Publication date: 29 November 2024

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 far eastern curlew, *Numenius madagascariensis* (Linnaeus, 1766) as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 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 the far eastern curlew, *Numenius madagascariensis* (Linnaeus, 1766), 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 DCCEEW (2023), the NSW Threatened Species Scientific Committee has made a decision to list the species as Critically Endangered.

Summary of Conservation Assessment

The far eastern curlew, *Numenius madagascariensis* (Linnaeus, 1766) 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) because it has undergone a very large reduction in population size estimated up to 82% over a three-generation timeframe between 1993 and 2012, and the causes of reduction have not ceased. Reductions are inferred based on: i) decreases in population counts from across repeatedly monitored sites.

The NSW Threatened Species Scientific Committee has found that:

1. The far eastern curlew, *Numenius madagascariensis* (Linnaeus, 1766) (Family Scolopacidae) is the largest migratory shorebird species in the world. The birds are 60–66 cm long, have a wingspan of approximately 110 cm and weigh around 900 g. Males and females appear similar, but females tend to be larger and have a longer bill. The species shows slight seasonal variation in plumage. Adult breeding far eastern curlews have a long neck, a long, strongly decurved dark-brown bill and noticeably long legs. The head and neck of far eastern curlews are buff-brown, streaked darker brown. They have a whitish chin and throat, and thick white eye-rings. The feathers of the mantle, back, scapulars and tertials have black centres with broad, pale rufous or brownish-olive edges. The rump and uppertail-coverts are pale rufous with narrow, dark barring. The tail is dark brown, also gradually turning pale rufous and with dark barring throughout. Far eastern curlews have a dark brown underbody with creamy-buff areas on the rear belly. Dense, fine, dark-brown streaking runs across the foreneck and breast. The underwing is whitish, finely barred darker. The bill is dark brown with a fleshy pink base. The legs and feet are dull blue-grey. Non-breeding adult far eastern curlews exhibit duller grey-brown upperparts, without any rufous tones. The pale creamy-buff colour on the underparts also appears paler. Juveniles appear similar to breeding adults but are generally paler and possess neater plumage. Adult non-breeding or juvenile plumage is the typical appearance of birds in Australia.

2. The far eastern curlew is a migratory shorebird of the East Asian – Australasian Flyway. During the austral summer non-breeding season, an estimated 73% of the far eastern curlew population inhabits in Australia (Bamford *et al.* 2008; Hansen *et al.* 2016). Within Australia, far eastern curlews have a mostly coastal distribution; they are rarely recorded inland. The species is found in all states and territories, but is most prominent in the north, east, and south-east regions, including Tasmania. The distribution of the far eastern curlew is continuous from Barrow Island and the Dampier Archipelago in Western Australia, through the Kimberley Division and along the Northern Territory, Queensland, the islands of the Torres Strait and New South Wales coasts. They occur patchily elsewhere.

3. The estimated Extent of Occurrence (EOO) for the far eastern curlew in Australia is 10,400,000 km^2, based on a minimum convex polygon, the method of assessment recommended by IUCN (2022). The estimated Area of Occupancy (AOO) is 13,000 km^2. Estimated AOO is based on 2 km x 2 km grid cells, the scale recommended for assessing AOO by IUCN (2022). The estimates of EOO and AOO were calculated using all records since 1990.

4. The estimated number of mature far eastern curlew in Australia in 2020 was 22,500 (range 22,000–24,100) (Hansen *et al.* 2016; Studds *et al.* 2017; Clemens et al. 2019; DCCEEW 2023). The far eastern curlew has been experiencing a declining population trend (Lilleyman *et al.* 2021), with various estimates of decline based on count data ranging from 52–82% (Clemens *et al.* 2016; Studds *et al.* 2017; Clemens *et al.* 2019). The most recent analysis by Rogers *et al*. (2023) estimated the mean change in population was -5.1% annually (1993-2021) for an estimated total decline of -63.6% (95% CI: -72.8, -51.6) over three generations. The mean annual change in the last 10 years (2012-2021) was -1.5% (95%CI: -4.9, 2.1), suggesting the decline may be 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. Feeding habitat for the far eastern curlew consists primarily of sheltered intertidal sandflats or mudflats that are open and without vegetation or covered with seagrass. The species shows a preference for soft substrates containing little or no hard material (*e.g*., rock, shell grit, coral, debris) that provide better access to their prey (Finn *et al.* 2007, 2008). Roosting habitat consists primarily of sheltered coasts especially estuaries, bays, harbours, inlets, and coastal lagoons with large intertidal mudflats or sandflats. During the non-breeding season, there are local-scale movements between areas of suitable habitat, often driven by changes in the tide (Jackson *et al.* 2020). Where natural habitat is limited in availability, anthropogenic wetlands such as aquaculture ponds, saltworks and sewage farms can provide alternative coastal habitats for the species (Higgins and Davies, 1996; Jackson *et al.* 2020; Lei *et al.* 2021).

6. After breeding in the northern hemisphere (Siberia, far eastern Russia, and north-eastern China), the species moves south towards Australia for the austral summer (Xu *et al.* 2019). Far eastern curlews nest from early May to late June, often in small colonies of 2-3 pairs. Clutch sizes of four eggs are typical. The species takes longer to reach maturity than most other shorebirds, possibly not breeding until

they reach 3-4 years old (del Hoyo *et al.* 1996; Rogers *et al.* 2006). The species have an estimated generation length of 9.5 years (Bird *et al.* 2020; BirdLife International 2019). Far eastern curlew mainly feed on crustaceans and occasionally feed on small molluscs and some insects (Zharikov and Skilleter 2003, 2004a, 2004b; Dann 2005, 2014).

7. Far eastern curlews arrive in north-west and eastern Australia as early as July, with onward movement throughout the rest of Australia by October (Lane 1987). Most individuals arriving in eastern Australia move down the eastern coastline from northern Queensland, with influxes occurring at sites along the east coast from mid-August to late December (Choi *et al.* 2016). Historic sighting data suggests there is a general southward movement until mid-February (Alcorn 1988). Most far eastern curlews leave Australia between late February and March-April (Higgins and Davies 1996; (Driscoll and Ueta 2002). Like many other large shorebirds, young far eastern curlews might spend their second and even third austral winter in Australia before undertaking their first northward migration (Wilson 2000). Around 25 percent of the peak austral summer individuals remain within the non-breeding grounds during the austral winter (Finn *et al*. 2001).

8. The main threat to the far eastern curlew in Australia is habitat loss and disturbance at feeding and roosting sites, particularly disturbance from off-leash dogs. Habitat loss is caused by residential and commercial development, industrial aquaculture, sea level rise due to natural climate variability and climate change and chronic pollution. '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.

9. Coastal wetland loss and degradation results in the loss of feeding and roosting habitat for the far eastern curlew in Australia and has occurred mainly due to shoreline development and changes in local hydrology. Due to the distribution of the human population, estuaries and permanent wetlands of the coastal lowlands have experienced most losses, especially in the southern and eastern parts of the continent (Lee *et al.* 2006). Specific threats include landfill or reclamation associated with construction, infrastructure, and urban development. Additional threats include damage of wetlands from the run-off from urban areas altering the natural salinity regime of wetland areas (Geoscience Australia 2021 in DCCEEW 2023). Far eastern curlew populations have also experienced very large declines due the loss or degradation of intertidal flats and other important staging sites in the East Asian – Australasian Flyway, particularly within the Yellow Sea. Any loss or degradation of these staging sites affects the far eastern curlew's ability to rest and feed en route to Australia, likely reducing migration success and resulting in very large population declines.

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 (Ahmed and Thompson 2019). Aquaculture activities that may adversely affect the far eastern curlew include: intertidal oyster farming, bait harvesting, sediments compaction by vehicles, beach nourishment, nutrient enrichment, and the dumping of rubbish or debris. Any structural modification of

soft-sediment feeding habitat may inhibit successful foraging by this species (Fuller *et al.* 2019 in DCCEEW 2023).

11. Recreational activities such as shellfish harvesting, fishing, aquaculture and dog-walking can directly disturb far eastern curlews (Davidson and Rothwell 1993; Barter *et al.* 2005; Weston and Stankowich 2013). Anthropogenic disturbance forces shorebirds away from roosting and feeding sites (Lilleyman *et al.* 2014). This can reduce fat/energy reserves and affect the species migration back to their breeding grounds, negatively affecting survival and reproductive success.

12. Global sea level rose by around 17 ± 5 cm during the 20th century (IPCC 2007; Watson 2011). 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, with influences from natural climate variability and anthropogenic climate change (McInnes *et al.* 2015; Zhang *et al.* 2017). Coastal wetlands in Australia are vulnerable to sea level rise, likely resulting in reduced area available for feeding and roosting, and alterations to nutrient and sediment flows. The full extent of this influence on far eastern curlews has not been quantified.

13. Shorebird habitats are threatened by the chronic accumulation and concentration of pollutants and damage of wetland areas by rubbish dumping and storm water draining. Migratory shorebirds may be exposed to chronic pollution threats in feeding areas in Australia (herbicides, pesticides, industrial waste) and along migration routes, although the extent and implications of this exposure remains largely unknown.

14. Due to the effects of the above threats, the far eastern curlew is estimated to have undergone a very large reduction in the number of mature individuals over a three-generation timespan, which is estimated to be as high as 82% (between 1993 and 2012) and the causes, disturbance at feeding and roosting sites, coastal development in the EAAF and in Australia, industrial aquaculture, sea level rise and chronic pollution have not ceased.

15. *Numenius madagascariensis* (Linnaeus, 1766) 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)

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)

(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.

Professor Caroline Gross
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NSW Threatened Species Scientific Committee

Supporting Documentation:

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