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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 ruddy turnstone *Arenaria interpres* (Linnaeus, 1758) as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act on the basis of its extinction risk in Australi**a**. Listing of Vulnerable species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that the ruddy turnstone *Arenaria interpres* (Linnaeus, 1758) 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 Vulnerable on the basis of its extinction risk in Australia.

Summary of Conservation Assessment

The ruddy turnstone *Arenaria interpres* (Linnaeus, 1758) was found to be Vulnerable in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: Clause 4.2 (1 c)(2 b). The main reason for this species being eligible for listing in the Vulnerable category is the moderate population reduction estimated at 26-72% that has occurred over three generations, and the causes of the decline are not fully understood. This species is assessed only on the basis of its extinction risk in Australia because that scale is appropriate to the biology of the taxon due to its annual migratory movements into, and within Australia.

The NSW Threatened Species Scientific Committee has found that:

1. The ruddy turnstone *Arenaria interpres* (Linnaeus, 1758) (family Scolopacidae) is a stocky, medium-sized wader, about 22–24 cm long with a wingspan of 50–57 cm and weight of approximately 115 g. They have a short, slightly uptilted bill, and short orange-red legs. The sexes appear similar but show marked seasonal variation in plumage. Breeding adults have a mostly white head with black streaks on the crown. Black spots are present on the sides of the nape, and a black line runs across the forehead between the eyes. A black line also runs from the gape, joining a vertical black band that runs down from the eyes to a broad black breast patch. The species' neck is black with a narrow white hindneck collar that broadens into a white patch on the sides of the breast. The upperparts and innerwing coverts are black with bright chestnut tips, giving a variegated tortoise-shell appearance. The underparts are primarily white except for a black breast, a narrow dark trailing-edge to wings, and a blackish subterminal tail-band. The bill is black, but is paler at the base of the mandible. Adult non-breeding or juvenile plumage is the typical appearance of birds in Australia. Non-breeding adults are similar to breeding adults, but duller and with no chestnut colour in the upperparts. Juvenile plumage is similar to that of non-breeding adults, except that juveniles possess larger pale patches on the head (Commonwealth DCCEEW 2023).

2. There are two recognised subspecies of ruddy turnstone. The nominate subspecies, *Arenaria interpres interpres*, breeds in western Alaska, the Canadian Arctic, Greenland, and northern Eurasia and is the only subspecies known to occur in Australia. The subspecies *A. i. morinella* breeds in arctic Canada (Higgins and Davies 1996).

3. The ruddy turnstone is widespread within Australia during the austral summer non-breeding season (Bamford *et al.* 2008), occurring around coastlines and occasionally inland (Weller *et al*. 2020). The species is also found on Lord Howe Island, Norfolk Island, Christmas Island, the Cocos-Keeling Islands, and Macquarie Island (Higgins and Davies 1996).

4. The Australian Extent of Occurrence (EOO) for the ruddy turnstone is estimated at 11,600,000 km^2 (range 11,000,000–12,200,000 km^2) and the Australian Area of Occupancy (AOO) is estimated at 9,200 km^2 (range 9,200–14,000 km^2) (Clemens *et al.* 2021). The AOO is estimated using 2 x 2 km grid cells, the scale recommended by IUCN (2024), encompassing all records of the taxon in Australia since 1990 (Commonwealth DCCEEW 2023) and the EOO is measured by a simple minimum convex polygon around all occurrences at the season when a taxon's range is most constrained (Clemens *et al.* 2021). Clemens *et al*. (2021) states that the species' EOO and AOO are 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).

5. The estimated population of the ruddy turnstone reaching Australia annually is 18,700 (range 16,900 – 22,200) mature individuals, based on an extrapolation of the estimate of 20,800 in Hansen *et al.* (2016) using data on trends from Clemens *et al.* (2016, 2019). Several studies have recorded declines of the ruddy turnstone with the following change over three generations (18.6 years): −72% (Clemens *et al.* 2016), −28% and –42% (waterbird meta-analysis; Clemens *et al.* 2019). These results are consistent with declines described a decade ago (Garnett *et al*. 2011). The most recent analysis by Rogers *et al.* (2023) estimated the mean change in population was -2.6% annually (1993-2021) for an estimated total decline of -26% (95%CI: -53.5, 21.8) over three generations. The mean annual change in the last 10 years (2012-2021) was +2.5% (95%CI: -4.1, 9.5), suggesting the decline may have recently stabilised (Rogers *et al*. 2023). However, given the severe reduction in population size estimated by three earlier studies, a total decline of >30% is assumed until population stabilisation can be confirmed over coming years.

6. In Australia including in New South Wales (NSW), ruddy turnstones typically roost along platforms and shelves of rock, shingle, or gravel beaches, often with shallow tidal pools nearby. They strongly prefer rocky shores or beaches where there are large deposits of rotting seaweed. They can also be found roosting along sand, coral, or shell beaches, and along shoals, cays, and dry ridges of sand or coral beaches. ruddy turnstones have occasionally been sighted roosting in estuaries, harbours, bays, and coastal lagoons among low saltmarsh, or on exposed beds of seagrass, around sewage ponds and on mudflats. In northern parts of the Australian range, they are known to occur in a wide variety of habitats and may

prefer wide mudflats. In the southern parts of the Australian range, the ruddy turnstone prefers rockier coastlines and are less numerous on large embayments with extensive mudflats.

7. The ruddy turnstone breeds near the coast or up to several kilometres inland in the high Arctic. Nesting typically occurs on coastal plains, marshes, and tundra. The species shows a preference for mosaics of bare rock, clay or shingle, and vegetation near water or in areas that remain damp until late summer (Johnsgard 1981; Hayman *et al*. 1986; del Hoyo *et al*. 1996; Snow and Perrins 1998)

8. In general, feeding takes place over the whole tidal range, however, most populations of the ruddy turnstone will likely spend disproportionate amounts of time foraging on the upper tidal flats (Wu and Wilcove 2020). Ruddy turnstones are carnivorous, feeding primarily on insects, worms, crustaceans, molluscs, and spiders (Higgins and Davies 1996). Feeding is both diurnal and nocturnal. They have also been occasionally recorded feeding on eggs and carrion. During the non-breeding season, their main or only food source is maggots obtained from rotting seaweed and the larvae of sandhoppers obtained from the top of sandy beaches, where rotting seaweed is buried under a thin layer of sand (Clemens *et al*. 2021). The species forages specifically within decomposing rather than fresh kelp. Ruddy turnstones use their strong neck and bill to toss shells, kelp, and small stones, searching for maggots, larvae, and other invertebrates. They also peck at exposed objects on rock platforms as the tide recedes (Higgins and Davies 1996). The species has occasionally been recorded chasing small crabs and using their beak to probe crab holes.

9. Ruddy turnstones are a migratory bird, breeding in the northern hemisphere from mid-May to early July, and flying south for the boreal winter (Marchant and Higgins 1993). Like other migratory shorebird species, ruddy turnstones rely on a network of suitable habitat along their migration routes - temporarily occupying stopover sites between breeding and non-breeding grounds (Xu *et al.* 2019). Multiple stopover sites throughout the flyway are required for resting and feeding during these migrations (Xu *et al.* 2019). Hence, connectivity among sites along the flyway is essential for the species' survival and reproduction (Xu *et al.* 2019).

10. There are two potential migration routes to Australia. Individuals occurring in east Australia and New Zealand migrate from east Asia south across the Pacific. They return north via the east coast of Asia. The birds in the western areas of Australia likely migrate directly south from east Asia. These individuals return north via east Asia. In the non-breeding season, ruddy turnstones tend to arrive in the Northern Territory and Western Australia from August onwards. Inland records from September to November suggest some overland movement to the south coast. They arrive in NSW, South Australia and Victoria from September onwards, with most arriving between November to December. In south-east Australia, numbers tend to be stable from December until February. Large numbers of ruddy turnstones occur in north Tasmania, but few move further south. At some sites, birds are not present every year (Higgins and Davies 1996).

11. The main threats to the ruddy turnstone in Australia are habitat loss caused by residential and commercial development, and industrial aquaculture.

Anthropogenic disturbance at feeding and roosting sites is also a threat to the species. '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.

12. The ruddy turnstone's population reduction is thought to be primarily due to changes to the species' coastal stopover locations within the East Asian - Australasian Flyway (EAAF), particularly along the coast of the Yellow Sea. Rapid development for aquaculture, industry, and rapidly increasing human populations are the main drivers of these changes. The degradation and loss of stopover locations is being amplified by the invasion of Cordgrass (*Spartina alterniflora*) and by excessive domestic, industrial and aquaculture discharges. The ruddy turnstone's habitat area is also 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.

13. Wetland loss and degradation, and the subsequent loss of feeding and roosting habitat for the ruddy turnstone in Australia has occurred mainly due to competing land uses and ignorance of the values of wetlands (Geoscience Australia 2021). 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 drivers of wetland habitat loss. Specific threats to wetland habitat across the species' Australian range and potentially operating in NSW include: Landfill or reclamation associated with industrial, housing, port developments, road construction, marinas, canals and resorts; clearing areas of saltmarsh for solar salt production; damage of wetland areas by rubbish dumping and storm water draining; and damage to wetlands from run-off of urban areas, which alters the natural salinity regime of wetland areas (Geoscience Australia 2021). The increasing requirement for residential housing and urban and coastal infrastructure is also causing the draining and filling of wetlands throughout the EAAF, affecting the ruddy turnstone's ability to rest and feed en route to both breeding and non-breeding areas.

14. 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). Direct and indirect effects may arise from activities including aquaculture, intertidal oyster farming, bait harvesting, the compaction of sediments by vehicles, beach nourishment, nutrient enrichment, and the dumping of rubbish or debris (Fuller *et al*. 2019). Any structural modification of soft-sediment feeding habitat may considerably affect probing shorebirds such as the ruddy turnstone and may inhibit successful shorebird foraging (Fuller *et al*. 2019).

15. Tourist visitation to many ruddy turnstone roosting and feeding sites such as sandflats, beaches, bays, and estuaries is increasing. Human recreation, and the associated increase in development to meet tourism demands is likely to disturb shorebirds such as the ruddy turnstone. Disturbance to shorebirds is also caused by activities such as shellfish harvesting, fishing, and aquaculture (Barter *et al*.

2005; Davidson and Rothwell 1993), with disturbance from off-leash dogs being particularly problematic (Weston and Stankowich 2013). Anthropogenic disturbance causes shorebirds to stop feeding and fly around. This may force birds away from traditional roosting and feeding sites (Lilleyman *et al*. 2014) and reduce fat/energy reserves. This can affect an individual's ability 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).

16. Ruddy turnstones that overwinter in Australia are dependent on multiple habitat types throughout the EAAF at different points in time. A reduction in the extent or quality of habitat in one part of the Flyway can have far-reaching consequences for the species, even if its other habitats remain in good condition (Dhanjal-Adams *et al*. 2019; Jackson *et al*. 2019). Moreover, events affecting the species during one stage of its annual cycle can carry-over to subsequent stages (Murray *et al*. 2018). As such, population changes experienced in Australia may be driven by processes occurring thousands of kilometres away and during different life stages for the species (Murray *et al*. 2018).

17. The highest risk for possible arrival of high pathogenicity avian influenza (HPAI) into Australia annually is during September and October each year when millions of migratory seabirds and shorebirds, including the ruddy turnstone, migrate from Asia and North America to Australia (Wille *et al.* 2024). These migratory species traverse countries where HPAI is present and are known to be gregarious, often forming high-density multi-species flocks while roosting and foraging. While these movement pathways and behaviours increase the potential for these species' exposure to HPAI, international evidence from species in this group is that there have been small numbers of individuals that have died as a result of exposure to the H5N1 strain of HPAI since 2020, rather than large scale population losses. Despite the lack of evidence internationally of significant population level effects of H5N1 on migratory shorebirds, the ruddy turnstone has been identified as being at very high risk of population declines due to HPAI (NSW DCCEEW 2024), and so this threat may compound currently estimated population reductions if it were to affect the ruddy turnstone in the future.

18. Due to the effects of the above threats, the Australian population of the ruddy turnstone is estimated to have undergone a moderate reduction in the number of mature individuals over three generations (18.6 years) of between 26% and 72%, based on the range of available estimates (Clemens *et al*. 2016, 2019; Rogers *et al.* 2023). Most estimates within this plausible range of decline, including the most recent one, are below 50%, the threshold that delimits the Vulnerable and Endangered categories. The causes, while likely related to the threats listed above operating across the EAAF and Australia, are not fully understood.

19. *Arenaria interpres* (Linnaeus, 1758) is not eligible to be listed as an Endangered or Critically Endangered species.

20. *Arenaria interpres* (Linnaeus, 1758) is eligible to be listed as a Vulnerable species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a high risk of extinction in Australia in the medium-term 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: Vulnerable under Clause 4.2 (1 c)(2 b)

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Vulnerable under Clause 4.2 (1 c)(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.

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Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Commonwealth DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2023). Conservation advice for *Arenaria interpres* (Ruddy Turnstone). Australian Government, Canberra, ACT.

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