**Publication date: 25 July 2025**

**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 red knot *Calidris canutus* (Linnaeus, 1758) as a VULNERABLE SPECIES in Part 3 of Schedule 1 of the Act. Listing of Vulnerable species is provided for by Part 4 of the Act on the basis of its extinction risk in Australia.

The NSW Threatened Species Scientific Committee is satisfied that the red knot *Calidris canutus* (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 (2024), 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 red knot *Calidris canutus* (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 suspected to be between 31-61% that has occurred over a three-generation timespan of *c.* 21 years. Additionally, the causes of this reduction 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 red knot *Calidris canutus* (Linnaeus, 1758) (family Scolopacidae) is a medium-small sized, dumpy shorebird that is 23–25 cm long, has a wingspan of 45–54 cm, and weighs approximately 120 g. Both sexes appear similar, but the female is slightly larger, less evenly chestnut-red on the underbody, and has a greater amount of white on the rear belly. The species shows marked seasonal variation and juveniles are distinctive from adults. Adult non-breeding or juvenile plumage is the typical appearance of birds in Australia. The centre of non-breeding adults' forehead, crown, nape, hindneck and sides of the neck are plain brownish-grey and are finely streaked black. The chin and throat of the bird are white. The rest of the head and neck are also white with fine dark streaking. An obvious white supercilium runs from the bill to above the rear ear-coverts. The mantle, scapulars, tertials, and innerwing coverts are plain brownish-grey. These feathers have a black shaft and are thinly fringed white. The underbody is primarily white with grey suffusion on the sides of the breast. Fine dark streaks and spots run from the foreneck to the upper belly and along the sides of the belly. These grade into fine wavy bars that run along the lower breast and flanks. The bird's upperparts become browner with wear. Red knots have a black bill, and dark olive legs and feet. Juveniles appear similar to non-breeding adults, however, their mantle, scapular,

tertials, and innerwing coverts are faintly washed brown. These have a characteristic pattern of dark shafts, thin dark submarginal lines, and crisp narrow white fringes. These act to give a scaly appearance above. The bird's foreneck, breast, and upper belly have a faint pinkish wash. This is lost with wear. The foreneck and breast tend to be less heavily marked than on adults. Their legs and feet are also paler and have a more yellow-green colour (Commonwealth DCCEEW 2024).

2. The red knot is a polytypic species comprising six subspecies. Only two of these winter within Australia. *Calidris canutus rogersi* breeds on the Chukotskiy Peninsula in Far Eastern Siberia and possibly further west, and winters in northern and eastern Australia, with many birds also travelling on to New Zealand (Van Gils *et al.* 2017; Weller *et al.* 2020). The other subspecies that appears in Australia, *C. c. piersmai*, breeds in the New Siberian Islands in Far Eastern Russia, and winters in north-west Australia. For the purpose of this Final Determination, *C. c. rogersi* and *C. c. piersmai* are being considered together as the Australian population of the species.

3. Red knots are widespread around the Australian coast. In New South Wales (NSW) it is recorded in some major river estuaries and sheltered embayments along the coast, particularly in the Hunter River estuary. Large numbers arrive in September, with most moving south to Victoria by October. The Red Knot rarely visits inland wetlands, with several records (mostly during the southward migration) as far west as Lake Menindee and the Riverina. Very large numbers are also regularly recorded in north-west Australia, with Eighty Mile Beach and Roebuck Bay in Western Australia being strongholds for the species. Small numbers visit Tasmania and its offshore islands (BirdLife Australia 2020), and the species is occasionally recorded inland in all regions. The species is less numerous in south-west Australia.

4. The Australian Extent of Occurrence (EOO) for the red knot is estimated at 10,900,000 km$^2$ (range 10,400,000–11,400,000 km$^2$) and the Australian Area of Occupancy (AOO) is estimated at 4,200 km$^2$ (range 4,200–6,000 km$^2$). 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 2024) 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). Despite the loss and degradation of wetland habitats, Clemens *et al.* (2021) considers both the EOO and AOO to be stable.

5. The estimated population of the red knot reaching Australia annually is 64,700 (range 53,600–94,300) mature individuals, based on an extrapolation of a 2016 population estimate (Hansen *et al.* 2016) using trends derived from Clemens *et al.* (2016, 2019) and Studds *et al.* (2017). Some studies estimate population increases of +31% (Clemens *et al.* 2016) and +29% (Waterbird meta-analysis; Clemens *et al.* 2019) over a three-generation timespan (*c.* 21 years), while others estimate population reductions of −61% (Studds *et al.* 2017) and −31% (Clemens *et al.* 2019) over three generations. The most recent analysis by Rogers *et al.* (2023) estimated a total change in abundance over three generations of +6.1% (95% CI: -63.9, 207.4). Despite large-scale coordinated counts across the country including strongholds in north-western and south-eastern Australia, the five analyses show

contrasting trends. Differing results may reflect non-linear changes over time, or different rates of decline in different parts of Australia.

6. Whilst in Australia, the red knot mainly inhabits intertidal mudflats, sandflats, and sandy beaches of sheltered coasts, estuaries, bays, inlets, lagoons, and harbours. Red knots are occasionally seen on terrestrial saline wetlands near the coast and have been recorded on sewage ponds and saltworks. Red knots are diurnal and nocturnal. In non-breeding areas, the bird's feeding activity is regulated by the tide, with individuals following the receding edge of the tide to feed. The species is known to feed in large mixed flocks with great knots (*Calidris tenuirostris*), bar-tailed godwits (*Limosa lapponica*), grey-tailed tattlers (*Heteroscelus brevipes*), curlew sandpipers (*Calidris ferruginea*), and red-necked stints (*Calidris ruficollis*; Higgins and Davies 1996). Whilst in its non-breeding range, the bird's diet consists of intertidal invertebrates such as bivalve and gastropod molluscs, crustaceans, annelid worms, and insects (del Hoyo *et al.* 1996; Karpanty *et al.* 2006). The species rarely takes fish and seeds.

7. Red knots are gregarious, often occurring in large flocks. The species roosts in open areas close to feeding grounds to reduce the risk from predators (Rogers 2001). Red knots nest in shallow depressions on open ground, which they line with grass and lichen. Egg laying occurs in June (del Hoyo *et al.* 1996), with clutch sizes of three to four eggs being typical. The incubation period lasts for around 21–22 days; females depart on hatching leaving the male to tend for young. The fledging period lasts for a further 18–20 days.

8. The red knot is a migratory shorebird. It tends to make long non-stop flights along the coast of East Asia between only a few staging areas and is known to migrate overland and visit inland wetlands while migrating. Most red knots arrive on the north-west coast of Australia and the Gulf of Carpentaria from late August. In the Gulf of Carpentaria, tens of thousands of individuals are recorded in September and October, before numbers drop by December (Garnett 1986; Lane 1987). The Gulf of Carpentaria is probably the main staging area for individuals moving to New Zealand and south-east Australia, including those that pass through NSW (Barter 1992). Southward migrations mostly occur along coasts, with some inland records from September–November. Red knots arrive in south-west and south Australia from September onwards, and generally arrive in Tasmania from August–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*, and that some *C.c. piersmai* may winter in eastern Australia. The subspecies *C.c. rogersii* mainly winters in eastern Australia (including NSW) and New Zealand, but some of these birds pass through north-west Australia on migration.

9. The main threat to the red knot in NSW and Australia is 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.

10. The red knot'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 red knot'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.

11. Wetland loss and degradation, and the subsequent loss of feeding and roosting habitat for the red knot in NSW and elsewhere 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 include: Landfill or reclamation associated with industrial, housing, port developments, road construction, marinas, canals and resorts. Additional threats include clearing areas of saltmarsh for 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 red knot's ability to rest and feed en route to breeding and non-breeding areas.

12. Australia's coastal environment, including that in NSW, 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 deep-probing shorebirds such as the red knot, and may inhibit successful shorebird foraging (Fuller *et al.* 2019).

13. Tourist visitation to many red knot 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 red knot. Disturbance to shorebirds is also caused by activities such as shellfish harvesting, fishing, and aquaculture (Barter *et al*. 2002; 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).

14. Red knots that spend the non-breeding period in Australia are dependent on multiple habitats 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 carryover to subsequent stages (Murray *et al.* 2018). Therefore, 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).

15. 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 red knot, 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 lack of evidence internationally of significant population level effects of H5N1 on migratory shorebirds, the red knot 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 red knot in the future.

16. Due to the effects of the above threats, the red knot is suspected to have undergone a moderate reduction in the number of mature individuals over three generations (*c.* 21 years) and the causes, while likely consisting of the threats listed above operating across the EAAF and Australia, are not fully understood. Noting the variable trends observed in Australia over time, and that the largest population reductions are estimated to be 31–61%, the red knot is suspected to have undergone a moderate reduction in the number of mature individuals over a three-generation timespan of 21 years, and these reductions are considered likely to continue into the future.

17. *Calidris canutus* (Linnaeus, 1758) is not eligible to be listed as an Endangered or Critically Endangered species.

18. *Calidris canutus* (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. |

Professor Em Caroline Gross
Chairperson
NSW Threatened Species Scientific Committee

**Supporting Documentation:**

Commonwealth DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024). Conservation advice for *Calidris canutus* (Red Knot). Australian Government, Canberra, ACT.

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