	1	87
Swan Coastal Plain Lakes	0	7	0	0	3	1370	4701	0	0	800
Gippsland Lakes	0	0	0	0	6	114	5397	0	0	3187
Tuggerah Lakes	6	1	12	47	325	60	1270	49	40	1936
Port MacDonnell	8	65	22	201	11	173	3874	1263	1108	443
Tourville Bay	300	310	4	13	700	334	2618	119	12	850
East Port Phillip	0	0	0	0	0	31	140	0	0	5006
Lacepede Islands IBA	1055	106	900	270	100	38	534	1900	40	20
Hamilton	0	0	0	0	0	54	1	0	0	5000
Lake Hindmarsh (Wimmera)	0	0	0	0	0	1237	4932	0	0	277
Gladstone	265	5	496	31	65	107	1581	37	0	90
Jack Smith Lake (Gippsland Lakes)	0	0	0	168	4	150	3600	0	0	750
BHP Saltfields	1000	131	0	0	1000	254	1640	20	0	860
Swan River & Rottneest Island	140	149	27	3	24	431	3430	430	125	150
Port Fairy	0	0	4	0	24	182	2539	223	550	1634
Tolderol	0	0	0	2	0	160	1410	0	0	2230
Carpenter Rocks	2	10	10	219	12	98	2512	938	114	1701
Mackay	762	93	373	126	65	135	615	103	36	400
Albany	640	145	34	50	395	483	2491	28	1	80
Troubridge Island / Shoal (Yorke)	800	20	1	0	303	150	1200	100	4	1000
Port Victoria	450	85	0	28	1500	225	1400	150	0	99

Armstrong Beach	2040	16	1	24	0	40	420	15	0	51
Shorebird Area	GRKN_MAX	GRPL_MAX	GRTA_MAX	PAPL_MAX	REKN_MAX	REPL_MAX	REST_MAX	RUTU_MAX	SAND_MAX	SHSA_MAX
Baird Bay	153	444	0	16	300	244	1820	86	1	817
Sceale Bay	0	32	5	0	0	396	2550	309	270	149
Alva Beach	1000	25	4	39	1400	92	3000	6	8	178
Cape Portland	0	2	5	223	40	177	2115	244	0	51
Clarence River	300	2	199	226	160	91	509	41	0	514
Streaky Bay	80	550	21	76	230	332	1635	354	4	370
Vasse-Wonnerup Estuary	0	4	0	0	0	785	2000	0	0	800
Port Stephens	500	1	100	71	26	104	150	20	0	406
Shoalhaven Estuary	3	3	16	310	76	220	1500	42	5	500
Lake Robe	0	0	0	0	0	135	2300	0	0	100
Lake Eliza	0	0	0	170	0	346	2210	1	0	673
Long Nose	66	400	0	1	99	120	850	104	350	300
Tullakool Saltworks	0	0	0	0	0	1200	160	0	0	2000
Cairns area	273	4	144	148	20	85	1450	8	12	1000
Botany Bay	5	1	147	192	390	78	415	100	2	197
Mullins Swamp	0	0	0	0	0	1	1200	4	0	955
Kangaroo Island	0	0	0	0	12	418	918	0	35	788
Marion Bay & Blackmans Bay	0	0	1	83	6	330	1925	11	1	0
Coobowie Inlet (Yorke Peninsula)	0	38	0	0	0	136	770	6	0	654
Richmond River estuary	100	20	160	246	267	41	221	100	62	215
Black Point (Yorke)	0	4	1	11	0	40	1070	22	0	0
Parramatta River	2	1	10	67	39	23	373	46	0	261
Herdsman Lake	52	50	0	0	14	40	1220	0	0	25
Georges Bay	0	0	0	6	0	62	1150	72	71	1
Lake Albacutya (Wimmera)	0	0	0	0	0	564	1029	0	0	751
Swan Hill	0	0	0	0	0	304	641	0	0	362
Lake Bathurst	0	1	0	24	3	667	181	1	0	1110
Black Rocks / Breamlea (Bellarine Peninsula)	0	0	0	26	0	54	800	22	1	500
Lake Gore	0	0	0	0	3	496	625	6	13	0
Fletcher Lake	0	0	0	0	0	578	428	0	0	690
Shark Bay	68	11	91	0	29	200	454	18	12	0
Venus Bay	12	137	1	0	0	148	850	12	44	25
Fivebough Swamp	0	0	0	5	1	113	10	2	0	1006
Bool lagoon	0	0	0	0	0	126	53	0	0	1050
George Town Reserve	0	2	10	32	11	46	600	200	0	3
Ocean Beach	0	0	0	0	0	109	650	0	450	0
Telfer's Swamp	0	0	0	0	0	438	30	0	0	896
Yarrawonga Point	240	32	58	4	0	60	464	48	0	63

Mildura	0	0	0	0	0	237	317	0	0	697
Shorebird Area	GRKN_MAX	GRPL_MAX	GRTA_MAX	PAPL_MAX	REKN_MAX	REPL_MAX	REST_MAX	RUTU_MAX	SAND_MAX	SHSA_MAX
Tweeds Estuary	0	0	77	80	0	7	1	4	1	72
Warden Lakes (Esperance)	0	1	0	0	52	200	505	0	0	152
Port Fairy West	0	1	0	71	0	83	546	54	300	318
Wallis Lake (Pelican Island)	0	35	113	121	0	109	78	5	0	0
Bushland Beach	600	2	130	0	200	250	180	2	0	0
Hastings River	0	0	104	100	2	46	58	9	0	0
Lake Wyn Wyn area (Wimmera)	0	0	0	0	0	744	282	0	0	488
Stansbury / Oyster Point (Yorke)	0	0	0	0	0	0	454	14	0	138
Cooke Point	0	5	200	5	4	6	12	300	1	12
St. Leonards Salt Lake (Bellarine Peninsula)	0	0	0	0	0	60	205	10	0	40
Lake MacQuarie entrance	0	0	49	15	19	36	249	50	0	19
Sea Elephant	0	0	0	18	0	37	469	309	0	0
Discovery Bay to Glenelg River	0	81	0	0	0	104	556	5	500	3
Farquhar Inlet	0	0	0	57	0	66	350	0	0	0
Broadwater (Busselton)	0	0	0	0	0	50	80	0	0	242
Great Musselroe Bay	0	0	0	0	16	100	450	90	0	4
Goldsmith Beach to Wattle Pt (Yorke)	3	18	0	8	10	150	340	35	0	0
Rivoli Bay	0	0	0	0	10	47	163	273	84	0
Hutt Lagoon	0	15	1	8	1	173	356	69	8	41
Lake St Clair	0	0	0	106	0	91	424	3	0	10
Reeves Lake	1	0	0	1	0	28	28	0	0	380
Nericon Swamp	0	0	0	0	0	81	8	1	0	467
Nadzab Lagoon	0	0	0	0	0	400	450	0	0	15
Nuytsland Nature Reserve	42	43	4	9	150	333	209	102	50	323
Guichen Bay	0	1	2	85	0	27	135	251	0	0
Horse Peninsula	0	46	7	5	0	30	292	67	0	41
Yellow Rock Beach	0	0	0	0	0	29	339	106	6	41
Blakeys Crossing	7	0	10	16	0	195	86	30	0	212
Kellidie Bay	0	16	0	0	0	22	400	0	0	20
Garden Island	170	23	2	0	200	20	10	40	100	0
Currie Harbour	0	0	0	5	0	12	8	419	0	0
Camila Beach	150	13	17	7	0	35	53	70	0	0
Lake Moondarra	0	2	0	6	0	66	60	0	0	100
Moulting Lagoon	0	0	0	34	0	60	125	0	0	8
Gunyah Beach	0	0	0	0	0	40	110	8	350	0
Toogoom to Point Vernon	4	0	0	6	0	100	100	3	0	150
Lake Illawarra	3	2	15	4	73	84	207	3	38	78
Canunda National Park	0	0	0	0	0	70	10	25	360	0

Point Richards (Bellarine Peninsula)	0	0	0	0	0	10	118	0	0	225
Shorebird Area	GRKN_MAX	GRPL_MAX	GRTA_MAX	PAPL_MAX	REKN_MAX	REPL_MAX	REST_MAX	RUTU_MAX	SAND_MAX	SHSA_MAX
Lades Beach	0	0	0	0	0	27	292	67	0	0
Douglas area (Wimmera)	0	1	0	0	0	207	276	0	0	116
Kelso, Tamar Estuary	0	1	1	0	0	41	250	30	0	3
Darwin Harbour	0	3	52	1	9	0	36	90	31	3
Fox and Pub Lakes	0	0	0	0	0	20	100	0	0	120
Sandspit Point	0	0	0	0	0	50	250	0	0	0
Narantapu National Park	0	1	0	28	0	42	200	20	0	0
Lake Merreti	0	0	0	67	0	172	15	0	0	236
Kinka Beach	5	0	6	4	0	223	150	2	0	70
Sleaford Bay	0	0	0	0	0	10	27	0	200	0
Finucane Island	140	2	20	0	5	6	50	50	0	0
Dubbo Sewage Ponds	0	0	0	0	0	0	1	0	0	204
Mallacoota	8	2	0	0	13	72	110	1	1	9
Pine Point (Yorke)	0	0	3	0	0	10	65	0	0	0
Moorland Point	0	0	2	5	0	14	3	180	0	0
Barren Box Swamp	1	0	0	0	0	28	0	2	0	134
The Broadwater (NSW)	0	0	0	100	0	47	47	0	0	18
Bendigo Sewage Farm	0	0	0	0	0	1	18	0	0	135
Woodman Point	100	25	2	0	24	33	13	25	60	3
Magnetic Island	0	0	80	8	0	30	1	0	0	25
Nambucca River	0	0	0	19	0	30	14	0	0	45
Moruya Estuary	0	0	5	0	0	30	0	0	0	0
Policeman's Point	0	0	0	0	0	57	65	18	34	0
Esperance	6	1	2	0	0	53	47	0	54	0
Brisbane Water	0	0	29	5	0	0	0	0	0	0
Maroochy River	0	0	0	50	0	27	39	0	0	0
Camden Haven	0	0	0	0	0	7	0	0	0	0
Maurouard Beach	0	0	0	2	0	45	35	58	66	0
Belmont Common (Bellarine Peninsula)	0	0	0	0	0	0	0	0	0	0
Begola (Bellarine Peninsula)	0	0	0	0	0	0	0	0	0	0
Fitzroy River Mouth	0	0	0	0	0	19	41	0	0	0
Batemans Bay	0	0	0	0	0	0	0	0	0	0
Brunswick River estuary	0	0	11	2	0	10	0	0	0	0
Bellambi Point	0	0	0	0	4	4	0	37	1	0
Little Swanport	0	0	0	0	0	20	22	0	0	0
Lake Lorne (Bellarine Peninsula)	0	0	0	0	0	10	0	0	0	0
Scamander	0	0	0	0	0	26	20	0	0	0
Ulladulla	0	0	0	0	0	4	0	0	0	0
Lake Dulverton	0	0	0	0	0	0	0	0	0	0

Yokinup

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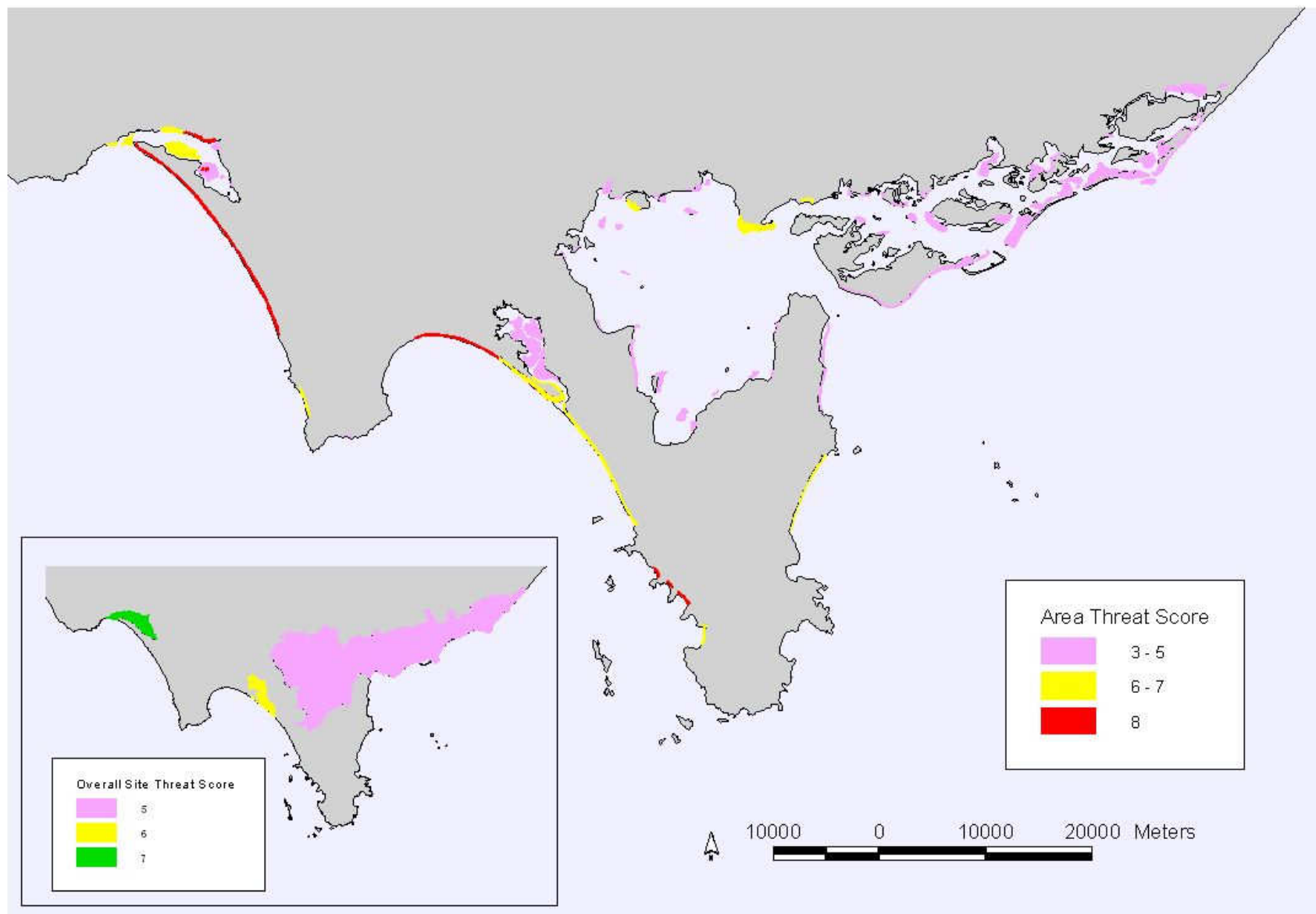
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APPENDIX E. EXAMPLES OF THREAT SCORES AND INFORMATION COLLECTED FOR MAPPED SHOREBIRD AREAS.

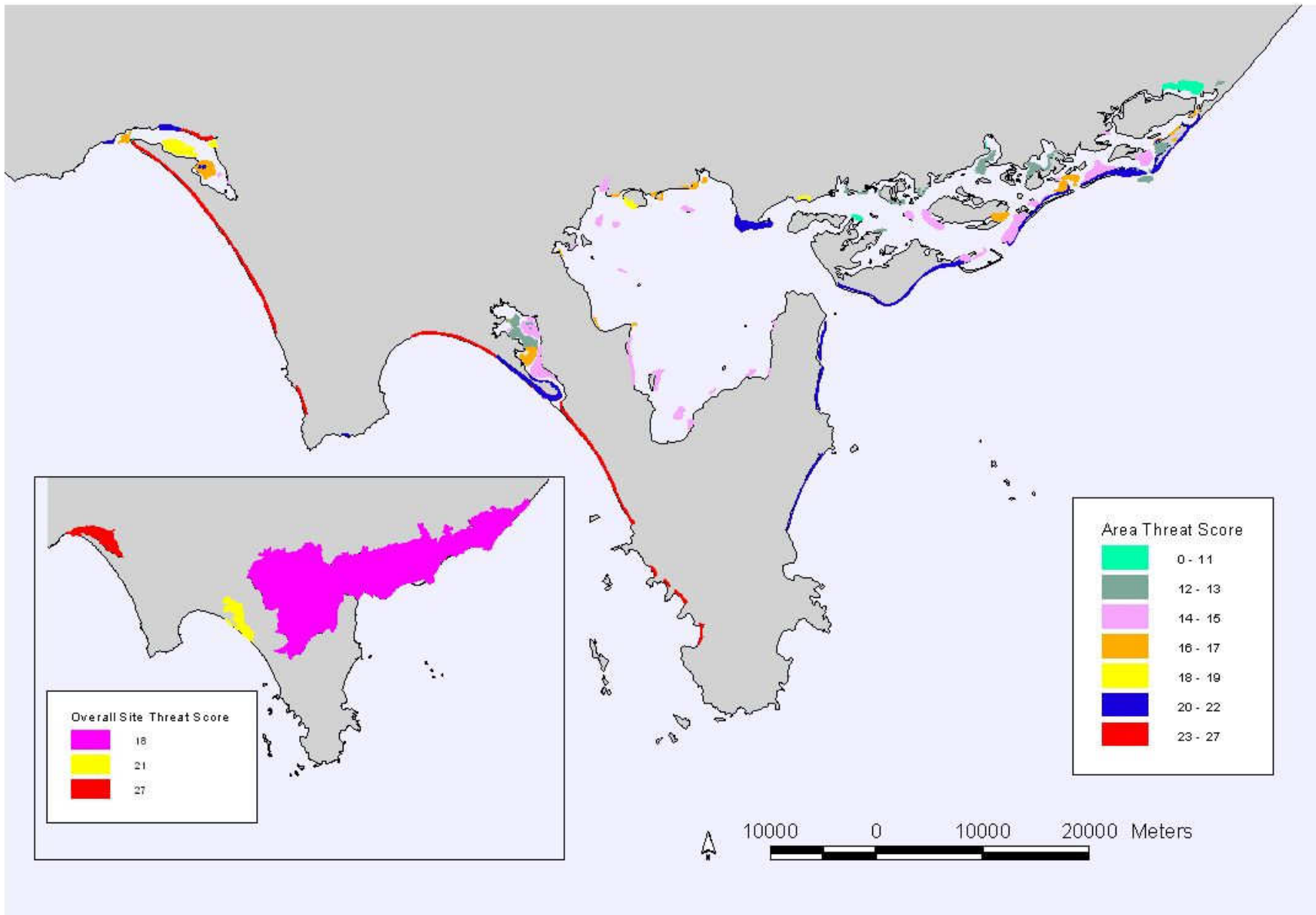
Shorebird Area	STATE	HAB_LOSS	HUM_DIST	INV_SP	POLLUTION	ACC_MORT	THREAT
Richmond River estuary	NSW	8	3	8	0	0	Lake Chikiba-habitat loss/invasive species from mangroves. Flat Rock-dogs off leash. South Ballina beach walkers/holiday makers in dunes where plovers nest-potential accidental mortality. Fishermen pumping for bait on mud flats.
Port Stephens	NSW	5	0	3	0	0	
Lake Illawarra	NSW	6	9	9	6	6	
Hunter Estuary	NSW	8	8	7	0	0	
Clarence River	NSW	3	3	6	0	0	Yamba Quays estate development-affect habitat. Dredging of estuary-across shorebird area. Possible fox predation on Pied Oystercatcher. Clarence River-history of acid sulphate. Large Prawn trawling industry. Potential accidental mortality-4wd on beaches. Public access encouraged to whole site but restricted-4 days/week. Foxes on increase." Threat Abatement Plans"-difficult to implement when close to residential areas. Habitat loss-sea level rise bush invasion. Human activity/dogs on increase.
Brunswick River estuary	NSW	8	9	9	6	4	
Townsville (Ross River area)	QLD	0	6	0	0	0	
Moreton Bay	QLD	5	7	6	7	0	
Mackay	QLD	5	8	4	0	4	
Armstrong Beach	QLD	4	7	4	0	0	
Rivoli Bay	SA	0	0	0	0	0	
Port MacDonnell	SA	3	7	2	0	3	
Guichen Bay	SA	0	0	0	0	0	
Coorong	SA	8	5	1	3	3	
Carpenter Rocks	SA	3	7	2	0	3	
Robbins Passage / Boullanger Bay	TAS	1	3	3	3	0	
Policeman's Point	TAS	0	3	0	0	3	
Narantapu National Park	TAS	0	3	2	0	0	
Moorland Point	TAS	0	6	1	0	6	
Maurouard Beach	TAS	0	0	0	0	0	
Georges Bay	TAS	0	0	0	0	0	
George Town Reserve	TAS	0	3	3	0	0	Oil spill in winter in 1993, apparently minimal effect on shorebirds. Loss of vegetation as a result of oil spill. Kelso to Greens Beach: some dogs walkers and quad bikes. Euphorbia/Sea spurge is present but not encroaching on shorebird areas currently
Cape Portland	TAS	0	5	0	0	0	Wind turbine proposal: 11+ turbine towers and access roads to be built in Cape Portland area; may affect flight routes to inland wetlands. May effect populations moving through the area (not necessarily reflected in count numbers at the site level).
Western Port Bay	VIC	0	5	0	0	0	French Island NP is relatively protected. Sites such as Tortoise Head, Rams Island and Barrallier Island are subject to disturbance via boating activities.
Werribee / Avalon	VIC	3	3	1	2	0	
Shallow Inlet	VIC	4	6	4	5	4	
Port Fairy West	VIC	6	7	6	7	6	

Shorebird Area	STATE	HAB_LOSS	HUM_DIST	INV_SP	POLLUTION	ACC_MORT	THREAT
Port Fairy	VIC	7	8	7	6	7	
Point Richards (Bellarine Peninsula)	VIC	0	6	0	0	6	
Moolap Saltworks	VIC	0	0	9	0	0	Foxes common, seen hunting waterbirds. Dead and partly eaten waterbirds possibly taken by foxes.
Mallacoota	VIC	3	6	3	0	0	Entrance sands-affected by boat ramp/marina development proposal. Holiday makers/dog walkers walking around entrance sands put up birds and walk over nesting areas. Sea Spurge-encroaching but actively managed, without which it will be severe.
Laverton/Altona	VIC	3	8	3	5	0	
Lake Corangamite area	VIC	4	6	5	2	0	
Kerang Lakes	VIC	9	0	0	0	0	Habitat loss-lack of water that the wetlands receive due to historical water regimes. No birds present when wetlands dry-this likely to persist into future. Duck hunting on some of the lakes may occur from time to time, otherwise disturbance is minimal.
Jack Smith Lake (Gippsland Lakes)	VIC	8	0	0	0	0	Lack of water relates to lack of habitat. Like to remain dry for a number of years. Introduced snail shells blow around and bank up around glasswort areas.
Gippsland Lakes	VIC	6	0	0	8	0	Water levels are down, which is main reason for loss of habitat. Algal blooms (pollution) persistent for last three years. Killing seagrass and shellfish.
East Port Phillip	VIC	3	0	3	0	3	
Corner Inlet	VIC	2	5	5	5	1	Habitat loss from land reclamation and residential/recreational development along the western shoreline. Human disturbance by boating and fishing in same areas. Erosion of shoreline around mangroves areas.
Anderson Inlet	VIC	4	7	7	5	4	
Wilson Inlet	WA	7	4	0	8	4	When bar not breached, water levels high and little suitable shorebird habitat. Pollution increasing- water levels needed to flush inlet. Accidental mortality observed for Red-capped Plover-strong winds force water up higher than usual, wiping out nests
Vasse-Wonnerup Estuary	WA	0	7	3	0	5	Main threat from Human disturbance is the close proximity of the residential development of the Busselton area (dogs, bikes etc)
Swan River & Rottnest Island	WA	5	6	1	4	1	
Shark Bay	WA	0	3	5	0	0	Greatest threat from human disturbances, only on a minor scale over the entire area, roosts near town disturbed by fishers, beach walkers and persons walking dogs. Fox numbers are relatively high and may affect bird numbers and nesting.
Roebuck Bay	WA	3	8	3	7	0	POTENTIAL POLLUTION-EXPANDING PORT.POTENTIAL HABITAT LOSS-PORT EXPANSION/MARINA CONSTRUCTION. HIGH DISTURBANCE BY RAPTORS AT HIGH TIDE ROOSTS. HABITAT LOSS-MUDFLATS COVERED BY MAN-INDUCED EROSION OF PINDAN ROADS FROM RAIN FALL. INVASIVE SPECIES-LYNGBYA
Peel & Yalgorup Lakes	WA	5	5	0	5	0	
Herdsmen Lake	WA	1	2	0	2	0	
Albany	WA	3	0	4	5	0	Future dredging activities may affect habitat. Boat use and agricultural run-off could increase pollution levels.
80 Mile Beach	WA	0	7	0	7	0	RELATIVELY PRISTINE. INCREASED CAR TRAFFIC POTENTIAL DISTURBANCE. PEARLING BOTS FISHING BOATS POTENTIAL POLLUTORS.
Scamander		7	6	0	0	6	

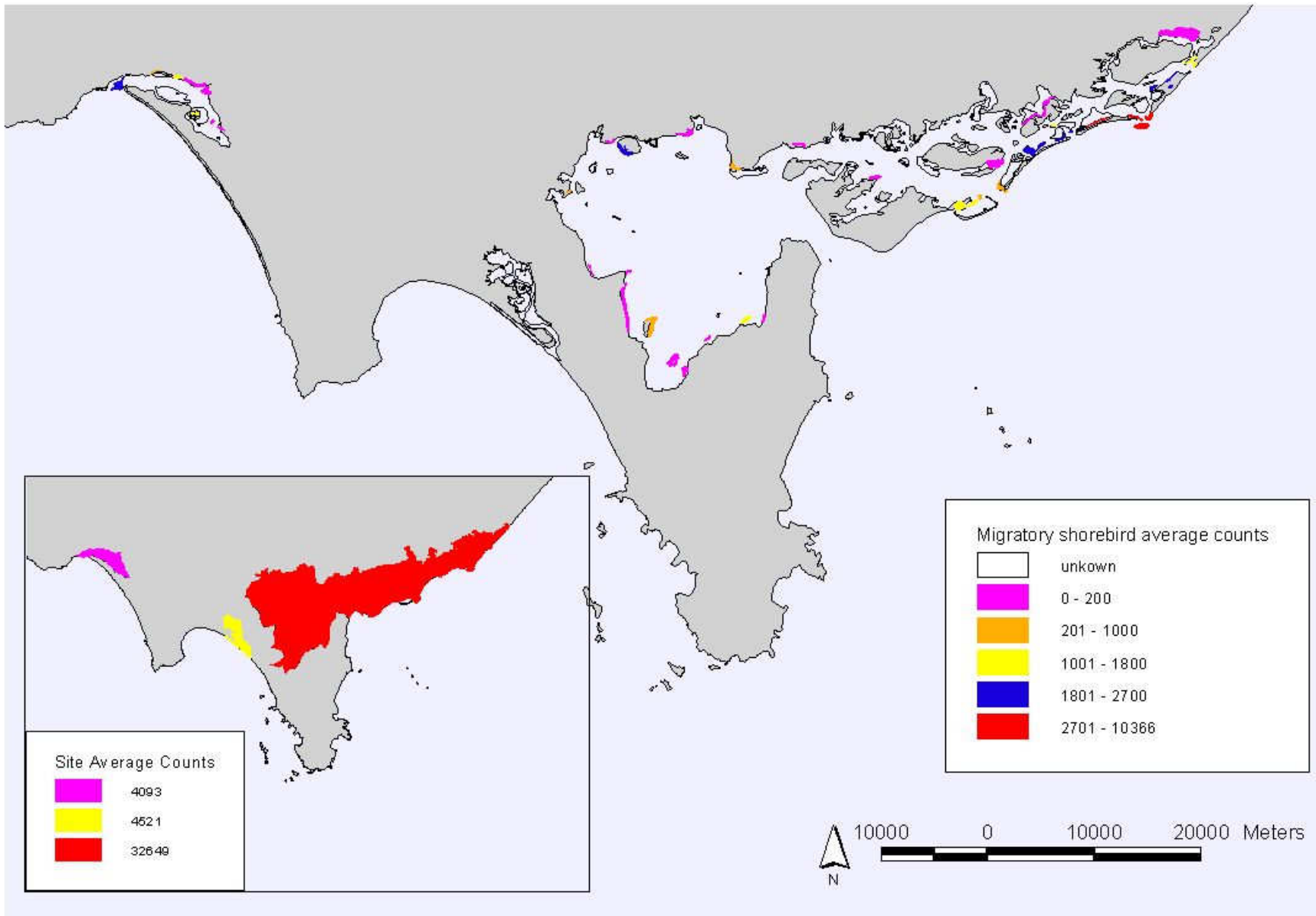
APPENDIX F. EXAMPLES OF HOW RELATIVE COMPARISONS BETWEEN AREAS CAN BE FACILITATED FOR SHOREBIRD AREAS USING SPATIALLY EXPLICIT DATA (FROM CLEMENS ET AL. 2007).



Maximum threat scores for shorebird areas: Anderson Inlet, Shallow Inlet, and Corner Inlet (maximum possible threat score = 9)



Sum of 5 threat scores for shorebird areas: Anderson Inlet, Shallow Inlet, and Corner Inlet (maximum possible summed threat score = 45)



Average migratory shorebird counts in shorebird areas for: Anderson Inlet, Shallow Inlet, and Corner Inlet.

APPENDIX G. POPULATION ESTIMATES & TRENDS, AND HABITAT USED BY AUSTRALIA'S MIGRANT SHOREBIRDS.

Common name	Scientific name	Flyway MPE	Declining?	Source**	primary habitat used in Australia
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	24,000	unknown		saltworks, sheltered coastal sandflats or mudflats
Australian Pratincole	<i>Stiltia isabella</i>	60,000	unknown		arid to semi-arid open plains usually within 2km of water
Bar-tailed Godwit	<i>Limosa lapponica</i>	325,000	regional declines	c, d	large intertidal sandflats, often round seagrass beds
Black-tailed Godwit	<i>Limosa limosa</i>	160,000	regional declines***	a	sheltered coastal areas with large mudflats and sandflats
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	25,000	unknown		large soft intertidal mudflats in sheltered coastal areas
Common Greenshank	<i>Tringa nebularia</i>	60,000	regional declines***	c	wide variety of inland wetlands and sheltered coastal areas
Common Redshank	<i>Tringa totanus</i>	75,000	unknown		coastal open flats, saltlakes, freshwater lagoons, artificial wetlands
Common Sandpiper	<i>Actitis hypoleucos</i>	25,000 to 100,000	unknown		wide variety of wetlands with muddy margins or rocky shores
Curlew Sandpiper	<i>Calidris ferruginea</i>	180,000	national declines	a, b, c, d, e	protected intertidal coastal mudflats, or near-coastal wetlands
Double-banded Plover	<i>Charadrius bicinctus</i>	50,000	no evidence of decline	a	various coastal and fresh or saline terrestrial wetlands
Eastern Curlew	<i>Numenius madagascariensis</i>	38,000	regional declines	b, c	large intertidal mudflats and sandflats, often with beds of seagrass
Great Knot	<i>Calidris tenuirostris</i>	375,000	regional declines***	a	sheltered intertidal mudflats or sandflats, various coastal areas
Greater Sand Plover	<i>Charadrius leschenaultii</i>	110,000	no evidence of decline	a	sheltered beaches, intertidal mudflats or sandbanks
Grey Plover	<i>Pluvialis squatarola</i>	125,000	regional declines***	a, d	large tidal mudflats and sandflats, sandy beaches or rocky coast
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	50,000	regional declines***	a	rocky coastlines, reefs, or intertidal mudflats
Latham's Snipe	<i>Gallinago hardwickii</i>	36,000	unknown		freshwater wetlands with cover nearby
Lesser Sand Plover	<i>Charadrius mongolus</i>	140,000	regional declines***	a	sheltered beaches, intertidal mudflats or sandflats
Little Curlew	<i>Numenius minutus</i>	180,000	unknown		short, dry grasslands and sedgelands, artificial short grass flats
Little Ringed Plover	<i>Charadrius dubius</i>	25,000	unknown		mudflats or mudbanks near edge of freshwater or tidal wetlands
Long-toed Stint	<i>Calidris subminuta</i>	25,000	unknown		variety of terrestrial fresh and brackish wetlands
Marsh Sandpiper	<i>Tringa stagnatilis</i>	100,000 to 1,000,000	unknown		intertidal mudflats, shallow freshwater lakes, saltworks, various others
Oriental Plover	<i>Charadrius veredus</i>	70,000	unknown		arid to semi-arid open grasslands, often short grass & hard bare ground
Oriental Pratincole	<i>Glareola maldivarum</i>	2,880,000	unknown		open country often near water, grassy flats, and mudflats
Pacific Golden Plover	<i>Pluvialis fulva</i>	100,000	regional declines***	a, b	coastal reefs, sandy, muddy, or rocky shores, saltmarsh, short grass
Pectoral Sandpiper	<i>Calidris melanotos</i>	insufficient data	unknown		shallow fresh to saline wetlands usually near-coastal
Pin-tailed Snipe	<i>Gallinago stenura</i>	25,000 to 1,000,000	unknown		variety of freshwater wetlands on coastal plains
Red Knot	<i>Calidris canutus</i>	220,000	national declines***	a	sheltered coastal mudflats, sandflats, and sandy beaches
Red-necked Phalarope	<i>Phalaropus lobatus</i>	100,000 to 1,000,000	unknown		usually pelagic, occasionally on coasts and coastal wetlands
Red-necked Stint	<i>Calidris ruficollis</i>	325,000	regional declines	c, d, e	coastal sheltered intertidal mudflats
Ruddy Turnstone	<i>Arenaria interpres</i>	35,000	no evidence of decline	a	coastal areas with exposed rock, reefs, or various beaches
Ruff	<i>Philomachus pugnax</i>	insufficient data	unknown		exposed mudflats, usually at terrestrial fresh or brackish wetlands
Sanderling	<i>Calidris alba</i>	22,000	no evidence of decline	a	open sandy beaches
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	160,000	regional declines***	a, d	muddy edges of shallow fresh or brackish wetlands
Swinhoe's Snipe	<i>Gallinago megala</i>	25,000 to 100,000	unknown		dense fringing vegetation of freshwater and brackish wetlands
Terek Sandpiper	<i>Xenus cinereus</i>	60,000	national declines***	a	intertidal coastal saline mudflats, mudbanks, sand banks and spits
Wandering Tattler	<i>Heteroscelus incanus</i>	insufficient data	unknown		rocky coasts with reefs and platforms
Whimbrel	<i>Numenius phaeopus</i>	100,000	no evidence of decline	a	intertidal mudflats of sheltered coasts often with mangroves
Wood Sandpiper	<i>Tringa glareola</i>	100,000 to 1,000,000	unknown		well-vegetated, shallow freshwater wetlands

* occur in significant numbers at known count areas in Australia, and therefore enough data is available for analysis

** source: a - recent analysis of AWSG data at birds Australia looking at national trends, and trends for southeast Australia

b - Wilson, J.R. 2001. The Australasian Wader Studies Group Population Monitoring Project: Where to now? Perspectives from the Chair. Stilt 39: 13-26.

c - Olsen, P., M. Weston, R. Cunningham, and A. Silcocks. 2003. The State of Australia's Birds 2003. Supplement to Wingspan 13(4): 23pp.

d - Creed, K. E., and M. Bailey. 1998. Decline in Migratory Waders at Pelican Point, Swan River, Western Australia. Stilt 33: 10-14.

e - Gosbell, K., and M. Christie. 2005. Wader Surveys in the Coorong & S.E. Coastal Lakes, February 2005. Unpublished report, Australasian Wader Study Group.

*** - possible population declines

APPENDIX H. REVIEW OF SPECIES RANGE BOUNDARIES & PREFERENCES OF AUSTRALIA'S MIGRANT SHOREBIRDS.

Common_name	Significant #s *	extreme range boundary	general range boundary	fidelity	Coastal	Ephemeral	Flocking	Assn with wetland	Assn with Grassland	PM Counts
Asian Dowitcher	NO	insufficient data	most records NW Australia	High	High	Low	High	High	Low	High
Australian Pratincole	NO	south of 35 degrees	south of 30 degrees Latitude	Low	High	High	Mod	Mod	High	Low
Bar-tailed Godwit	YES	Tasmania	Tasmania, southern Victoria	High	High	Low	High	High	Low	High
Black-tailed Godwit	YES	southern Victoria	south of 30 degrees Latitude	High	High	Low	High	High	Low	High
Broad-billed Sandpiper	NO	south of 20 degrees latitude	south of 20 degrees latitude	High	High	Low	High	High	Low	High
Common Greenshank	YES	Tasmania	Tasmania, southern Victoria	Low	Mod	High	Mod	High	Low	Mod
Common Redshank	NO	insufficient data	south of 20 degrees latitude	High	High	Low	High	High	Low	High
Common Sandpiper	NO	Tasmania, southern Victoria	south of 35 degrees latitude	High	Low	High	Mod	High	Low	Low
Curllew Sandpiper	YES	southern Tasmania	Tasmania, southern Victoria	High	High	Low	High	High	Low	High
Double-banded Plover	YES	west of 140 degrees longitude	W of 140, or N of 25 degrees	High	High	Low	High	High	Low	High
Eastern Curlew	YES	Tasmania	Tasmania, southern Victoria	High	High	Low	High	High	Low	High
Great Knot	YES	Tasmania	south of 30 degrees Latitude	High	High	Low	High	High	Low	High
Greater Sand Plover	YES	south of 27 degrees latitude	south of 27 degrees latitude	High	High	Low	High	High	Low	High
Grey Plover	YES	Tasmania, southern Victoria	south of 33 degrees Latitude	High	High	Low	High	High	Low	High
Grey-tailed Tattler	YES	Tasmania, southern Victoria	south of 32 degrees latitude	Moderate	High	Low	High	High	Low	High
Latham's Snipe	NO	southern Tasmania	Tasmania, southern Victoria	High	Low	High	Low	High	Mod	Low
Lesser Sand Plover	YES	Tasmania, southern Victoria	south of 30 degrees Latitude	Low	High	Low	High	High	Low	High
Little Curlew	NO	south of 30 degrees Latitude	south of 22 degrees Latitude	Low	Low	High	High	Mod	High	Low
Little Ringed Plover	NO	insufficient data	insufficient data	Low	Low	High	High	High	Low	Low
Long-toed Stint	NO	south of 30 degrees Latitude	south of 30 degrees Latitude	High	High	High	High	High	Low	Low
Marsh Sandpiper	NO	southern Victoria	south of 33 degrees Latitude	Low	Mod	High	Mod	High	Low	Mod
Oriental Plover	NO	south of 20 degrees latitude	south of 20 degrees latitude	Low	High	High	High	Mod	High	Low
Oriental Pratincole	NO	south of 20 degrees latitude	south of 20 degrees latitude	High	High	High	High	Mod	High	Low
Pacific Golden Plover	YES	Tasmania	Tasmania, southern Victoria	Low	High	Low	High	High	Mod	High
Pectoral Sandpiper	NO	insufficient data	south of 30 degrees Latitude	High	Low	High	Low	High	Mod	Low
Red Knot	YES	Tasmania	south of 30 degrees Latitude	Low	High	Low	High	High	Low	High
Red-necked Phalarope	NO	insufficient data	south of 30 degrees Latitude	Low	High	Low	High	High	Low	
Red-necked Stint	YES	southern Tasmania	Tasmania	High	High	Low	High	High	Low	High
Ruddy Turnstone	YES	southern Tasmania	Tasmania	High	High	Low	High	High	Low	Low
Ruff	NO	insufficient data	insufficient data	Low	Mod	Mod	Low	High	Mod	Low
Sanderling	YES	Tasmania	Tasmania, southern Victoria	High	High	Low	High	High	Low	Low
Sharp-tailed Sandpiper	YES	Tasmania	Tasmania, southern Victoria	Low	Mod	High	High	High	Mod	Low
Swinhoe's Snipe	NO	insufficient data	insufficient data	Moderate	Low	High	Low	High	Mod	Low
Terek Sandpiper	YES	south of 30 degrees Latitude	south of 30 degrees Latitude	High	High	Low	High	High	Low	High
Wandering Tattler	NO	insufficient data	south of 20 degrees latitude	Moderate	High	Low	Low	High	Low	Low
Whimbrel	YES	Tasmania, southern Victoria	south of 33 degrees Latitude	High	High	Low	High	High	Mod	High
Wood Sandpiper	NO	south of 30 degrees Latitude	south of 30 degrees latitude	Low	Low	High	Mod	High	Low	Low

* occur in significant numbers at known AWSG count sites in Australia, and therefore enough data is available for analysis

Site Fidelity – Codes are an assessment of a species' site fidelity Taken from Bamford et al. (*in prep*)

Coastal, Ephemeral, Flocking, Assn with wetland, Grassland - Codes refer to degree to which species use those habitats.

Taken from: Bamford et al. (2008)

PM Counts –Population Monitoring counts; Codes refer to the degree to which the Population Monitoring counts capture numbers of each species.