Wildlife Conservation Plan for Migratory Shorebirds Commonwealth of Australia 2015

Adopted as an Interim Recovery Plan for the Threatened Migratory Shorebirds visiting Western Australia

Red knot (*Calidris canutus*)
Curlew Sandpiper (*Calidris ferruginea*)
Great Knot (*Calidris tenuirostris*)
Greater Sand Plover (*Charadrius leschenaultii*)
Lesser Sand Plover (*Charadrius mongolus*)
Bar-tailed Godwit (western Alaskan) (*Limosa lapponica baueri*)
Bar-tailed Godwit (northern Siberian) (*Limosa lapponica menzbieri*)
Eastern Curlew (*Numenius madagascariensis*)

Wildlife Management Program No. 65

Western Australia
Department of Biodiversity, Conservation and Attractions

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Western Australia Department of Biodiversity, Conservation and Attractions
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983

Foreword

Recovery plans are developed within the framework laid down in the Department of Biodiversity, Conservation and Attractions *Corporate Policy Statement No. 35* (Parks and Wildlife, 2015b) and *Corporate Guideline No. 36* (Parks and Wildlife, 2015a).

Interim recovery plans outline the recovery actions that are needed to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities.

The *Wildlife Conservation Plan for Migratory Shorebirds*, Commonwealth of Australia 2015, has been adopted as an interim recovery plan by the Department of Biodiversity, Conservation and Attractions, Western Australia. Interim recovery plans are subject to modification as dictated by new findings, changes in status of the taxon or ecological community, and the completion of recovery actions. Information in the conservation plan was accurate as of August 2015 and the attached conservations advices in May 2015 or May 2016.

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Department of the Environment

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August 2015

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

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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 the 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 (EAAF). 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.

Based on expert opinion and new information, 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. The species is a known regular visitor to northern Australia in low 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 EAAF 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 five years and will be reviewed in 2020. It is available for download from the Department's website at: www.environment.gov.au/resource/wildlife-conservation-plan-migratory-shorebirds

Photo: Aerial view of the Oyster Farms and coastal area of Barilla Bay (Nick Rains)

2 Introduction

Most migratory shorebirds make an annual return journey of many thousands of kilometres between their breeding grounds in the northern hemisphere and their non-breeding grounds in the southern hemisphere. The EAAF extends 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 south-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 during the non-breeding season as places for these migratory shorebirds to rest and feed, accumulating 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 body mass by up to 70 per cent to sustain their journey.

Shorebirds that migrate from the northern hemisphere reach 'staging areas', such as Roebuck Bay and Eighty-mile Beach in north-western Western Australia and the Gulf of Carpentaria in Queensland, by September. From these staging areas, the 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 others spread along the coastline. Migratory shorebirds are often gregarious, gathering in mixed flocks, but 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, such as 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 previously dispersed across the country begin to gather at staging areas, once again forming large flocks and feeding virtually round the clock to accumulate energy reserves for their northward migration.

The ecology of migratory shorebirds is complex, especially in Australia where investigations are continuing to unravel their patterns of movement, roosting and dispersal behaviours through targeted research programs. To be effective, shorebird conservation and management initiatives in Australia must take into account the unique distributions and ecology of shorebirds–and the critical importance of international migratory pathways and staging areas, particularly the Yellow Sea region (Barter 2002; MacKinnon et al. 2012; Iwamura et al. 2013; Murray et al. 2014).

As some migratory shorebird populations decrease there is a growing need to minimise threats to the remaining habitats that are critical 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 EAAF that would otherwise be difficult to achieve. As migratory shorebird populations in Australia remain stable for about three months of the year (December to February), Australia plays an important role in monitoring population changes in the species that regularly visit here.

Australia's national shorebird monitoring programme, Shorebirds 2020– coordinated by BirdLife Australia–has expanded its monitoring coverage to include remote and sparsely populated areas in northern Australia, particularly in the Gulf of Carpentaria region. The Gulf of Carpentaria contains internationally and nationally important habitat for migrating and wintering shorebirds, with extensive and largely pristine wetlands and beach habitats. Accurate information on shorebird abundance and distribution is urgently required from this region, particularly in light of recent steep declines in southern Australia. Whether these declines are mirrored in northern Australia will have implications for the management of important habitat in the region.

The growing and skilled workforce of Indigenous land and sea management organisations (including ranger programmes based in remote areas with management authority for extensive beach and wetland habitats) presents a valuable opportunity to improve information about migratory shorebirds in northern Australia. Partnerships between BirdLife Australia and the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) are already developing to achieve this aim. There are likely to be many unidentified migratory shorebird areas, particularly in northern Australia, that meet the criteria of important habitat (Section 7).

Monitoring and research projects undertaken by governments, academic institutions and conservation groups in Australia and other parts of the EAAF continue to indicate decreasing 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, and in some cases restoration, are needed throughout the EAAF.

2.1 Review of the 2006–2011 Wildlife Conservation Plan

After reviewing progress made in 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 original 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 decrease 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 EAAF, 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. It recommended that, based on expert opinion and new information, the Little ringed plover (*Charadrius dubius*) should be considered as an addition to the revised Appendix A. This species is a known regular visitor to northern Australia in low numbers (Geering et al. 2007). The review further recommended that the plan should be updated to remove the completed actions and include new, focused conservation priorities.

This 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 organisations. The revised plan provides 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 35 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 low 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. Instead, threatened species receive separate, approved conservation advice and in some cases a recovery plan which sets out what could appropriately be done to stop the decline or support the recovery of the species. On 26 May 2015, Eastern curlew and Curlew sandpiper were listed as critically endangered under the EPBC Act. This decision made them ineligible to be included in the revised Wildlife Conservation Plan for Migratory Shorebirds. Both species have approved Conservation Advice which sets out species specific actions to support the recovery of these species.

If any additional migratory shorebird species that are currently considered to be vagrant were to be recorded on a regular basis, monitoring programmes 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 habitats for migratory shorebirds has occurred throughout the EAAF.
2. Wetland habitats in Australia, on which migratory shorebirds depend, are 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 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; www.cms.int/) and bilateral migratory bird agreements with Japan (JAMBA), China (CAMBA) and the 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 established under the EPBC Act is available at: 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, Eastern curlew (*Numenius madagascariensis*) and Great knot (*Calidris tenuirostris*) are 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
- 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 do not 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 EAAF.

Ramsar Convention on Wetlands

Australia is a signatory to the *Convention on Wetlands of International Importance* (see 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, nominating these wetlands to the List of Wetlands of International Importance (the Ramsar List) and ensuring the maintenance of the ecological character of each listed Ramsar site.

As at July 2015, 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).

Photo: Black-tailed godwits (Brian Furby Collection)

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 EAAF 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 EAAF is home to over 50 million migratory waterbirds—including shorebirds, Anatidae (ducks, geese and swans), seabirds and cranes—from 207 species, including 33 globally threatened and 13 near threatened species.

Flyway partners include countries, intergovernmental agencies, international non-government organisations and the international business sector. A cornerstone of the partnership is the establishment of a network of internationally important sites for migratory waterbirds throughout the EAAF. 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 at: 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. 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:

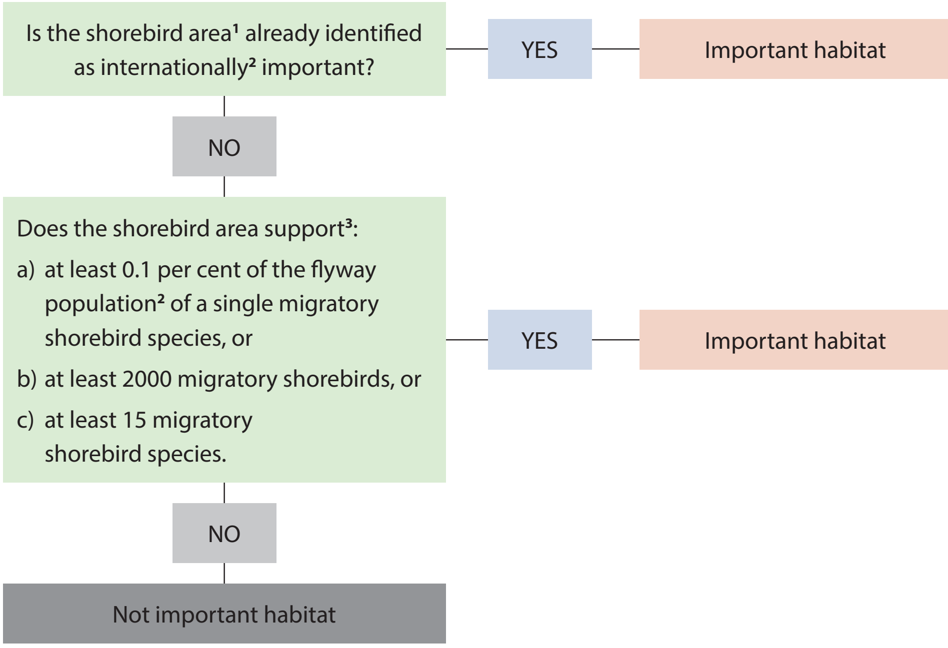
- 0.1 per cent of the flyway population of a single species of migratory shorebird or
- 2000 migratory shorebirds or
- 15 migratory shorebird species.

Photo: Black-tailed Godwit (Graeme Chapman)

Photo: Long view northwards of the restored area of dunes behind Merewether Beach (John Baker)

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 (see below).

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



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. Bamford et al. (2008) detailed a list of internationally important areas within the EAAF and is available at: www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html
   Shorebird population estimates may from time-to-time be updated as new information is published. Further information can be found on the Department's website.
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*.

Photo: Birdlife of the Little Swamp Wetland in Port Lincoln (Dragi Markovic)

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 cannot be identified using the process outlined in Figure 2 and different criteria are 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. Likely future issues that could affect shorebird population include microplastics, global hydro-security and changes in sedimentation rates. The review demonstrates the breadth of issues facing shorebirds, ranging from 'likely but with minor effects' to 'unlikely but catastrophic effects causing species extinction'.

In Australia and the EAAF, many of the current threats are linked to the changing availability of wintering, stop-over and breeding habitats (MacKinnon et al. 2012). The loss of key locations at any point on the migratory pathway will have significant consequences for a number of species. Key threats to the migration and survival of Australian migratory shorebirds are identified in this section. The list is no by means exhaustive, but identifies the main threats that are likely to significantly affect shorebird populations adversely.

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 EAAF. 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. On the Swan Coastal Plain of Western Australia 75 per cent of wetlands have been filled or drained. In south-east South Australia 89 per cent has been lost. Urban development in Australia has often involved the draining and filling of wetlands for industrial or commercial use 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 habitats, fringing wetlands and streamside vegetation.

In Australia, due to the nature of the environment and the distribution of the human population, estuaries and permanent wetlands of the coastal lowlands have experienced most losses, especially in the southern parts 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 EAAF 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 shorebird's ability to complete long migration flights depends on the availability of suitable habitat at sites throughout the EAAF 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 (Barter 2002; Bamford et al. 2008; Iwamura et al. 2013). 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 decreases in biodiversity and ecosystem services in the intertidal zone of the region (MacKinnon et al. 2012). Further reclamation projects are occurring or are in the planning stage in the Yellow Sea region.

8.2 Habitat modification

Modification of wetland habitats 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, 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 habitats as their normal feeding, staging or roosting areas become unusable is erroneous. As areas become unsuitable to support migratory shorebirds, remaining habitats 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 habitats are threatened by the chronic accumulation and concentration of pollutants. Chronic pollution may arise from both local and widespread sources. Migratory shorebirds may be exposed to chronic pollution during their time in Australia and along their migration routes, 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 affected 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, such as Sea spurge (*Euphorbia paralias*), 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 (*Felix catus*) and foxes (*Vulpes vulpes*) 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 an 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 habitats. 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 affect 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), and the 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 affecting habitat and food sources.

Water regulation can alter the chemical make-up of wetlands. For example, reduced flushing flows can cause saltwater 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 from human activities 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 which renders an area unusable is equivalent to habitat loss and can exacerbate population declines. Disturbance is greatest where increasing human populations and development pressures may have an impact on important habitats. 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 over-flights, industrial operations and construction, artificial lighting, and recreational activities such as fishing, off-road driving on beaches, unleashed dogs and jet-skiing (Weston et al. 2012).

A recent study by Martin et al. (2014) examined the responses to human presence of an abundant shorebird species in an important coastal migration staging area. Long-term census data were used to assess the relationship between bird abundances and human densities and to determine population trends. In addition, changes in individual bird behaviour in relation to human presence were evaluated by direct observation of a shorebird resident species. The results showed that a rapid increase in the recreational use of the study area in summer dramatically reduced the number of shorebirds and gulls which occurred, limiting the capacity of the site as a post-breeding stop-over area. In addition, the presence of people at the beach significantly reduced the time that resident species spent consuming prey. The study found negative effects of human presence on bird abundance remained constant over the research period, indicating no habituation to human disturbance in any of the studied species. Moreover, although intense human disturbance occurred mainly in summer, the human presence observed was sufficient to have a negative impact on the long-term trends of a resident shorebird species. The authors suggested that the impacts of disturbance detected on shorebirds and gulls may be reversible through management actions that decrease human presence. They suggest minimum distances for any track or walkway from those areas where shorebirds are usually present, particularly during spring and summer, as well as an appropriate fencing in the most sensitive areas.

8.4 Climate variability and change

There is strong scientific evidence that anthropogenic greenhouse gas emissions are causing changes to the world's climate (Fifth Assessment Report of the Intergovernmental Panel on Climate Change 2013). 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 affect 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, 2011; Iwamura et al. 2013).

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 affecting ecosystem processes throughout the intertidal zone. 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 by causing 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 EAAF (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 presently 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 (New South Wales), 1983 (Tasmania) and 1984 (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 (Park 1983; Marchant & Higgins 1993) and have been hunted intensively on their breeding grounds in Russia 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 shorebirds in 1991 and 9 000 shorebirds in 1992 were captured with clap nets during northward migrations. They suggested that the decrease between the two years was due to decreasing 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 decreased 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) also reported hunting activity in the Yellow River Delta, estimating that 18 000 to 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 decreasing in South Korea, with the only reported instance being minor hunting activity in Mangyeung 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 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 adversely affected but no effect at population level

Moderate—population recovery stalls or reduces

Major—population decreases

Catastrophic—population extinction

Figure 4. Migratory Shorebird Population Residual Risk Matrix

Likelihood of occurrence	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain		• Harvesting of shorebird prey	• Coastal development in Australia		• Coastal development, particularly in the Yellow Sea*
Likely		• Hunting* • Fisheries by-catch*	• Anthropogenic disturbance • Altered hydrological regimes • Invasive species	• Climate variability and change	
Possible					
Unlikely		• Chronic pollution			
Rare or Unknown		• Acute pollution			

* 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.[1] Lead organisations are identified in bold type.

Objective 1: *Protection of important habitats for migratory shorebirds has occurred throughout the EAAF.*

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies[1] and potential partners
1a	Maintain, and where possible, improve existing international obligations that concern migratory shorebird conservation.	Very High	Continue or improve existing international obligations to minimise threats.	Coastal development, particularly in the Yellow Sea Climate variability and change Altered hydrological regimes Hunting	**Australian Government**
1b	Seek the support of the Chinese and South Korean governments to protect remaining tidal flats in the Yellow Sea.	Very 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	**Australian Government** East Asian—Australasian Flyway Partnership
1c	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	**Australian Government** **East Asian—Australasian Flyway Partnership**
1d	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	**Australian Government**

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

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies[1] and potential partners
2a	Identify key areas for shorebird species and improve legal site protection and management using international, national and state mechanisms.	Very 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	**Australian Government** **State and Territory governments** Relevant NGOs Relevant Indigenous land and sea management organisations
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	**Australian Government** **State and territory governments** **Relevant NGOs**

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[1] and potential partners
3a	Develop and implement a community education and awareness program to reduce the effects of recreational disturbance on migratory shorebirds.	High	A reduction of disturbance can be demonstrated through observational data, particularly in areas where disturbance is high.	Anthropogenic disturbance	**Australian Government** **State and territory governments** **Relevant NGOs including their State and regional groups** Relevant Indigenous land and sea management organisations
3b	Investigate the impacts of climate change on migratory shorebird habitat and populations in Australia.	Very High	An improved understanding of the effects of climate change on migratory shorebirds and their habitat can be demonstrated.	Climate variability and change	**Academic institutions** Australian Government Relevant Indigenous land and sea management organisations
3c	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia.	Very High	An improved understanding of the cumulative impacts of development on migratory shorebird habitat can be demonstrated by 2020.	Coastal development in Australia	**Academic institutions** Australian Government Industry and commercial bodies
3d	Investigate the impacts of hunting and shorebird prey harvesting on migratory shorebirds in Australia and the EAAF.	Medium	An improved understanding of the effects of hunting on migratory shorebirds populations can be demonstrated by 2020.	Hunting Fisheries by-catch Harvesting of shorebird prey	**Academic institutions** Australian Government

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies[1] and potential partners
3e	Develop guidelines for wetland rehabilitation and the creation of artificial wetlands to support populations of migratory shorebirds.	High	Guidelines developed to support land managers rehabilitate degraded wetlands are published by 2018.	Altered hydrological regimes Invasive species Chronic pollution Acute pollution	**Australian Government** **State and territory governments** **Relevant NGOs** Relevant Indigenous land and sea management organisations Industry and commercial bodies
3f	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes.	Very High	All assessments of future developments are undertaken in accordance with 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	**Australian Government** **State and territory governments** Industry and commercial bodies

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[1] and potential partners
4a	Identify and prioritise knowledge gaps that are required to support the conservation and management of migratory shorebirds and their habitats.	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	**Australian Government** **State and territory governments** **Academic institutions** **Relevant NGOs** **Relevant Indigenous land and sea management organisations**
4b	Identify important stop-over and staging areas for migratory shorebirds in the East Asian—Australasian Flyway.	Very High	Important stop-over and staging areas are identified and published by 2018.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change	**Australian Government** **East Asian—Australasian Flyway Partnership** Relevant NGOs Relevant Indigenous land and sea management organisations

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies[1] and potential partners
4c	Survey northern and inland Australia for migratory shorebird populations and identify important habitats.	Very High	Priority areas have been identified and surveyed for migratory shorebird populations by 2018.	Coastal development in Australia Climate variability and change Altered hydrological regimes Invasive species	**Australian Government** **State and territory governments** **Academic institutions** **Relevant NGOs** **North Australian Indigenous Land and Sea Management Alliance** **Relevant Indigenous land and sea management organisations, including ranger programs**
4d	Maintain Shorebirds 2020 as Australia's national shorebird monitoring programme.	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	**BirdLife Australia** Relevant NGOs Australian Government
4e	Complete a review of the conservation status of all migratory shorebirds in Australia.	Very High	The conservation status, including revised EAAF population estimates, of all migratory shorebirds is reviewed and published by 2017.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species	**Academic institutions** **Birdlife Australia** East Asian—Australasian Flyway Partnership Australian Government

	Action	Priority	Performance Criteria	Threat to be mitigated	Responsible agencies[1] and potential partners
4f	Promote conservation of migratory shorebirds through strategic programmes and educational products.	High	Knowledge of shorebirds and their conservation needs is widespread amongst decision makers and within the community by 2020.	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	**Australian Government** **Relevant NGOs** **State and territory governments** East Asian—Australasian Flyway Partnership North Australian Indigenous Land and Sea Management Alliance Relevant Indigenous land and sea management organisations, including ranger programs
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 by 2020.	Coastal development, particularly in the Yellow Sea Coastal development in Australia Climate variability and change Anthropogenic disturbance Altered hydrological regimes Invasive species	**Australian Government** **State and territory governments** **Relevant NGOs** East Asian—Australasian Flyway Partnership North Australian Indigenous Land and Sea Management Alliance Relevant Indigenous land and sea management organisations, including ranger programs

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; Indigenous land and sea management groups (including ranger programmes); researchers; bird watching groups; conservation groups; wildlife interest groups; 4WD and fishing groups; environmental consulting companies; Industry and commercial bodies; 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, Land, Water and Planning, 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, 'care' and 'Friends of' groups

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

Photo: Wetland (John Baker)

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

On 26 May 2015, Eastern curlew and Curlew sandpiper were listed as critically endangered under the EPBC Act. This decision makes them ineligible to be included in the revised wildlife conservation plan. However, both species have approved Conservation Advice which outlines specific conservation and management actions, monitoring priorities, information and research priorities. Actions in this wildlife conservation plan will have major cross-cutting benefits for Eastern curlew and Curlew sandpiper conservation action.

There are a number of major benefits to species other than migratory shorebirds that 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 as 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, share similar habitat requirements with migratory shorebirds and would therefore benefit from habitat management actions. Marine turtles in WA, NT and Qld share nesting habitat with migratory shorebirds and may 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 species that share habitats with migratory shorebirds. Although it is not a legislative requirement to specify benefits to non-migratory shorebirds, there are at least 18 species of resident shorebirds including the Banded stilt (*Cladorhynchus leucocephalus*), Hooded plover (*Thinornis rubricollis*) and Australian pied oystercatcher (*Haematopus longirostris*) that share many habitat requirements and characteristics with their migratory relatives and would also gain major benefits from the plan's implementation.

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14 Appendix A

Migratory shorebird species included under the wildlife conservation plan:

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

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Appendix 1 - Approved Conservation Advice for the Red knot (*Calidris canutus*)

The Minister approved this conservation advice and included this species in the Endangered category, effective from 5 May 2016

Conservation Advice

Calidris canutus

Red knot

Taxonomy

Conventionally accepted as *Calidris canutus*, Linnaeus 1758.

Other common names: knot, common knot, Iceland sandpiper, East Siberian sandpiper, lesser knot.

The species is polytypic, meaning more than one subspecies exists. Globally, the following six subspecies are recognised:

- *Calidris canutus canutus* (nominate subspecies) breeds in central Siberia;
- *C.c. piersmai* breeds in the New Siberian Islands;
- *C.c. rogersi* breeds on Chukotka Peninsula (north-eastern Siberia);
- *C.c. roselaari* breeds at Wrangel Island, Siberia, and north-west Alaska;
- *C.c. rufa* breeds in the Canadian Arctic, south of 75 °N; and
- *C.c. islandica* breeds on the islands of the Canadian high Arctic and northern Greenland (Bamford et al. 2008; Leyrer et al. 2014; Gill & Donsker 2015).

Two subspecies, *C. c. piersmai* and *C. c. rogersi,* regularly occur in Australia (Garnett et al. 2011). One other subspecies, *C. c canutus,* is considered a vagrant in Australia (Garnett et al. 2011).

Summary of assessment

Conservation status

Endangered: Criterion 1 A2(a)

The highest category for which *Calidris canutus* is eligible to be listed is Endangered.

Calidris canutus has been found to be eligible for listing under the following listing categories:
Criterion 1: A2 (a): Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Calidris canutus*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/Sub-species Information

Description

The red knot is a small to medium migratory shorebird. It has a length of 23–25 cm, a wingspan of 45–54 cm and a weight of 120 g. The species is robust, short-necked with a short straight bill, long wings extending beyond the tail and short legs (Higgins & Davies 1996). The red knot has a faint pale brow line. The upper body is brownish grey with fine dark streaks on the head and neck and the underbody is white with some light streaking. In breeding plumage, the upper body is boldly marked, contrasting with the mainly chestnut-red body (BirdLife Australia 2012).

Breeding plumage:

- *C. c. piersmai*: Deep brick-red underparts and reddish napes with black mantle and scapulars boldly marked by rufous fringes and panels within each feather. Many scapulars have narrow white tips but these are inconspicuous;
- *C. c. rogersi*: Paler, peachier underparts, and whitish napes with more extensive silvery variegation on the upperparts caused by a combination of broader grey-white tips to individual feathers, the presence of many scapulars with grey-white panels within the feather, and only a pale rufous tinge to other markings within the scapulars (Rogers et al. 2010).

The two subspecies *C. c. piersmai* and *C. c. rogersi* cannot be distinguished from each other in nonbreeding plumage (Rogers et al. 2010). However, the location in which the individual is present can help distinguish the two subspecies, with *C. c. piersmai* tending to overwinter almost exclusively in North-west Australia, and *C. c. rogersi* tending to overwinter in other parts of Australasia (del Hoyo et al. 2014).

Distribution

Global Distribution

The red knot (all six subspecies combined) has a global distribution and an extremely large range. The species breeds at a range of locations around the Arctic and, for the boreal winter, migrates to non-breeding areas that extend to the southernmost parts of the Americas, Africa, Europe and Australasia (del Hoyo et al. 1996). For the species, the global extent of occurrence is estimated to be 1,600,000 km^2 (BirdLife International 2015).

Australian Distribution

The red knot breeds in the northern hemisphere and undertakes migrations along the East Asian-Australasian Flyway (EAAF) to spend the boreal winter in Australasia. The vast majority of the population is considered to spend the non-breeding period in Australia (Bamford et al. 2008).

The red knot is common in all the main suitable habitats around the coast of Australia (Barrett et al. 2002), is less numerous in south-west Australia and is occasionally recorded inland in all regions (Higgins & Davies 1996). Very large numbers are regularly recorded in north-west Australia. In Queensland, the red knot migrates along the coast north of 19 °S, sometimes in large numbers. It is widespread along the coast south of Townsville, along the coasts of NSW and Victoria, and is a regular visitor, in small numbers, to the coasts of Tasmania. In South Australia, the species is found mostly from The Coorong, north and west to the Yorke Peninsula and Port Pirie. The red knot has also been recorded at Norfolk Island, Lord Howe Island, Macquarie Island, Kermadec Island, Chatham Islands, Auckland Islands and Campbell Islands (Higgins & Davies 1996). Red knots migrating to New Zealand may stage in Australia, particularly in the Gulf of Carpentaria (Bamford et al. 2008; Rogers et al. 2010; Garnett et al. 2011).

Relevant Biology/Ecology

Life History

The generation time of 7.8 years (Garnett et al., 2011) is derived from an age of first breeding of 2.0 years (Cramp et al. 1983), an adult survival of 68% (Boyd 1962) and a maximum longevity of 18.8 years (Garnett et al., 2011).

Breeding

The red knot does not breed in Australia. Red knots breed in north Siberia and Alaska during the austral winter (Department of the Environment 2015a,b). In June, the red knot lays 3-4 eggs and incubation lasts for around 21–22 days. On hatching, females depart the nest leaving the male to tend for young. Fledging occurs after 18–20 days. In one sample of 26 eggs, 54% hatched and 27% fledged (del Hoyo et al. 1996).

General Habitat

The red knot breeds on dry upland tundra in high Arctic areas. During the boreal summer, they nest on open vegetated tundra or stone ridges, often close to a clump of vegetation. Breeding density is normally around one pair per km^2 (del Hoyo et al. 1996).

During the non-breeding season in Australasia, the red knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. They are occasionally seen on terrestrial saline wetlands near the coast and on sewage ponds and saltworks (Higgins & Davies 1996).

Feeding Habitat

The red knot usually forages in soft substrate near the water edge on intertidal mudflats or sandflats exposed by low tide. At high tide they may feed at nearby lakes, sewage ponds and floodwaters (Higgins & Davies 1996).

Roosting Habitat

The red knot roosts on sandy beaches, spits and islets, and mudflats (Higgins & Davies 1996). They have been seen roosting on an inland claypan near Roebuck Bay, north-west Western Australia (Collins et al. 2001). They like to roost in open areas far away from potential cover for predators, but close to feeding grounds (Rogers 2001). In hot conditions, shorebirds prefer to roost where a damp substrate lowers the local temperature and different roosts were used at night when birds chose safer, but more distant, roosts from foraging areas (Rogers et al. 2006).

Feeding

The red knot eats worms, bivalves, gastropods, crustaceans and echinoderms (Higgins & Davies 1996). In Australia, they predominantly forage on shellfish by being able to detect pore-water pressure differentials to locate hard, buried prey (Piersma et al. 1998). They have a large muscular gizzard for crushing bivalves which are swallowed whole (Piersma et al. 1993; van Gils et al. 2005; Rogers et al. 2010). In some circumstances they also visually locate prey items and sometimes take prey from the surface (Rogers 2001).

The red knot is diurnal and nocturnal. They forage in large, dense, often mixed-species flocks, with birds rapidly, intensively and methodically probing the wet mud as they walk quickly across the mudflats exposed by the falling tide (BirdLife Australia 2012). In non-breeding areas, feeding activity is regulated by the tide with birds closely following the tide-edge when foraging (Rogers 2001).

Migration Patterns

The red knot is migratory, breeding in the high Arctic and moving south to non-breeding areas to approximately 50 °S. They are capable of flying non-stop between north-eastern China and northern Australia and tend to use only a few staging areas (Bamford et al. 2008).

Depature from breeding grounds

The subspecies *C. c. rogersi* breeds in north-east Siberia, including around the Chukotka Peninsula and possibly farther west, and migrates mainly to Australia and New Zealand. Although the route of migration to Australia is not known it may move in a loop, migrating south across the west Pacific Ocean and north along the east Asian coast. The subspecies *C. c. piersmai* breeds in the New Siberian Islands and migrates along the coast of east Asia, with some birds reaching Australia and New Zealand (Higgins & Davies 1996).

Non-breeding season

In Australia, most red knots arrive on the north-west coast and the Gulf of Carpentaria from late August (Higgins & Davies 1996). They move south, mostly along coasts, with some inland records from September–November and arrive in south-west Australia from September (Higgins & Davies 1996). Information derived from banding and flagging programs suggests that the population that remains in north-west Australia is mostly the subspecies *C. c. piersmai*, although some may also occur in eastern Australia. The subspecies *C. c. rogersi* mainly occur in eastern Australia and New Zealand although some of these birds pass through north-west Australia on migration (Rogers et al. 2010).

During the non-breeding period, around 93% of the EAAF population of the red knot (subspecies *C.c. piersmai* and *C.c. rogersi*) occurs in Australia and New Zealand, with smaller numbers in China, Indonesia and other countries in southeast Asia (Bamford et al. 2008).

Return to breeding grounds

Red knots leave Tasmania from February–May and leave south-east mainland Australia from late February or late March to early April. Inland records suggest that some birds move overland on northern migration. They leave north-west Australia from late March to late April. Most probably passing through the northern half of the Yellow Sea (Barter 2002) with large numbers seen in the Korean Peninsular in April and May. Some birds overwinter in Australia, mainly northern Australia (Higgins & Davies 1996).

Internationally, the Yellow Sea is extremely important as stopover habitat for red knot, with over 45% of the EAAF population using a single site at Bohai Bay, Yellow Sea during their migration (Rogers et al. 2010; Iwamura et al. 2013).

Threats

Migratory shorebirds, such as the red knot, are sensitive to certain development activities due to their high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the red knot across its range include habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion, changes to the water regime, invasive plants and environmental pollution), over-exploitation of shellfish, pollution/contamination impacts, disturbance, direct mortality (hunting), diseases, extreme weather events, and climate change impacts (BirdLife International 2015; Department of the Environment 2015a,b).

Habitat loss and habitat degradation

The red knot is threatened by wetland degradation in East Asia, where it stages on migration (Bamford et al. 2008). The red knot is specifically threatened at Bohai Bay, Yellow Sea where both subspecies (*C. c. piersmai* and *C. c. rogersi*) stage on the intertidal mudflats. Rogers et al. (2010) estimated that their study site area of 20 km of coastline in Bohai Bay was used by over 45% of the combined global population of adult *C. c. piersmai* and *C. c. rogersi.* Between 1994 and 2010, the reclamation of large areas (including intertidal mudflats) in the bay for two industrial projects caused the northward migrating red knot to become concentrated in an ever smaller remaining area. The northward migration numbers of *C. c. piersmai* and *C. c. rogersi* in this so far little affected area increased from 13% in 2007 to 62% in 2010 of the global populations (Yang et al. 2011). With the proposed continuation of land reclamation in Bohai Bay, it is predicted that shorebird densities in the remaining areas will increase to a point of collapse (Yang et al. 2011). Along with other major areas of tidal flat habitat in East Asia, the Bohai Bay tidal flats currently have no formal protection (Murray & Fuller 2015). Reclamation on intertidal mudflats is also a threat in other areas of the EAAF, for example Malaysia (Wei et al. 2006). In addition, intensive oil exploration and extraction, and reduction in river flows due to upstream water diversion, are other potentially significant threats in parts of China where this species is present in internationally significant numbers (Barter 2005; Barter et al. 1998).

In Australia, the loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss which include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b).

As most migratory shorebirds, such as the red knot, have specialized feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include, but are not restricted to loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats; invasion of intertidal mudflats by weeds such as cordgrass; water pollution and changes to the water regime; changes to the hydrological regime; and exposure of acid sulphate soils, hence changing the chemical balance at the site (Department of the Environment 2015a,b).

The non-breeding grounds of the species in south-eastern Australia are threatened by habitat degradation, loss and human disturbance (Garnett et al. 2011), but those in the north are generally free of such disturbances (NTDoLRM 2012).

Climate change

Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Harding et al. 2007). Rises in sea level could have a major impact on the red knot due to loss of intertidal habitat (Iwamura et al. 2013). Taking into account upshore movements of intertidal habitat, modelling indicates that, for both *C.c. piersmai* and *C.c. rogersi*, population flow could reduce by 15% with a 150 cm sea level rise (Iwamura et al. 2013).

Pollution/contamination

Migratory shorebirds may be adversely affected by pollution, both on passage and in non-breeding areas (Harding et al. 2007; Wei et al. 2006).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al., 2006; Glover et al., 2011; Weston et al., 2012).

Disturbance can result from recreational activities including fishing, boating, four wheel driving, walking dogs, noise and night lighting. While some disturbances may have a low impact, it is important to consider the combined effect of disturbances with other threats (Department of the Environment 2015a,b).

Diseases

The red knot is susceptible to avian influenza and so may be threatened by future outbreaks of the virus (Melville & Shortridge 2006).

Since, 1992, the viral disease testing of Charadriiformes from coastal northwest Australia has not detected any evidence of avian influenza virus excretion in the red knot or any other species tested. However, from serologic testing, there was evidence of past exposure to the virus in the sampled red knots and the exposure risk profile for this species had significantly higher values compared to other species (Curran et al. 2014).

Direct mortality

Direct mortality may result from the construction of wind farms located in migration or movement pathways, bird strike with vehicles and aircraft, hunting, chemical spills and oil spills (Schacher et al., 2013; Department of the Environment 2015a,b).

Hunting is still a very serious problem for shorebirds in China, and the red knot has been identified as one of the species caught (Ming et al. 1998). Records between 1985 and 1998 indicate that at least 709 individuals of this species were hunted in China and Thailand alone. Within this period, taking into account the year with lowest take (lower bound) and the year with highest take (upper bound), the possible range of annual take is at least 39 to 469 individuals (Parish and Melville 1985, Ruttanadakul and Ardseungnerm 1986, Tang and Wang 1995, Ming et al. 1998, Ge et al. 2006).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2(a) for listing as Endangered

The global population of red knot was previously estimated at 1,090,000 with the population in the EAAF at 220,000 (Bamford et al. 2008). Although numbers at several sites have declined, it is also thought that the previous estimate of red knots at Eighty Mile Beach, WA (80,700), based on extrapolation from aerial surveys, may have been inflated (Rogers et al. 2010). Rogers et al. (2010) presented revised estimates for Australian and New Zealand sites using the most recently available austral summer counts. Assuming around 93% of the EAAF population of the red knot occurs in Australia and New Zealand (Bamford et al. 2008), a revised population estimate for the EAAF, based on a sum of revised estimates for the Australian and New Zealand populations of 104,986 (Rogers et al. 2010), is approximately 112,000 individuals, of which 68,000 occur in Australia (Garnett et al., 2011).

In Australia, direct counts of red knots at key sites (e.g. Rogers et al. 2009) have shown a population decline of more than 30% over the last 20 years. For example, numbers in Victoria showed a decline in count data from 4,474 to 2,419 individuals (Wilson 2001). Numbers at Eighty-mile Beach declined by c.78% between 2000 and 2008 (Rogers et al. 2009), at Moreton Bay by 75% between 1993 and 2008 (Fuller et al. 2009) and by c.27% across 49 Australian sites between c.1983 and c.2007 (Garnett et al. 2011).

Numbers of red knots appear to have had a less severe decline elsewhere in the EAAF e.g. no clear trends in Japan between 1978 and 2008 (Amano et al. 2010).

A subsequent and more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council collaborative grant), suggests the rate of decline is large enough to pass the threshold for the endangered category (Studds et al., submitted). Time series data from directly observed summer counts at a large number of sites across Australia indicate a severe population decline of 62.0% over 23 years (4.4% per year) which for this species is equal to three generations (Studds et al., submitted).

In large part, the observed decline in red knot numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). As such, qualification under criterion A2 rather than A1 seems warranted. In addition, threats are also occurring in Australia including coastal development and recreational activities causing disturbance.

The Committee considers that the species has undergone a severe reduction in numbers over three generation lengths (23 years for this assessment), equivalent to at least 62 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 36 000 km^2 (stable) and area occupied 2 400 km^2 (stable; Garnett et al., 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 68 000 in 2011 (Garnett et al., 2011), but has declined since. There are no current data available to allow assessment against this criterion. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The total number of mature individuals is 68 000 which is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites in Australia.
- Incorporate requirements for red knot into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.

- Manage disturbance at important sites which are subject to anthropogenic disturbance when red knot are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess red knot life history, population size, distribution and ecological requirements.
- Improve knowledge about dependence of red knot on key migratory staging sites, and non-breeding sites in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Endangered category:

Calidris canutus

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 2 - Approved Conservation Advice for the Curlew Sandpiper (*Calidris ferruginea*)

Conservation Advice

Calidris ferruginea

curlew sandpiper

Taxonomy

Conventionally accepted as curlew sandpiper *Calidris ferruginea* Pontoppidan, 1763. Scolopacidae. Other common names are pygmy curlew, curlew stint and redcrop.

No subspecies are recognised (Bamford et al. 2008). Taxonomic uniqueness: medium (22 genera/family, 20 species/genus, 1 subspecies/species; Garnett et al. 2011).

Cox's sandpiper (*Calidris paramelanotos*) was described as a new species in 1982, but is now known to be a hybrid between a female curlew sandpiper and a pectoral sandpiper (*C. melanotos*) (McCarthy 2006; Christidis & Boles 2008). Before 1990 there were said to be 4-7 (unverified) Australian reports of Cox's sandpiper annually (Higgins & Davies 1996), but reports are now very rare. Curlew sandpipers have also been reported to hybridise with white-rumped sandpipers (*Calidris fuscicollis*) (McCarthy 2006).

Summary of assessment

Conservation status

Critically endangered: Criterion 1 A2, (a)

Calidris ferruginea has been found to be eligible for listing under the following listing categories:

Criterion 1: A2 (a): Critically Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

The highest category for which *Calidris ferruginea* is eligible to be listed is Critically Endangered.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of information provided by a committee nomination based on information provided in the *Action Plan for Australian Birds 2010* (Garnett et al., 2011), and experts from the University of Queensland.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 33 business days between 1 October 2014 and 14 November 2014. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The curlew sandpiper is a small, slim sandpiper 18–23 cm long and weighing 57 g, with a wingspan of 38–41 cm. It has a long decurved black bill with a slender tip; the legs and neck are also long. The head is small and round, and the iris is dark brown. The legs and feet are black or black-grey. When at rest, the wing-tips project beyond the tip of the tail. It has a square white patch across the lower rump and uppertail-coverts, a prominent flight character in all plumages. The sexes are similar, but females have a slightly larger and longer bill and a slightly paler underbelly in breeding plumage (Higgins & Davies, 1996).

In breeding plumage, the head, neck and underbody to rear belly are a rich chestnut-red with narrow black bars on the belly and flanks. There are black streaks on the crown, a dusky loral stripe, and white around the base of the bill. When the plumage is fresh, the head, neck and underbody are often mottled by white tips to the feathers. The feathers on the mantle and scapulars are black with large chestnut spots and greyish-white tips (Higgins & Davies, 1996).

The non-breeding plumage looks very different, with pale brownish grey upperparts and predominantly white underparts (with a brownish-grey wash and fine dark streaks on the foreneck and breast). The cap, ear-coverts, hindneck and sides of neck are pale brownish-grey with fine dark streaks, grading to off-white on the lower face, with white on the chin and throat. There is a narrow dark loral stripe and white supercilium from the bill to above the rear ear-coverts. (Higgins & Davies, 1996).

Distribution

Australian distribution

In Australia, curlew sandpipers occur around the coasts and are also widespread inland, though erratic in their appearance across much of the interior. There are records from all states during the non-breeding period, and also during the breeding season when many non-breeding birds remain in Australia rather than migrating north.

In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread records along the coast south of Cairns. There are sparsely scattered records inland. In NSW, they are widespread east of the Great Divide, especially in coastal regions. They are occasionally recorded in the Tablelands and are widespread in the Riverina and south-west NSW, with scattered records elsewhere. In Victoria, they were widespread in coastal bays and inlets; despite recent declines these are still their Victorian strongholds; they are widespread in near-coastal wetlands, and they occur intermittently on inland wetlands (e.g. in the Kerang area, Mildura, and western districts). In Tasmania, they were recorded on King Island and the Furneaux Group. They mostly occur in south-eastern Tasmania, but also at several sites in north-west Tasmania, with occasional records in low numbers on the west coast. In South Australia, curlew sandpipers occur in widespread coastal and sub-coastal areas east of Streaky Bay. Important sites include ICI and Price Saltfields, and the Coorong. Occasionally they occur in inland areas south of the Murray River and elsewhere. In Western Australia, they are widespread around coastal and sub-coastal plains from Cape Arid to south-west Kimberley. They occur in large numbers, in thousands to tens of thousands, at Port Hedland Saltworks, Eighty-mile Beach, Roebuck Bay and Lake Macleod. They are rarely recorded in the north-west Kimberley, around Wyndham and Lake Argyle, and occasionally they occur inland, in areas south of 26° S. In the Northern Territory, they mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island. They have been recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies, 1996).

Global distribution

The global population size of the curlew sandpiper has been estimated to be 1,350,000 (Delany & Scott, 2002; Bamford et al., 2008), however, these estimates are out of date. The global extent of occurrence is estimated at 100 000–1 000 000 km² (BirdLife International, 2014). Approximately 13% of the global population occurs in the East Asian-Australasian Flyway (180

000 individuals) (Bamford et al., 2008), however, these estimates are out of date and the true estimate is probably much lower.

The breeding range of the curlew sandpiper is restricted to the Russian Arctic from Chosha Bay east to Kolyuchiskaya Bay, on the Chukchi Peninsula, and also the New Siberian Islands (Lappo et al., 2012). It is a passage migrant through Europe, north Africa, Kazakhstan, west and south-central Siberia, Ussuriland, China, Taiwan, Japan, the Philippines and Papua New Guinea.

During the non-breeding period, they occur throughout Africa, south of southern Mauritania and Ethiopia, along the valley of the Nile River and in Madagascar. They also occur in Asia, from the coastal Arabian Peninsula to Pakistan and India, through Indonesia and Malaysia, south-east Asia and Indochina to south China and Australasia (Higgins & Davies, 1996).

Relevant Biology/Ecology

Life history

A generation time of 7.6 years (BirdLife International, 2014) is derived from an age at first breeding of 2.0 years, an annual survival of adults of 79% and a maximum longevity of 14.8 years, all extrapolated from congeners (Garnett et al., 2011). Estimates of apparent and true survival rate respectively for curlew sandpipers in Victoria are 73.1% and 80.5% (Rogers and Gosbell 2006). Rogers and Gosbell (2005) demonstrated that long-term decline in Victorian curlew sandpipers, although influenced by consecutive years of low breeding success, has been driven by reduced adult survival. Minton et al. (2006) confirmed that curlew sandpipers do not begin northwards migration and breeding until 2 years old.

Data extracted from the Australian Bird and Bat Banding Scheme (ABBBS) reports a longevity record of 18 years, 1.9 months (Australian Government, 2014).

Breeding

This species does not breed in Australia.

In Siberia, nesting occurs during June and July (Hayman et al., 1986). The nest is a cup positioned on the margins of marshes or pools, on the slopes of hummock tundra, or on dry patches in *Polygonum* tundra (BirdLife International, 2014). Curlew sandpipers usually have a clutch size of four eggs (Johnsgard, 1981).

General habitat

In Australia, curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies, 1996).

"*The Shorebird Community occurring on the relict tidal delta sands at Taren Point*" is listed as an Endangered Ecological Community in NSW (NSW DECC, 2005). The curlew sandpiper is one of 20 shorebird species that make up this community.

Feeding habitat

Curlew sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they sometimes forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beachcast seagrass or seaweed. They rarely forage on exposed reefs (Higgins & Davies, 1996). In Roebuck Bay, northern Western Australia, they tend to follow the receding tide to forage near the water edge (Rogers 1999, 2005) but they also feed on part of the mudflats that have been exposed for a longer period, foraging in small groups (Tulp & de Goeij, 1994).

Roosting habitat

Curlew sandpipers roost in open situations with damp substrate, especially on bare shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies, 1996). They have also been recorded roosting in mangroves in Inverloch, Victoria (Minton & Whitelaw, 2000).

Feeding

This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds. Outside Australia, they also forage on shrimp, crabs and small fish. Curlew sandpipers usually forage in water, near the shore or on bare wet mud at the edge of wetlands. On wet mud they forage by pecking and probing. They probe in shallow water, and jab at the edge of the water where a film of water remains on the sand. They glean from mud and less commonly from the surface of water, or in drier areas above the edge of the water. For a 'jab' less than half the length of the bill is inserted into the substrate; a probe is performed with a slightly open bill inserted to its full length. Curlew sandpipers may wade up to the belly, often with their heads submerged while probing. They often forage in mixed flocks (Dann, 1999a), including with red-necked stints (*Calidris ruficollis*).

The diet of the curlew sandpiper includes the following taxa (Barker & Vestjens, 1989; Higgins & Davies, 1996; Dann, 1999a):

Plants (*Ruppia* spp. seeds), Annelid worms: *Ceratonereis eurythraeensis*, *Nereis caudate,* Molluscs: Kelliidae, Gastropods: Rissoidae, Cerithiidae, Fossaridae, *Polinices* sp., *Salinator fragilis*, Hydrococcidae, Hydrobiidae, *Assiminea brazieri*, *A. tasmanica*, Crustaceans: *Cymadusa* sp., *Paracorophium* sp., Brachyurans; Sentinel Crab (*Macrophthalamus latifrons*), Insects: Diptera (Stratiomyidae, Chironomidae), adults, larvae and pupae, larvae (of Coleoptera, Dytiscidae and Scarabaeidae), Lepidoptera

Curlew sandpipers have been recorded consuming grit. In tidal waters, on the outgoing tide, the birds move onto the most recently exposed parts of the tidal flats until low tide when they disperse widely (Rogers 1999). On the rising tide, the flocks remain in areas close to the water's edge until these areas are covered and then retreat in stages rather than moving continuously as they do on the outgoing tide. Occasionally, individuals feed at high tide near the roost, along stretches of sandy beach where piles of decomposing vegetation are scattered in the high-tide zone. Supratidal feeding mainly occurs during the pre-migratory fattening periods (February-April) (Dann, 1999b). In other studies supratidal foraging has been recorded throughout the austral summer, and has been found to occur more on neap tides when tidal flat exposure is reduced (Rogers et al. 2013).

Migration patterns

Curlew sandpipers are migratory. Overlapping breeding grounds occur in Siberia, and populations move south to widely different non-breeding areas which generally occur south of 35° N. Most birds migrate south, probably overland across Siberia and China, and south Asia. The northern migration occurs much further east, mainly along the south-east and east coasts of China, where staging occurs, then continuing overland to breeding areas (Higgins & Davies, 1996).

Departure from breeding grounds

Males depart breeding grounds during early July, followed by females in July and early August, then juveniles in August, with juveniles usually arriving in the non-breeding range later than adults. Southwards migration is poorly known but flag resightings indicate that the main passage is initially overland, and that some birds migrate well to the west of the direct great circle route from the breeding grounds to south-eastern Australia (Minton et al., 2006). They cross Russia during July till late October, and pass through Mongolia, with a few records from inland Asia. They reach the Asian coast on a broad front between India and China in August. Adults pass through the Inner Gulf of Thailand during August, with a second influx, probably mainly juveniles, in late October and early November. Thousands pass over the west coast of Malaysia and arrive in Singapore in July and August but the migratory destination of these birds is unclear. Small numbers pass through Myanmar and Hong Kong during August-October. The relatively low numbers of curlew sandpipers, and of resightings of Australian-flagged birds on the coast of Indonesia, Borneo, the Philippines and Papua New Guinea, suggest that curlew sandpipers migrating to Australia migrate in a direct flight from staging areas on the east Asian coast. They are regular in small numbers on passage through southern Papua New Guinea, and in the Port Moresby district they arrive as early as late August. Adults are capable of flying non-stop to Australia from Hong Kong and Singapore. They reach the northern shores of Australia in late August and early September (Higgins & Davies, 1996; Minton, 1996; Minton et al., 2006).

Non-breeding season

Substantial numbers of Curlew Sandpipers remain in northern Australia throughout the non-breeding season (e.g. Rogers et al. 2008). Others stopover in northern Australia before continuing migration to south-east Australia, the first birds arriving in late August, but the majority not until September. Some birds are also thought to move through the Gulf of Carpentaria to east and south-east Australia, with records from coastal Queensland and NSW. Some, occasionally hundreds, pass through north-east South Australia during late August to early December, and small numbers occur regularly in south-west NSW from early August. Some birds also move from north-west Australia, south to southern Western Australia, sometimes arriving in coastal south-western Western Australia as early as August, with small numbers also passing through Eyre, south-eastern Western Australia, mainly during August-November. Birds may return to the same non-breeding sites each year (Higgins & Davies, 1996; Minton, 1996).

Return to breeding grounds

The return north begins in March, the northern route being further to the east than the southern route. Sightings of colour-marked birds, and influx at inland sites in south-eastern Australia in April, suggest some passage occurs through inland areas, and at least some birds from south-eastern Australia move to north-west Australia before leaving the mainland. Curlew sandpipers leave coastal sites in east Queensland between mid-January and mid-April, with a possible passage along the north-east coast. They migrate north on a broad front, with fewer occurring in north-west Australia than on the southern migration. Young birds stay in non-breeding areas during breeding season (Higgins & Davies, 1996). Recoveries and flag resightings indicate that a large proportion of the Australian population migrate through southern China (including Hong Kong and Taiwan), Vietnam and Thailand in the last few days of March and through April. Migration is however on a broad front and smaller numbers of birds pass though Papua New Guinea in early April to mid-May, and Bali and Sumatra during March-April. Small numbers pass through Brunei, during mid-February to May, with large numbers passing through the Philippines during March-April. The birds depart Singapore during early March, passing through Malaysia during March-April. They move through the Inner Gulf of Thailand during late March-May and depart Myanmar during May. By May the majority of recoveries and flag resightings occur on or near the Asian coast, notably on the northern coast of Bohai Bay, with other major concentrations in the Yangtse Estuary and the northern base of the Shandong Peninsula. A few pass through the Republic of Korea, Japan and Sakhalin during April-May. They first arrive in Chukotka region, Russia, during late in May or early June (Higgins & Davies, 1996; Minton, 1996, Minton et al. 2006, Hong-Yan et al. 2011).

Descriptions of migratory pathways and important sites

Birds banded in Australia have been recovered in the upper Yenisey River and Daursky Nature Reserve, Russia, south India, Tanggu near Tianjin, many in Hong Kong, in China, Pu-tai, Chiayi and Cheng-his-li, Tainan City, Taiwan, south Vietnam, Gulf of Thailand and Java (Higgins & Davies, 1996; Minton & Jessop, 1999a, b, Minton et al., 2006). Long distance recoveries include birds banded in Victoria being recovered in Russia, at Yakutia, Verkhoyanskiy District, 11,812 km north of the banding site on the northern extremity of the breeding range and well to the west, on the Taimyr Peninsula, over 13,000 km from its banding location (Minton, 1996), and in China and Hong Kong (Minton, 1991).

The distribution of important sites is well known in the non-breeding period, with internationally important sites in Australia (22), Malaysia (2), Indonesia (1) and Thailand (1) (Bamford et al., 2008). In Australia, 9 sites are known to be important during migration, all in the southward period (Bamford et al., 2008). On northward migration Barter (2002) estimated that only 10% of the population use the Yellow Sea, most occurring in western Bohai Wan. However the discovery of very large numbers staging in Bohai Wan (Hong-Yan et al., 2011) suggests that the Yellow Sea is of more importance to the species than initially realised.

Threats

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al., 2006; Australian Government, 2009; Garnett et al., 2011).

In the non-breeding grounds of Australia, some populations of this species occurs in highly populated areas that are vulnerable to habitat alteration. It is necessary to maintain undisturbed feeding and roosting habitat along the south-east coast and at sites on the north-west coasts used during migration for the species to survive at current population levels (Lane, 1987). Coastal development, land reclamation, construction of barrages and stabilisation of water levels can destroy feeding habitat. Pollution around settled areas may have reduced the availability of food.

Curlew sandpipers are threatened by wetland degradation in East Asia where it stages on migration (Bamford et al., 2008). Specifically this species is threatened at Bohai Bay which is being developed at a rapid rate (Murray et al., 2014). Threats at migratory staging sites include environmental pollution, reduced river flows, sea level rise, human disturbance and reclamation for tidal power plants and barrages, industrial use and urban expansion (Garnett et al., 2011; Iwamura et al., 2013).

<u>How judged by the Committee in relation to the EPBC Act Criteria and Regulations</u>

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased. A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible. A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*] A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.	*based on any of the following:*	(a) direct observation [*except A3*] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2(a) for listing as Critically Endangered.

The global population has been estimated at 1 850 000 individuals, of which about 180 000 are found in the East Asian – Australasian Flyway (Bamford et al., 2008), however, these are old data. In Australia, 115 000 individuals were thought to visit during the non-breeding period (Bamford et al., 2008), but numbers have subsequently declined (Garnett et al., 2011).

Numbers declined on Eighty-Mile Beach, WA, by c. 59% between 2000 and 2008 (Rogers et al., 2009), at the Coorong, SA, by 79% between the 1980s and 2004 (Wainwright and Christie, 2008), at sites across Queensland by 6.3% per year between 1998 and 2008 (Fuller et al., 2009), at Corner Inlet in Victoria by 3.4% per year between 1982 and 2011 (Minton et al., 2012), at Gulf St Vincent, SA, by 71% between 1981 and 2004 (Close, 2008), and by 82% across 49 Australia sites between 1983 and 2007 (BirdLife Australia *in litt.* 2011). Models suggest that this decline is due to reduced adult survival rates (Rogers and Gosbell, 2006).

Numbers in south east Tasmania have decreased by 100% in the period 1973 – 2014, with no curlew sandpipers recorded during coordinated summer counts in 2008, and 2010 – 2014 inclusive (Woehler pers. comm., 2014).

Numbers declined less severely elsewhere in the flyway. There were no clear trends in Japan between 1978 and 2008 (Amano et al., 2010), but as discussed above, Japan is not a major part of the migration route of this species.

A subsequent and more detailed assessment by a University of Queensland team (partly funded by the Department under an Australian Research Council collaborative grant), puts the species into the critically endangered category (Fuller, pers. comm., 2014). Time series data from directly observed summer counts at a large number of sites across Australia indicate a severe population decline of 75.9% over 20 years (7.5% per year; Fuller, pers. comm., 2014). This equates to a decline of 49.1% over a 10 year period, and 80.8% over 23 years, which is three generations for this species (Garnett et al., 2011).

In large part, the observed decline in curlew sandpiper numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). As such, qualification under criterion A2 rather than A1 is warranted. However, threats are occurring locally in Australia, such as coastal development and recreational activities causing disturbance, also impact the species.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (23 years for this assessment), equivalent to at least 80.8 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as critically endangered.

Criterion 2. Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered **Very restricted**	**Endangered** **Restricted**	**Vulnerable** **Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 7 600 000 km^2 (stable) and area occupied 6 800 km^2 (stable; Garnett et al., 2011). Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Small population size and decline			
	Critically Endangered **Very low**	**Endangered** **Low**	**Vulnerable** **Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future	**Very high rate** **25% in 3 years or 1 generation (whichever is longer)**	**High rate** **20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate** **10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia is estimated to be 115 000 with a decreasing trend (Bamford et al., 2008; Garnett et al., 2011), however, these estimates are out of date and likely to be an overestimate. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 4. Very small population			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia is estimated to be 115 000 with a decreasing trend (Bamford et al., 2008; Garnett et al., 2011), however, these estimates are out of date and likely to be an overestimate.

The total number of mature individuals is 115 000 which is not considered extremely low, very low or low. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, state and local levels.

Primary Conservation Objectives

International objectives

1. Achieve a stable or increasing population.
2. Maintain and enhance important habitat.
3. Disturbance at key roosting and feeding sites reduced.

Australian objectives

1. Achieve a stable or increasing population.

2. Maintain and enhance important habitat.
3. Disturbance at key roosting and feeding sites reduced.
4. Raise awareness of curlew sandpiper within the local community.

Conservation and Management Actions

1. Work with governments along the East Asian – Australasian Flyway to prevent destruction of key migratory staging sites.
2. Support initiatives to protect and manage key staging sites of curlew sandpiper.
3. Maintain and improve protection of roosting and feeding sites in Australia.
4. Incorporate requirements for curlew sandpiper into coastal planning and management.
5. Manage important sites to identify, control and reduce the spread of invasive species.
6. Manage disturbance at important sites when curlew sandpipers are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary beach closures.
7. Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Monitoring priorities

1. Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.

Information and research priorities

1. More precisely assess curlew sandpiper population size, distribution and ecological requirements particularly across northern Australia.
2. Improve knowledge about dependence of curlew sandpiper on key migratory staging sites, and wintering sites to the north of Australia.
3. Improve knowledge about threatening processes including the impacts of disturbance.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:

Calidris ferruginea

(ii) The Committee recommends that there should not be a recovery plan for this species.

Threatened Species Scientific Committee

4/3/2015

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Appendix 3 - Approved Conservation Advice for the Great Knot (*Calidris tenuirostris*)

The Minister approved this conservation advice and included this species in the Critically Endangered category, effective from 05 May 2016

Conservation Advice

Calidris tenuirostris

Great knot

Taxonomy

Conventionally accepted as *Calidris tenuirostris* Horsfield, 1821. Scolopacidae.

Other common names include slender-billed knot; stripe-crowned knot; eastern knot; large sandpiper; great sandpiper (Higgins & Davies 1996).

Monotypic, no subspecies are recognised. Taxonomic uniqueness: medium (22 genera/family, 20 species/genus, 1 subspecies/species; Garnett et al. 2011).

Summary of assessment

Conservation status

Critically Endangered: Criterion 1 A2(a)

The highest category for which *Calidris tenuirostris* is eligible to be listed is Critically Endangered.

Calidris tenuirostris has been found to be eligible for listing under the following listing categories:
Criterion 1: A2 (a): Critically Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Calidris tenuirostris.*

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/Sub-species Information

Description

The great knot is the largest of the calidrid shorebirds. It is a medium-sized shorebird and grows to a length of 26–28 cm with a wingspan of approximately 58 cm. Females are slightly larger than males. It has a straight, slender bill that is black with a green tinge at the tip. The eye is brown and legs and feet are dark greenish-grey. The bird has distinctive breeding, non-breeding and juvenile plumages (Higgins & Davies 1996).

In Australia, they are usually seen in non-breeding plumage which is grey upperparts with pale scalloping, and white underparts with heavy streaking on the neck, grading to spots on the breast. In breeding plumage, great knots have a black band across the chest, and black, white and reddish speckles on the upperparts (BirdLife Australia 2012). Juveniles are darker and browner than non-breeding adults and the breast is washed buff-brownish and streaked and spotted dark brown (Higgins & Davies 1996).

When is Australia, the great knot can be confused with similar species. The red knot *Calidris canutus* is slightly smaller with a shorter, more slender bill and a more prominent eyebrow, smaller spots on the underparts, and shorter wings. The curlew sandpiper *Calidris ferruginea* is smaller and has a down-curved bill (BirdLife Australia 2012).

Distribution

Australian distribution

The great knot breeds in the northern hemisphere and undertakes biannual migrations along the East Asian-Australasian Flyway, EAAF. Most of the population winters in Australia (probably >90%; Bamford et al. 2008), mainly at sites on the northern coast (CMS 2014).

The great knot has been recorded around the entirety of the Australian coast, with a few scattered records inland. It is no longer regular at some sites along the south coast of Australia which used to support small numbers (Garnett et al. 2011). The greatest numbers are found in northern Western Australia and the Northern Territory. The species is common on the coasts of the Pilbara and Kimberley, from the Dampier Archipelago to the Northern Territory border, and in the Northern Territory from Darwin and Melville Island, through Arnhem Land to the south-east Gulf of Carpentaria. Other important sites include the Broad Sound-Shoalwater Bay area, the Mackay region and Moreton Bay in Queensland. The species is much less common in south-west Australia, South Australia, Victoria and Tasmania (Higgins & Davies 1996).

For the population visiting Australia, the extent of occurrence is estimated to be 35,000 km^2 (stable) and the area of occupancy is 2800 km^2 and decreasing (Garnett et al. 2011).

Global distribution

The great knot breeds in north-east Siberia and the far north-east of Russia. The species has been recorded from the mouth of the Kolyma River and the Gorelovy Mountains (possibly from Verkhoyanskii Ranges), and from the eastern Anadyr and Koryatsky Ranges (Higgins & Davies 1996).

The great knot is one of 36 migratory shorebird species that breed in the northern hemisphere and are known to regularly migrate to the non-breeding grounds of Australia along the East Asian–Australasian Flyway (EAAF). The EAAF 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 (Department of the Environment 2015a,b).

During migration common stop-over areas for the great knot include east China, the Korean Peninsular and Japan. Less common stop-over areas include the Philippines, Vietnam, Thailand, Malaysia, Indonesia and Papua New Guinea (Higgins & Davies 1996; Barter 2002). The species is also a vagrant in New Zealand, the Arabian Peninsula, the islands of the Indian Ocean, Morocco, north-west Europe and Alaska (Higgins & Davies 1996).

The bays and estuaries of the north-east and north-west parts of the Sea of Okhotsk and northern Sakhalin Island (Russia) have been identified as important staging areas for the southward migration of the great knot (Tomkovich 1997). The Yellow Sea supports about 80% of the EAAF great knot population especially on its northward migration (CMS 2014). Fifteen sites of international importance for the northward migration have been identified in the Yellow Sea area, compared to nine for the southern migration. The area provides a rich feeding source for the birds prior to their flight to Russian breeding grounds which may be still covered in ice and snow making foraging difficult (Bamford et al. 2008).

During the non-breeding season, although most of the great knot population occurs in Australia, small numbers are also known to winter from Myanmar and Bangladesh, west to the Bay of Bengal, and occasionally to the Persian Gulf (Higgins & Davies 1996).

Relevant Biology/Ecology

Life history

A generation time of 8.6 years (BirdLife International 2015) is derived from age at first breeding of 1.7 years, an annual adult survival of 79% (both extrapolated from congeners) and a maximum longevity of 19.7 years (Australian Bird and Bat Banding Scheme; Garnett et al. 2011).

Breeding

The great knot does not breed in Australia.

This species breeds in north-east Siberia and the far north-east of Russia (Higgins & Davies 1996) where it shows a high fidelity to breeding sites (del Hoyo et al. 1996). The great knot is monogamous (Battley et al. 2004) and lays 3-4 eggs in late May to late June. Incubation takes around 21 days. The female departs the breeding grounds after the eggs hatch leaving the male to tend to the chicks (del Hoyo et al. 1996). Around 47–57% of chicks survive to fledge, and fledging takes approximately 20–25 days. Young are independent a few days after fledging. Around 2.3–2.8 fledglings are raised per brood (Tomkovich 1996).

General habitat

In Australia, great knots prefer sheltered coastal habitats with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, salt lakes and non-tidal lagoons. The species rarely occurs on inland lakes and swamps (Higgins & Davies 1996; del Hoyo et al. 1996; Rogers et al. 2006). Along sheltered coasts with areas of intertidal mudflats, they often congregate with other small species of shorebirds and can form large flocks comprising hundreds or thousands of birds (BirdLife Australia 2012).

Roosting habitat

Typically, the great knot roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding grounds (Higgins & Davies 1996; Rogers 2001). A group of approximately 8 610 birds have been recorded roosting at an inland claypan near Roebuck Bay in north-west Western Australia (Collins et al. 2001).

Diet

The great knot feeds on invertebrates by pecking at or just below the surface of moist mud or sand. They feed on bivalves, gastropods, crustaceans and other invertebrates (Higgins and Davies 1996; Moores 2006; Garnett et al. 2011).

Migration patterns

The great knot is one of 36 migratory shorebird species that breed in the northern hemisphere and are known to regularly migrate to the non-breeding grounds of Australia along the EAAF. The EAAF 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 (Department of the Environment 2015a,b).

During migration common resting areas for the great knot include east China, the Republic of Korea and Japan. Less common resting areas include the Philippines, Vietnam, Thailand, Malaysia, Indonesia and Papua New Guinea (Higgins & Davies 1996; Barter 2002).

Departure from breeding grounds

Post-breeding migration starts in late June and seems to occur in three waves up to early September. Birds fly towards the northern Sea of Okhotsk, though individuals have been recorded in inland Ussuriland, Russia. Non-breeders, failed breeders and females migrate southward first, followed by males which have bred successfully which are then followed by young birds (Tomkovich 1997).

The great knot passes through south-east Siberia, and along the coasts of the Sea of Okhotsk, southern Ussuriland (from early August to early September), Sea of Japan, Republic of Korea (late August to mid-October), East China Sea (late July to late October, but mostly August to September), Taiwan (September-October) and Hong Kong (late August-November) (Barter 2002; Higgins & Davies 1996; Tomkovich 1997). Other stop-overs occur in Myanmar, Thailand, the Philippines, western Micronesia, Cambodia, Vietnam, Malaysia, Indonesia, Wallacea, Borneo, Bali, Timor and Papua New Guinea (Higgins & Davies 1996).

Non-breeding season

The great knot arrives on southern non-breeding grounds between August and October (CMS 2014). Large numbers arrive in north-west Australia in late August-early September (Lane 1987), though juveniles and many males may not arrive till October-November (Barter 1986). Most birds stay in northern Australia (Lane 1987) although some move further south and occasionally reach New Zealand (Higgins & Davies 1996) and some move through the Torres Strait (Draffan et al. 1983).

Some birds do move from north-west Australia by November with some arriving at the Gulf of Carpentaria in September-December and some arriving on the east coast in September-November. A few birds may move through inland Queensland, NSW and Victoria from September-February (Higgins & Davies 1996). Usually great knots arrive in South Australia, Victoria and Tasmania from October-November (Lane 1987). Some appear to move from north-west to south-west Australia along the western coast, sometimes moving into south-west Australia in October. At Eyre Bird Observatory, the great knot generally arrives late August-December.

Return to breeding grounds

The great knot is a long-haul migrant that leaves north-west Australia in late March to early April and flies 5400-6000 km non-stop to migration staging sites in China and the Republic of Korea (Battley et al. 2003). Thousands of great knots have been recorded in south-east Irian Jaya in February-April. Immature non-breeders often remain in the tropical parts of the wintering range for the austral winter. The species forages in large flocks of one hundred to many thousand at favoured sites on passage (del Hoyo et al. 1996; CMS 2014). One of the most important staging sites for this species during the northward migration is Yalu Jiang coastal wetland in the north Yellow Sea with an annual average of 44 000 great knots at this site in 2010-12 (i.e. 22% of EAAF population) (Choi et al. 2015). Birds arrive in the breeding grounds from late May with males arriving before females (Tomkovich 1996).

Threats

Migratory shorebirds, such as the great knot, are sensitive to certain development activities due to their high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the great knot across its range include: habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion; changes to the water regime; invasive plants; water quality deterioration; environmental pollution); pollution/contaminants; disturbance; diseases; direct mortality e.g. hunting; and climate change impacts (Moores 2006; Rogers et al. 2006; Garnett et al. 2011; Curran et al. 2014).

Habitat loss and habitat degradation

Almost half of the Republic of Korea's tidal-flats have been reclaimed or degraded (Moores et al. 2008). One of the largest reclamation projects in the world is the Saemangeum project which, through the construction of a 33-km long seawall, has converted two free-flowing estuaries and 40 100 ha of tidal-flats and sea shallows into a vast reservoir and surrounding land (Moores et al. 2008; Murray et al. 2014). Twenty-eight percent of Yellow Sea tidal flats that existed in the 1980s had disappeared by the late 2000s (rate of 1.2% per year; Murray et al. 2014). Furthermore, reference to historical maps suggests that up to 65% of tidal flats in the Yellow Sea region have been lost since the 1960s (Murray et al. 2014).

The great knot is probably more vulnerable to reclamation activities than most other shorebirds due to the very specific species and sizes of shellfish that they eat. Wetland degradation in the Yellow Sea is a particular threat to the great knot as 80% of the population stages in this area on the northward migration (Garnett et al. 2011).

Threats in Australia also include local mangrove encroachment on foraging habitat (Department of the Environment 2015a,b) and habitat loss and degradation from pollution, changes to the water regime and invasive plants (Garnett et al 2011; CMS 2014). Intensive oil exploration, water regulation and diversion infrastructure in major water tributaries have resulted in the reduction of water and sediment flows which compound the problem of habitat loss for shorebird species (Barter 2002).

Climate change

Climate change and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Melville 1997; Harding et al. 2007). Rises in sea level could have a major impact on the great knot due to loss of intertidal habitat (Iwamura et al. 2013). Modelling indicates that the great knot could lose 35% of its remaining population with a 200 cm sea level rise (Iwamura et al. 2013).

Migratory shorebirds, such as the great knot, that live in the tropics before embarking on long migration flights (>5000 km) are susceptible to heat load issues leading up to departure (Battley et al. 2003).

Pollution/contaminants

Migratory shorebirds are adversely affected by pollution (e.g. organochlorines or heavy metals discharged into the sea from industrial or urban sources) both on passage and in non-breeding areas (e.g. Harding et al. 2007). An analysis of the feathers of great knots at Okgu Mudflat, Republic of Korea showed that iron, zinc and copper concentrations in the feathers were within the normal range of other studies for wild birds in the world. However, some of the great knots had elevated concentrations of lead and cadmium (Kim & Oh 2012). High lead concentrations could cause sublethal and reproductive effects and high cadmium concentrations could cause reduced growth rates of bone (Kim & Oh 2012).

Disturbance

Human disturbance can cause waders to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012). Disturbance from construction activities, recreational activities, shellfish harvesting, fishing and aquaculture is likely to increase significantly in the future (Barter 2005; Rogers 2001). Causes of disturbance to shorebirds in Roebuck Bay, Western Australia included birds of prey (39%), people or vehicles (18%) and false alarms (10%, i.e. no cause for disturbance), with the remaining disturbance (33%) being from unknown causes (Rogers 2001).

Diseases

The viral disease testing of Charadriiformes from coastal northwest Australia did not detect any evidence of avian influenza virus excretion in the great knot or any other species from testing carried out since 1992. However, from serologic testing, there was evidence of a very low level of past exposure to the virus (Curran et al. 2014).

Direct mortality

The great knot is still hunted in many countries on migration (Ming et al. 1998; CMS 2014). Number taken each year are unknown. Records between 1982 and 1998 indicate that at least 3,008 individuals of this species were hunted in China, Russia, and Thailand alone. Within this period, taking into account the year with lowest take (lower bound) and the year with highest take (upper bound), the possible range of annual take is at least 4 to 2,319 individuals (Parish and Melville 1985, Ruttanadakul and Ardseungnerm 1986, Bamford 1992, Tang and Wang 1995, Barter et al. 1997, Ming et al. 1998, Ge et al. 2006).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Critically Endangered

The global population was previously estimated at c.380,000 individuals including 360,000 estimated in Australia (Bamford et al. 2008). The Australian population (number of mature individuals) was revised down by Garnett et al. (2011) to 290,000 (Garnett et al. 2011; BirdLife International 2015). This population estimate is likely out of date given the ongoing population declines.

In Australia, numbers declined at survey locations including a 24% decline at Eighty-mile Beach, WA between 2000–2008 (Rogers et al. 2009; Garnett et al. 2011), a 4.5% per year between 1992 and 2008 at Moreton Bay, Qld (Wilson et al. 2011), and a 34% decline across 49 sites between 1983 and 2007 (Garnett et al. 2011). A recent survey of significant coastal wetlands in the north and north-east Australia found no evidence that great knots have shifted their wintering grounds in Australia (Chatto 2012; CMS 2014).

The numbers of great knots at Yalu Jiang (north Yellow Sea), one of the most important staging sites for this species, declined by 18% from 1999 to 2010-12 (Choi et al. 2015).

The great knot is classified as endangered on the IUCN Red List owing to the rapid population decline caused by the reclamation of non-breeding stopover grounds, and under the assumption that further proposed reclamation projects will cause additional declines in the future (BirdLife International 2015).

A recent more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council collaborative grant), suggests the rate of decline is large enough to pass the threshold for the critically endangered category (Studds et al., submitted). Time series data from directly observed summer counts at a large number of sites across Australia indicate a very severe population decline of 83.1% over 25 years (7.1% per year) which for this species is equal to three generations (Studds et al., submitted).

In large part, the observed decline in great knot numbers across Australia stems from ongoing loss of intertidal habitat at key migration staging sites in the Yellow Sea (Murray et al. 2014). Threats are also occurring in Australia including coastal development, habitat degradation and human disturbance. As such, qualification under criterion A2 rather than A1 seems warranted.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (25 years for this assessment), equivalent to at least 83.1 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Critically Endangered.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated at 35 000 km^2 (stable) and area occupied 2 800 km^2 (decreasing; Garnett et al., 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 290 000 (decreasing) in 2011 (Garnett et al., 2011), but has declined since. There are no current data available to allow assessment against this criterion. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 290 000 in 2011 (Garnett et al., 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key breeding and migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites.
- Incorporate requirements for great knot into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.
- Manage disturbance at important sites which are subject to anthropogenic disturbance when great knots are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess great knot life history, population size, distribution and ecological requirements particularly across northern Australia.
- Improve knowledge about dependence of great knot on key migratory staging sites, and non-breeding sites to the in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:

Calidris tenuirostris

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 4 - Approved Conservation Advice for the Greater Sand Plover (*Charadrius leschenaultii*)

The Minister approved this conservation advice and included this species in the Vulnerable category, effective from 5 May 2016

Conservation Advice

Charadrius leschenaultii

Greater sand plover

Taxonomy

Conventionally accepted as *Charadrius leschenaultii* Lesson, 1826. Charadriidae.

Other common names include: large sand plover; great, large or large-billed dotterel or sand-dotterel; Geoffroy's plover (Marchant & Higgins 1993).

The greater sand plover is a conventionally accepted species (Marchant & Higgins 1993; Christidis & Boles 2008). There are three subspecies:

- nominate subspecies *C. l. leschenaultii* which breeds in the northern parts of the Gobi Desert in Mongolia, in north-western China and southern Siberia, and spends the non-breeding season in Australasia, south-east Asia and the Indian subcontinent;
- *C. l. columbinus* which breeds in the Middle East, Turkey to southern Afghanistan, and spends the non-breeding season in the Red Sea, Gulf of Aden and the south-eastern shores of the Mediterranean Sea (Marchant & Higgins 1993); and,
- *C. l. scythicus* which breeds from Turkmenistan through south Kazakhstan and spends the non-breeding season along the coasts of eastern and southern Africa (Gill & Donsker 2015).

Note that *C. l. scythicus* was previously known as *C. l. crassirostris* until it was established that this name is pre-occupied by another plover, a subspecies of Wilson's Plover, *C. wilsonia crassirostris* (Carlos et al. 2012; Gill & Donsker 2015).

Summary of assessment

Conservation status

Vulnerable: Criterion 1 A2 (a)

The highest category for which *Charadrius leschenaultii* is eligible to be listed is Vulnerable.

Charadrius leschenaultii has been found to be eligible for listing under the following listing categories
Criterion 1: A2 (a): Vulnerable
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice assessment of new information provided to the Committee to list *Charadrius leschenaultia.*

Public Consultation
Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/Sub-species Information

Description
The greater sand plover is a small-to-medium sized shorebird (length 22–25 cm; body mass 75–100 g) with a straight longish bill that bulges towards the end but has a pointed tip. The legs are long and olive-grey (Marchant & Higgins 1993; Ward 2012).

In non-breeding plumage, the head, nape and upperparts are grey-brown and there are large grey-brown patches on the sides of the breast. The forehead eyebrow, chin, neck and underparts are white. Sexes are non-distinguishable from each other when in non-breeding plumage. However, sexes differ when in breeding plumage with males having a chestnut breast-band and rufous tinging to the head and nape and with black on the face (Marchant & Higgins 1993; Ward 2012). Juvenile birds appear similar to non-breeding adults, but the feathers of the upperparts have narrow buff fringes and indistinct dark streaking and sub-terminal bands. Juveniles may also have a buff tinge to the face, and grey-brown patches at the sides of the breast, which may extend as a wash across the breast (Marchant & Higgins 1993).

When in Australia the species is usually in non-breeding plumage and is often difficult to distinguish from the similar lesser sand plover *C. mongolus* although the greater sand plover is distinctly larger (Marchant & Higgins 1993). To untrained observers, greater sand plovers may be difficult to detect in mixed flocks of shorebirds although, when roosting, the greater sand plover tends to roost higher up the beach than other shorebirds and is usually segregated from lesser sand plovers (Marchant & Higgins 1993). Similar to the oriental plover *C. veredus*, although the greater sand plover has a smaller head, longer neck and longer wings (Marchant & Higgins 1993).

Distribution

Australian distribution

The greater sand plover breeds in the northern hemisphere and undertakes annual migrations to and from southern feeding grounds for the austral summer. The subspecies *C. l. leschenaultii* occurs in the East Asian-Australasian Flyway, EAAF (Bamford et al. 2008). Nearly three quarters of the EAAF population is in Australia during the non-breeding period (Bamford et al. 2008).

The greater sand plover distribution in Australia during the non-breeding season is widespread, although the most are found in northern Australia (Minton et al. 2006; Garnett et al. 2011; Ward 2012). In general, the distribution of this species is:

Western Australia - especially widespread between North West Cape and Roebuck Bay and also occasionally recorded along the coast of southern Western Australia;

Northern Territory - recorded from most of the coastline with the most significant areas around the Joseph Bonaparte Gulf, the coast from Anson Bay to Murgenella Creek (including the south coast of the Tiwi Islands), the northern Arnhem coast, and the Port McArthur area;

Queensland - south-eastern parts of the Gulf of Carpentaria and widespread from the Torres Strait along the eastern coast of Queensland;

New South Wales - found from the Queensland border along the coast to the Northern Rivers region with occasional records south to about Shoalhaven Heads;

Victoria - mostly recorded from Corner Inlet, Western Port and Port Phillip Bay;

Tasmania - small numbers occur in most years; and,

South Australia - mostly recorded from the Coorong, Gulf St Vincent and Spencer Gulf, as well as on the Eyre Peninsula, west to about Streaky Bay (Marchant & Higgins 1993; Barrett et al. 2003; Chatto 2003; Minton et al. 2006; Garnett et al. 2011).

This species has also been recorded on Ashmore Reef, Cocos (Keeling) Islands, Christmas Island and Lord Howe Island (Marchant & Higgins 1993).

Global distribution

The greater sand plover has an extremely large global range with the extent of occurrence estimated to be 3,460,000 km^2 (BirdLife International 2015).

The greater sand plover is one of 35 migratory shorebird species that breed in the northern hemisphere during the boreal summer and are known to annually migrate to the non-breeding grounds of Australia along the EAAF for the austral summer. In general, the EAAF 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 (Department of the Environment 2015a,b). Of the three subspecies of the greater sand plover, only *C. l. leschenaultii* occurs in the EAAF and this subspecies also occurs in the Central Asian Flyway (Bamford et al. 2008).

The greater sand plover breeds in the northern Gobi Desert of Mongolia and adjacent areas of southern Siberia; north-western China; from south-eastern Kazakhstan west to the Aral Sea and the eastern shores of the Caspian Sea, and south to Afghanistan; and at scattered sites from Azerbaijan, west into Turkey and south through Syria to Jordan (Marchant & Higgins 1993; Wiersma 1996; Gill & Donsker 2015).

The subspecies *C. l. leschenaultii* , which occurs in Australia during the non-breeding period, breeds in China, Mongolia and nearby parts of Russia (Bamford et al. 2008; Garnett et al. 2011).

Relevant Biology/Ecology

Life history

A generation time of 8 years (BirdLife International 2015) is derived from an average age at first breeding of 2 years (Cramp et al. 1983), an annual adult survival of 56% (extrapolated from congeners) and a maximum longevity of 12.6 years (Australian Bird and Bat Banding Scheme; Garnett et al. 2011).

Breeding

The migratory greater sand plover does not breed in Australia.

At breeding sites in Mongolia, north-western China and southern Siberia, the greater sand plover nests in a shallow scrape on the ground amongst sand-hills, gravel, or on other barren substrates. In these areas, this species is predominantly found in open desert or semi-arid areas that are predominantly treeless and at elevations up to 3 000 m (del Hoyo et al. 1996; BirdLife International 2015). Egg laying occurring in April and May. Clutches usually comprise three eggs (range 2-4), which are incubated by both parents for at least 24 days. The chicks fledge after about 30 days (del Hoyo et al. 1996).

General habitat

In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches, large intertidal mudflats, sandbanks, salt-marshes, estuaries, coral reefs, rocky islands rock platforms, tidal lagoons and dunes near the coast (Marchant & Higgins 1993; del Hoyo et al. 1996; BirdLife International 2015).

Feeding habitat

Greater sand plovers usually feed from the surface of wet sand or mud on open intertidal flats of sheltered embayments, lagoons or estuaries (Marchant & Higgins 1993).

Roosting habitat

Greater sand plovers usually roost on sand-spits and banks on beaches or in tidal lagoons (Marchant & Higgins 1993), and occasionally on rocky points or in adjacent areas of saltmarsh (Gosper & Holmes 2002) or claypans (Collins et al. 2001). They tend to roost further up the beach than other shorebirds, sometimes well above high-tide mark (Marchant & Higgins 1993). To avoid heat stress in tropical areas, shorebirds showed a strong preference for roost sites where a damp substrate lowered the local temperature (Battley et al. 2003; Rogers et al. 2006). Approximately one day after a cyclone at Broome, Western Australia, greater sand plovers were recorded in lower than expected numbers and it was thought that some birds may have moved to sheltered areas to avoid the high winds and heavy rain associated with the cyclone (Jessop & Collins 2000).

Diet

During the breeding season, the diet of the greater sand plover consists mainly of terrestrial insects and their larvae (especially beetles, termites, midges and ants), and occasionally lizards (del Hoyo et al. 1996). During the non-breeding season, the diet mostly consists of molluscs, worms, crustaceans (especially small crabs and sometimes shrimps) and insects (including adults and larvae of termites, beetles, weevils, earwigs and ants) (Marchant & Higgins 1993; Jessop 2003; del Hoyo et al. 1996; BirdLife International 2015).

The greater sand plover usually forages visually, with a running, stopping and pecking action typical of many species of plovers. It gleans the surface of the substrate or probes just below the surface (Marchant & Higgins 1993; Jessop 2003).

Migration patterns

After the end of breeding, migratory flocks of the greater sand plover form between mid-June and early-August, and arrive at non-breeding grounds between mid-July and November with adults arriving before juveniles (del Hoyo et al. 1996; BirdLife International 2015). The greater sand plover is often seen migrating in large flocks with lesser sand plovers (Draffan et al. 1983).

The greater sand plover is one of the first migratory shorebirds to return to north-western Australia, usually arriving in late July (Minton et al. 2005a). It is thought that greater sand plovers may make the trip between the breeding grounds and the non-breeding grounds (a distance of ~7,500 km) with only one major stopover (Minton et al. 2006).

The birds who spend the non-breeding period in south-east Asia start moving northwards to the breeding grounds in late-February (the migration peaking in March to early-April), arriving from mid-March to May. Most non-adult birds remain in the southern non-breeding areas during the breeding season (del Hoyo et al. 1996; BirdLife International 2015).

Departure from breeding grounds

The migratory route of the greater sand plover is more westerly than other shorebirds that visit Australia (Minton et al. 2004; Minton et al. 2006). Most band recoveries and flag sighting records have been concentrated in a fairly narrow band in Vietnam, in the southern half of the Chinese mainland, and in Taiwan (Minton et al. 2006). On migration, the species has been recorded only in small numbers in eastern Asia, including eastern and south-eastern China (including Hong Kong), Taiwan and Vietnam (Minton 2005; Ma et al. 2006; Minton 2006; Zheng et al. 2006). However, greater numbers are recorded on passage through south-east Asia, e.g. the Philippines, the Malay Peninsula and Indonesia (Crossland et al. 2006; Bamford et al. 2008).

It has been suggested that greater sand plovers may be capable of non-stop flight between breeding and non-breeding grounds (Marchant & Higgins 1993), which could explain the scarcity of large numbers of greater sand plovers (and "important sites") in east-Asia (Bamford et al. 2008). It may be that sites in south-east Asia, where large numbers have been recorded during southward migration, are the arrival points for birds migrating southwards from the breeding grounds (Bamford et al. 2008). An assessment of the body fat proportions in both adult and juvenile birds considered that greater sand plovers have the ability to fly directly from Taiwan to Australia (Chiang & Liu 2005).

Non-breeding season

The greater sand plover is gregarious during the non-breeding season when it occurs in flocks, sometimes comprising up to several hundred birds (e.g. a single flock of this species at Fog Bay, south-west of Darwin was estimated as 1,800 individuals; Chatto 2005). The greater sand plover often flocks with other shorebirds, especially the lesser sand plover, though the two species usually remain segregated when roosting with one another (Marchant & Higgins 1993).

In Australasia, most records of greater sand plovers during the non-breeding season are from the north coast of Australia, with smaller numbers occurring along other Australian coasts, as well as in Papua New Guinea and New Zealand (Marchant & Higgins 1993). The paucity of inland records within Australia suggests that movements to southern and eastern areas occur around the coastline rather than across the continent, and small numbers migrate through Torres Strait and south along the east coast between September and November (Draffan et al. 1983; Barter & Barter 1988; Marchant & Higgins 1993). The species begins to depart from southern coasts by March, moving north along the east coast, with influxes recorded in Queensland in late March. Birds migrate north through the Top End between late February and April with most adult birds having left the north-west by mid to late April (Barter & Barter 1988; Marchant & Higgins 1993).

Return to breeding grounds

It is considered that a substantial proportion of greater sand plovers departing from Australia have sufficient weight which may enable them to overfly south-eastern Asia and reach the coast of south-west China (Barter & Barter 1988).

Using geolocators, the northward migration of greater sand plovers was tracked from north-west Australia (Broome). The tracked birds appeared to complete large initial flights before stopping in Vietnam or locations further east and then continuing onwards to breeding grounds. All geolocators in this study ceased to function when birds were over north China or Mongolia (Minton et al. 2011). Only a small proportion of greater sand plovers are known to visit the Yellow Sea area. Further geolocator deployments on greater sand plovers will provide more extensive data on stopover locations (Minton et al. 2011).

Threats

Migratory shorebirds, such as the greater sand plover, are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands required for migration; and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the greater sand plover across its range, but particularly at East Asian staging sites, include: habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion; reduced river flows; environmental pollution; invasive plants), pollution/contamination impacts, disturbance, direct mortality (e.g. hunting), diseases; and, climate change impacts (Melville 1997; Garnett et al. 2011; BirdLife International 2015; Department of the Environment 2015a,b).

Threats to the greater sand plover in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Garnett et al. 2011; Department of the Environment 2015a,b).

Habitat loss and habitat degradation

There are a number of threats that affect migratory shorebirds in the EAAF with the greatest threat being indirect and direct habitat loss (Melville 1997). As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to): loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats, invasion of intertidal mudflats by weeds such as cordgrass, water pollution and changes to the water regime, changes to the hydrological regime and exposure of acid sulphate soils, hence changing the chemical balance at the site (Department of the Environment 2015a,b).

Migratory shorebird staging areas used during migration through eastern Asia are being lost and degraded by activities which are reclaiming intertidal mudflats for development or converting them for the aquaculture industry (Moores et al. 2008; MacKinnon et al. 2012; Murray et al. 2014).

It is thought that only a small proportion of the EAAF population of greater sand plovers visit the Yellow Sea (Minton et al. 2011). Therefore, compared to a range of other migratory shorebird species that occur in Australia, the greater sand plover may be less likely to have been affected by major loss of intertidal habitat and foreshore reclamation that has been occurring, and continues to occur, in the Yellow Sea region (Minton et al. 2011).

However, habitat loss and intertidal reclamation is also a threat in other areas of the EAAF, such as in Malaysia, where significant numbers of greater sand plovers have been recorded (Wei et al. 2006). In coastal and intertidal areas of Malaysia, migration shorebird habitat is being destroyed or degraded due to land reclamation development activities (e.g. for industries, housing, aquaculture, agriculture and tourism purposes), fishing, logging/destruction of mangroves, and pollution (e.g. domestic sewage, industrial waste, aquaculture waste; Wei et al. 2006).

One of the species' migratory staging areas in China (Chongming Island) is undergoing significant habitat loss and degradation through conversion to aquaculture ponds, farmlands and vegetable gardens, the cultivation of the invasive plant *Spartina alterniflora* on tidal flats (promoting rapid sedimentation with the intention of reclaiming the area), and the Three Gorges Dam on the upper reaches of the Yangtze River reducing the supply of river-borne sediment to mudflats in the area (Ma et al. 2002b; BirdLife International 2015). More than half of all Chinese coastal wetlands were lost between 1950 and 2000 (An et al. 2007). In addition, intensive oil exploration and extraction, and reduction in river flows due to upstream water diversion, are other potentially significant threats in parts of China where this species is present in internationally significant numbers (Barter et al. 1998; Barter 2005).

In Australia, there are a number of threats common to most migratory shorebirds, including the greater sand plover. The loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss at Australian sites. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b).

Residential, farming, industrial and aquaculture/fishing activities represent the major cause of habitat loss or modification in Australia (Department of the Environment 2015a,b).The non-breeding grounds of the species in south-eastern Australia are threatened by habitat degradation, loss and human disturbance (Garnett et al. 2011) whereas sites in the Northern Territory are thought to be generally free of such disturbances (Ward 2012).

Climate change

Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Harding et al. 2007). Migratory shorebirds are also particularly susceptible to heat stress (Battley et al. 2003; Rogers et al. 2006). Climate change projections for Australia include the likelihood of increased temperatures and rising sea levels with more frequent and/or intense extreme climate events which may result in species loss and habitat degradation (Chambers et al. 2005).

Any sea level rise will greatly alter coastal ecosystems, causing habitat change and loss for shorebird species. Modelling has shown that migratory species in the EAAF are at greater risk from sea level rise than previously thought (Iwamura et al. 2013). The modelling indicated that the effect of sea level rise inundating 23–40% of intertidal habitat areas along the migration routes of migratory shorebirds would cause a reduction in population flow (i.e. maximum flow capacity of the migratory population) of up to 72% across the shorebird species assessed. This magnification of effect was particularly due to shorebirds using a few key sites in the EAAF where a large proportion of the population stops and stages (Iwamura et al. 2013).

Pollution/contamination impacts

Migratory shorebirds are also adversely affected by pollution, both on passage and in non-breeding areas (Melville 1997; Harding et al. 2007). Pollution is a particular threat as pollutants tend to accumulate and concentrate in wetlands (Department of the Environment 2015a,b). Industrial pollution (e.g. via accidental release) can lead to the build-up of heavy metals or toxic elements in the substrate of wetlands which, in turn, can affect the benthic prey fauna of shorebirds like the greater sand plover (Department of the Environment 2015a,b).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human recreation activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012).

Disturbance can result from recreational activities including fishing, boating, four wheel driving, walking dogs, noise and night lighting. While some disturbances may have a low impact, it is important to consider the combined effect of disturbances with other threats (Department of the Environment 2015a,b).

With increasing tourist visitation and development around Broome, Western Australia, increasing levels of disturbance from human recreational activity are likely for the migratory shorebirds in this area. Recreational fishing, four-wheel driving, unleashed dogs and jet-skiing may disturb the foraging or roosting behaviour of migratory shorebirds. Migratory shorebirds are most susceptible to disturbance during daytime roosting and foraging periods (Department of the Environment 2015a,b).

Introduced species

Introduced plants, such as cord grass *Spartinia*, can invade intertidal mudflats and reduce the amount of suitable foraging areas, as has already occurred in other countries (Goss-Custard & Moser 1988). Exotic marine pests may also result in the loss of benthic food sources (Department of the Environment 2015a,b).

Direct mortality

Direct mortality may result from collision with large structures (e.g. wind farms) which cause a barrier to migration or movement pathways, bird strike with vehicles and aircraft, hunting, chemical spills, oil spills and predation (attack by domestic pets, hunting by humans; Schacher et al., 2013; Department of the Environment 2015a,b).

The greater sand plover is subject to commercial hunting (for sale at market or to restaurants) which is a major threat in the area of Chongming Island, China (Ma et al. 2002a; BirdLife International 2015). Records between 1985 and 2009 indicate that at least 567 individuals of this species were hunted in China, Thailand, and Myanmar. Within this period, taking into account the year with lowest take (lower bound) and the year with highest take (upper bound), the possible range of annual take is at least 1 to 340 individuals (Ruttanadakul and Ardseungnerm 1986, Tang and Wang 1995, Ming et al. 1998, Ge et al 2006, Zöckler et al. 2010).

Disease

Since, 1992, the viral disease testing of Charadriiformes from coastal northwest Australia has not detected any evidence of avian influenza virus excretion in the greater sand plover or any other shorebird species tested. However, from serologic testing, there was evidence of a very low level of past exposure to the virus (Curran et al. 2014).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Vulnerable

The global population of the greater sand plover has been estimated to be c.180,000 - 360,000 individuals (Wetlands International 2006; BirdLife International 2015). The global population trend for the species is unknown although it is not thought to be decreasing sufficiently rapidly to warrant up-listing from its current global status of 'Least Concern' (BirdLife International 2015). However, the global population trend is difficult to determine because of uncertainty surrounding the impacts of habitat modification on population sizes (BirdLife International 2015).

Of the total global population of 180,000 - 360,000 individuals for the species (Birdlife International 2015), about 125,000–200,000 are thought comprise the subspecies *C. l. leschenaultii*, >10,000 the subspecies *C. l. columbinus*, and about 65,000 the subspecies *C. l. scythicus* (Wiersma 1996).

It has been estimated that ~46% of the global population of the great sand plover occurs in the EAAF (MacKinnon et al. 2012) with about three quarters of the EAAF population occurring in Australia (Bamford et al. 2008). The number of greater sand plovers (all belonging to the subspecies *C. l. leschenaultii*) that occur in the EAAF has been estimated at around 100,000 with approximately 75,000 of these spending the non-breeding period at sites in Australia (Bamford et al. 2008; Garnett et al. 2011).

Numbers of greater sand plovers declined at Moreton Bay, Queensland by c.60% between 1998 and 2008 (Fuller et al. 2009) which has been assessed as a statistically significant decrease of 6% per year (Wilson et al. 2011). Numbers decreased at Eighty-mile Beach, Western Australia by c.65% between 2000 and 2008, whereas numbers at Bush Point were variable between 2004 and 2008 (Rogers et al. 2009; MacKinnon et al. 2012).

Population trends outside Australia are poorly known but numbers in Japan have, in general, slightly increased between 1978 and 2008 (Amano et al. 2010). Overall, the evidence suggests there has been a decline of 30-49% over 17 years across Australia (averaging some contradictory trends) (Garnett et al. 2011). This decline is likely to continue given ongoing threats to this species' migratory staging sites in East Asia (Garnett et al. 2011).

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (24 years for this assessment), equivalent to at least 30-49 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Vulnerable.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 35 700 km^2 (stable) and area occupied 2 600 km^2 (stable; Garnett et al. 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a) (ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 75 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 75 000 in 2011 (Garnett et al., 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key breeding and migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites.
- Incorporate requirements for greater sand plover into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.
- Manage disturbance at important sites which are subject to anthropogenic disturbance when greater sand plovers are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess greater sand plover life history, population size, distribution and ecological requirements particularly across northern Australia.
- Improve knowledge about dependence of greater sand plover on key migratory staging sites, and non-breeding sites to the in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:

Charadrius leschenaultii

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 5 - Approved Conservation Advice for the Lesser Sand Plover (*Charadrius mongolus*)

The Minister approved this conservation advice and included this species in the Endangered category, effective from 5 May 2016

Conservation Advice

Charadrius mongolus

Lesser sand plover

Taxonomy

Conventionally accepted as *Charadrius mongolus* Pallas, 1776. Charadriidae.

Other common names include Mongolian plover, dotterel, sand-plover or sand-dotterel; lesser dotterel or sand-dotterel; short-nosed sand plover (Marchant & Higgins 1993).

Two subspecies occur in Australia, *Charadrius mongolus mongolus* lesser sand plover (Mongolian) and *C. m. stegmanni* lesser sand plover (Kamchatkan). Taxonomic uniqueness: medium (11 genera/family, 35 species/genus, 5 subspecies/species; Garnett et al., 2011).

Summary of assessment

Conservation status

Endangered: Criterion 1 A2 (a)

The highest category for which *Charadrius mongolus* is eligible to be listed is Endangered.

Charadrius mongolus has been found to be eligible for listing under the following listing categories:
Criterion 1: A2 (a): Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Charadrius mongolus*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/Sub-species Information

Description

The lesser sand plover is a small to medium-sized (18 - 21 cm in length and 56 - 71 g in body mass) grey-brown and white shorebird. It has a dark eye-stripe, short stout black bill and short grey legs (Marchant & Higgins 1993; Ward 2012).

Sexes differ when in breeding plumage, but are inseparable when in non-breeding plumage. In non-breeding plumage, the head, nape and upperparts are dark brown-grey and there are large brown-grey patches on the sides of the breast. The cheeks are dark brown and the forehead, eyebrow, chin, neck and underparts are white (Marchant & Higgins 1993; Ward 2012).

Males in breeding plumage have a broad chestnut breast-band with a black upper margin, a chestnut forehead and nape, and a broad black mask on the face (Marchant & Higgins 1993; Ward 2012). The female is similar except the mask is dark grey-brown or rufous and the crown, hindneck, sides of the neck and the breast-band are duller chestnut (Marchant & Higgins 1993).

Juvenile birds are similar to adults in non-breeding plumage but have buff fringes to their feathers and the breast-band is indistinct (Marchant & Higgins 1993).

When in Australia the species is usually in non-breeding plumage and is often difficult to distinguish from the similar greater sand plover *C. leschenaultii* although the lesser sand plover is distinctly smaller (Marchant & Higgins 1993).

Distribution

Australian distribution

The lesser sand plover breeds in the northern hemisphere and undertakes annual migrations to and from southern feeding grounds for the austral summer. Four of the five subspecies occur in the East Asian-Australasian Flyway, EAAF (Bamford et al. 2008). Two of these EAAF subspecies, *C. m. mongolus* and *C. m. stegmanni*, occur in Australia during the non-breeding season (Bamford et al. 2008).

Within Australia, the lesser sand plover is widespread in coastal regions and has been recorded in all states. It mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula, islands in Torres Strait, and along the entire east coast. It is most numerous in Queensland and New South Wales (Marchant & Higgins 1993; Watkins 1993; Milton & Driscoll 2006; Minton et al. 2006). In the Northern Territory, lesser sand plovers have been recorded from most of the coastline with the most significant areas being the coast from Anson Bay to Murgenella Creek, the northern Arnhem coast, Blue Mud Bay and the Port McArthur area (Chatto 2003; Ward 2012). The species has also been recorded on Lord Howe Island, Norfolk Island and Christmas Island (Marchant & Higgins 1993).

Global distribution

The lesser sand plover has an extremely large global range with the extent of occurrence estimated to be 3,620,000 km^2 (BirdLife International 2015).

East Asian-Australasian Flyway (EAAF)

The lesser sand plover is one of 36 migratory shorebird species that breed in the northern hemisphere during the boreal summer and are known to annually migrate to the non-breeding grounds of Australia along the EAAF for the austral summer. In general, the EAAF 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 (Department of the Environment 2015a,b).

With the exception of *C. m. pamirensis* that breeds in central Siberia and migrates to southern Asia and eastern Africa, the remaining four subspecies of the lesser sand plover all occur in the EAAF and two of these occur in Australia during the non-breeding period (Table 1; distribution information from Marchant & Higgins 1993; Tomkovich 2003; Bamford et al. 2008; Gill & Donsker 2015).

Table 1: Breeding and non-breeding distribution of subspecies of the lesser sand plover that occur in the East Asian-Australasian Flyway (EAAF).

EAAF subspecies	Breeding distribution	Non-breeding distribution
C. m. mongolus	Inland eastern Siberia, including the Russian Far East, and Mongolia.	China, Philippines, Indonesia, Papua New Guinea and Australia. This is the most common subspecies observed in Australia (Bamford et al. 2008).
C. m. stegmanni	Russia, especially around Kamchatka, on the northern Kuril and Commander Islands and on the Chukotka Peninsula.	Tends to be more northerly than that of *C. m. mongolus* and includes China, Japan, the Philippines, eastern Indonesia, Melanesia and Australia.
C. m. atrifrons	Himalayas and southern Tibet.	Includes sites around the Bay of Bengal, Malaysia, Thailand and western Indonesia.
C. m. schaeferi	Southern Mongolia to eastern Tibet and adjacent provinces of China.	Malaysia, Thailand and western Indonesia.

Relevant Biology/Ecology

Life history

A generation time of 8 years (BirdLife International 2015) is derived from an average age at first breeding of 2 years, an annual adult survival of 56% and a maximum longevity of 12.6 years, all extrapolated from *C. leschenaultii.*

Breeding

The lesser sand plover does not breed in Australia.

This species nests in the northern hemisphere during the boreal summer with egg laying occurring between mid-May and mid-June. Clutch size is typically three eggs, but occasionally two, and incubation lasts for 22–24 days. Chicks are usually tended by the male, but sometimes by both parents, and fledge at about 30–35 days old (Wiersma 1996).

General habitat

At northern breeding grounds, the lesser sand plover's nest is a shallow scrape in bare sand or shingle, sometimes beside bushes and big stones (del Hoyo et al. 1996; BirdLife International 2015).The breeding grounds are at high elevations (up to 5,500 m), above the tree-line, in tundra on steppes and in flat, barren valleys and basins, usually in boggy areas. In Siberia and the Commander Islands, Russia, the species also occurs at sea-level and breeds in the sand dunes and shingle along the coast (Marchant & Higgins 1993; del Hoyo et al. 1996).

During the non-breeding season, the species is almost strictly coastal, preferring sandy beaches, mudflats of coastal bays and estuaries, sand-flats and dunes near the coast (del Hoyo et al. 1996) and occasionally frequenting mangrove mudflats in Australia (BirdLife International 2015).

The lesser sand plover is gregarious and usually occurs in small to large flocks often with more than 100 individuals at favoured sites in northern Australia (Department of the Environment

2015a,b). This species often occurs with other shorebird species when feeding especially the greater sand plover although the two species usually remain segregated when roosting (Marchant & Higgins 1993). The species is mainly diurnal but may forage on moonlit nights (del Hoyo et al. 1996; BirdLife International 2015).

Feeding habitat

The lesser sand plover mainly feeds on extensive, freshly-exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks. They also occasionally forage on coral reefs and on sandy or muddy river margins and, at inland sites, they have been recorded foraging in muddy areas around lakes, soaks and bores (Marchant & Higgins 1993).

Roosting habitat

The lesser sand plover roosts near foraging areas, on beaches, banks, spits and banks of sand or shells and occasionally on rocky spits, islets or reefs (Marchant & Higgins 1993).

Diet

The breeding diet of the lesser sand plover includes beetles, weevils, fly larvae, stalk worms and crabs (del Hoyo et al. 1996). During the non-breeding season, the diet includes insects, crustaceans (especially crabs and amphipods), molluscs (especially bivalves) and polycheate worms (Marchant and Higgins 1993; Garnett et al. 2011; BirdLife International 2015).

Prey is located by sight, using the typical run-stop-peck method used by most *Charadrius* plovers. The lesser sand plover gleans the surface of moist substrates or probes or digs just below the surface for prey (Marchant & Higgins 1993).

Migration patterns

The lesser sand plover is a shorebird that breeds in the northern hemisphere and migrates south for the boreal winter. The five different subspecies have different breeding and non-breeding ranges, although the non-breeding ranges of subspecies *C. m. mongolus* and *C. m. stegmanni* overlap in southern China, Philippines, Thailand, Malaysia, western Indonesia and northern Australia (Marchant & Higgins 1993).

Departure from breeding grounds

Populations breeding in eastern Russia, Kamchatka, the Commander Islands and the Chukotka Peninsula (i.e. *C. m. stegmanni*) leave the breeding grounds from late-July to early-September to spend the non-breeding period from Taiwan to Australia (del Hoyo et al. 1996; BirdLife International 2015). Females leave from late July (though mostly in August and early September) and juveniles leave in the first two or three weeks of September (Wiersma 1996). The timing of departure from the breeding grounds by the subspecies *C. m. mongolus* is unknown, but is probably similar to that of *C. m. stegmanni* (Marchant & Higgins 1993).

Non-breeding season

The species is present at non-breeding grounds in Australasia mostly between September and April or May, with greatest numbers occurring in northern Australia (Marchant & Higgins 1993). Birds generally arrive in Australia between August and October and start moving along the northern and eastern coasts until October or November. Maximum numbers occur at most sites by December and remain fairly constant until late February. In southern Australia, numbers usually increase gradually between August and December. Numbers begin to increase at various sites in northern Australia between February and April (mostly March to April), suggesting that birds move along the eastern and northern coasts before they leave on their northern migration in April (Marchant & Higgins 1993). Some non-breeding individuals (most likely one-year-old birds) may stay at southern non-breeding sites during the austral winter (del Hoyo et al. 1996; BirdLife International 2015).

Apart from arrivals and departures before northern migration, numbers of lesser sand plovers remain fairly constant at many sites from mid-November to late February. However, fluctuations in numbers in some areas (e.g. sites in northern Queensland) suggest that local movements take place (Marchant & Higgins 1993).

Return to breeding grounds

Northward and southward migration are reported to follow similar routes through eastern Russia, the Yellow Sea, along the east coast and overland through China, and through Japan (northward migration only) and the Philippines. The distribution of important sites in the two migration periods was similar except for there being more sites in China and Japan during northward migration. There may be additional significant sites in North Korea (Bamford et al. 2008).

Description of migratory pathways and important sites

The Yellow Sea is a very important region for the migration of the lesser sand plover. It is estimated that 50% of the lesser sand plovers in the EAAF utilise the Yellow Sea area on northward migration (Barter 2002; Garnett et al. 2011). In this region, sites in the Republic of Korea and China are of international importance as well as some areas in the inner Gulf of Thailand (Barter 2002; Bamford et al. 2008). Bamford et al. (2008) provide maps of the northward and southward key migration sites.

It is thought that it may be possible for *C. m. mongolus* moving to and from Australia to overfly much of south-eastern Asia (Bamford et al. 2008) as theoretical flight ranges of 2,600 – 4,400 km have been proposed (Barter 1991 cited in Bamford et al. 2008).

High counts in Malaysia and Thailand during both migration periods may be of the subspecies *C. m. schaeferi* (Bamford et al. 2008). On northward migration *C. m. mongolus* (northern breeding range) have been reported from Hong Kong (China) and *C. m. stegmanni* (north-eastern breeding range) have been reported from the Korean Peninsula (Marchant & Higgins 1993; Bamford et al. 2008).

Threats

Migratory shorebirds, such as the lesser sand plover, are sensitive to certain development activities due to their high site fidelity, tendency to aggregate, very high energy demands required for migration, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the lesser sand plover across its range, but particularly at East Asian staging sites, include: habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion; reduced river flows; environmental pollution; invasive plants); pollution/contamination impacts; disturbance; direct mortality (e.g. hunting); diseases; and, climate change impacts (Melville 1997; Garnett et al. 2011; BirdLife International 2015; Department of the Environment 2015a,b).

Threats to the lesser sand plover in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Garnett et al. 2011; Department of the Environment 2015a,b).

Habitat loss and habitat degradation

There are a number of threats that affect migratory shorebirds in the EAAF with the greatest threat being indirect and direct habitat loss (Melville 1997). As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to): loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats; invasion of intertidal mudflats by weeds such as cordgrass; water pollution and changes to the water regime; changes to the hydrological regime and exposure of acid sulphate soils, hence changing the chemical balance at the site (Department of the Environment 2015a,b).

Migration staging areas through eastern Asia are being lost and degraded by activities which are reclaiming intertidal mudflats for development or converting them for the aquaculture industry (Barter 2002; Ge et al. 2007; Moores et al. 2008; MacKinnon et al. 2012; Murray et al. 2014). This is especially evident in the Yellow Sea region where 28% of Yellow Sea tidal flats that existed in the 1980s had disappeared by the late 2000s (rate of 1.2% per year; Murray et al. 2014). Furthermore, reference to historical maps suggests that up to 65% of tidal flats in the Yellow Sea region have been lost since the 1960s (Murray et al. 2014). It is predicted that the rate of decrease in the intertidal area in the Yellow Sea will continue (Barter 2002).

In the Korean area of the Yellow Sea, the Mangyeung and Dongjin River estuaries, which were important staging areas for the lesser sand plover on both northern and southern migration, have been reclaimed as part of the Saemangeum Reclamation Project (Barter 2002). One of the largest reclamation projects in the world, this project has converted the two free-flowing estuaries and 40,100 ha of tidal-flats and sea shallows into a vast reservoir and surrounding land through the construction of a 33-km long seawall (Barter 2002; Moores et al. 2008; Murray et al. 2014).

Between 1994 and 2010, the reclamation of large areas (including intertidal mudflats) in Bohai Bay (Yellow Sea, China) for two industrial projects caused migrating shorebirds, including the lesser sand plover, to become concentrated in an ever smaller remaining area. With the proposed continuation of land reclamation in Bohai Bay, it has been predicted that shorebird densities in the remaining areas will increase to a point of collapse (Yang et al. 2011).

At Chongming Island in China, a site of international importance for the lesser sand plover (Ma et al. 2002), there is ongoing and significant habitat loss and degradation through conversion to aquaculture ponds, farmlands and vegetable gardens, the cultivation of the alien plant *Spartina alterniflora* on tidal flats (promoting rapid sedimentation with the intention of reclaiming the area), and the Three Gorges Dam on the upper reaches of the Yangtze River reducing the supply of river-borne sediment to mudflats in the area (Ma et al. 2002; BirdLife International 2015).

At study sites on the Shanghai shoreline (China), the lesser sand plover was one of the most common species in the 1984–85 boreal summer counts and in the 2004-05 summer counts although there appeared to be decreases in numbers in the spring and autumn counts between 1984-85 and 2004-05 (Ge et al. 2007). More than half of all Chinese coastal wetlands were lost between 1950 and 2000 (An et al. 2007) and, since the 1980s, over 500 km^2 of intertidal mudflats along the Shanghai shoreline have been reclaimed (Ge et al. 2007). In addition, intensive oil exploration and extraction, and reduction in river flows due to upstream water diversion, are other potentially significant threats in parts of China where the lesser sand plover is present in internationally significant numbers (Barter et al. 1998; Barter 2005).

In Australia, there are a number of threats common to most migratory shorebirds, including the lesser sand plover. The loss of important habitat reduces the availability of foraging and roosting sites. This affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss at Australian sites. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b).

Residential, farming, industrial and aquaculture/fishing activities represent the major cause of habitat loss or modification in Australia (Department of the Environment 2015a,b). The non-breeding grounds of the species in south-eastern Australia are threatened by habitat degradation, loss and human disturbance (Garnett et al. 2011) whereas sites in the Northern Territory are thought to be generally free of such disturbances (Ward 2012).

Climate change

Climate change projections for Australia include the likelihood of increased temperatures and rising sea levels with more frequent and/or intense extreme climate events which may result in species loss and habitat degradation (Chambers et al. 2005). Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Harding et al. 2007).

In tropical areas, migratory shorebirds may be particularly susceptible to heat stress for a range of reasons including the need to store increased levels of fat prior to migration (Battley et al. 2003; Rogers et al. 2006).

Any sea level rise will greatly alter coastal ecosystems, causing habitat change and loss for shorebird species. Modelling has shown that migratory species in the EAAF are at greater risk from sea level rise than previously thought (Iwamura et al. 2013). The modelling indicated that the effect of sea level rise inundating 23–40% of intertidal habitat areas along the migration routes of migratory shorebirds would cause a reduction in population flow (i.e. maximum flow capacity of the migratory population) of up to 72% across the shorebird species assessed. This magnification of effect was particularly due to shorebirds using a few key sites in the EAAF where a large proportion of the population stops and stages (Iwamura et al. 2013).

Rises in sea level could impact on the lesser sand plover due to loss of intertidal and coastal habitat. Taking into account up-shore movements of intertidal habitat, modelling indicated that, for this species, population flow could reduce by 5% with a 150 cm sea level rise (Iwamura et al. 2013).

Pollution/contamination impacts

Migratory shorebirds are also adversely affected by pollution, both on passage and in non-breeding areas (Melville 1997; Harding et al. 2007). Industrial pollution (e.g. via accidental release) can lead to the build-up of heavy metals or toxic elements in the substrate of wetlands which, in turn, can affect the benthic prey fauna of shorebirds like the lesser sand plover (Department of the Environment 2015a,b).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human recreation activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012).

Disturbance can result from recreational activities including fishing, boating, four-wheel driving, walking dogs, noise and night lighting. While some disturbances may have a low impact, it is important to consider the combined effect of disturbances with other threats (Department of the Environment 2015a,b).

With increasing tourist visitation and development along the Queensland coast and around Broome, Western Australia, increasing levels of disturbance from human recreational activity are likely for the migratory shorebirds in this area. Recreational fishing, four-wheel driving, unleashed dogs and jet-skiing may disturb the foraging or roosting behaviour of migratory shorebirds. Migratory shorebirds are most susceptible to disturbance during daytime roosting and foraging periods (Department of the Environment 2015a,b).

Introduced species

Introduced plants, such as cord grass *Spartinia*, can invade intertidal mudflats and reduce the amount of suitable foraging areas, as has already occurred in other countries (Goss-Custard & Moser 1988). Exotic marine pests may also result in the loss of benthic food sources (Department of the Environment 2015a,b).

Direct mortality

Direct mortality may result from collision with large structures (e.g. wind farms) which cause a barrier to migration or movement pathways, bird strike with vehicles and aircraft, hunting, chemical spills, oil spills and predation (attack by domestic pets, hunting by humans; Schlacher et al., 2013; Department of the Environment 2015a,b) .

The lesser sand plover may still be subject to commercial hunting (for sale at market or to restaurants) which is a major threat in areas like Chongming Island, China (Ma et al. 2002). Records between 1985 and 2009 indicate that at least 869 individuals of this species were hunted in China, Thailand, and Myanmar alone. Within this period, taking into account the year with lowest take (lower bound) and the year with highest take (upper bound), the possible range of annual take is at least 423 to 737 individuals (Ruttanadakul and Ardseungnerm 1986, Tang and Wang 1995, Ming et al 1998, Zöckler et al. 2010).

The lesser sand plover is vulnerable to predation by foxes on breeding grounds as they nest on the ground and the chicks are very precocial (Wiersma 1996).

Disease

Since, 1992, the viral disease testing of Charadriiformes from coastal northwest Australia has not detected any evidence of avian influenza virus excretion in the lesser sand plover or any other shorebird species tested. However, for a number of shorebirds species, there was evidence of a very low level of past exposure to the virus from serologic testing (Curran et al. 2014).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Endangered

The global estimate was 130 000 individuals including 40 000 of *C.m. mongolus* and 20 000 of *C. m. stegmanni* (Bamford et al. 2008; Garnett et al. 2011). This population estimate is out of date given the ongoing population declines. There are no population estimates of the Australian population, however, Garnett et al. (2011) assumed the population to be 24 000 (both subspecies combined).

Numbers (both subspecies combined) declined by c.84% across 49 Australian sites between c.1983 and c.2007 (AWSG data cited in Garnett et al. 2011) although there were few data from northern Australia (e.g. Rogers et al. 2009). At the Pioneer River mouth (Mackay, Queensland), counts of lesser sand plover declined from an average of 517 birds in January 1999 to 71 birds in March 2003 (Harding & Milton 2003).

Population trends outside of Australia are poorly known. However, in Japan, the two subspecies combined have declined in general, and by about 61% in autumn between 1978 and 2008 (Amano et al. 2010). The *Action Plan for Australian Birds 2010* suggested an overall 50–79% decline over 16 years across the EAAF (Garnett et al 2011). On the basis of this observed decline in numbers visiting Australia, the Australian status of the subspecies *C. m. mongolus* and the subspecies *C. m. stegmanni* has been assessed as endangered by Garnett et al. (2011).

A subsequent and more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council collaborative grant), suggests the rate of decline is large enough to pass the threshold for the endangered category (Studds et al., submitted). Time series data from directly observed summer counts at a large number of sites across Australia indicate a severe population decline of 74.8% over 24 years (6% per year) which for this species (both subspecies combined) is equal to three generations (Studds et al., submitted).

In large part, the observed decline in lesser sand plover numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al. 2014). Threats are also occurring in Australia including coastal development, habitat degradation and human disturbance. As such, qualification under criterion A2 rather than A1 seems warranted.

The Committee considers that the species has undergone a severe reduction in numbers over three generation lengths (24 years for this assessment), equivalent to at least 74.8 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

Within Australia the species showed an overall decline in area of occupancy between the early 1980s and the late 1990s to the early 2000s (Barrett et al. 2003). However, the extent of occurrence in currently Australia is estimated to be 35 300 km^2 (stable) and area occupied 2 600 km^2 (stable; Garnett et al. 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline				
		Critically Endangered **Very low**	**Endangered** **Low**	**Vulnerable** **Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate** **25% in 3 years or 1 generation (whichever is longer)**	**High rate** **20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate** **10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a)	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 24 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. There are no current data available to allow assessment against this criterion. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered **Extremely low**	**Endangered** **Very Low**	**Vulnerable** **Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 24 000 in 2011 (Garnett et al., 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered **Immediate future**	**Endangered** **Near future**	**Vulnerable** **Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key breeding and migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites.
- Incorporate requirements for lesser sand plover into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.
- Manage disturbance at important sites which are subject to anthropogenic disturbance when lesser sand plovers are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess lesser sand plover life history, population size, distribution and ecological requirements particularly across northern Australia.
- Improve knowledge about dependence of lesser sand plover on key migratory staging sites, and non-breeding sites to the in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Endangered category:

Charadrius mongolus

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 6 - Approved Conservation Advice for the Bar-tailed Godwit (western Alaskan) (*Limosa lapponica baueri*)

The Minister approved this conservation advice and included this species in the Vulnrable category, effective from 5 May 2016

Conservation Advice

Limosa lapponica baueri

Bar-tailed godwit (western Alaskan)

Taxonomy

Conventionally accepted as *Limosa lapponica baueri* Naumann, 1836. Scolopacidae.

Other common names include barred-rumped godwit, Pacific Ocean godwit, southern or small godwit.

The bar-tailed godwit is polytypic, meaning more than one subspecies exists. Globally, the following four subspecies are recognised:

- The nominate species, *L. l. lapponica*, breeds in northern Europe and north-western Asia;
- The subspecies *L. l. taymyrensis* breeds in north-west and north-central Siberia;
- The subspecies *L. l. baueri* breeds in north-east Siberia and west Alaska;
- The subspecies *L. l. menzbieri* also breeds in northern Siberia (Woodley 2009; Gill & Donsker 2015).

Note that some assessments recognise a fifth subspecies, *L. l. anadyrensis*, (Tomkovich 2010; Leyrer et al. 2014). Based on plumage differences, *L. l. anadyrensis* has been proposed as a separate subspecies rather than as a cline between westerly Siberian *L. l. menzbieri* and easterly Siberian *L. l. baueri* (e.g. Tomkovich 2010; Leyrer et al. 2014). However, this taxonomic split does not appear to be universally accepted with some considering the *L. l. baueri* population includes *L. l. anadyrensis* (Gill & Donsker 2015).

Two subspecies, *L. l. baueri* and *L. l. menzbieri*, regularly occur in Australia (Garnett et al. 2011).

Summary of assessment

Conservation status

Vulnerable: Criterion 1 A2(a)

The highest category for which *Limosa lapponica baueri* is eligible to be listed is Vulnerable.

Limosa lapponica baueri has been found to be eligible for listing under the following listing categories:
Criterion 1: A2 (a): Vulnerable
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Limosa lapponica baueri*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

<u>Species/Sub-species Information</u>

Description

The bar-tailed godwit (western Alaskan) is a large migratory shorebird. It has a length around 37-39 cm, a wingspan of 62-75 cm and body mass between 250 - 450 g. It has a long neck with a very long upturned bill which is characterized by a dark tip and pinkish base. All non-breeding plumages have a uniform upper pattern, with a dark back and upper rump. It is distinguishable from other godwits by the dark barring on the lower white rump, upper-tail and lining of the underwing. The sexes differ with females being larger and with longer bills than males and having a duller breeding plumage. Males and females exhibit marked variation in plumages with males having a deep rufous head and neck. Juveniles are similar to non-breeding adults with the exception that the crown is more heavily streaked (Higgins & Davies 1996).

The two subspecies in the East Asian – Australasian Flyway (EAAF), *L. l. baueri* and *L. l. menzbieri*, are distinguishable morphologically in the field (Wilson et al. 2007; Choi et al. 2015). The bar-tailed godwit (western Alaskan) is slightly larger and stockier than the similar black-tailed godwit, *L. limosa*, with a shorter neck and legs, a steeper forehead, and a more upturned and pointed bill (Higgins & Davies 1996).

Distribution

Australian distribution

The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. In Tasmania, the bar-tailed godwit has mostly been recorded on the south-east coast. In South Australia it has mostly been recorded around coasts from Lake Alexandrina to Denial Bay. In Western Australia it is widespread around the coast, from Eyre to Derby. Populations have also been recorded in the northern Australia, from Darwin east to the Gulf of Carpentaria. The bar-tailed godwit is a regular migrant to Christmas Island, Norfolk Island, Lord Howe Island. It has also been recorded on subantarctic islands such as Macquarie Island, Snares Islands, Auckland Islands and Campbell Islands (Higgins & Davies 1996).

During the non-breeding period, the distribution of bar-tailed godwit (western Alaskan) is predominately New Zealand, northern and eastern Australia (Bamford et al. 2008). In Australia, *L. l. baueri* mainly occur along the north and east coasts (Garnett et al. 2011).

Global distribution

The bar-tailed godwit (all subspecies combined) has an extremely large global range. For the species, the global extent of occurrence is estimated to be 1,470,000 km^2 (BirdLife International 2015).

The subspecies *L. l. baueri* breeds in north-east Siberia from around the Kolyma River to east of the Chukotka Peninsula as well as in west Alaska, from Wales to Barrow (Higgins & Davies 1996). There is some overlap in the breeding range of the two subspecies *L. l. baueri* and *L. l. menzbieri* and, based on plumage differences, some authors have recently recognised *L. l.*

anadyrensis as a new subspecies rather than as a cline between westerly Siberian *L. l. menzbieri* and easterly Siberian *L. l. baueri* (e.g. Woodley 2009; Tomkovich 2010; Leyrer et al. 2014). The breeding range of *L. l. anadyrensis* is very restricted to the Anadyr River Lowlands, Chukotka, north-east Siberia (Tomkovich 2010; Leyrer et al. 2014). However, as this taxonomic split does not appear to be universally accepted at this stage, apart from the summary information below from Leyrer et al. (2014), most of this species profile assumes that *L. l. anadyrensis* is part of the *L. l. baueri* population (as per Gill & Donsker 2015).

The subspecies *L. l. baueri* spends the non-breeding season in northern and eastern Australia and New Zealand (Bamford et al. 2008; Garnett et al. 2011). Migrating birds stage in the Yellow Sea region during northwards migration. The Yalu Jiang coastal wetland supports, on average, at least 42% of the EAAF's northward-migrating *L. l. baueri* godwits (Choi et al. 2015). During southwards migration, birds that breed in north-west Alaska stage in south-west Alaska before flying directly to non-breeding grounds (Leyrer et al. 2014).

Relevant Biology/Ecology

Life history

A generation time of 9.7 years (BirdLife International 2015) is derived from an average age at first breeding of 2 years (Cramp et al. 1983), an annual adult survival of 70% (Cramp et al. 1983) and a maximum longevity in the wild of 22.8 years (Australian Bird and Bat Banding Scheme; Garnett et al. 2011).

Breeding

The migratory bar-tailed godwit (western Alaskan) does not breed in Australia.

They nest in the northern hemisphere during the boreal summer with egg laying occurring from late May through June (del Hoyo et al. 1996). This species nests in solitary pairs although nests may be grouped together due to polyandrous behaviour. They lay two to five eggs, incubate for 20-21 days, and have a nestling period of 28 days (del Hoyo et al. 1996). The species is gregarious and they often fly in large flocks. They forage in groups outside of the breeding season (del Hoyo et al. 1996); occasionally aggregating into huge flocks of several hundreds or thousands of individuals at favoured sites (BirdLife International 2015).

General habitat

At northern hemisphere breeding sites, the bar-tailed godwit (western Alaskan) nests on the ground in open tundra, usually on dry elevated sites and often between clumps of grass (del Hoyo et al. 1996; Woodley 2009). The nest is usually a depression lined with bits of vegetation and lichens (del Hoyo et al. 1996).

The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (Higgins & Davies 1996).

Feeding habitat

The bar-tailed godwit (western Alaskan) usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches. On Heron Island, Qld they have been seen feeding on insect larvae among the roots of Casuarina (Higgins & Davies 1996).

Roosting habitat

The bar-tailed godwit (western Alaskan) usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh (Higgins & Davies 1996). In some conditions, shorebirds may choose roost sites where a damp substrate lowers the local temperature. During periods of cyclonic activity, shorebirds moved to sheltered areas to avoid high winds and heavy rain (Jessop & Collins 2000).

Diet

The bar-tailed godwit (western Alaskan) is mainly carnivorous with a diet consisting of worms, molluscs, crustaceans, insects and some plant material. While it is in breeding grounds it eats mainly ground dwelling insects (Higgins & Davies 1996). On the estuary of the Parramatta River, NSW, polychaetes represented at least 86.7% of their diet and were the only prey able to be identified (Taylor et al. 1996). At Roebuck Bay, Western Australia, birds were observed feeding on bivalves which had been exposed by a cyclone (Jessop & Collins 2000).

The bar-tailed godwit (western Alaskan) generally feeds during the day, but sometimes by moonlight (Higgins & Davies 1996). At the Parramatta River estuary, NSW, bar-tailed godwits (western Alaska) lost between 0.1–1% of their prey to Silver Gulls, *Larus novaehollandiae* (Taylor et al. 1996). Sexual differences in the length of the bill (i.e. females have a longer bill than males) lead to corresponding differences in diet and behaviour. At the Parramatta estuary, both sexes fed on polychaete worms with females spending most of their time in water and males spending 50% of their time in the water, 30% on dry ridges and 20% in wet hollows. The prey capture rates of females feeding in water were 41% higher than those of males (Taylor et al. 1999). At Moreton Bay, Queensland, males mainly foraged in areas with seagrass cover (65%), whereas females were more common on sandy flats (83%). It was thought that, as the seagrass areas supported about twice the density of godwits, the males may have been utilising better foraging habitat (Zharikov & Skilleter 2000). In Roebuck Bay, north-west Western Australia, birds showed a strong tendency to follow the tide edge and females tending to feed closer to the sea edge than males (Rogers 1999).

Migration patterns

The bar-tailed godwit breeds in the northern hemisphere and migrates southwards for the boreal winter. Leg flag sightings and plumage differences suggest that *L. l. menzbieri*, from north-west Australia, has a more westerly migration route than *L. l. baueri* (Barter 2002).

Satellite tracking data has confirmed that some bar-tailed godwits (western Alaska) fly over 11,000 km from Alaska to New Zealand without stopping, making it one of the longest non-stop migrations of any bird (Gill et al. 2009; Woodley 2009). A satellite-tracked bar-tailed godwit (western Alaskan) recorded a long distance, non-stop flight (around 10,200 km in about eight days) from the North Island of New Zealand to Yalu Jiang, Yellow Sea.

From satellite telemetry data, a single *L. l baueri* godwit had a fully completed return track for the whole migration which totalled 29,280 km over a round-trip journey of 174 days. Bar-tailed godwit (western Alaskan) makes the longest (southbound) and second-longest (northbound) non-stop migratory flights documented for any bird essentially making only single stops when moving between non-breeding and breeding sites in opposite hemispheres. This reinforces the critical importance of the intertidal habitats used by fuelling godwits in Australasia, the Yellow Sea, and Alaska (Battley et al. 2012).

Despite these large migration distances, bar-tailed godwit adults are thought to have high site fidelity in the non-breeding season (Barter 1989).

Departure from breeding grounds

The post-breeding migration for *L. l baueri* involved several weeks of staging in southwest Alaska followed by non-stop flights across the Pacific Ocean to New Zealand (11,690 km in a complete track) or stopovers on islands in the south-western Pacific en route to New Zealand and eastern Australia (Battley et al. 2012).

Return to breeding grounds

Most bar-tailed godwits (western Alaskan) that had not left south-eastern Australia by the end of the first week of April were immature (Wilson et al. 2007). Most if not all bar-tailed godwits (western Alaskan) may spend their second austral winter in the non-breeding range, and some their third winter as well (Wilson 2000).

Using satellite telemetry, the migration of *L. l baueri* (travelling between non-breeding grounds in New Zealand) and *L. l. menzbieri* (from northwest Australia) to breeding grounds in Alaska and eastern Russia, respectively was studied (Battley et al. 2012). Individuals of both subspecies made long flights from non-breeding grounds to coastal staging grounds in the Yellow Sea region of East Asia (average 10,060 ± SD 290 km for *L. l baueri* and 5,860 ± 240 km for *L. l. menzbieri*). *L. l baueri* staged for 41.2 ± 4.8 days before flying over the North Pacific Ocean and then heading northeast to the Alaskan breeding grounds (6,770 ± 800 km). *L. l. menzbieri* staged for 38.4 ± 2.5 days before flying over land and sea northeast to high arctic Russia (4,170 ± 370 km) (Battley et al. 2012).

At the key staging site of Yalu Jiang, the mean arrival date for *L. l. baueri* godwits was 29 March and mean departure date was 8 May.

Threats

Migratory shorebirds, such as the bar-tailed godwit (western Alaskan), are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the bar-tailed godwit (western Alaskan) across its range include: habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion; changes to the water regime; invasive plants; environmental pollution); over-exploitation of shellfish; pollution/contamination impacts; disturbance; direct mortality (hunting); diseases; extreme weather events; and climate change impacts (Garnett et al. 2011; BirdLife International 2015; Department of the Environment 2015a,b).

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance as well as habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al. 2006; Garnett et al. 2011; Department of the Environment 2015a,b).

Habitat loss and habitat degradation

Threats at migratory staging sites include environmental pollution, reduced river flows, reclamation for tidal power plants and barrages, industrial use and urban expansion (Barter 2002; Moores 2006; Garnett et al. 2011). A significant and serious threat to the bar-tailed godwit (western Alaskan) is loss of habitat and/or habitat degradation, particularly at migration staging sites. Staging areas used during migration through eastern Asia are being lost and degraded by activities which are reclaiming the mudflats for development or utilising them for aquaculture (Barter 2002; Ge et al. 2007; Round 2006; Murray et al. 2014).

There have been major changes and loss of intertidal habitat in the Yellow Sea where c.80% of the EAAF population of bar-tailed godwit (subspecies combined) stages on northward migration (Barter 2002; Bamford et al. 2008). Around 75% of the tidal flat area that historically existed in the Republic of Korea was lost by 2010 (Moores 2012 cited in Choi et al. 2015). These coastal wetlands are important staging areas where shorebirds stop and replenish their energy reserves in order to complete their migration (Battley et al. 2012; Choi et al. 2015). The rates of loss of intertidal habitat in the Yellow Sea region show no sign of slowing (Murray et al. 2014).

The degradation of foraging habitat in some areas, including Australian locations, may also be caused by the invasion of mudflats and coastal saltmarshes from the spread of mangroves. This may be due to increased sedimentation and nutrient loads at the coast from land-use practices in upstream catchment areas (Straw & Saintilan 2006; Woodley 2009) as well as from sea level rise causing landward invasion of plants (Straw & Saintilan 2006; BirdLife International 2015).

In Australia, the loss of important habitat reduces the availability of foraging and roosting sites. This probably affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b). Anthropogenic nutrient enrichment of wetland areas can cause cyanobacterium blooms that may impact the prey species of bar-tailed godwits (e.g. at Roebuck Bay; Estrella et al. 2011).

As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to): loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats; invasion of intertidal mudflats by weeds such as cord grass; water pollution and changes to the water regime; changes to the hydrological regime and exposure of acid sulphate soils, hence changing the chemical balance at the site (Department of the Environment 2015a,b).

Climate change

Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Harding et al. 2007). Rises in sea level could have a major impact on the bar-tailed godwit due to loss of intertidal habitat (Iwamura et al. 2013). Taking into account up-shore movements of intertidal habitat, modelling indicates that, for this species, population flow (i.e. maximum flow capacity of the migratory population) could reduce by 15% with a 150 cm sea level rise (Iwamura et al. 2013).

Pollution/contamination

Migratory shorebirds are adversely affected by pollution, both on passage and in non-breeding areas (Harding et al. 2007; Wei et al. 2006).

Feather samples of bar-tailed godwits (western Alaskan) from two New Zealand sites were tested for mercury. The distribution of mercury concentrations in all samples did not differ significantly from normal either from non-breeding plumage samples on arrival in New Zealand or from breeding plumage samples prior to departure from New Zealand (Thompson 2001).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human recreation activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012). Human disturbance can interrupt feeding and may restrict the area of feeding habitat available for bar-tailed godwits. Bar-tailed godwits (western Alaskan) at Phillip Island, Victoria, were recorded taking flight when humans approached within 10–70 m of them (Taylor & Bester 1999).

Disturbance can result from recreational activities including fishing, boating, four wheel driving, walking dogs, noise and night lighting. While some disturbances may have a low impact, it is important to consider the combined effect of disturbances with other threats (Department of the Environment 2015a,b).

Diseases

The bar-tailed godwit is also susceptible to avian influenza and so may be threatened by future outbreaks of the virus (Melville & Shortridge 2006; BirdLife International 2015).

Since, 1992, the viral disease testing of Charadriiformes from coastal northwest Australia has not detected any evidence of avian influenza virus excretion in the bar-tailed godwit or any other species tested. However, from serologic testing, there was evidence of a very low level of past exposure to the virus (Curran et al. 2014).

Direct mortality

Direct mortality may result from collision with large structures (e.g. wind farms) which cause a barrier to migration or movement pathways, bird strike with vehicles and aircraft, hunting, chemical spills and oil spills (Department of the Environment 2015a,b). Hunting is still a very serious problem for shorebirds in China, and the bar-tailed godwit has been identified as one of the species caught (Ming et al. 1998).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Vulnerable

The global estimate of the bar-tailed godwit population has been estimated to be between 1,100,000-1,200,000 individuals (BirdLife International 2015). Globally, the overall population trend is decreasing, although some flyway populations may be stable and others have unknown trends. Although around the world the species is considered to be decreasing in numbers, the rate of decline is not great enough to warrant listing as a vulnerable species under the IUCN Red List (BirdLife International 2015).

The number of bar-tailed godwits in the EAAF has been estimated to be 325,000 and, during the non-breeding period, 88% of the EAAF population occurs in Australia and New Zealand

(Bamford et al. 2008). Previously, there have been estimated of 185,000 bar-tailed godwits (both subspecies) in Australia during the non-breeding period (Bamford et al. 2008).

On the basis of the hypothesised distribution of the two subspecies during the non-breeding period, and using regional population estimates for Australia, the EAAF population estimate of *L. l. baueri* is 155,000 individuals (Bamford et al. 2008; Garnett et al. 2011). Therefore, by extrapolation, the population spending the non-breeding period primarily in Australia is assumed to be 61,000 individuals as most of the c.94 000 bar-tailed godwits in New Zealand are *L. l. baueri* (Southey 2009; Garnett et al. 2011).

Numbers of bar-tailed godwits (western Alaskan) declined at Moreton Bay by 68% between 1993 and 2008 (Fuller et al. 2009) and at Gulf St Vincent by 78% between c.1981 and c.2004 (Close 2008) although numbers increased by around 8% across 49 Australian sites between c.1983 and c.2007 (Garnett et al. 2011). At Corner Inlet, counts gave the appearance of periods of sustained growth and decline over a 30 year period although there was no significant change in either summer or winter count data (1982-2011; Minton et al. 2012).

In Japan, between 1998 and 2008, populations of both subspecies have declined in general and by about 53% in spring counts (Amano et al. 2010). The numbers of bar-tailed godwits on migration at Saemangeum and adjacent estuaries declined by 11% from 2006 to 2008 (Choi et al. 2015). Populations of bar-tailed godwits in New Zealand (mainly considered to be *L. l. baueri*) declined by 18% (103,000 to 85,000) between 1993 and 2003 (Southey 2009).

A recent and more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council grant), puts the subspecies into the vulnerable category (Studds et al. submitted). Time series data from directly observed summer counts at a large number of sites across Australia indicate a substantial population decline of 32.4% over 29 years (1.4% per year) which for this subspecies is equal to three generations (Studds et al., submitted).

In large part, the observed decline in bar-tailed godwit (western Alaskan) numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). Threats are also occurring in Australia including coastal development, habitat degradation and human disturbance. As such, qualification under criterion A2 rather than A1 seems warranted.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (29 years for this assessment), equivalent to at least 32.4 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Vulnerable.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**			
		Critically Endangered **Very restricted**	**Endangered** **Restricted**	**Vulnerable** **Limited**
B1.	Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2.	Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 7 500 000 km^2 (stable) and area occupied 8 100 km^2 (stable; Garnett et al. 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
(a)	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

The number of mature individuals in Australia was estimated at 61 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. There are no current data available to allow assessment against the criterion. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 61 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered **Immediate future**	**Endangered** **Near future**	**Vulnerable** **Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key breeding and migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites.
- Incorporate requirements for bar-tailed godwit (western Alaskan) into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.
- Manage disturbance at important sites which are subject to anthropogenic disturbance when bar-tailed godwit (western Alaskan) are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess bar-tailed godwit (western Alaskan) life history, population size, distribution and ecological requirements.
- Improve knowledge about dependence of bar-tailed godwit (western Alaskan) on key migratory staging sites, and non-breeding sites to the in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:

Limosa lapponica baueri

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 7 - Approved Conservation Advice for the Bar-tailed Godwit (northern Siberian) (*Limosa lapponica menzbieri*)

The Minister approved this conservation advice and included this species in the Critically Endangered category, effective from 5 May 2016

Conservation Advice

Limosa lapponica menzbieri

Bar-tailed godwit (northern Siberian)

Taxonomy

Conventionally accepted as *Limosa lapponica menzbieri* Portenko, 1936. Charadriidae.

Other common names include barred-rumped godwit, Pacific Ocean godwit, southern or small godwit.

The bar-tailed godwit is polytypic, meaning more than one subspecies exists. Globally, the following four subspecies are recognised:

- The nominate species, *L. l. lapponica*, breeds in northern Europe and north-western Asia;
- The subspecies *L. l. taymyrensis* breeds in north-west and north-central Siberia;
- The subspecies *L. l. baueri* breeds in north-east Siberia and west Alaska;
- The subspecies *L. l. menzbieri* also breeds in northern Siberia (Woodley 2009; Gill & Donsker 2015).

Note that some assessments recognise a fifth subspecies, *L. l. anadyrensis*, (Tomkovich 2010; Leyrer et al. 2014). Based on plumage differences, *L. l. anadyrensis* has been proposed as a separate subspecies rather than as a cline between westerly Siberian *L. l. menzbieri* and easterly Siberian *L. l. baueri* (e.g. Tomkovich 2010; Leyrer et al. 2014). However, this taxonomic split does not appear to be universally accepted with some considering the *L. l. baueri* population includes *L. l. anadyrensis* (Gill & Donsker 2015).

Two subspecies, *L. l. baueri* and *L. l. menzbieri*, regularly occur in Australia (Garnett et al. 2011).

Summary of assessment

Conservation status

Critically Endangered: Criterion 1 A2(a)

The highest category for which *Limosa lapponica menzbieri* is eligible to be listed is Critically Endangered.

Limosa lapponica menzbieri has been found to be eligible for listing under the following listing categories:
Criterion 1: A2 (a): Critically Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Limosa lapponica menzbieri*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 47 business days between 1 October and 4 December 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/Sub-species Information

Description

The bar-tailed godwit (northern Siberian) is a large migratory shorebird. It has a length around 37-39 cm, a wingspan of 62-75 cm and body mass between 250 - 450 g. It has a long neck with a very long upturned bill which is characterized by a dark tip and pinkish base. All non-breeding plumages have a uniform upper pattern, with a dark back and upper rump. It is distinguishable from other godwits by the dark barring on the lower white rump, upper-tail and lining of the underwing. The sexes differ with females being larger and with longer bills than males and having a duller breeding plumage. Males and females exhibit marked variation in plumages with males having a deep rufous head and neck. Juveniles are similar to non-breeding adults with the exception that the crown is more heavily streaked (Higgins & Davies 1996).

The two subspecies in the East Asian – Australasian Flyway (EAAF), *L. l. baueri* and *L. l. menzbieri*, are distinguishable morphologically in the field (Wilson et al. 2007; Choi et al. 2015). The bar-tailed godwit (northern Siberian) is slightly larger and stockier than the black-tailed godwit, *L. limosa*, with a shorter neck and legs, a steeper forehead, and a more upturned and pointed bill (Higgins & Davies 1996).

Distribution

Australian distribution

The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. In Tasmania, the bar-tailed godwit has mostly been recorded on the south-east coast. In South Australia it has mostly been recorded around coasts from Lake Alexandrina to Denial Bay. In Western Australia it is widespread around the coast, from Eyre to Derby. Populations have also been recorded in the northern Australia, from Darwin east to the Gulf of Carpentaria. The bar-tailed godwit is a regular migrant to Christmas Island, Norfolk Island, Lord Howe Island. It has also been recorded on subantarctic islands such as Macquarie Island, Snares Islands, Auckland Islands and Campbell Islands (Higgins & Davies 1996).

During the non-breeding period, the distribution of *L. l. menzbieri* is predominantly in the north and north-west of Western Australia and in south-eastern Asia (Bamford et al. 2008).

Global distribution

The bar-tailed godwit (all subspecies combined) has an extremely large global range. For the species, the global extent of occurrence is estimated to be 1,470,000 km^2 (BirdLife International 2015).

The subspecies *L. l. menzbieri* breeds in northern Siberia, Russia between the Khatanga River and the delta of the Kolyma River (Higgins & Davies 1996). This subspecies spends the non-breeding period mostly in the north of Western Australia, but also in south-east Asia (Bamford et al. 2008). Migrating birds stage for over one month during both southwards and northwards migration in western and northern parts of the Yellow Sea (Leyrer et al. 2014). The Yalu Jiang coastal wetland supports, on average, at least 19% of the EAAF's northward-migrating *L. l. menzbieri* godwits (Choi et al. 2015).

Relevant Biology/Ecology

Life history

A generation time of 9.7 years (BirdLife International 2015) is derived from an age at first breeding of 2 years (Cramp et al. 1983), an adult survival of 70% (Cramp et al. 1983) and a maximum longevity of 22.8 years (Australian Bird and Bat Banding Scheme; Garnett et al. 2011).

Breeding

The migratory bar-tailed godwit (northern Siberian) does not breed in Australia.

They nest in the northern hemisphere during the boreal summer with egg laying occurring from late May through June (del Hoyo et al. 1996). This species nests in solitary pairs although nests may be grouped together due to polyandrous behaviour. They lay two to five eggs, incubate for 20-21 days, and have a nestling period of 28 days (del Hoyo et al. 1996). The species is gregarious and they often fly in large flocks. They forage in groups outside of the breeding season (del Hoyo et al. 1996); occasionally aggregating into huge flocks of several hundreds or thousands of individuals at favoured sites (BirdLife International 2015).

General habitat

At northern hemisphere breeding sites, the bar-tailed godwit (northern Siberian) nests on the ground in open tundra, usually on dry elevated sites and often between clumps of grass (del Hoyo et al. 1996; Woodley 2009). The nest is usually a depression lined with bits of vegetation and lichens (del Hoyo et al. 1996).

The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It has also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (Higgins & Davies 1996).

Feeding habitat

The bar-tailed godwit (northern Siberian) usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches.

Roosting habitat

The bar-tailed godwit (northern Siberian) usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh (Higgins & Davies 1996). In some conditions, shorebirds may choose roost sites where a damp substrate lowers the local temperature. During periods of cyclonic activity, shorebirds moved to sheltered areas to avoid high winds and heavy rain (Jessop & Collins 2000).

Diet

The bar-tailed godwit (northern Siberian) is mainly carnivorous with a diet consisting of worms, molluscs, crustaceans, insects and some plant material. While it is in breeding grounds it eats mainly ground dwelling insects (Higgins & Davies 1996). On the estuary of the Parramatta River, NSW, polychaetes represented at least 86.7% of their diet and were the only prey able to be identified (Taylor et al. 1996). At Roebuck Bay, Western Australia, birds were observed feeding on bivalves which had been exposed by a cyclone (Jessop & Collins 2000). At Roebuck Bay, birds showed a strong tendency to follow the tide edge and females tending to feed closer to the sea edge than males (Rogers 1999).

Migration patterns

The bar-tailed godwit breeds in the northern hemisphere and migrates southwards for the boreal winter. Leg flag sightings and plumage differences suggest that *L. l. menzbieri*, from north-west Australia, has a more westerly migration route than *L. l. baueri* (Barter 2002).

The entire migrations of *L. l. menzbieri* averaged 21,940 ± 570 km over 154 days. Despite these large migration distances, bar-tailed godwit adults are thought to have high site fidelity in the non-breeding season (Barter 1989).

Departure from breeding grounds

The post-breeding migration to Australia for *L. l. menzbieri* involved stopovers in the New Siberian Islands, Russia, and the Yellow Sea. *L. l. menzbieri* travelling on average 4,510 ± 360 km from Russia to the Yellow Sea, staged there for 40.8 ± 5.6 days, and then flew another 5,680 – 7,180 km to Australia (i.e. 10,820 ± 300 km in total) (Battley et al. 2012).

Return to the breeding grounds

At Broome Bird Observatory, 103,123 bar-tailed godwits were counted leaving on northward migration and the median departure date was 8 April (Wilson et al. 2007). Most birds that had not left south-eastern Australia by the end of the first week of April were immature (Wilson et al. 2007). Most if not all bar-tailed godwits may spend their second austral winter in the non-breeding range, and some their third winter as well (Wilson 2000).

Using satellite telemetry, the migration of *L. l baueri* (travelling between non-breeding grounds in New Zealand) and *L. l. menzbieri* (from northwest Australia) to breeding grounds in Alaska and eastern Russia, respectively was studied (Battley et al. 2012). Individuals of both subspecies made long flights from non-breeding grounds to coastal staging grounds in the Yellow Sea region of East Asia (average 10,060 ± SD 290 km for *L. l baueri* and 5,860 ± 240 km for *L. l. menzbieri*). *L. l baueri* staged for 41.2 ± 4.8 days before flying over the North Pacific Ocean and then heading northeast to the Alaskan breeding grounds (6,770 ± 800 km). *L. l. menzbieri* staged for 38.4 ± 2.5 days before flying over land and sea northeast to high arctic Russia (4,170 ± 370 km) (Battley et al. 2012).

At the key staging site of Yalu Jiang, the mean arrival date for *L. l. baueri* godwits was 29 March and mean departure date was 8 May. Corresponding dates were 11 April and 15 May for *L. l. menzbieri* godwits (Choi et al. 2015).

Threats

Migratory shorebirds, such as the bar-tailed godwit (northern Siberian), are sensitive to certain development activities due to their: high site fidelity, tendency to aggregate, very high energy demands, and need for habitat networks containing both roosting and foraging sites (Department of the Environment 2015a,b).

Threats to the global population of the bar-tailed godwit (northern Siberian) across its range include: habitat loss and habitat degradation (e.g. through land reclamation, industrial use and urban expansion; changes to the water regime; invasive plants; environmental pollution); over-exploitation of shellfish; pollution/contamination impacts; disturbance; direct mortality (hunting); diseases; extreme weather events; and climate change impacts (Garnett et al. 2011; BirdLife International 2015; Department of the Environment 2015a,b).

Threats in Australia, especially northern and north-west Australia, include ongoing human disturbance as well as habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al. 2006; Garnett et al. 2011; Department of the Environment 2015a,b).

Habitat loss and habitat degradation

Threats at migratory staging sites include environmental pollution, reduced river flows, reclamation for tidal power plants and barrages, industrial use and urban expansion (Barter

2002; Moores 2006; Garnett et al. 2011). A significant and serious threat to the bar-tailed godwit (northern Siberian) is loss of habitat and/or habitat degradation, particularly at migration staging sites. Staging areas used during migration through eastern Asia are being lost and degraded by activities which are reclaiming the mudflats for development or utilising them for aquaculture (Barter 2002; Ge et al. 2007; Round 2006; Murray et al. 2014).

There have been major changes and loss of intertidal habitat in the Yellow Sea where c.80% of the EAAF population of bar-tailed godwit (subspecies combined) stages on northward migration (Barter 2002; Bamford et al. 2008). Around 75% of the tidal flat area that historically existed in the Republic of Korea was lost by 2010 (Moores 2012 cited in Choi et al. 2015). These coastal wetlands are important staging areas where shorebirds stop and replenish their energy reserves in order to complete their migration (Battley et al. 2012; Choi et al. 2015). The rates of loss of intertidal habitat in the Yellow Sea region show no sign of slowing (Murray et al. 2014).

The degradation of foraging habitat in some areas, including Australian locations, may also be caused by the invasion of mudflats and coastal saltmarshes from the spread of mangroves. This may be due to increased sedimentation and nutrient loads at the coast from land-use practices in upstream catchment areas (Straw & Saintilan 2006; Woodley 2009) as well as from sea level rise causing landward invasion of plants (Straw & Saintilan 2006; BirdLife International 2015).

In Australia, the loss of important habitat reduces the availability of foraging and roosting sites. This probably affects the ability of the birds to build up the energy stores required for successful migration and breeding. Some sites are important all year round for juveniles who may stay in Australia throughout the breeding season until they reach maturity. A variety of activities may cause habitat loss. These include direct losses through land clearing, inundation, infilling or draining. Indirect loss may occur due to changes in water quality, hydrology or structural changes near roosting sites (Department of the Environment 2015a,b). Anthropogenic nutrient enrichment of wetland areas can cause cyanobacterium blooms that may impact the prey species of bar-tailed godwits (e.g. at Roebuck Bay; Estrella et al. 2011).

As most migratory shorebirds have specialised feeding techniques, they are particularly susceptible to slight changes in prey sources and foraging environments. Activities that cause habitat degradation include (but are not restricted to): loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats; invasion of intertidal mudflats by weeds such as cord grass; water pollution and changes to the water regime; changes to the hydrological regime and exposure of acid sulphate soils, hence changing the chemical balance at the site (Department of the Environment 2015a,b).

Climate change

Global warming and associated changes in sea level are likely to have a long-term impact on the breeding, staging and non-breeding grounds of migratory shorebirds (Harding et al. 2007). Rises in sea level could have a major impact on the bar-tailed godwit due to loss of intertidal habitat (Iwamura et al. 2013). Taking into account up-shore movements of intertidal habitat, modelling indicates that, for this species, population flow (i.e. maximum flow capacity of the migratory population) could reduce by 15% with a 150 cm sea level rise (Iwamura et al. 2013).

Pollution/contamination

Migratory shorebirds are adversely affected by pollution, both on passage and in non-breeding areas (Harding et al. 2007; Wei et al. 2006).

Feather samples of bar-tailed godwits (western Alaskan) from two New Zealand sites were tested for mercury. The distribution of mercury concentrations in all samples did not differ significantly from normal either from non-breeding plumage samples on arrival in New Zealand or from breeding plumage samples prior to departure from New Zealand (Thompson 2001).

Disturbance

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding or roosting habitat that is actually used. Disturbance from human recreation activities may force migratory shorebirds to increase the time devoted to vigilance and anti-predator behaviour and/or may compel the birds to move to alternative, less favourable feeding areas (Goss-Custard et al. 2006; Glover et al., 2011; Weston et al., 2012). Human disturbance can interrupt feeding and may restrict the area of feeding habitat available for bar-tailed godwits. Bar-tailed godwits (western Alaskan) at Phillip Island, Victoria, were recorded taking flight when humans approached within 10–70 m of them (Taylor & Bester 1999).

Disturbance can result from recreational activities including fishing, boating, four wheel driving, walking dogs, noise and night lighting. While some disturbances may have a low impact, it is important to consider the combined effect of disturbances with other threats (Department of the Environment 2015b).

Diseases

The bar-tailed godwit is also susceptible to avian influenza and so may be threatened by future outbreaks of the virus (Melville & Shortridge 2006; BirdLife International 2015).

Since, 1992, the viral disease testing of Charadriiformes from coastal northwest Australia has not detected any evidence of avian influenza virus excretion in the bar-tailed godwit or any other species tested. However, from serologic testing, there was evidence of a very low level of past exposure to the virus (Curran et al. 2014).

Direct mortality

Direct mortality may result from collision with large structures (e.g. wind farms) which cause a barrier to migration or movement pathways, bird strike with vehicles and aircraft, hunting, chemical spills and oil spills (Schacher et al., 2013; Department of the Environment 2015b). Hunting is still a very serious problem for shorebirds in China, and the bar-tailed godwit has been identified as one of the species caught (Ming et al. 1998).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Critically Endangered

The global estimate of the bar-tailed godwit population has been estimated to be between 1,100,000-1,200,000 individuals (BirdLife International 2015). Globally, the overall population trend is decreasing, although some flyway populations may be stable and others have unknown trends. Although around the world the species is considered to be decreasing in numbers, the rate of decline is not great enough to warrant listing as a vulnerable species under the IUCN Red List (BirdLife International 2015).

The number of bar-tailed godwits in the EAAF has been estimated to be 325,000 and, during the non-breeding period, 88% of the EAAF population occurs in Australia and New Zealand (Bamford et al. 2008). Previously, there have been estimated of 185,000 bar-tailed godwits (both subspecies) in Australia during the non-breeding period (Bamford et al. 2008).

On the basis of the hypothesised distribution of the two subspecies during the non-breeding period, and using regional population estimates for Australia, the EAAF population estimate of *L. l. menzbieri* is 170,000 individuals (Bamford et al. 2008; Garnett et al. 2011). By extrapolation, the population of this subspecies spending the non-breeding period in Australia is assumed to be 124,000 individuals, based on 185,000 for the species (Bamford et al. 2008) minus 61,000 *L. l. baueri* (Southey 2009; Garnett et al. 2011).

At Eighty Mile Beach, Western Australia, numbers of bar-tailed godwits (northern Siberian) declined from 110,000 to 52,000 between 2000 and 2008, and at northern Roebuck Bay from ~12,000 in 2001-2004 to ~9,000 in 2005-2008 (Rogers et al. 2009).

In Japan, between 1998 and 2008, populations of both subspecies have declined in general and by about 53% in spring counts (Amano et al. 2010). The numbers of bar-tailed godwits on migration at Saemangeum and adjacent estuaries declined by 11% from 2006 to 2008 (Choi et al. 2015). Populations of bar-tailed godwits in New Zealand (mainly considered to be *L. l. baueri*) declined by 18% (103,000 to 85,000) between 1993 and 2003 (Southey 2009).

A recent and more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council grant), puts the subspecies into the critically endangered category (Studds et al., submitted). Time series data from directly observed summer counts at a large number of sites across Australia indicate a very severe population decline of 81.9% over 29 years (6.1% per year) which for this subspecies is equal to three generations (Studds et al., submitted).

In large part, the observed decline in bar-tailed godwit (northern Siberian) numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). Threats are also occurring in Australia including coastal development, habitat degradation and human disturbance. As such, qualification under criterion A2 rather than A1 seems warranted.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (29 years for this assessment), equivalent to at least 81.9 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Critically Endangered.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 7 500 000 km^2 (stable) and area occupied 8 100 km^2 (stable; Garnett et al. 2011). Therefore, the species does not meet this required element of this criterion.

Criterion 3. Population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**

C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 124 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. There are no current data available to allow assessment against the criterion. Therefore, the species does not meet this required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 124 000 (decreasing) in 2011 (Garnett et al. 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species does not meet this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, national, state and local levels.

Conservation and Management Actions

- Work with governments along the East Asian – Australasian Flyway to prevent destruction of key breeding and migratory staging sites.
- Protect important habitat in Australia.
- Support initiatives to improve habitat management at key sites.
- Maintain and improve protection of roosting and feeding sites in Australia.
- Advocate for the creation and restoration of foraging and roosting sites.
- Incorporate requirements for bar-tailed godwit (northern Siberian) into coastal planning and management.
- Manage important sites to identify, control and reduce the spread of invasive species.
- Manage disturbance at important sites which are subject to anthropogenic disturbance when bar-tailed godwit (northern Siberian) are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.

Survey and monitoring priorities

- Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Information and research priorities

- Undertake work to more precisely assess bar-tailed godwit (northern Siberian) life history, population size, distribution and ecological requirements particularly across northern Australia.
- Improve knowledge about dependence of bar-tailed godwit (northern Siberian) on key migratory staging sites, and non-breeding sites to the in south-east Asia.
- Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:

Limosa lapponica menzbieri

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

01/03/2016

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Appendix 8 - Approved Conservation Advice for the Eastern Curlew (*Numenius madagascariensis*)

Conservation Advice

Numenius madagascariensis

eastern curlew

Taxonomy

Conventionally accepted as eastern curlew *Numenius madagascariensis* Linnaeus, 1766, Scolopacidae. Other common names include Australian or sea curlew, far eastern curlew and curlew.

Monotypic, no subspecies are recognised (Bamford et al., 2008). Taxonomic uniqueness: medium (22 genera/family, 8 species/genus, 1 subspecies/species; Garnett et al., 2011).

Summary of assessment

Conservation status

Critically endangered: Criterion 1 A2,(a)

Numenius madagascariensis has been found to be eligible for listing under the following listing categories:

Criterion 1: A2 (a): Critically Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

The highest category for which *Numenius madagascariensis* is eligible to be listed is Critically Endangered.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of information provided by a committee nomination based on information provided in the *Action Plan for Australian Birds 2010* (Garnett et al., 2011), and experts from the University of Queensland.

Public Consultation

Notice of the proposed amendment and a consultation document were made available for public comment for 33 business days between 1 October 2014 and 14 November 2014. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The eastern curlew is the largest migratory shorebird in the world, with a long neck, long legs, and a very long downcurved bill. The wingspan is 110 cm and the birds weigh approximately 900 g. The head and neck are dark brown and streaked with darker brown. The chin and throat are whitish and there is a prominent white eye-ring; the iris is dark brown. The feathers of the upper parts of the body are brown, with blackish centres, and have broad pale rufous or olive-brown edges or notches. The tail is grey-brown with narrow dark banding on the feathers. The underside of the bird is dark brownish-buff, becoming paler on the rear belly. There is fine dark-brown streaking on the fore-neck and breast, which becomes thicker arrow-shaped streaks and barring on the fore-flanks. The upper belly and rear flanks have finer and sparser dark streaking. The underneath of the wing is whitish, but appears darker due to fine dark barring. The bill is dark brown with a pinkish base and the legs and feet are blue-grey.

The female is slightly larger than the male with noticeably longer bill (Higgins & Davies, 1996).

Distribution

Australian distribution

Within Australia, the eastern curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern curlews are rarely recorded inland. They have a continuous distribution from Barrow Island and Dampier Archipelago, Western Australia, through the Kimberley and along the Northern Territory, Queensland, and NSW coasts and the islands of Torres Strait. They are patchily distributed elsewhere.

In Victoria, the main strongholds are in Corner Inlet and Western Port Bay, with smaller populations in Port Phillip Bay and scattered elsewhere along the coast. Two thirds of the birds in the Victorian population are female (Nebel et al. 2013); given that the species is monogamous, it is likely there are male-skewed non-breeding populations elsewhere, but sex-ratios have not been studied outside Victoria. Eastern curlews are found on islands in Bass Strait and along the north-west, north-east, east and south- east coasts of Tasmania. In South Australia, the species is scarce between the Victorian border and Cape Jaffa and patchily distributed from the Coorong north-west to the Streaky Bay area, and has previously been recorded in Lake Alexandrina and Lake Albert, South Australia. In southern Western Australia, eastern curlews are recorded from Eyre, and there are scattered records from Stokes Inlet to Peel Inlet. The species is a scarce visitor to Houtman Abrolhos and the adjacent mainland, and is also recorded around Shark Bay. It is also recorded on Norfolk Island and Lord Howe Island (Marchant & Higgins, 1993).

Global distribution

The eastern curlew is endemic to the East Asian – Australasian Flyway. Eastern curlews breed in Russia in southern Ussuriland, the Iman River, scattered through south, west and north Kamchatka, the lower and middle Amur River basin, the Lena River basin, between 110° E and 130° E up to 65° N, and on the Upper Yana River, at 66° N. It also breeds in Mongolia and north-eastern China

The eastern curlew is a common passage migrant in Japan, Republic of Korea, China and Indonesia, and is occasionally recorded moving through Thailand and the Malay Peninsula. During the non-breeding season a few birds occur in southern Republic of Korea, Japan and China. About 25% of the population is thought to winter in the Philippines, Indonesia and Papua New Guinea but most (estimated at 73% or 28 000 individuals) spend the non-breeding season in Australia. Eastern curlews are regular non-breeding visitors to New Zealand in small numbers, and occur rarely on Kermadec Island and the Chatham Islands (Marchant & Higgins, 1993).

Relevant Biology/Ecology

Life history

The generation time is 10.1 years (Garnett et al., 2011).

Data extracted from the Australian Bird and Bat Banding Scheme (ABBBS) reports a longevity record of 19 years, 1 month (Australian Government, 2014).

Breeding

The eastern curlew does not breed in Australia.

Eastern curlews nest in the Northern Hemisphere summer, from early May to late June, often in small colonies of two to three pairs. They nest on small mounds in swampy ground, often near where wild berries are growing. The nest is lined with dry grass and twigs. The birds may delay breeding until three to four years of age (del Hoyo et al., 1996).

General habitat

During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes within the mangroves. The birds are also found in coastal saltworks and sewage farms (Marchant & Higgins, 1993).

Feeding habitat

The eastern curlew mainly forages during the non-breeding season on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline. The birds are rarely seen on near-coastal lakes or in grassy areas (Marchant & Higgins, 1993).

Roosting habitat

The eastern curlew roosts during high tide periods on sandy spits, sandbars and islets, especially on beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. They occasionally roost on reef-flats, in the shallow water of lagoons and other near-coastal wetlands. Eastern curlews have occasionally been recorded roosting in trees and on the upright stakes of oyster-racks (Marchant & Higgins, 1993). At Roebuck Bay, Western Australia, birds have been recorded flying from their feeding areas on the tidal flats to roost 5 km inland on a flooded supratidal claypan (Collins et al., 2001). In some conditions, shorebirds may choose roost sites where a damp substrate lowers the local temperature. This may have important conservation implications where these sites are heavily disturbed beaches (Rogers, 1999). It may be possible to create artificial roosting sites to replace those destroyed by development (Harding et al., 1999). Eastern curlews typically roost in large flocks, separate from other shorebirds (Marchant & Higgins, 1993).

Feeding

The eastern curlew is carnivorous during the non-breeding season, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects. In studies at Moreton Bay, south-east Qld, three species of intertidal decapod dominated the diet: soldier crabs (*Myctryris longicarpus*), sentinel crabs (*Macrophthalmus crassipes*) and ghost-shrimps (*Trypea australiensis*) (Zharikov and Skilleter 2004). In Victoria, ghost-shrimps are an important part of the diet (Dann 1986, 1987). In Roebuck Bay, Western Australia, the birds feed mainly on large crabs, but will also catch mantis shrimps and chase mudskippers (Rogers, 1999).

The eastern curlew is extremely wary and will take flight at the first sign of danger, long before other nearby shorebirds become nervous. The birds are both diurnal and nocturnal with feeding and roosting cycles determined by the tides. Eastern curlews find the burrows of prey by sight during the day or in bright moonlight, but also locate prey by touch. The sexual differences in bill length lead to corresponding differences in diet and behaviour (Marchant & Higgins, 1993). Eastern curlews usually feed singly or in loose flocks. Occasionally, this species is seen in large feeding flocks of hundreds (Marchant & Higgins, 1993).

Migration patterns

The eastern curlew is migratory. After breeding, they move south for the Northern Hemisphere winter. The birds migrate by day and night at varying altitudes (Marchant & Higgins, 1993).

Departure from breeding grounds

Eastern curlews leave Kamchatka Peninsula (Eastern Russia) from mid-July. There is a weak migration through Ussuriland, Russia, from mid-July to late September and birds pass through Kurile Island and Sakhalin, (Eastern Russia), from mid-July to late August (P.S. Tomkovich pers comm. in Marchant & Higgins, 1993). Fewer birds appear in continental Asia on the southern migration than on the northern migration (Dement'ev & Gladkov, 1951). Eastern curlews are commonly seen in Republic of Korea, Japan and China during August-October. Migration from the Yellow Sea to Australia is usually undertaken in a single direct flight (Minton et al., 2013). There are also records of migrants in Thailand, the Malaysian Peninsular, Singapore, the Philippines, and Borneo (Indonesia), broadly between August and December (Marchant & Higgins, 1993). The birds arrive in north-west and eastern Australia as early as July (Lane, 1987). In north-west Australia, the maximum arrival was recorded between mid-August and the end of August (Minton & Watkins, 1993). At least some birds stopover in northern Australia or Papua New Guinea before moving on to non-breeding grounds in southern Australia (Minton et al. 2013, Lane, 1987), either is a series of short flights or one long flight. Many birds arriving in eastern Australia appear to move down the coast from northern Queensland with influxes occurring on the east coast have suggested a general southward movement until mid-February (Alcorn, 1988); this is presumably dominated by late-arriving juveniles. Records from Toowoomba, Broken Hill and the Murray-Darling region in August and September suggest that some birds move overland (Marchant & Higgins, 1993) and arrival along the east and south-east Australian coasts suggests some fly directly to these areas (Alcorn, 1988). In southern Tasmania, most arrive in late August to early October; later arrivals, probably of juveniles, occur until December (Marchant & Higgins, 1993). When eastern curlews first arrive in south-eastern Tasmania they are found at a number of localities before congregating at Barilla Bay or Orielton Lagoon (BirdLife Tasmania unpubl. data).

Eastern curlews arrive in New Zealand from the second week of August until mid-November with median date mid-October (Marchant & Higgins, 1993). These relatively late arrivals suggest that the small NZ population (<20 birds) is dominated by immatures.

Non-breeding season

During the non-breeding season small numbers of eastern curlew occur in southern Republic of Korea, Japan, China and Taiwan. Unquantified numbers occur in Papua New Guinea, Borneo, and possibly Peninsular Malaysia and the Philippines (Marchant & Higgins, 1993). The majority of the eastern curlew population is found in Australia during the non-breeding season (Bamford et al., 2008), mostly at a few sites on the east and south coasts and in north-western Australia (Lane, 1987). Population numbers are stable at most sites in November or between December-February, indicating little movement during this period (Lane, 1987; Alcorn, 1988). Eastern curlews move locally between high-tide roost-sites and intertidal feeding zones (Marchant & Higgins, 1993).

Return to breeding grounds

In Australia, most eastern curlews leave between late February and March-April (Marchant & Higgins, 1993). The birds depart New Zealand from mid-March to mid-May (Marchant & Higgins, 1993). Satellite-tracking (Driscoll and Ueta 2002) and geolocation studies (Minton et al., 2013) indicate that it is usual for eastern curlew to migrate from south-eastern Australian non-breeding grounds to the northern Yellow Sea in a single flight, but that birds may take additional stops if they encounter poor migration conditions. The species has been recorded on passage in various locations mostly between March and May, arriving at Kamchatka, Russia, during May (Marchant & Higgins, 1993).

Most shorebirds including eastern curlew, spend their first and second austral (southern) winters in Australia, and some or all may also spend their third winter here before undertaking their first northward migration to the breeding grounds (Wilson, 2000). Eastern curlews probably have longer-delayed maturity than any other Australian shorebird, with many individuals not migrating north until their third year and some not migrating north until their fourth (Rogers et al. 2008).

Descriptions of migratory pathways and important sites

Internationally, the Yellow Sea is extremely important as stopover habitat for eastern curlews. It supports about 80% of the estimated flyway population on the northern migration. Counts on southwards migration appear to be lower (Barter 2002) but this probably reflects search effort and timing, given that preliminary geolocator results suggest the same staging sites in the Yellow Sea are used on both southwards and northwards migration (Minton et al., 2013). Relatively few eastern curlews pass through Japan. Thirteen sites of international importance have been identified in the Yellow Sea (six in China, six in Republic of Korea and one in North Korea). Twelve sites are known to be important during the northern migration and seven during the southern migration, with six sites (Dong Sha, Shuangtaizihekou National Nature Reserve, Ganghwa Do, Yeong Jong Do, Mangyeung Gang Hagu and Dongjin Gang Hagu) important during both (Barter, 2002).

Threats

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al., 2006; Australian Government, 2009; Garnett et al., 2011).

Human disturbance can cause shorebirds to interrupt their feeding or roosting and may influence the area of otherwise suitable feeding habitat that is actually used. Disturbance to pre-migratory eastern curlews may adversely affect their capacity to migrate, as the birds will use energy reserves to avoid disturbance, rather than for migration. Eastern curlews take flight when humans approach to within 30–100 metres (Taylor & Bester, 1999), or even up to 250 metres away (Peter, 1990). Coastal development, land reclamation, construction of barrages and stabilisation of water levels can destroy feeding habitat (Close & Newman, 1984). Pollution around settled areas may reduce the availability of food (Close & Newman, 1984).

Formerly, eastern curlews were shot for food in Tasmania (Marchant & Higgins, 1993). The species has been hunted intensively on breeding grounds and at stopover points while on migration (Marchant & Higgins, 1993).

Eastern curlews are threatened by wetland degradation in the Yellow Sea where it stages on migration (Bamford et al., 2008; van de Kam et al., 2010; Murray et al., 2014). Threats along their migratory route include sea level rise, environmental pollution, reduced river flows, human disturbance and reclamation for tidal power plants and barrages, industrial use and urban expansion (Barter, 2002; Kelin and Qiang, 2006; Moores, 2006; Iwamura et al., 2013). Additional threats include disturbance at nesting sites and hunting on the breeding grounds (Barter et al., 1997).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased. A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible. A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a*) *cannot be used for A3*] A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.	*based on any of the following:* (a) direct observation [*except A3*] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2 (a) for listing as Critically Endangered

The global population estimate was 38 000 individuals including 28 000 in Australia (Bamford et al., 2008), but numbers have recently declined (Garnett et al., 2011). This population estimate is out of date given the ongoing population declines.

Numbers appear to have declined on Eighty-mile Beach, WA by c.40% between 2000 and 2008, whereas numbers at Roebuck Bay, WA have remained relatively stable (Rogers et al., 2009). At Moreton Bay, QLD they declined by c. 2.4% per year between 1992 and 2008 (Wilson et al., 2011), across the whole of QLD they declined by c. 4.14% between 1992 and 2008 (Fuller et al., 2009), in Victoria by 2.2% per year between 1982 and 2011 (Minton et al., 2012) and in Tasmania by 80% between the 1950s and 2000 (Reid & Park, 2003) and by 40% across 49 Australian sites between 1983 and 2007 (BirdLife Australia *in litt.* 2011). An observation of over 2000 eastern curlews at Mud Islands, Port Phillip Bay in 1953 (Tarr and Launder 1954), *cf* current counts of fewer than 50 birds in Port Phillip Bay, suggests that population declines in eastern curlew may have begun well before regular shorebird counts were initiated in Australia.

An unpublished assessment of the numbers of eastern curlews at roost sites in Tasmania showed decreases of between 55% and 93%, depending on site (Woehler pers. comm., 2014). In the southeast, the decrease was 90% for the period 1964/65 – 2010/11, and in the north, the decrease was 93% between 1973/74 and 2010/11 (Woehler pers. comm., 2014). At both of these sites, and at other roost sites in Tasmania, the decreases have continued, with fewer birds seen in 2014 (Woehler pers. comm., 2014).

There are no clear trends in Japan between 1978 and 2008 (Amano et al., 2010), but this region lies outside the main migration route of eastern curlew.

A subsequent and more detailed assessment by a University of Queensland team (partly funded by the Department of the Environment under an Australian Research Council collaborative grant), puts the species into the critically endangered category (Fuller, pers. comm., 2014). Time series data from directly observed summer counts at a large number of sites across Australia indicate a severe population decline of 66.8% over 20 years (5.8% per year; Fuller, pers. comm. 2014), and 81.4 % over 30 years which for this species is equal to three generations (Garnett et al., 2011).

In large part, the observed decline in eastern curlew numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). As such, qualification under criterion A2 rather than A1 seems warranted. However, threats are also occurring in Australia including coastal development and recreational activities causing disturbance.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (30 years for this assessment), equivalent to at least 81.4 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as critically endangered.

Criterion 2. Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km^2**	**< 5,000 km^2**	**< 20,000 km^2**
B2. Area of occupancy (AOO)	**< 10 km^2**	**< 500 km^2**	**< 2,000 km^2**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 30 000 km^2 (stable) and area occupied 8 500 km^2 (decreasing; Garnett et al., 2011). Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Small population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or			

	inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia was estimated at 28 000 in 2008 (Bamford et al., 2008; Garnett et al., 2011), but has declined since. There are no current data available to allow assessment against this criterion. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 4. Very small population			
	Critically Endangered **Extremely low**	**Endangered** **Very Low**	**Vulnerable** **Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The total number of mature individuals was estimated at 28 000 in 2008 (Bamford et al., 2008; Garnett et al., 2011), but has declined since. The estimate is not considered extremely low, very low or low. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered **Immediate future**	**Endangered** **Near future**	**Vulnerable** **Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, state and local levels.

An International Single Species Action Plan will be developed and implemented across the East Asian – Australasian Flyway. Additionally, BirdLife Australia coordinates Australia's national shorebird monitoring program, Shorebirds 2020. This volunteer-based program conducts national shorebird surveys twice per year.

Primary Conservation Objectives

International objectives

1. Achieve a stable or increasing population.
2. Maintain and enhance important habitat.
3. Reduce disturbance at key roosting and feeding sites.

Australian objectives

1. Achieve a stable or increasing population.
2. Maintain and enhance important habitat.
3. Reduce disturbance at key roosting and feeding sites.
4. Raise awareness of eastern curlew within the local community.

Conservation and Management Actions

1. Work with governments along the East Asian – Australasian Flyway to prevent destruction of key migratory staging sites.
2. Develop and implement an International Single Species Action Plan for eastern curlew with all range states.
3. Support initiatives to improve habitat management at key sites.
4. Maintain and improve protection of roosting and feeding sites in Australia.
5. Incorporate requirements for eastern curlews into coastal planning and management.
6. Manage important sites to identify, control and reduce the spread of invasive species.
7. Manage disturbance at important sites when eastern curlews are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary site closures.
8. Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Monitoring priorities

1. Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia

Information and research priorities

1. More precisely assess eastern curlew life history, population size, distribution and ecological requirements particularly across northern Australia.
2. Improve knowledge about dependence of eastern curlew on key migratory staging sites, and wintering sites to the north of Australia.

3. Improve knowledge about threatening processes including the impacts of disturbance and hunting.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:

Numenius madagascariensis

(ii) The Committee recommends that there should not be a recovery plan for this species.

Threatened Species Scientific Committee

4/3/2015

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