



Australian Government

Department of the Environment

# Draft Wildlife Conservation Plan for Migratory Shorebirds

**DRAFT**



---

August 2014

---

© Copyright Commonwealth of Australia, 2014.



The *Draft Wildlife Conservation Plan for Migratory Shorebirds* is licensed by the Commonwealth of Australia for use under a Creative Commons Attribution 3.0 Australia licence with the exception of the Coat of Arms of the Commonwealth of Australia, the logo of the agency responsible for publishing the report, content supplied by third parties, and any images depicting people. For licence conditions see: <http://creativecommons.org/licenses/by/3.0/au/>

This report should be attributed as '<insert name of report>, Commonwealth of Australia <insert year>'. The Commonwealth of Australia has made all reasonable efforts to identify content supplied by third parties using the following format '© Copyright, [name of third party] '.

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government or the Minister for the Environment.

While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Front cover: Latham's snipe feeding on Bribie Island (Graeme Chapman)  
Back cover: Sharp-tailed sandpiper (Brian Furby Collection)

# Table of Contents

<b>1</b>	Summary .....	3
<b>2</b>	Introduction .....	3
2.2	Review of the 2006 – 2011 Wildlife Conservation Plan .....	5
<b>3</b>	Species covered under the Wildlife Conservation Plan .....	6
<b>4</b>	Vision.....	6
<b>5</b>	Objectives .....	6
<b>6</b>	Legal Framework.....	6
6.1	Statutory commitments relevant to migratory birds .....	6
6.2	Other Australian commitments relevant to migratory shorebirds .....	8
<b>7</b>	Important habitat for migratory shorebirds in Australia.....	10
<b>8</b>	Threats .....	12
8.1	Habitat loss .....	12
8.2	Habitat modification.....	13
8.3	Anthropogenic disturbance .....	15
8.4	Climate variability and change .....	15
8.5	Harvesting of shorebird prey.....	15
8.6	Fisheries by-catch .....	16
8.7	Hunting .....	16
8.8	Threat prioritisation.....	17
<b>9</b>	Actions to achieve the Specific Objectives .....	20
<b>10</b>	Affected interests.....	24
<b>11</b>	Organisations/persons involved in evaluating the performance of the Plan.....	24
<b>12</b>	Major benefits to other migratory species, marine species, species of cetacean or conservation dependent species .....	25
<b>13</b>	References .....	26
<b>14</b>	Appendix A.....	29

# 1 Summary

Migratory species which visit Australia such as shorebirds and seabirds received national protection as a matter of national environmental significance when the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) took effect in July 2000. Under the EPBC Act, wildlife conservation plans may be prepared for the purposes of protection, conservation and management of listed migratory, marine, cetacean or conservation dependant species.

This Wildlife Conservation Plan for Migratory Shorebirds provides a framework to guide conservation of migratory shorebirds and their habitat in Australia, and in recognition of their migratory habits, outlines national activities to support their appreciation and conservation throughout the East Asian-Australasian Flyway. The previous Wildlife Conservation Plan for Migratory Shorebirds came into effect in February 2006, and was the first wildlife conservation plan developed under the EPBC Act.

A review of the previous wildlife conservation plan recommended that Little Ringed Plover (*Charadrius dubius*) should be added to the revised list of species covered by the plan based on expert opinion and new information. This species is a known regular visitor to northern Australia in small numbers (Geering et al. 2007). This revised plan contains clarification of statutory elements of the EPBC Act by addressing topics relevant to the conservation of migratory shorebirds, including a summary of Australia's commitments under international conventions and agreements, and identification of important habitat. It outlines national actions to support flyway shorebird conservation, and should be used to ensure these activities are integrated and remain focused on the long-term survival of migratory shorebird populations and their habitats.

The Wildlife Conservation Plan for Migratory Shorebirds will remain in place until such time that the shorebird populations that visit Australia have improved to the point where they do not need research or management actions to support their survival. This Plan will be in place for 10 years and must be reviewed every five years. It is available for download from the Department's website at: <http://www.environment.gov.au/resource/wildlife-conservation-plan-migratory-shorebirds>

## 2 Introduction

Most migratory shorebirds make an annual return journey of many thousands of kilometres between breeding grounds in the northern hemisphere and their non-breeding grounds in the southern hemisphere. The East Asian-Australasian Flyway (the flyway) stretches from breeding grounds in the Russian tundra, Mongolia and Alaska southwards through east and south-east Asia, to non-breeding areas in Indonesia, Papua New Guinea, Australia and New Zealand. One species, the Double-banded Plover (*Charadrius bicinctus*), breeds in New Zealand and migrates to eastern Australia.



**Figure 1.** East Asian – Australasian Flyway

Thirty-seven species of migratory shorebird regularly and predictably visit Australia during their non-breeding season, from the Austral spring to autumn. Australia's coastal and freshwater wetlands are important habitat for these migratory shorebirds during the non-breeding season as places to rest and feed, building energy reserves to travel the long distance (up to 13 000 kilometres) back to their breeding grounds. In the month or two before migrating, migratory shorebirds need to increase their bodyweight by up to 70 per cent to sustain their journey.

Flocks that migrate from the northern hemisphere reach 'staging areas' such as Roebuck Bay and Eighty-mile Beach in north-western Western Australia by September. From these staging areas birds disperse across Australia, reaching the south-eastern states by October. Smaller flocks – cumulatively numbering thousands of birds – take advantage of ephemeral wetlands across inland Australia while the others spread over the western, northern and eastern coastlines. Migratory shorebirds are often gregarious, gathering in mixed flocks, but they also occur in single-species flocks or feed and roost with resident shorebird species such as stilts, avocets, oystercatchers and plovers. The picture is further complicated because flocks or individuals of some migratory species remain in Australia during the winter months, for example, first-year birds that lack the experience or physical condition to return to their natal sites but often do so in their second year. By March the birds that have dispersed across the country have begun to gather at staging areas, once again forming large flocks and feeding virtually round the clock to build up energy reserves for their northward migration.

The ecology of migratory shorebirds is complex, especially in Australia where investigations are continuing to unravel patterns of movement, roosting and dispersal behaviour through targeted research programs. To be effective, shorebird conservation and management initiatives in Australia must take into account the unique distribution and ecology of shorebirds, and the critical importance of international migratory pathways and staging areas, particularly the Yellow Sea region (MacKinnon et al. 2012; Iwamura et al. 2013; Murray et al. 2014).

As migratory shorebird populations decline there is a growing need to minimise threats to remaining habitats which are important for their ongoing survival (MacKinnon et al. 2012). This need is occurring in the face of ever increasing human development and loss of habitat. Efforts to conserve migratory shorebirds in one country can only be effective with cooperation and complementary actions in all countries that shorebirds visit. Australia is therefore well positioned to lead conservation and research action for migratory shorebirds in the Flyway that would otherwise be difficult. As migratory shorebird populations in Australia remain stable for about three months of the year (December – February), Australia plays an important role in monitoring population changes in species that regularly visit here.

Monitoring and research projects undertaken by governments, academic institutions and conservation groups in Australia and other parts of the flyway continue to indicate declining migratory shorebird populations, largely attributed to ongoing loss of critical intertidal habitat in east Asia (MacKinnon et al. 2012; Murray et al. 2014). For the migratory shorebird populations that visit Australia to have a reasonable chance of survival through this century, increased levels of habitat protection are needed across the flyway.

## 2.2 Review of the 2006 – 2011 Wildlife Conservation Plan

After reviewing progress made with the conservation of Australia's migratory shorebirds since 2006, some fundamental problems with the previous wildlife conservation plan were identified. Specifically, only moderate progress was made against the objectives and actions in the wildlife conservation plan. Of the 31 actions listed, four were completed comprehensively. While progress was made on a further 20 actions, these were mostly considered to be on-going. Little or no progress was made on the remaining seven actions. In a holistic sense the wildlife conservation plan failed to meet its objectives, because it had apparently not reduced the rate of decline of any of the listed species nor did it have any measurable influence on the known core impacts in East Asia.

The review recommended that given the contemporary and likely future threats to migratory shorebirds in Australia and the East Asian – Australasian Flyway, there was a need to retain a wildlife conservation plan for the 36 listed species to maintain a national framework identifying research and management actions. Little Ringed Plover (*Charadrius dubius*) should be considered as an addition to the revised Appendix A based on expert opinion and new information. This species is a known regular visitor to northern Australia in small numbers (Geering et al. 2007). The review further recommended that the wildlife conservation plan should be updated to remove the completed actions and include new, focused conservation priorities. The revised wildlife conservation plan builds upon the previous plan's achievements and was made in consultation with representatives from the Australian, state and territory governments, NGOs, industry and research agencies. The new plan should provide for the research and management actions necessary to support the survival of the listed migratory shorebirds.

### 3 Species covered under the Wildlife Conservation Plan

This Wildlife Conservation Plan includes 37 species of migratory shorebird that regularly visit Australia (Appendix A). Little Ringed Plover has been added to the revised list based on expert opinion and new information. This species is a regular visitor to northern Australia in small numbers (Geering et al. 2007). The plan will cease to apply to any of these species should they become a listed threatened species under the EPBC Act.

If an additional migratory shorebird species that is currently considered to be vagrant was to be recorded on a regular basis, monitoring programs for the species should be supported to determine whether inclusion under the plan is appropriate.

### 4 Vision

Ecologically sustainable populations of migratory shorebirds remain distributed across their range and diversity of habitats in Australia, and throughout the East Asian-Australasian Flyway.

### 5 Objectives

1. Protection of important habitat for migratory shorebirds has occurred throughout the flyway.
2. Wetland habitat in Australia, on which migratory shorebirds depend, is protected and conserved.
3. Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.
4. Knowledge gaps in migratory shorebird ecology in Australia are identified and addressed to inform decision makers, land managers and the public.

### 6 Legal Framework

#### 6.1 Statutory commitments relevant to migratory birds

The EPBC Act is the Australian Government's key piece of environmental legislation. Under the Act approval is required for any proposed action, including projects, developments, activities, or alteration of these things, likely to have a significant impact on any of the identified matters of national environmental significance. One of these matters specifically protected by the Act is migratory species; specifically those migratory species listed under

the *Convention on Conservation of Migratory Species of Wild Animals* (also known as the CMS or the Bonn Convention; <http://www.cms.int/> ) and bilateral migratory bird agreements with Japan (JAMBA), China (CAMBA), and Republic of Korea (ROKAMBA).

Australia's list of migratory species is established under Section 209 of the EPBC Act and must include:

*“(a) all migratory species that are:*

*(i) native species; and*

*(ii) from time to time included in the appendices to the Bonn Convention; and*

*(b) all migratory species from time to time included in annexes established under JAMBA and CAMBA; and*

*(c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister under subsection (4). [Which includes ROKAMBA]*

*The list must not include any other species.”*

The migratory species list formed under the EPBC Act is available at: <http://www.environment.gov.au/topics/biodiversity/migratory-species> .

Section 211(A to E) of the EPBC Act prohibits the killing, injuring, taking, trading, keeping or moving of any migratory species in or on a Commonwealth area, although certain exemptions are allowed for in Section 212. For places outside of Commonwealth areas, the EPBC Act prevents actions (Section 140) or approvals under Strategic Assessments (Section 146L) being inconsistent with Australia's migratory species' obligations under the Bonn Convention or JAMBA, CAMBA or ROKAMBA.

Under the Bonn Convention, species are listed on Appendix I or Appendix II (or both), with Appendix I species recognised as endangered. Appendix II species are those which have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those which would significantly benefit from the international cooperation that could be achieved by an international agreement. All of Australia's migratory shorebird species are listed on Appendix II, and Eastern Curlew (*Numenius madagascariensis*) is also listed on Appendix I. Endangered migratory species included in Appendix I, in addition to enjoying strict legal protection by Parties, can benefit from the development of Concerted Actions. These range from field research and conservation projects to the establishment of technical and institutional frameworks for action. International Single Species Action Plans are an important instrument to promote and coordinate activities that seek to protect and restore habitat, mitigating obstacles to migration and other controlling factors that might endanger species.

Parties to the convention that are Range States of a migratory species commit to prohibiting the taking of animals listed in Appendix I, and endeavour:

- to conserve and, where feasible and appropriate, restore those habitats of the species which are of importance in removing the species from danger of extinction;



- to prevent, remove, compensate for or minimize, as appropriate, the adverse effects of activities or obstacles that seriously impede or prevent the migration of the species; and
- to the extent feasible and appropriate, prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species.

Signatories to JAMBA, CAMBA and ROKAMBA are committed to taking appropriate measures to preserve and enhance the environment of migratory birds, in particular, by seeking means to prevent damage to such birds and their environment. These agreements also commit the governments to exchange research data and publications, to encourage formulation of joint research programs, and to encourage the conservation of migratory birds.

Australia's obligations under the Bonn Convention and JAMBA, CAMBA and ROKAMBA amount to ensuring adverse effects on listed migratory species and their habitats in Australia do not occur. The EPBC Act seeks to prevent such adverse impacts by imposing civil penalties (Section 20) to persons who take actions that have, or are likely to have, a significant impact on a listed migratory species. *EPBC Act Policy Statement 3.21 – Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* provides assistance in determining the likelihood of a significant impact on migratory shorebirds.

This wildlife conservation plan gives clarification to the concept of 'important habitat' in relation to migratory shorebirds (Section 9). It also identifies other actions to assist Australia's commitments under both the Bonn Convention and the bilateral migratory bird agreements.

## 6.2 Other Australian commitments relevant to migratory shorebirds

While the Bonn Convention, JAMBA, CAMBA and ROKAMBA provide mechanisms for pursuing conservation outcomes for migratory birds, they encompass all migratory birds and are binding only on a limited number of countries. As Australia became increasingly concerned about the conservation status of migratory waterbirds, additional mechanisms have been developed for multilateral cooperation on waterbird conservation throughout the flyway.

### *Ramsar Convention on Wetlands*

Australia is a signatory to the *Convention on Wetlands of International Importance* (see <http://www.ramsar.org>). The Ramsar Convention, as it is commonly known, is an intergovernmental treaty dedicated to the conservation and 'wise use' of wetlands.

The Ramsar Convention focuses on conservation of important habitats rather than species. Parties are committed to identifying wetlands that qualify as internationally significant against a set of criteria, to nominating these wetlands to the List of Wetlands of International Importance (the Ramsar List) and to ensuring the maintenance of the ecological character of each listed Ramsar site.

As at August 2014, Australia has 65 Wetlands of International Importance that cover a total of approximately 8.1 million hectares. Many of Australia's Ramsar sites were nominated and listed using waterbird-based criteria, and in some of these cases migratory shorebirds are a major component of the waterbird numbers (e.g. Roebuck Bay and Eighty-mile Beach Ramsar Sites in Western Australia).

#### *East Asian – Australasian Flyway Partnership*

The Partnership for the Conservation of Migratory Waterbirds and the Sustainable Use of their Habitats in the East Asian–Australasian Flyway (East Asian – Australasian Flyway Partnership) was launched on 6 November 2006. A Ramsar regional initiative, the Partnership is an informal and voluntary collaboration of effort focusing on protecting migratory waterbirds, their habitat and the livelihoods of people dependant on them. The flyway is one of nine major migratory waterbird flyways around the globe. It extends from within the Arctic Circle in Russia and Alaska, southwards through East and South-east Asia, to Australia and New Zealand in the south, encompassing 22 countries. Migratory waterbirds share this flyway with 45 per cent of the world's human population. The flyway is home to over 50 million migratory waterbirds - including shorebirds, Anatidae (ducks, geese and swans), seabirds and cranes - from over 250 different populations, including 28 globally threatened species. Flyway partners include countries, intergovernmental agencies, international non-government organisations and the international business sector. A cornerstone of the partnership is establishment of a network of internationally important sites for waterbirds throughout the flyway. The Partnership operates via working groups and task forces; one working group and a number of task forces focus on migratory shorebirds. More information about the Partnership is available online at: <http://www.eaaflyway.net/> .

## 7 Important habitat for migratory shorebirds in Australia

Under the EPBC Act, 'important habitat' is a key concept for migratory species, as identified in *EPBC Act Policy Statement 1.1 Significant Impact Guidelines - Matters of National Environmental Significance 2009*. Defining this term for migratory shorebirds in Australia is important to ensure that habitat necessary for the ongoing survival of the 37 species is appropriately managed.

Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important (see below). The widely accepted and applied approach to identifying internationally important shorebird habitat throughout the world has been through the use of criteria adopted under the Ramsar Convention on Wetlands. Further assistance in identifying important habitats and survey guidelines for migratory shorebirds is available in *EPBC Act Policy Statement 3.21 – Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*.

According to this approach, wetland habitat should be considered internationally important if it regularly supports:

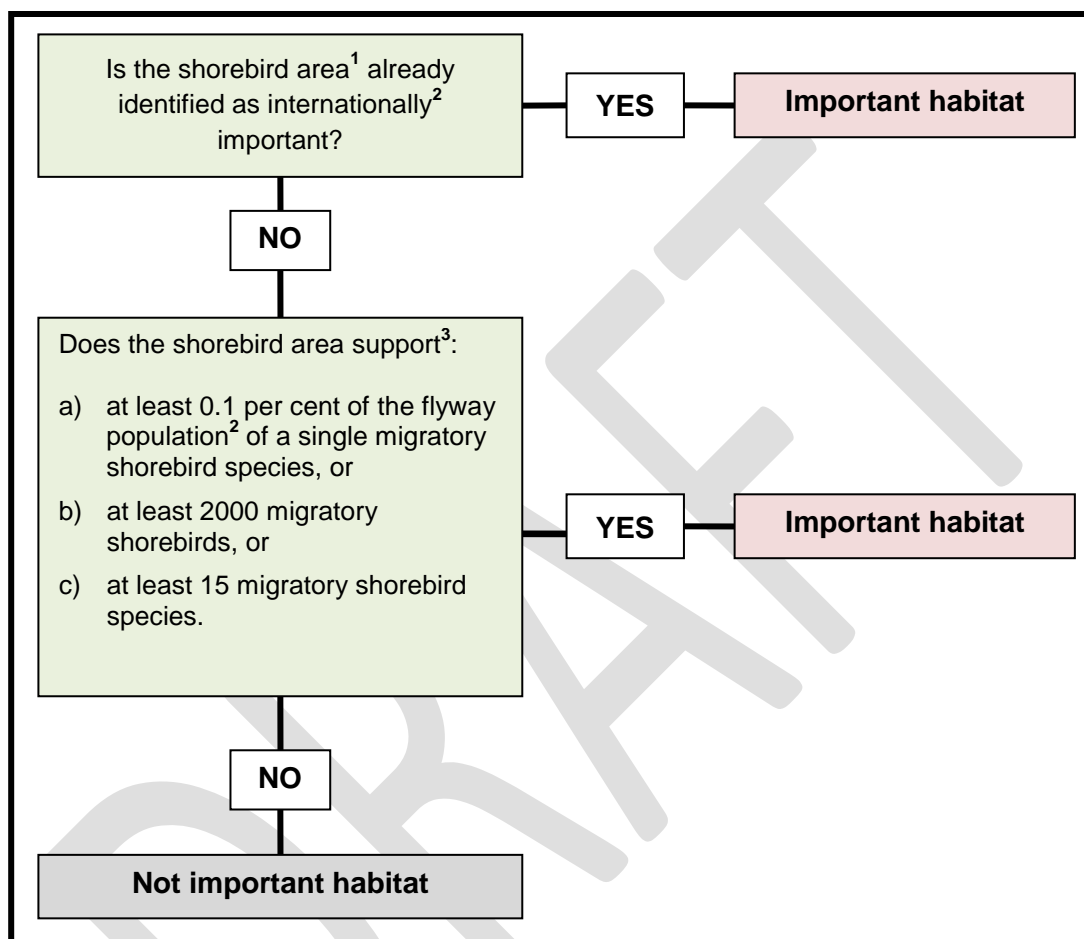
- 1 per cent of the individuals in a population of one species or subspecies of waterbird or
- a total abundance of at least 20 000 waterbirds.

Nationally important habitat for migratory shorebirds can be defined using a similar approach to these international criteria, i.e. if it regularly supports:

- 0.1 per cent of the flyway population of a single species of migratory shorebird or
- 2000 migratory shorebirds or
- 15 migratory shorebird species.

Figure 2 illustrates the process for identifying important habitat for migratory shorebirds under the EPBC Act. This process applies to each of the migratory shorebird species with the exception of Latham's Snipe (*Gallinago hardwickii*) which is treated differently, reflecting its cryptic lifestyle.

**Figure 2.** Process for identifying important habitat for migratory shorebirds (excluding Latham's snipe)



1. Following Clemens *et al.* (2010) a shorebird area is defined as: *the geographic area that has been used by the same group of shorebirds over the main non-breeding period*. This is effectively the home range of the local population when present. Shorebird areas may include multiple roosting and feeding habitats. While most migratory shorebird areas will represent contiguous habitat, non-contiguous habitats may be included as part of the same area where there is evidence of regular bird movement between them. Migratory shorebird areas may therefore extend beyond the boundaries of a property or project area, and may also extend beyond Ramsar boundaries for internationally important areas. Existing information and/or appropriate surveys can determine the extent of a migratory shorebird area.
2. A list of internationally important areas, current at 2008, is available at: [www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html](http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html)
3. 'Support' is defined differently depending on whether the habitat is considered permanent or ephemeral.
  - For permanent wetlands, 'support' is defined as: *migratory shorebirds are recorded during surveys and/or known to have occurred within the area during the previous five years*.
  - For ephemeral wetlands, 'support' is defined as: *habitat that migratory shorebirds have ever been recorded in, and where that habitat has not been lost permanently due to previous actions*.

Another issue regarding important habitat is the degree of importance of habitat components within complexes or areas. For example, a large area may be considered internationally or nationally important, but within that area there may be particular habitats that are more valuable than others, such as those used most regularly for roosting and feeding. In promoting the wise use of wetlands it may be pertinent to strongly protect such habitat from development and recreational activities that may disturb shorebirds, but consider allowing these activities within parts of the broader area.

### **Latham's Snipe (*Gallinago hardwickii*)**

Latham's Snipe does not commonly aggregate in large flocks or use the same habitats as other migratory shorebird species. Consequently, habitat important to Latham's Snipe is not regularly identified using the process outlined in Figure 2 and different criteria are therefore necessary. Threshold criteria are still considered the best way to identify important sites in the absence of data sufficient for more rigorous methods. For the purposes of this plan, important habitat for Latham's Snipe is described as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species. Definitions for shorebird 'area' and 'support' are as above.

## **8 Threats**

In a global review, Sutherland et al. (2012) identify 45 threats facing shorebird populations that can be divided into three categories: natural, current anthropogenic and future issues. The natural issues include volcanoes and cyclones, while current anthropogenic threats encompass climate change, abandonment of rice fields and human disturbance (Sutherland et al. 2012). Likely future issues that could affect shorebird population include microplastics, global hydro-security and changes in sedimentation rates (Sutherland et al. 2012). The review conducted by Sutherland et al. demonstrates the breadth of issues facing shorebirds, ranging from unlikely to highly catastrophic events causing species extinction.

In Australia and the East Asian – Australasian Flyway, many of the current threats are linked to the changing availability of wintering, stop-over and breeding habitat (MacKinnon et al. 2012). The loss of key locations at any point on the migratory pathway will have significant consequences to a number of species. Key threats to the migration and survival of Australian migratory shorebirds are identified in this section. The list is not by means exhaustive but identifies the main threats that are likely to significantly affect shorebird populations.

### **8.1 Habitat loss**

#### *Infrastructure / coastal development in Australia*

Habitat loss occurring as a result of development is the most significant threat currently affecting Australian migratory shorebirds, both in Australia and along the East Asian–Australasian Flyway. It is estimated that since European settlement approximately 50 per cent of Australia's non-tidal wetlands have been converted to other uses. In some regions

the rate of loss has been even higher. For example, on the Swan Coastal Plain of Western Australia 75 per cent of wetlands have been filled or drained and in south-east South Australia 89 per cent have been lost. Urban development in Australia has often involved draining and filling of wetlands for industrial, commercial, and waste disposal (Lee et al. 2006). Many watercourses in urban areas have been converted to concrete-lined drains resulting in loss of in-stream habitat, fringing wetlands and streamside vegetation.

In Australia, due to the nature of the environment and the distribution of the human population, losses of this type have been concentrated in estuaries and in the permanent wetlands of the coastal lowlands of the southern part of the continent (Lee et al. 2006). Agricultural development and infrastructure has been attributed to the substantial loss of wetlands on the floodplains of inland and coastal rivers. Drainage and conversion of wetlands for agricultural activities has been a major cause of wetland loss worldwide.

*Infrastructure /coastal development in staging and stop-over areas, particularly the Yellow Sea*

Of particular concern in the East Asian-Australasian Flyway is coastal development and intertidal mudflat 'reclamation' in the Yellow Sea region, which is bordered by China, the Democratic People's Republic of Korea and the Republic of Korea (Murray et al. 2014). A migratory shorebirds' ability to complete long migration flights depends on the availability of suitable habitat at sites across the flyway that provide adequate food and roosting opportunities to build sufficient energy reserves. The Yellow Sea region is a major staging area for several species of shorebird, including significant populations of Great Knot (*Calidris tenuirostris*), which fly between Australia and the east coast of Asia on migration (Bamford et al. 2008). In a recent study using historical topographical maps, remote sensing and geographical information system (GIS) analysis, Murray et al. (2014) suggest that up to two-thirds (65 per cent) of the tidal flats existing in the Yellow Sea in the 1950s have been lost to development. Losses of such magnitude are likely the key drivers of declines in biodiversity and ecosystem services in the intertidal zone of the region (MacKinnon et al. 2012). Further reclamation projects are taking place or are in the planning stage in the Yellow Sea region.

## 8.2 Habitat modification

Modification of wetland habitat can arise from a range of different activities including, fishing or aquaculture, forestry and agricultural practices, mining, changes to hydrology and development near wetlands for housing or industry (Lee et al. 2006; Sutherland et al. 2012). Such activities may result in increased siltation, pollution and weed and pest invasion, all of which can change the ecological character of a shorebird area, potentially leading to deterioration of the quantity and quality of food and other resources available to support migratory shorebirds (Sutherland et al. 2012 and references therein). The notion that migratory shorebirds can continue indefinitely to move to other important habitat as their normal feeding, staging or roosting areas become unusable is erroneous. As areas become unsuitable to support migratory shorebirds, remaining habitat will attract more birds, in turn creating overcrowding, competition for food and depletion of food resources, and increased risk of disease transmission.

### *Chronic pollution*

Shorebird habitat is threatened by chronic accumulation and concentration of pollutants. Chronic pollution may arise from both local and widespread sources. Migratory shorebirds may be exposed to chronic pollution and high nutrient loads both during their time in Australia and along their migration route, although the extent and implications of this exposure remains largely unknown. In their feeding areas, shorebirds are most at risk from bioaccumulation of human-made chemicals such as organochlorines from herbicides and pesticides and industrial waste. Agricultural, residential and catchment run-off carries excess nutrients, heavy metals, sediments and other pollutants into waterways and eventually wetlands.

### *Acute pollution*

Wetlands and intertidal habitats are threatened by acute pollution caused by, for example, oil or chemical spillage. Acute pollution generally arises from accidents, such as chemical spills from shipping, road or industrial accidents. Generally migratory shorebirds are not directly affected by oil spills, but important habitat may be impacted for many years through catastrophic loss of marine benthic food sources.

### *Invasive species*

Introduced plant species such as Water Hyacinth (*Eichhornia crassipes*), *Ludwigia peruviana*, *Salvinia* sp. and *Mimosa pigra* have adversely affected the ecological character and biodiversity of wetlands across Australia; introduced animals such as pigs (*Sus* sp.), Cane Toads (*Rhinella marina*) and European Carp (*Cyprinus carpio*) are also well known for their destructive impacts on wetland areas. There is also a constant risk of new introductions of exotic pasture, aquarium and garden species, and exotic marine pests from ballast water and hull transport. Of specific concern for migratory shorebirds is the introduction of exotic marine pests resulting in loss of benthic food sources at important intertidal habitat (Neira et al. 2006). Predation by invasive animals, such as cats and foxes in Australia has not been quantified but anecdotal evidence suggests some individuals are taken as prey.

Outside Australia invasive species are negatively affecting coastal habitat, causing local species to be displaced by species accidentally or deliberately introduced from other areas. With increase in global shipping trade the influx of such species is increasing, especially in the coastal zone. Examples include *Spartina* grass in China, Zebra Mussels (*Dreissena polymorpha*), and Tilapia (*Tilapia* spp.) in wetlands and estuaries and along coasts (MacKinnon et al. 2012).

### *Altered hydrological regimes*

Altered hydrological regimes can directly and indirectly threaten migratory shorebird habitat. Water regulation, including extraction of surface and ground water (for example, diversions upstream for consumptive or agricultural use), can lead to significant changes to flow regime, water depth and water temperature. Changes to flows can lead to permanent inundation or drying down of connected wetlands, and changes to the timing, frequency and duration of floods. These changes impact both habitat availability and type (for example, loss of access to mudflats through permanent higher water levels, or a shift from freshwater to

salt-tolerant vegetation communities), as well as disruption of lifecycles of plants and animals in the food chain for migratory shorebirds.

Reduced recharge of local groundwater that occurs when floodplains are inundated can change the vegetation that occurs at wetland sites, again impacting habitat and food sources.

Water regulation can alter the chemical make-up of wetlands. For example, reduced flushing flows can cause salt water intrusion or create hyper-saline conditions. Permanent inundation behind locks and weirs can cause freshwater flooding of formerly saline wetlands, as well as pushing salt to the surface through rising groundwater.

### 8.3 Anthropogenic disturbance

Research suggests that disturbance has a high energetic cost to shorebirds and may compromise their capacity to build sufficient energy reserves to undertake migration (Goss-Custard et al. 2006; Weston et al. 2012). Disturbance is greatest where increasing human population and development pressure may have an impact on important habitat. Migratory shorebirds are most susceptible to disturbance during daytime roosting and foraging periods. As an example, disturbance of migratory shorebirds in Australia is known to result from aircraft, industrial operations and construction, and recreational activities such as fishing, off-road driving on beaches, unleashed dogs and jet-skiing (Weston et al. 2012).

### 8.4 Climate variability and change

There is strong scientific evidence that anthropogenic greenhouse gas emissions are causing changes to the world's climate. As such, '*Loss of habitat caused by anthropogenic emissions of greenhouse gases*' has been declared a Key Threatening Process under the EPBC Act. Such changes have the potential to impact on migratory shorebirds and their habitats by reducing the extent of coastal and inland wetlands or through a poleward shift in the range of many species (Chambers et al. 2005; Iwamura et al. 2013). Climate change projections for Australia suggest likely increased temperatures, rising sea levels and an overall drying trend for much of the continent together with more frequent and/or intense extreme climate events resulting in likely species loss and habitat degradation (Chambers et al. 2005).

### 8.5 Harvesting of shorebird prey

Overharvesting of intertidal resources, including fish, molluscs, annelids, sea-cucumber, sea-urchins and seaweeds can lead to decreased productivity and changes in prey distribution and availability (MacKinnon et al 2012). The recent industrialisation of harvesting methods in China has resulted in greater harvests of intertidal flora and fauna with less manual labour required, which is impacting ecosystem processes throughout the intertidal zone (MacKinnon et al. 2012). In many important shorebirds areas, the intertidal zone is a



maze of fishing platforms, traps and nets that not only add to overfishing, but prevent access to shorebird feeding areas from human disturbance.

## 8.6 Fisheries by-catch

Competition for food by human fishers together with associated disturbance by humans and boats has continued to put pressure on waterbirds along the East Asian – Australasian Flyway (MacKinnon et al. 2012). Fishing nets, set for shrimp or fish species, accidentally kill shorebirds if left on intertidal flats at low tide. Birds caught in the nets drown when the tide rises. The significance of this threat is not quantified and requires further investigation.

## 8.7 Hunting

Hunting of migratory shorebirds in Australia has been prohibited for a number of decades. It is unclear if illegal hunting occurs during the annual duck hunting season in certain states. Historically, Latham's Snipe was particularly vulnerable to hunting. The species was formerly hunted, legally, in all states in eastern Australia. It has been estimated that up to 10 000 birds (including 6000 birds in Victoria and 1000 birds in Tasmania) were killed annually by hunters before bans on shooting were introduced in 1976 (in New South Wales), 1983 (in Tasmania) and 1984 (in Victoria). Shooting is also banned in Queensland and South Australia, but the dates at which bans were introduced are unknown (Naarding 1981, 1983, 1985, 1986). Eastern Curlews were also shot for food in Tasmania (Marchant & Higgins 1993) and have been hunted intensively on breeding grounds and at stopover points while on migration (Marchant & Higgins 1993).

There have been a number of investigations into hunting activity at international sites, including in the Chang Jiang Estuary, China (Tang & Wang 1991, 1992, 1995; Barter et al. 1997; Ma et al. 1998). Tang and Wang (1992) estimated that approximately 30 000 and 9 000 shorebirds were captured with clap nets in the 1991 and 1992 northward migrations respectively. They suggested that the decrease between the two years was due to declining hunter numbers, increasing incomes from alternative activities and/or reduction in shorebird habitat due to reclamation. However, a study during the 1996 northward migration showed that hunter numbers had not declined since 1991 and that the number of shorebirds caught was similar (Barter et al. 1997). Studies during the 2000-2001 period indicate that hunting activity had declined at Chongming Dao, China (Ma et al. 2002).

Wang et al. (1991, 1992) reported hunting activity in the Yellow River Delta, estimating that 18 000 - 20 000 shorebirds were caught with clap nets during northward migration in 1992 and probably a higher number during southward migration in 1991. However, no hunting was observed in the Delta during surveys in the 1997, 1998 and 1999 northward migrations (Barter 2002). With the exception of the Chang Jiang Estuary, no hunting activity has been detected in China during recent shorebird surveys that covered about one-third of Chinese intertidal areas between 1996 and 2001 (Barter 2002). Hunting also appears to be declining in South Korea, with the only reported instance being minor hunting activity in Mangyeong Gang Hagu (Barter 2002).

## 8.8 Threat prioritisation

Each of the threats outlined above has been assessed to determine the risk posed to migratory shorebird populations using a risk matrix. This in turn determines the priority for actions outlined in Section 9. The risk matrix considers the likelihood of an incident occurring and the consequences of that incident. Threats may act differently on different species and populations at different times of year, but the precautionary principle dictates that the threat category is determined by the group at highest risk. Population-wide threats are generally considered to present a higher risk.

The risk matrix uses a qualitative assessment drawing on peer reviewed literature and expert opinion. In some cases the consequences of activities are unknown. In these cases, the precautionary principle has been applied. Levels of risk and the associated priority for action are defined as follows:

Very High - immediate mitigation action required

High - mitigation action and an adaptive management plan required, the precautionary principle should be applied

Moderate – obtain additional information and develop mitigation action if required

Low – monitor the threat occurrence and reassess threat level if likelihood or consequences change

**Figure 3.** Risk Prioritisation

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Moderate	Very High	Very High	Very High
Likely	Low	Moderate	High	Very High	Very High
Possible	Low	Moderate	High	Very High	Very High
Unlikely	Low	Low	Moderate	High	Very High
Rare or Unknown	Low	Low	Moderate	High	Very High

**Categories for likelihood are defined as follows:**

Almost certain – expected to occur every year

Likely – expected to occur at least once every five years

Possible – might occur at some time

Unlikely – such events are known to have occurred on a worldwide basis but only a few times

Rare or Unknown – may occur only in exceptional circumstances; OR it is currently unknown how often the incident will occur

**Categories for consequences are defined as follows:**

Not significant – no long-term effect on individuals or populations

Minor – individuals are affected but no affect at population level

Moderate – population recovery stalls or reduces

Major – population declines

Catastrophic – population extinction

**Figure 4.** Migratory Shorebird Population Residual Risk Matrix

Likelihood of occurrence	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain		<ul style="list-style-type: none"> <li>Harvesting of shorebird prey</li> </ul>	<ul style="list-style-type: none"> <li>Coastal development in Australia</li> </ul>	<ul style="list-style-type: none"> <li>Coastal development, particularly in the Yellow Sea</li> </ul>	
Likely		<ul style="list-style-type: none"> <li>Hunting*</li> <li>Fisheries by-catch*</li> </ul>	<ul style="list-style-type: none"> <li>Anthropogenic disturbance</li> <li>Altered hydrological regimes</li> <li>Invasive species</li> </ul>	<ul style="list-style-type: none"> <li>Climate variability and change</li> </ul>	
Possible		<ul style="list-style-type: none"> <li>Chronic pollution</li> </ul>			
Unlikely					
Rare or Unknown			<ul style="list-style-type: none"> <li>Acute pollution</li> </ul>		

\* threat occurs mostly outside Australia.

## 9 Actions to achieve the Specific Objectives

Actions identified for the protection, conservation and management of the species covered by this plan are described below. Some of the objectives are long-term and may not be fully achieved during the lifetime of this wildlife conservation plan. <sup>1</sup> Lead organisations are identified in bold type.

**Objective 1:** *Protection of important habitat for migratory shorebirds has occurred throughout the flyway.*

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies <sup>1</sup> and potential partners
1a	Maintain, and where possible, improve existing international obligations that concern migratory shorebird conservation.	High	Continue or improve existing international obligations to minimise threats.	Coastal development, particularly in the Yellow Sea  Climate variability and change  Altered hydrological regimes	<b>Australian Government</b>
1b	Seek the support of the Chinese and South Korean Governments to protect remaining tidal flats in the Yellow Sea.	High	Undertake negotiations with the Chinese and South Korean Governments through multilateral environmental agreements and biennial migratory bird consultative meetings.	Coastal development, particularly in the Yellow Sea  Altered hydrological regimes  Invasive species	<b>Australian Government</b>  East Asian – Australasian Flyway Partnership
1c	Support the development of a single species action plan for Eastern Curlew through the Convention on Migratory Species.	High	An Eastern Curlew task force is formed and a single species action plan developed by 2017.	Coastal development, particularly in the Yellow Sea  Coastal development in Australia  Anthropogenic disturbance  Invasive species  Hunting	<b>Australian Government</b>
1d	Make available via the EAAFP website, Australian Government standards and case studies for assessing development proposals that may impact on important migratory shorebird habitats.	Medium	Development assessment standards relevant to important migratory shorebird habitat are discussed and considered by national governments across the flyway.	Coastal development, particularly in the Yellow Sea	<b>Australian Government</b>  East Asian – Australasian Flyway Partnership
1e	Support the East Asian – Australasian Flyway Partnership Implementation Strategy.	Medium	Progress with Implementation Strategy objectives can be demonstrated by 2016.	Coastal development, particularly in the Yellow Sea	<b>Australian Government</b>

**Objective 2:** Wetland habitat in Australia, on which migratory shorebirds depend, is protected and conserved.

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies <sup>1</sup> and potential partners
2a	Identify key areas for shorebird species and improve legal site protection and management using international, national and state mechanisms.	High	An increased number of important sites for migratory shorebirds in Australia are formally recognised as new protected areas by 2020.	Coastal development in Australia Climate variability and change Harvesting of shorebird prey Anthropogenic disturbance	<b>Australian Government</b> <b>State and Territory governments</b> Relevant NGOs
2b	Update a directory of important habitat for migratory shorebirds.	High	A review of internationally and nationally important habitat is completed and published by 2018.	Coastal development in Australia Altered hydrological regimes Anthropogenic disturbance	<b>Australian Government</b> <b>State and territory governments</b> <b>Relevant NGOs</b>

**Objective 3:** Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies <sup>1</sup> and potential partners
3a	Develop and implement a community education and awareness program to reduce the effects of recreational disturbance on migratory shorebirds.	High	Community education programs and initiatives implemented, particularly in communities where disturbance is high and where highest risk species exist.	Anthropogenic disturbance	<b>Australian Government</b> <b>State and territory governments</b> <b>Relevant NGOs</b>
3b	Investigate the impacts of climate change on migratory shorebird habitat and populations in Australia.	High	An improved understanding of the effects of climate change on migratory shorebirds can be demonstrated.	Climate variability and change	<b>Academic institutions</b> Australian Government
3c	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia.	High	Undertake research to identify the level of threat that cumulative impacts of development have on migratory shorebird habitat.	Coastal development in Australia	<b>Academic institutions</b> Australian Government
3d	Investigate the impacts of hunting and shorebird prey harvesting on	Medium	An improved understanding of the effects of hunting on migratory shorebirds populations can be	Hunting Fisheries by-catch	<b>Academic institutions</b> Australian Government

	migratory shorebirds in Australia and the flyway.		demonstrated by 2020.	Harvesting of shorebird prey	
3e	Develop guidelines for wetland rehabilitation and the creation of artificial wetlands to support populations of migratory shorebirds.	Medium	Guidelines developed to support land managers rehabilitate degraded wetlands are published by 2020.	Altered hydrological regimes Invasive species Chronic pollution Acute pollution	<b>Australian Government</b> <b>State and territory governments</b> <b>Relevant NGOs</b>
3f	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes.	High	All assessments of future developments are undertaken in accordance to the EPBC Act and the associated guidelines and policy documents and take account of information included in the wildlife conservation plan for migratory shorebirds and other sources of information.	Coastal development in Australia	<b>Australian Government</b> <b>State and territory governments</b>

**Objective 4:** Knowledge gaps in migratory shorebird ecology in Australia are identified and addressed to inform decision makers, land managers and the public.

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies <sup>1</sup> and potential partners
4a	Identify and prioritise knowledge gaps that are required to support the conservation and management of migratory shorebirds.	High	Priority knowledge gaps are identified, and responses are agreed and implemented for migratory shorebirds in Australia by 2018.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species Hunting Harvesting of shorebird prey	<b>Australian Government</b> <b>State and territory governments</b> <b>Academic institutions</b> <b>Relevant NGOs</b>
4b	Identify important stop-over and staging areas for migratory shorebirds in the East Asian – Australasian Flyway.	Medium	Important stop-over and staging areas are identified and published by 2020.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change	<b>Australian Government</b> East Asian – Australasian Flyway Partnership
4c	Survey northern and inland Australia for migratory shorebird populations and identify important habitat.	High	Priority areas have been identified and surveyed for migratory shorebird populations by 2020.	Coastal development in Australia Climate variability and change Altered hydrological	<b>Australian Government</b> <b>State and territory governments</b>

				regimes Invasive species	<b>Academic institutions</b> <b>Relevant NGOs</b>
4d	Maintain Shorebirds 2020 as Australia's national shorebird monitoring program.	High	The Shorebirds 2020 program remains active and relevant over the duration of this plan.	Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species	<b>Australian Government</b> <b>Birdlife Australia</b> <b>Relevant NGOs</b>
4e	Complete a review of the conservation status of all migratory shorebirds.	High	The conservation status, including revised population estimates, of all migratory shorebirds is reviewed and published by 2020.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species	<b>Australian Government</b> Academic institutions Birdlife Australia
4f	Promote conservation of migratory shorebirds through strategic programs and educational products.	High	Knowledge of shorebirds and their conservation needs is widespread amongst decision makers and across the community.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species Harvesting of shorebird prey	<b>Australian Government</b> <b>Relevant NGOs</b> State and territory governments
4g	Promote exchange of shorebird conservation information between governments, NGOs and communities through use of networks, publications and web sites.	High	Information on shorebird conservation is available in a form useful to Governments, NGOs, land managers and the community.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological	<b>Australian Government</b> <b>State and territory governments</b> <b>Relevant NGOs</b>



				regimes	
				Invasive species	

## 10 Affected interests

Organisations likely to be affected by the actions proposed in this plan include: government agencies (Commonwealth, state and territory, local), particularly those involved with coastal environments and wetland conservation; researchers; birdwatching groups; conservation groups; wildlife interest groups; environmental consulting companies; and, proponents of coastal development in the vicinity of important habitat. This list however should not be considered exhaustive, as there may be other interest groups that would like to be included in the future or need to be considered when specialised tasks are required.

## 11 Organisations/persons involved in evaluating the performance of the Plan

This plan must be formally reviewed no later than five years from when it was endorsed and made publicly available. The review will determine the performance of the plan; whether the plan continues unchanged; whether the plan is varied to remove completed actions and include new conservation priorities; or whether a wildlife conservation plan is no longer necessary for the species.

The review will be coordinated by the Department of the Environment in association with relevant state and territory agencies, and key stakeholder groups including scientific research organisations.

Key stakeholders who may be involved in reviewing the performance of this Wildlife Conservation Plan:

### Australian Government

Department of Agriculture  
Department of Defence  
Department of Foreign Affairs and Trade  
Department of Industry  
Great Barrier Reef Marine Park Authority  
Indigenous Land Corporation

### State / Territory Governments

Department of Environment and Conservation, WA  
Department of Environment and Heritage Protection, QLD  
Department of Lands, Planning and the Environment, NT  
Department of Environment, Water and Natural Resources, SA  
Office of Environment and Heritage, NSW  
Department of Environment and Primary Industries, VIC

Department of Primary Industries, Parks, Water and Environment, TAS  
Environment and Sustainable Development Directorate, ACT  
Museums  
Natural Resource Management Bodies/ Catchment Management Authorities  
Shipping, oil and gas exploration and development agencies  
Local Governments

## **Industry and Non-Government Organisations**

Conservation groups  
Indigenous Land Councils and communities  
Indigenous land and sea management organisations  
Local communities  
Nature-based tourism industry  
Oil and gas exploration and production industry  
Salt works, land developers and port authorities  
Universities and other research organisations  
Recreational boating and four-wheel driving groups

## **12 Major benefits to other migratory species, marine species, species of cetacean or conservation dependent species**

There are a number of major benefits to species other than migratory shorebirds, which will result from implementation of the wildlife conservation plan. Some migratory and threatened seabirds may benefit from the implementation of a wildlife conservation plan for migratory shorebirds. For example, Fairy Tern (*Sternula nereis nereis*) is listed vulnerable under the EPBC Act and the Little Tern (*Sternula albifrons*), listed as endangered under State threatened species legislation in QLD, NSW and TAS and listed threatened in VIC, shares similar habitats to migratory shorebirds and would therefore benefit from habitat management actions. Marine turtles in Western Australia, Northern Territory and Queensland share nesting habitat with migratory shorebirds and may therefore benefit from habitat management actions. Coastal and freshwater wetlands serve as nurseries for many species of fish and aquatic invertebrates.

As much of the wildlife conservation plan focuses on identifying and developing effective management strategies for important habitats, there will also be major conservation benefits for those marine species that share habitats with migratory shorebirds. Although it is not a legislative requirement to specify benefits to non-migratory shorebirds, there are eighteen species of resident shorebirds including the Banded Stilt (*Cladorhynchus leucocephalus*), Hooded Plover (*Thinornis rubricollis*) and Australian Pied Oystercatcher (*Haematopus longirostris*) that share many habitats and characteristics with their migratory relatives and thus would also gain major benefits from the plan's implementation.

## 13 References

- Bamford, M., Watkins, D., Bancroft, W., Tischler, G., & Wahl, J. (2008) Migratory Shorebirds of the East Asian – Australasian Flyway; Population Estimates and Internationally Important Sites. Wetlands International – Oceania. Canberra, Australia.
- Barter, M.A., Qian, F.W., Tang, S.X., Yuan, X. & Tonkinson, D. (1997a) Hunting of waders on Chongming Dao; a declining occupation? *Stilt* 31: 18-22.
- Barter, M.A., Tonkinson, D., Tang, S.X., Yuan, X. & Qian, F.W. (1997b) Wader numbers on Chongming Dao, Yangtze Estuary, China, during early northward migration and the conservation implications. *Stilt* 30: 7-13.
- Barter, M. (2002) Shorebirds of the Yellow Sea: Importance, threats and conservation status. Wetlands International Global Series 9, International Wader Studies 12. Canberra, Australia
- Chamber, L.E., Hughes, L., & Weston M.A. (2005) Climate change and its impact on Australia's avifauna. *Emu* 105: 1-20.
- Clemens, R. S., Weston, M. A., Haslem, A., Silcocks, A., & Ferris, J. (2010). Identification of significant shorebird areas: thresholds and criteria. *Diversity and Distributions* 16: 229-242.
- Geering, A., Agnew, L., & Harding, S. (2007) Shorebirds of Australia. CSIRO Publishing. Collingwood, Australia.
- Goss-Custard, J.D., Triplet, P., Sueur, F., West, A.D., (2006) Critical thresholds of disturbance by people and raptors in foraging wading birds. *Biological Conservation* 127: 88-97.
- Iwamura, T., Possingham, H.P., Chadès, I., Minton, C., Murray, N.J., Rogers, D.I., Trembl, E.A., & Fuller, R.A. (2013) Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. *Proceedings of the Royal Society Biological Sciences* 280: 20130325.
- Lee, S.Y., Dunn, R.J.K., Young, R.A., Connolly, R.M., Dale, P.E.R., Dehayr, R., Lemckert, C.J., McKinnon, S., Powell, B., Teasdale, P.R., & Welsh, D.T. (2006) Impact of urbanization on coastal wetland structure and function. *Austral Ecology* 31: 149-163.
- Ma, M., Lu, J.J., Tang, C.J., Sun, P.Y. & Hu, W. (1998) The contribution of shorebirds to the catches of hunters in the Shanghai area, China, during 1997-1998. *Stilt* 33: 32-36.
- Ma, Z.J., Jing, K, Tang, S.M. & Chen, J.K. (2002) Shorebirds in the Eastern Intertidal Areas of Chongming Island during the 2001 Northward Migration. *Stilt* 41: 6-10.
- MacKinnon, J., Verkuil, Y.I. & Murray, N. (2012) IUCN situation analysis on East and Southeast Asian intertidal habitats, with particular reference to the Yellow Sea (including the Bohai Sea). Occasional Paper of the IUCN Species Survival Commission No. 47. IUCN, Gland, Switzerland and Cambridge, UK. ii + 70 pp.

- Marchant, S. & P.J. Higgins, eds. (1993) Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings. Oxford University Press. Melbourne, Victoria.
- Murray, M.J., Clemens, R.S., Phinn, S.R., Possingham, H.P. & Fuller, R.A. (2014) Tracking the rapid loss of tidal wetlands in the Yellow Sea. *Frontiers in Ecology and the Environment*
- Naarding, J.A. (1981). Latham's Snipe (*Gallinago hardwickii*) in Tasmania. Wildlife Division Technical Report. 81/2. Tasmania: National Parks and Wildlife Service.
- Naarding, J.A. (1983). Latham's Snipe (*Gallinago hardwickii*) in Southern Australia. Wildlife Division Technical Report. 83/01. Tasmania: National Parks and Wildlife Service.
- Naarding, J.A. (1985). Latham's Snipe (*Gallinago hardwickii*) in Australia and Japan. Wildlife Division Technical Report. 85/2. Tasmania: National Parks and Wildlife Service.
- Naarding, J.A. (1986). Latham's Snipe, *Gallinago hardwickii*, in Australia and Japan. RAOU Report Series. 24:1-74.
- Neira, C., Grosholz, E.D., Levin, L.A., & Blake, R. (2006) Mechanisms generating modification of benthos following tidal flat invasion by a *Spartina* hybrid. *Ecological Applications* 16: 1391-1404.
- Smit, C.J., & Visser, G.J.M. (1993) Effects of disturbance on shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area. *Wader Study Group Bulletin* 68: 6-19.
- Sutherland, W.J., Alves, J.A., Amano, T., Chang, C.H., Davidson, N.C., Finlayson, C.M., Gill, J.A., Gill, R.E., González, P.M., Gunnarsson, T.G., Kleijn, D., Spray, C.J., Székely, T., & Thompson, D.B.A. (2012) A horizon assessment of current and potential future threats to migratory shorebirds. *Ibis* 54: 663-679.
- Tang S.X. & Wang T.H. (1991) A Survey of Hunting Pressure on Waterbirds near Shanghai, March-May 1991. East China Waterbirds Ecology Group Report, June 1991. East China Normal University, Shanghai.
- Tang S.X. & Wang T.H. (1992) Assessment of Hunting Pressure on Shorebirds near Shanghai, Phase II (Socio-economic Analysis). East China Waterbirds Ecology Group Report, December 1992. East China Normal University, Shanghai.
- Tang, S.X. & Wang, T.H. (1995) Waterbird hunting in East China. Asian Wetland Bureau Publication No. 114, Kuala Lumpur.
- Wang, T.H., Tang, S.X. & Ma, J.S. (1991) Survey of shorebirds and coastal wetlands in the Yellow River Delta, Shandong Province. Autumn 1991. East China Waterbird Ecology Group, East China Normal University, Shanghai.
- Wang, T.H., Tang, S.X., Sai, D.J. & Fu, R.S. (1992) A survey of coastal wetlands and shorebirds in the Yellow River Delta, Shandong Province. Spring 1992. East China Waterbird Ecology Group, East China Normal University, Shanghai.

Weston, M.A., McLeod, E.M., Blumstein, D.T., & Guay, P.-J. (2012) A review of flight-initiation distances and their application to managing disturbance to Australian birds. *Emu* 112: 269-286.

DRAFT

## 14 Appendix A

Migratory shorebird species included under the wildlife conservation plan:

Scientific Name	Common Name
<b>Charadriidae</b>	<b>Plovers and Lapwings</b>
<i>Pluvialis fulva</i>	Pacific golden plover
<i>Pluvialis squatarola</i>	Grey plover
<i>Charadrius dubius</i>	Little ringed plover
<i>Charadrius bicinctus</i>	Double-banded plover
<i>Charadrius mongolus</i>	Lesser sand plover
<i>Charadrius leschenaultii</i>	Greater sand plover
<i>Charadrius veredus</i>	Oriental plover
<b>Scolopacidae</b>	<b>Sandpipers</b>
<i>Gallinago hardwickii</i>	Latham's snipe
<i>Gallinago stenura</i>	Pin-tailed snipe
<i>Gallinago megala</i>	Swinhoe's snipe
<i>Limosa limosa</i>	Black-tailed godwit
<i>Limosa lapponica</i>	Bar-tailed godwit
<i>Numenius minutus</i>	Little curlew
<i>Numenius phaeopus</i>	Whimbrel
<i>Numenius madagascariensis</i>	Eastern curlew
<i>Xenus cinereus</i>	Terek sandpiper
<i>Actitis hypoleucos</i>	Common sandpiper
<i>Tringa brevipes</i>	Grey-tailed tattler
<i>Tringa incana</i>	Wandering tattler
<i>Tringa nebularia</i>	Common greenshank
<i>Tringa stagnatilis</i>	Marsh sandpiper
<i>Tringa totanus</i>	Common redshank
<i>Tringa glareola</i>	Wood sandpiper
<i>Arenaria interpres</i>	Ruddy turnstone
<i>Limnodromus semipalmatus</i>	Asian dowitcher
<i>Calidris tenuirostris</i>	Great knot
<i>Calidris canutus</i>	Red knot
<i>Calidris alba</i>	Sanderling
<i>Calidris ruficollis</i>	Red-necked stint
<i>Calidris subminuta</i>	Long-toed stint
<i>Calidris melanotos</i>	Pectoral sandpiper
<i>Calidris acuminata</i>	Sharp-tailed sandpiper
<i>Calidris ferruginea</i>	Curlew sandpiper
<i>Limicola falcinellus</i>	Broad-billed sandpiper
<i>Philomachus pugnax</i>	Ruff
<i>Phalaropus lobatus</i>	Red-necked phalarope
<b>Glareolidae</b>	<b>Pratincoles</b>
<i>Glareola maldivarum</i>	Oriental pratincole

