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Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list the curlew sandpiper *Calidris ferruginea* (Pontoppidan, 1763) as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act and, as a consequence, to omit reference to the curlew sandpiper *Calidris ferruginea* (Pontoppidan, 1763) in Part 2 of Schedule 1 (Endangered Species) of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that the curlew sandpiper *Calidris ferruginea* (Pontoppidan, 1763) has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of Commonwealth DCCEEW (2023), the NSW Threatened Species Scientific Committee has made a decision to list the species as Critically Endangered.

Summary of Conservation Assessment

The curlew sandpiper *Calidris ferruginea* (Pontoppidan, 1763) was found to be Critically Endangered in accordance with the following provisions in the Biodiversity Conservation Regulation 2017: Clause 4.2 (1)(a)(2)(b)(c)(e) because the species has suffered a suspected very large population reduction of at least 80% over a three-generation timespan of approximately 16.5 years. Additionally, the causes of these reductions, especially increasing drought and increasing habitat loss in the East Asian-Australasian Flyway, have not ceased.

The NSW Threatened Species Scientific Committee has found that:

1. Curlew sandpipers *Calidris ferruginea* (Pontoppidan, 1763) (family Scolopacidae) are migratory shorebirds. They are 18 – 23 cm long, have a wingspan of 38 – 41 cm, and weigh approximately 57 g. The bill is long, black and decurved, with a finely pointed tip. Females are slightly larger than males and have a longer bill. In breeding plumage, females have a slightly paler chestnut-coloured underbody, with more white feathers and darker barring. The species shows marked seasonal variation, and juveniles are distinctive from adults. Adults in full breeding plumage are unlikely to be observed in Australia, however, vestiges of this plumage may be seen on individuals on arrival and before departure from Australia. Adult non-breeding or juvenile plumage is the typical appearance of birds in Australia. In non-breeding adults the cap, ear-coverts, hindneck, and sides of the neck are all pale brownish-grey with fine dark streaks. This grades to an off-white colour with fine grey streaks on the lower face. The chin and throat are white. The bird has a narrow, dark loral stripe and prominent white supercilium that runs from the bill to above the rear ear coverts. The mantle, back, scapulars, tertials and inner wing coverts are pale brownish-grey with fine dark streaks and narrow white fringes. The underbody is white with a varying brownish-grey wash and fine dark streaking on the sides of the fore neck and breast. This extends across the whole breast in some

individuals. The lower rump and upper tail coverts are white and only possess a few small dark streaks or spots. The rest of the body is like that of breeding adults. Juveniles appear similar to non-breeding adults except the centre of their forehead, crown, and nape are streaked black and buff.

2. In the non-breeding season, curlew sandpipers migrate through SE Asia to Australia (Van Gils and Wiersma 1996; BirdLife International 2024) and can occur in coastal areas Australia wide. Curlew sandpipers are most common in the far south-east and north-west of Australia. They can be found in many Australian coastal sites and inland in suitable wetland habitats in all states and the Northern Territory. In New South Wales, the species is widespread east of the Great Divide and occurs along the entire coast of New South Wales, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Sightings of colour-marked birds and influxes at inland sites in south-eastern Australia in April suggest that some passage occurs through inland areas and that some individuals from south-east 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 individuals occurring in north-west Australia than on the southern migration. The birds fly north within the East Asian-Australasian Flyway (EAAF) arriving in the arctic breeding regions late in May or early June (Higgins and Davies 1996; Minton 1996; Minton *et al.* 2006, Yang *et al*. 2011).

3. The extent of occurrence (EOO) is estimated at 10,900,000 km^2 (range 10,400,000–11,400,000 km^2) and area of occupancy (AOO) at 8,000 km^2 (8,000–12,000 km^2). Despite the loss and degradation of wetland habitats, Clemens *et al*. (2021) considers both the EOO and AOO to be stable. The species' population is not severely fragmented, and the species is not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations, or mature individuals (Clemens *et al*. 2021).

4. The estimated population of the curlew sandpiper is 40,100 (range 8,100 – 125, 300) mature individuals in the wild with a continuing declining trend (Clemens *et al*. 2021). Several studies have recorded declines of curlew sandpipers with the following change over three generations (15-18 years): −81% (Clemens *et al*. 2016), −72% (Studds *et al*. 2017), −22% (Clemens 2017), −50% (waterbird meta-analysis; Clemens *et al*. 2019) and −41% (Clemens *et al*. 2019). These estimates suggest there was a rapid decline at least until ~ 2010 (Garnett *et al* 2011). The most recent analysis by Rogers *et al*. (2023) estimated the mean change between 1993 and 2021 was -6.4% annually for an estimated total decline of -84.5% (95%CI: -90.9, -74.4). This is equivalent to a decline of -53% (95%CI: -72.3, -18.7) over three generations (Clemens *et al*. 2021). The mean annual change in the last 10 years (2012-2021) was -3.8% (95%CI: -10.25, 3.47), suggesting the decline is continuing (Rogers *et al*. 2023). This decline is lower than many previous reports and may indicate that the decline of this species has slowed in the past decade.

5. Curlew sandpipers forage within fresh, brackish and saltwater environments including mudflats, wetlands, shallow intertidal pools and drains, and along sandy shores (Tulp and de Goeij 1994; Higgins and Davies 1996), or occasionally on wet

mats of algae or waterweed, or on banks of beach cast seagrass or seaweed. At high tide, the species tends to forage among low, sparse, emergent vegetation such as saltmarsh, or at times within flooded paddocks or inundated salt flats (Higgins and Davies 1996). Their primary diet consists of marine invertebrates, and they occasionally feed on terrestrial invertebrates and seeds (del Hoyo *et al*. 1996). Curlew sandpipers are gregarious, often occurring in large flocks where they mix freely with other birds when feeding and roosting (Higgins and Davies, 1996). Roosting mainly occurs around intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and around non-tidal swamps, lakes, and lagoons near the coast. Roosting has been recorded on occasion near ponds in saltworks and sewage farms.

6. Curlew sandpiper breed across Arctic Siberia in June-July before the birds fly south of the equator within the East Asian-Australasian Flyway (EAAF) during the non-breeding period (Minton *et al*. 2006; BirdLife International 2024). Adult curlew sandpipers arrive in their non-breeding range in northern Australia in late August and early September, with the juveniles arriving later than adults (Higgins and Davies 1996; Minton 1996). Many will stay in the area while others travel to south-east Australia with the majority arriving there in September. Some individuals are thought to move through the Gulf of Carpentaria to east and south-east Australia, with records of the species' occurrence from coastal Queensland and New South Wales. Some individuals pass through north-east South Australia during late August until early December, and small numbers occur regularly in south-west New South Wales from early August. Individuals may return to the same non-breeding sites each year (Higgins and Davies 1996; Minton 1996; Weller *et al*. 2020).

7. Within Australia, the increased frequency and length of droughts is a primary threat to the curlew sandpiper (Clemens 2017), and this is exacerbated by climate change (Evans *et al*. 2017). Further threats include habitat and foraging site losses caused by residential and commercial development, industrial aquaculture, sea level rise, and the installation of water infrastructure, as well as human disturbance at feeding and roosting sites. 'Anthropogenic climate change', 'Clearing of native vegetation' and 'Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands' are listed as Key Threatening Processes under the Act.

8. The survival of curlew sandpipers is higher in wet years than in years of drought, as drought conditions can change the environmental characteristics of key habitats and make them unsuitable for the species (Clemens 2017). Global drought extremes are projected to increase under future warming scenarios. Around Australia, climate warming has contributed towards a southward shift in weather fronts from the Southern Ocean, which typically brings rain to southern Australia during winter and spring. As these weather fronts have shifted southwards, rainfall in southern Australia has declined increasing the risk of drought conditions. The region has also experienced significant warming during the last 50 years, with climate change driving an increase in the intensity and frequency of hot days and heatwaves, exacerbating drought conditions (Steffen *et al*. 2018). Curlew sandpiper survival in drought years may be considerably lower than in years of extensive inland rainfall due to increases in physiological stress, fewer food resources, and a reduction in roosting site availability (Lindenmayer *et al*. 2018).

9. Wetland loss and degradation in Australia has occurred mainly due to competing land uses and ignorance of the value of wetlands (Geoscience Australia 2021 in Commonwealth DCCEEW 2023). Due to 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). Shoreline development and changes in local hydrology are the biggest driver of wetland habitat loss. Specific threats include landfill or reclamation associated with industrial, housing, or port developments, road construction, marinas, canals and resorts. Additional actions include clearing areas of saltmarsh for solar salt production; damage of wetland areas by rubbish dumping and storm water draining; and damage of wetlands from the run-off from urban areas which alters the natural salinity regime of wetland areas (Geoscience Australia 2021 in Commonwealth DCCEEW 2023).

10. Australia's coastal environment has undergone rapid changes over the last three decades as the aquaculture industry expands and intensifies to meet the rising demand for seafood products (Ayyam *et al*. 2019; Ahmed and Thompson 2019 in Commonwealth DCCEEW 2023; Commonwealth of Australia 2020 in Commonwealth DCCEEW 2023). Direct and indirect effects of aquaculture may arise from activities including intertidal oyster farming, bait harvesting, the compaction of sediments by vehicles, beach nourishment, nutrient enrichment, and rubbish dumping (Fuller *et al*. 2019 in Commonwealth DCCEEW 2023). Any structural modification of the soft-sediment feeding habitat may considerably affect deep-probing shorebirds and inhibit successful foraging (Fuller *et al*. 2019 in Commonwealth DCCEEW 2023).

11. Global sea levels have risen by around 17 ± 5 cm during the 20th century (IPCC 2007; Watson 2011). Current projections predict an increased rate of sea level rise over the duration of the 21st century, with the upper bound global rise ranging from 1.3-1.6m (van de Wal *et al*. 2022). These increases are likely to submerge more than 20% of coastal wetlands worldwide (Rodriguez *et al*. 2017). The longest continuous Australasian records show a rise in mean sea level of approximately 12 cm between 1920 and 2000 (Watson 2011). Forecasts predict a further rise of 70 cm by the end of the century (McInnes *et al*. 2015; Zhang *et al*. 2017). Coastal wetlands in Australia may be particularly vulnerable to sea level rise, where a reduction in the area of land available for feeding and roosting is likely, with nutrient and sediment flows altered. The effect of these changes on curlew sandpipers have not been quantified and further research is required to understand how further sea level rises will affect the species.

12. Many areas of curlew sandpiper habitat are shrinking due to a combination of restricted inflow of sediments from increasingly dammed rivers (Murray *et al*. 2014; Melville *et al.* 2016), and sea level rise - with sea walls at many sites preventing suitable habitat migrating inland. Additionally, water regulation and diversion infrastructure along major tributaries has resulted in the reduction of water and sediment flows (Melville 1997; Barter *et al*. 1998; Barter 2002). Wetlands are particularly vulnerable to the presence of dams and river management activities as they are dependent on seasonal flooding to sustain ecosystem function (Sun *et al*. 2012; Junk *et al*. 2013). Damming reduces flooding to wetlands, causing them to

shrink and become inhospitable for a range of aquatic biota, including wetland-dependent birds (Sun *et al*. 2012).

13. Tourist visitation to many curlew sandpiper roosting sites such as sandflats, beaches, bays, and estuaries is increasing. The resultant increase in development and human recreation is likely to disturb shorebirds including curlew sandpipers. Disturbance from human activities, including recreation, shellfish harvesting, fishing, and aquaculture is likely to increase significantly in the future (Barter *et al*. 2005; Davidson and Rothwell 1993), and disturbance from off-leash dogs is particularly problematic (Weston and Stankowich 2013). Anthropogenic disturbance at feeding and roosting sites causes birds to stop feeding and fly around and may force birds away from traditional sites (Lilleyman *et al*. 2014 in Commonwealth DCCEEW 2023). This can cause reduced fat/energy reserves needed to complete the northward migration back to their breeding grounds and may negatively affect survival or reproductive success. Frequent disturbances may place additional and unsustainable pressures on populations already experiencing major declines (Lilleyman *et al*. 2014 in Commonwealth DCCEEW 2023).

14. As a migratory species, many of the threats facing the curlew sandpiper occur outside of Australia, primarily habitat loss, pollution, and changes to coastal staging locations, particularly along the Yellow Sea coast (Iwamura *et al*. 2013). The loss of stopping sites due to these habitat losses can have serious consequences for migratory birds as they may not be able to store sufficient energy reserves for the ongoing migratory flight, and fail to arrive at their destination, or they may arrive in poor condition due to inadequate refuelling, which could reduce reproductive success (Hua *et al*. 2015).

15. Because of the above threats, the curlew sandpiper is suspected to have undergone a very large reduction in the number of mature individuals over three generations (*c*. 15-18 years), which is plausibly higher than 80%, and the causes, especially increasing drought and coastal development in the EAAF and in Australia, have not ceased.

16. The curlew sandpiper *Calidris ferruginea* (Pontoppidan, 1763) is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation* 2017 criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: Critically Endangered under Clause 4.2 (1)(a)(2)(b)(c)(e)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically Endangered under Clause 4.2 (1)(a)(2)(b)(c)(e)

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 – Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)
Assessment Outcome: Not met.

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted.
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species.
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 – Low numbers of mature individuals of species and other conditions (Equivalent to IUCN criterion Clause C)
Assessment Outcome: Not met.

The estimated total number of mature individuals of the species is:			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low.

and either of the following 2 conditions apply:					
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):			
		(i)	for critically endangered species		very large, or
		(ii)	for endangered species		large, or
		(iii)	for vulnerable species		moderate,
	(e)	both of the following apply:			
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and		
		(ii)	at least one of the following applies:		
			(A)	the number of individuals in each population of the species is:	
				(I) for critically endangered species	extremely low, or
				(II) for endangered species	very low, or
				(III) for vulnerable species	low,
			(B)	all or nearly all mature individuals of the species occur within one population,	
			(C)	extreme fluctuations occur in an index of abundance appropriate to the species.	

Clause 4.5 – Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Not met.

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 – Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data Deficient.

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 – Very highly restricted geographic distribution of species–vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Not met.

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the

	species is prone to the effects of human activities or stochastic events within a very short time period.

Senior Professor Kristine French
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Commonwealth DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2023). Conservation advice for *Calidris ferruginea* (curlew sandpiper). Australian Government, Canberra, ACT.

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