



# Assessing waterbird susceptibility to disturbance by duck hunters in Victoria (2022 update)

P. W. Menkhorst and L. Thompson

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Arthur Rylah Institute for Environmental Research  
Department of Environment, Land, Water and Planning  
PO Box 137  
Heidelberg, Victoria 3084  
Phone (03) 9450 8600  
Website: [www.ari.vic.gov.au](http://www.ari.vic.gov.au)

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**Front cover photo:** Brolgas in pair-bonding display, one value potentially negatively affected by disturbance by hunters (Peter Menkhorst).

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# **Assessing waterbird susceptibility to disturbance by duck hunters in Victoria (2022 update)**

**Peter W. Menkhorst<sup>1</sup> and Louise Thompson<sup>2</sup>**

<sup>1</sup>Arthur Rylah Institute for Environmental Research  
123 Brown Street, Heidelberg, Victoria 3084

<sup>2</sup>Wildlife and Invasive Species Policy, Biodiversity Division,  
Department of Environment, Land, Water and Planning, East Melbourne, Victoria 3001

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# Summary

## Context

In Victoria, the hunting of eight species of native duck (game species) is allowed during a defined open season. Hunting takes place on wetlands that are also habitat for numerous other animal species, including more than 130 other waterbird species, some of which may be unintentionally adversely affected by the activities of hunters. To help reduce these potential impacts, targeted management of wetlands and hunters can be initiated if a need is identified. However, a lack of clarity around the decision-making process and the trigger points for instigating special management action has led to uncertainty and frustration among hunters and staff of the regulatory agencies, and sometimes to poor wildlife management outcomes.

To address these concerns, an earlier report (Menkhorst 2019) ranked waterbird species according to their estimated susceptibility to disturbance and proposed triggers for further management based on population estimates. This revised version updates the 2019 report by incorporating changes to threatened species listings made following recent amendments to the *Flora and Fauna Guarantee Act 1988*.

## Aims

This report improves the process for making decisions on waterbird management during the duck hunting season by:

- 1 Developing an explicit process to assess the susceptibility of non-game waterbird species to the types of disturbance associated with duck hunting,
- 2 Applying this process to all waterbird species that are listed as threatened in Victoria under the Flora and Fauna Guarantee Act,
- 3 Ranking threatened waterbird species according to the potential conservation implications of disturbance caused by duck hunting at the population level (i.e., south-eastern Australia),
- 4 Providing updated estimates of the south-eastern Australian population of each species and suggested trigger points for the consideration of special management attention at the level of an individual wetland.

## Methods

Assessments were made for 32 waterbird species that are listed as threatened in Victoria, including two duck species currently classified as game species. Each species was considered under four separate criteria:

- 1 Susceptibility to disturbance (based on scoring five separate factors).
- 2 Conservation status at state and national levels.
- 3 Do they breed colonially or flock at traditional sites outside the breeding season, and if so, might these behaviours overlap with duck shooting season?
- 4 Are they long-distance migrants?

Population estimates for south-eastern Australia were then used to derive recommended trigger points for the consideration of further management action for each of the 32 species.

## Results

Changed outcomes resulting from this reassessment are as follows:

- 1 The number of species of concern has decreased by 23% from 39 to 32.
- 2 Species that rose up the rankings tended to be migratory shorebirds whose conservation status has been upgraded at both Commonwealth and State levels.
- 3 The species that fell most in the ranking is the Blue-billed Duck, because its conservation status changed to Vulnerable at the state level and Least Concern at the national level.

## Conclusions and implications

This report provides a transparent process for determining which bird species are most likely to be negatively affected by disturbance from duck hunting activities. The species susceptibility ranking, combined with the recommendations of significant population numbers, provides a clearer and more defensible basis for decisions about the need for further management interventions at individual wetlands. It has been revised to include the latest estimates of conservation status. However, for this process to function well it is critical to have adequate wetland survey coverage by a workforce sufficiently skilled in waterbird identification and counting methods.

# 1 Introduction

In Victoria the hunting of eight species of native duck (game species) is allowed during a defined open season (Wildlife (Game) Regulations 2012, Schedule 11). Hunting takes place on natural and constructed wetlands that are also habitat for numerous other animal species, some of which may be unintentionally adversely affected by the activities of hunters, especially when large numbers of hunters gather at a wetland. Potential adverse effects (excluding death or injury from shotgun pellets) include abandonment of nests or young due to the close presence of hunters in areas not normally visited by people, reduced feeding and resting opportunities due to disturbance by noise and movement, increased energy expenditure as a consequence of having to spend longer periods in flight following disturbance and reduced habitat availability resulting from the temporary abandonment of a wetland due to disturbance.

To help reduce these potential adverse impacts on non-game waterbird species, the *Wildlife Act 1975*, combined with the Wildlife (Game) Regulations 2012, allow for targeted management of wetlands and hunters if a need is identified. Targeted management may involve a range of actions, including:

- the prohibition of hunting on a wetland, or part thereof, for the entire open season or for a shorter period
- the prohibition of hunting from a motorboat
- a greater compliance effort at a wetland
- an increased engagement with hunters to explain the risks.

However, a lack of clarity around the decision-making process and the trigger points for instigating special management action has, at times, led to uncertainty about the reasoning behind decisions and questioning of the scientific rigour of decision-making. This can result in reactive or delayed decisions, risking confusion and frustration among hunters and staff of the regulatory agencies, and poor wildlife management outcomes.

Additionally, the values that may trigger targeted management have changed over time and are increasingly being scrutinised by the public, further complicating the situation. In the past, wetland closures were triggered by only two criteria – the presence of trigger numbers of threatened, non-game species of duck (Freckled Duck and Blue-billed Duck but not Musk Duck, also listed as a threatened species in Victoria) or active breeding by colony-nesting waterbird species. More recently, the presence of significant numbers of other threatened waterbirds (e.g., Australasian Bittern, Brolga, Curlew Sandpiper) has also triggered management action. The presence of such species of concern is determined by surveys conducted in the month or so before duck hunting season begins – the Duck Season Priority Waterbird Count (e.g. Menkhorst and Stamation 2022) and by follow-up surveys through the course of the hunting season.

To assist in the decision process for reducing unwanted impacts on non-game species, a systematic process was devised to rank non-game waterbird species according to their susceptibility to disturbance by hunters (Menkhorst 2019). This process has been successfully implemented in the lead-up to each duck season since 2019 and has resulted in a small number of wetland closures and partial closures based on disturbance considerations.

This report aims to improve the process and outcomes for making decisions on waterbird management during the duck hunting season by updating the original report (Menkhorst 2019) to include revised conservation status categories for some species.

Since the publication of the original report (Menkhorst 2019) two game species, Australasian Shoveler and Hardhead, have been formally listed as threatened species under the Victorian *Flora and Fauna Guarantee Act 1988*. Consequently, both species were excluded from hunting during the 2022 duck season. (Special conditions have applied to Australasian Shoveler in all but one season since 1987, with a ban on hunting the species since 2016 (GMA 2022). Further, during 2018-2019, the conservation status of fauna species listed as threatened under the Flora and Fauna Guarantee Act (1988) were reviewed using the IUCN criteria (IUCN 2012) as part of the adoption of an Australia-wide common assessment method for classifying threatened species. This process resulted in some revisions to the categories of threat applied to some species in Victoria. Accordingly, the susceptibility to disturbance rankings were recalculated using the new information, resulting in some changes to the susceptibility score achieved by some species and corresponding changes to the species rankings.

## 2 Methods

### Species for assessment

For the purposes of this project, a broad definition of waterbird was adopted to include all bird species occurring in Victoria that routinely utilise wetlands or aquatic plants. The 146 species considered to meet these criteria are listed in Appendix 1 and include members of 27 bird families:

- Accipitridae (hawks and eagles)
- Acrocephalidae (Australian Reed-Warbler)
- Alcedinidae (Azure Kingfisher)
- Anatidae (swans, geese, ducks)
- Anhingidae (Australasian Darter)
- Anseranatidae (Magpie Goose)
- Ardeidae (herons, egrets, bitterns)
- Artamidae (White-breasted Woodswallow)
- Charadriidae (plovers, dotterels, lapwings)
- Ciconiidae (Black-necked Stork)
- Cisticolidae (Golden-headed Cisticola)
- Glareolidae (pratincoles)
- Gruidae (Brolga)
- Hirundinidae (swallows and martins)
- Laridae (gulls, terns)
- Locustellidae (grassbirds)
- Monarchidae (Australian Magpie-lark)
- Pandionidae (Eastern Osprey)
- Pelecanidae (Australian Pelican)
- Phalacrocoracidae (cormorants)
- Podicipedidae (grebes)
- Psittacidae (Orange-bellied Parrot)
- Rallidae (crakes, rails, gallinules)
- Recurvirostridae (stilts, avocets)
- Rostratulidae (painted-snipes)
- Scolopacidae (snipe, godwits, curlews, sandpipers, stints, phalaropes)
- Threskiornithidae (ibis, spoonbills)

The assessment of susceptibility to disturbance was restricted to those taxa of waterbirds recorded from Victoria (Appendix 1) that were listed as threatened under the Flora and Fauna Guarantee Act at 1 April 2022. This restriction assumes that, for non-listed taxa, any effects of disturbance resulting from the annual duck hunting season would not materially change their conservation status at the population level. Australian waterbirds are, on the whole, highly mobile and routinely move across State borders. Therefore, for this analysis 'population level' is defined as those birds inhabiting south-eastern mainland Australia. Species of duck that are available to be hunted (i.e., game species that are not listed as threatened) were also excluded because such a designation clearly makes any concerns about disturbance redundant.

The primary habitats of the 41 taxa identified by this selection process (Table 1) were then assessed to remove species that rarely, if ever, utilise wetlands open to hunting in Victoria. This led to the removal of nine taxa from further consideration because they are specialised birds of the seashore (called 'marine only' in Table 1) and are unlikely to be affected by duck hunting, which is not authorised on Victorian beaches. However, five primarily seashore species (Hooded Plover, Bar-tailed Godwit, Common Sandpiper, Fairy Tern, Little Tern) that also utilise coastal lakes or estuaries where hunting may be allowed were retained, as were shorebirds that regularly utilise inland wetlands. This left 32 species (Table 1) to be scored against criteria designed to estimate the potential impact of disturbance caused by duck hunting on the species, at a population level.



## Criteria for assessing potential impacts of disturbance

The 32 species for assessment were considered under four separate criteria:

- 1 Susceptibility to disturbance (based on scoring five separate factors).
- 2 Conservation status at state and national level.
- 3 Do they breed colonially or flock at traditional sites outside the breeding season, and if so, might these behaviours overlap with duck shooting season?
- 4 Are they long-distance migrants?

These criteria were distilled from the literature (e.g., Sokos *et al.* 2013), both author's participation in planning of duck hunting seasons, discussions with waterbird ecologists, and the senior author's observations of waterbird behaviour over several decades, including observations of bird behaviour at wetlands when duck hunting was taking place.

Criteria 2, 3 and 4 have simple binary answers, and values were assigned by the author alone. Criterion 1 requires a series of subjective judgements, so four waterbird biologists (including the senior author) were each asked to independently score each species against the five factors and the mean value was calculated for each factor (see below). The four criteria are described below:

### 1. Susceptibility to disturbance

A form of expert elicitation using a simplified IDEA protocol (Hanea *et al.* 2018) was used to score each species against five factors (see below). Four waterbird experts were asked to independently score each species-factor combination into a spreadsheet. Outlying scores were then brought to the attention of the expert concerned and discussed with the author. Experts were then given the opportunity to adjust individual scores. Finally, the mean score for each species-factor combination was calculated and the sum of the mean scores for each of the five factors became the susceptibility score for each species.

The five factors, based partly on those developed by Sokos *et al.* (2013), were given equal weighting in the scoring process. They are:

#### **Factor 1 Nocturnal feeding**

Duck hunting is legal only during daylight hours, so species that are capable of feeding during darkness should be less affected by hunting disturbance than those that require daylight to feed. Hunting may force obligate daytime feeders to feed while the disturbance is present or to fly to a wetland where hunting is not occurring.

Scores for nocturnal feeding were:

- able to feed at any time = 0
- obligate diurnal feeders = 1

#### **Factor 2 Group size**

Species that habitually occur in large groups will potentially suffer greater disturbance than those that prefer to utilise an area as singles or family groups and are therefore more widely scattered across the landscape. The assumption here is that dispersed species should more readily find space in refuge habitat than a large flock for which refuge habitat may be more limiting.

Scores for group size were:

- small/singles = -1
- intermediate = 0
- large = 1

#### **Factor 3 Response to disturbance**

The behavioural response of a species to disturbance from duck hunting activities is a significant determinant of the impact that hunting might have on that species. Species that can skulk into nearby dense cover and wait until the disturbance declines will presumably be less affected than those that take to the wing and circle the wetland, using more energy and exposing themselves to being shot. Species that quickly leave the hunted wetland for a refuge area are considered to be less affected than those that stay and may be repeatedly disturbed.

Scores for response to disturbance were:

- run to cover or crypsis = -1
- long flight to leave wetland = 0
- short flight or swim within wetland = 0.5
- circling flight over wetland = 1

#### **Factor 4 Dietary specialisation**

Birds have relatively high metabolic rates, and many waterbirds must forage fairly continuously to stay healthy. In general, dietary specialists such as high-order carnivores have fewer choices for refuge habitat than generalists such as herbivores and omnivores, and are therefore more susceptible to disturbance. Carnivores were categorised as small or large, based on the size of animals eaten: small carnivores feed primarily on macro-invertebrates and small fish (< 5 cm in length).

Scores for dietary specialisation were:

- herbivorous = -1
- omnivorous = 0
- carnivorous small = 0.5
- carnivorous large = 1

#### **Factor 5 Habitat breadth**

Habitat specialists are less flexible than habitat generalists in the sorts of places they can use as refugia or as foraging sites until the disturbance has passed. Therefore, species that can utilise a range of wetland types (e.g., different salinities, depths, vegetation communities) should have a greater capacity to find refuge habitat.

Scores for habitat breadth were:

- broad = -1
- intermediate = 0
- narrow = 1

## **2. Conservation status**

Disturbance due to the activities of hunters will potentially be of greater significance to populations of species that are already under stress from other threatening processes. Hence the conservation status of a species is an important component of this susceptibility assessment. Currently, three assessments of conservation status are available for Victorian bird taxa: two are formal lists maintained under legislation – Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999*) (EPBC Act) and State (*Flora and Fauna Guarantee Act 1988*) (FFG Act) – and the other is a national assessment conducted under the auspices of the Birdlife Australia Threatened Species Committee (Garnett and Baker 2021). The rankings under the FFG Act were the outcomes of a Conservation Status Assessment process conducted by DELWP during 2018–2019. Note that the adoption of the IUCN categories and criteria (IUCN 2012) under the FFG Act means that the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2013) is now redundant. Further, the IUCN category of Near Threatened was not included in the FFG Act listing process, meaning that nine species included at that level in the assessments of Menkhorst (2019) are not considered here. Those species are Baillon's Crake, Glossy Ibis, Long-toed Stint, Nankeen Night-Heron, Pectoral Sandpiper, Pied Cormorant, Royal Spoonbill, Whiskered Tern and White-winged Black Tern.

For this revised assessment we used the 2018–2019 FFG Act assessments of conservation threat category and those of Garnett and Baker (2021), because the EPBC Act listing will be amended to reflect the outcomes of Garnett and Baker (2021).

Scores for conservation status were Vulnerable – 2, Endangered – 3 and Critically Endangered – 4, at both state and national levels. Species included on both lists received the sum of the two scores.

## **3. Colony-breeding species**

Colony-breeding species are those which habitually aggregate to breed in a confined area with multiple nests built in proximity. Because breeding colonies contain a high density of individuals, disturbance of breeding colonies can result in a magnified impact compared to species which nest as dispersed pairs. A total of 26 species of waterbird may breed colonially in Victoria (Appendix 2).

Colony-breeding species received a score of 1.

One other species, the Brolga, also aggregates around the time of the duck hunting season, though not for breeding. In south-eastern Australia, Brolgas breed as isolated pairs mostly between July and December. Following breeding, and as the shallow freshwater marshes dry in late summer–autumn, Brolgas gather at a few traditional wetlands (Arnol et al. 1984; Marchant and Higgins 1993, Sheldon 2005) as part of their pair bonding and social learning behaviour. These gatherings, which in Victoria can involve up to 150 individuals, are thought to be important in the social life of a regional Brolga population and should not be unduly disturbed.

For this reason, Brolga received an additional score of 1.

#### 4. Long-distance migrants

Migratory birds need to build up energy reserves as their departure approaches to give them the best chance of reaching their destination. Of particular concern here are the migratory shorebirds that spend their non-breeding period (the austral summer) in Victoria and breed more than 15 000 km away in the high Arctic. These species leave Victoria during autumn and fly non-stop for several thousand km to reach stopover feeding sites in south-east Asia, where they can replenish reserves before continuing their flight to the breeding grounds. In the weeks leading up to departure it is critical that they can feed voraciously to reach a body weight and condition that will maximise their chances of successfully completing the migration and then breeding successfully (Zwarts et al. 1990, Battley and Rogers 2007). Disturbance during this critical period needs to be minimised. Note that first-year birds of most migratory shorebirds do not undertake a return (northward) migration, instead remaining in Victoria throughout their first southern winter; that is, through the duck hunting season. Therefore, disturbance of flocks of predominantly immature shorebirds late in the duck hunting season (May and June) is of less concern than disturbance of flocks containing adults prior to migration in March and April. With good views through binoculars or a spotting scope, first-year shorebirds can often be distinguished by plumage characters (see Menkhorst *et al.* 2019 page 120).

Long-distance migrants (i.e., trans-equatorial) received an additional score of 1.

**Table 1. Victorian waterbird species listed as threatened at the state level (Flora and Fauna Guarantee Act) or at the national level (Garnett and Baker 2021) assessed against the criteria for assessing potential impacts of disturbance. Values for the susceptibility scores are provided in Table 2.**

Shading indicates species not assessed for disturbance by duck hunting because they utilise only tidal marine habitats. CR – critically endangered; EN – endangered; VU – vulnerable; y – yes.

Species (alphabetical order)	Victorian threatened status	National threatened status	Game species?	Marine only?	Long-distance migrant?	Colony-breeding in Victoria?
Australasian Bittern	CR	EN				
Australasian Shoveler	VU		y			
Australian Little Bittern	EN					
Australian Painted-snipe	CR	EN				
Bar-tailed Godwit	VU	EN			y	
Black Bittern	EN					
Black-tailed Godwit	CR	EN			y	
Blue-billed Duck	VU					
Brolga	EN					
Caspian Tern	VU					y
Common Greenshank	EN	VU			y	
Common Sandpiper	VU				y	
Curlew Sandpiper	CR	EN			y	
Eastern Curlew	CR	EN		y	y	
Fairy Tern	CR	VU				y
Freckled Duck	EN					
Great Egret	VU					y
Great Knot	CR			y	y	
Greater Sand Plover	VU			y	y	
Grey Plover	VU	VU		y	y	
Grey-tailed Tattler	CR			y	y	
Australian Gull-billed Tern	EN					y
Hardhead	VU		y			
Hooded Plover	VU	VU				
Intermediate Egret	CR					y
Latham's Snipe	–	VU			y	
Lesser Sand Plover	EN	EN		y	y	
Lewin's Rail	VU					
Little Egret	EN					y
Little Tern	CR	VU				y
Maggie Goose	VU					y
Marsh Sandpiper	EN				y	
Musk Duck	VU					
Orange-bellied Parrot	CR	CR				
Pacific Golden Plover	VU				y	
Red Knot	EN	VU		y	y	
Ruddy Turnstone	EN	EN		y	y	
Terek Sandpiper	EN	VU		y	y	
Whimbrel	EN			y	y	
White-bellied Sea-Eagle	EN					
Wood Sandpiper	EN				y	

## 3 Results

### Susceptibility score

The results of the assessment of susceptibility to disturbance are provided in Table 2. Those for the final disturbance ranking (susceptibility plus conservation status, colony breeding and long-distance migrant assessments) are presented in Table 3.

**Table 2. Mean scores for each of the five factors that comprise the susceptibility to disturbance score for each species assessed.**

Species for assessment (alphabetical order)	Nocturnal feeding	Group size	Response to disturbance	Dietary specialisation	Habitat breadth	Susceptibility score
Australasian Bittern	0.25	-0.75	-1.0	1.0	1.0	0.5
Australasian Shoveler	0.25	0.25	0.75	-0.25	0.25	1.25
Australian Little Bittern	0.5	-1.0	-1.0	0.625	1.0	0.125
Australian Painted-snipe	0.25	-0.75	-0.625	0.5	1.0	0.375
Bar-tailed Godwit	0.0	0.0	0.5	0.5	0.75	1.75
Black Bittern	0.5	-1.0	-1.0	0.875	0.75	0.125
Black-tailed Godwit	0.0	0.0	0.625	0.5	0.75	1.875
Blue-billed Duck	0.75	1.0	0.5	0.125	0.5	2.875
Brolga	1.0	0.25	0.0	-0.125	0.75	1.875
Caspian Tern	1.0	0.0	0.5	0.875	-0.25	2.125
Common Greenshank	0.75	-0.5	0.5	0.5	0.5	1.75
Common Sandpiper	0.0	-1.0	0.5	0.5	1.0	1.0
Curlew Sandpiper	0.0	1.0	0.625	0.5	0.5	2.625
Fairy Tern	1.0	0.0	0.75	0.75	0.75	3.25
Freckled Duck	0.25	0.5	0.875	0.0	0.25	1.875
Great Egret	1.0	0.75	0.5	1.0	-0.25	3.0
Australian Gull-billed Tern	1.0	0.25	0.5	0.75	0.5	3.0
Hardhead	0.5	0.75	0.875	0.125	-0.25	2.0
Hooded Plover	1.0	-0.75	0.5	0.5	1.0	2.25
Intermediate Egret	1.0	-0.75	0.5	0.875	0.75	2.375
Latham's Snipe	0.25	0.0	0.625	0.5	0.75	2.125
Lewin's Rail	0.5	-1.0	-1.0	0.5	0.75	-0.25
Little Egret	1.0	-1.0	0.5	0.875	0.75	2.125
Little Tern	1.0	0.0	0.75	0.75	0.75	3.25
Magpie Goose	1.0	0.75	0.625	-1.0	0.5	1.875
Marsh Sandpiper	0.75	-0.25	0.5	0.5	0.75	2.25
Musk Duck	0.75	0.25	0.5	0.375	0.25	2.125
Orange-bellied Parrot	1.0	-1.0	0.75	-1.0	0.75	0.5
Pacific Golden Plover	0.0	-0.5	0.75	0.5	0.75	1.5
Ruddy Turnstone	0.75	-0.25	0.625	0.5	0.75	2.375
White-bellied Sea-Eagle	1.0	-1.0	0.25	1.0	0.25	1.5
Wood Sandpiper	0.75	-1.0	0.5	0.5	1.0	1.75

Scores: Nocturnal feeding – yes = 0, no = 1; Group size – small = -1, intermediate = 0, large = 1; Response to disturbance – run to cover/crypsis = -1, leave wetland = 0, short flight or swim within wetland = 0.5, circles over wetland = 1; Dietary specialisation – herbivore = -1, omnivore = 0, small carnivore = 0.5, large carnivore = 1; Habitat breadth – broad = -1, intermediate = 0, restricted = 1

## Combined disturbance score

Table 3 presents the 32 species assessed in rank order of their total score for disturbance susceptibility.

**Table 3. Disturbance ranking for Victorian waterbird species that may be disturbed by ducking hunting activity. Species sequence is highest to lowest total score.**

Scores for conservation status are Vulnerable – 2, Endangered – 3, Critically Endangered – 4. For species listed at both state and national levels, the two scores were summed.

Ranking	Species	Combined conservation status score	Susceptibility score	Colony-breeding/flocking site	Long-distance migrant	Total score
1	Curlew Sandpiper	7	2.625		1	10.62
2	Fairy Tern	6	3.25	1		10.25
3	Little Tern	6	3.25	1		10.25
4	Black-tailed Godwit	7	1.875		1	9.87
5	Bar-tailed Godwit	7	1.75		1	9.75
6	Ruddy Turnstone	6	2.375		1	9.37
7	Orange-bellied Parrot	8	0.5			8.50
8	Australian Painted-snipe	7	0.375	1		8.37
9	Common Greenshank	5	1.75		1	7.75
10	Australasian Bittern	7	0.5			7.50
11	Intermediate Egret	4	2.375	1		7.37
12	Australian Gull-billed Tern	3	3.0	1		7.00
13	Hooded Plover	4	2.25			6.25
14	Marsh Sandpiper	3	2.25		1	6.25
15	Little Egret	3	2.125	1		6.12
16	Great Egret	2	3.0	1		6.00
17	Brolga	3	1.875	1		5.87
18	Wood Sandpiper	3	1.75		1	5.75
19	Caspian Tern	2	2.125	1		5.12
20	Latham's Snipe	2	2.125		1	5.12
21	Blue-billed Duck	2	2.875			4.87
22	Freckled Duck	3	1.875			4.87
23	Magpie Goose	2	1.875	1		4.87
24	Pacific Golden Plover	2	1.5		1	4.50
25	White-bellied Sea-Eagle	3	1.5			4.50
26	Musk Duck	2	2.125			4.12
27	Common Sandpiper	2	1.0		1	4.00
28	Hardhead	2	2.0			4.00
29	Australasian Shoveler	2	1.25			3.25
30	Australian Little Bittern	3	0.125			3.12
31	Black Bittern	3	0.125			3.12
32	Lewin's Rail	2	-0.25			1.75

## Applying the disturbance score

Ranking species susceptibility highlights the species of greatest concern but does not indicate the circumstances under which extra management action is warranted. These need to be determined on a case-by-case basis, including consideration of the number of individuals at risk of disturbance at a given wetland and time. It is suggested that for each species in Table 3, a proportion of the estimated total south-eastern

Australian population could be nominated as a trigger. A value of 1% of a population has often been used as an indication of a significant proportion of a population, for example, for defining sites of significance such as Ramsar sites (see criterion 6 at <https://www.environment.gov.au/water/wetlands/ramsar/criteria-identifying-wetlands>).

Broad population estimates for most species of waterbird in the Australian region are available (Wetlands International 2019) and could be used as the basis for an estimate of the south-eastern Australian population.

Recent revised estimates of shorebird population numbers in the East Asian – Australasian Flyway (Hansen *et al.* 2016) form a solid basis for deriving defensible population estimates for south-eastern Australia. For those waterbird species listed as threatened under Victorian legislation (FFG Act), an estimate of the size of the Victorian population was required to implement the common assessment method. Population estimates based on these three compilations are provided in Table 4. For the current assessment an ecologically defensible estimate at the population (i.e., south-eastern Australian) level is required, rather than adopting the Victoria-only estimates used to inform the 2018–2019 FFG Act conservation status assessments.

Therefore, we have retained the population estimates of Wetlands International and Hansen *et al.* (2016) as used in the first iteration of this disturbance ranking (Menkhorst 2019).

Two sources of species population estimates were used to calculate the number of individuals present that should trigger consideration of further management action at a given wetland. They are, in order of priority based on quality and currency of the assessments, (1) Hansen *et al.* (2016) (migratory shorebirds only), (2) Wetlands International (<https://wpp.wetlands.org/explore>). The results of the FFG Act population estimates are presented in Table 4 for comparison.

In cases where the estimate applies to the entire continent (Wetlands International 2019), the first quartile is divided by three to give a conservative estimate for south-eastern Australia before calculating the 1% trigger. Estimates for migratory shorebirds (Hansen *et al.* 2016) are for the entire East Asian – Australasian Flyway (including New Zealand) and the first quartile was divided by 5 to give an estimate for south-eastern Australia before calculating the 1% trigger.

**Table 4. Population estimates for the species assessed, and recommended trigger points for consideration of further management action.**

Species	Estimate of flyway population (Wetlands International 2019)	Estimate of flyway population (Hansen <i>et al.</i> 2016)	Estimate of Victorian population (FFG assessment)	Recommended trigger point
Australasian Bittern	310–960		70–100	2
Australasian Shoveler	10,000–100,000		4500–7000	108
Australian Little Bittern	1000–10,000		30–300	11
Australian Painted-snipe	1500–2250		37–370	8
Bar-tailed Godwit		325,000	—	650
Black Bittern	10,000–100,000*		5–15	65
Black-tailed Godwit		160,000	0–50	320
Blue-billed Duck	10,000		4000–10,000	100
Brolga	1000 (southern Aust)		550–650	10
Caspian Tern	10,000–100,000		100–400	108
Common Greenshank		110,000	390	220
Common Sandpiper		190,000	72–181	380
Curlew Sandpiper		90,000	—	180
Fairy Tern	1200–1980		50–100	14
Freckled Duck	10,000–25,000		150–2000	137
Great Egret	25,000–100,000*		900–1000	38
Australian Gull-billed Tern	25,000–100,000		10–300	87
Hardhead	100,000–1,000,000		8000–10,000	1083
Hooded Plover ( <i>ssp cucullatus</i> )	3750		—	37
Intermediate Egret ( <i>ssp plumifera</i> )	25,000–100,000*		50–80	87
Latham's Snipe		30,000	—	60
Lewin's Rail ( <i>ssp pectoralis</i> )	1000–25,000		—	23
Little Egret ( <i>ssp nigripes</i> )	25,000–100,000		20–40	38
Little Tern	10,000–100,000		200–250	108
Magpie Goose	3000**		700–1000	30
Marsh Sandpiper		130,000	116	260
Musk Duck ( <i>ssp menziesi</i> )	10,000–25,000		2000–10,000	137
Orange-bellied Parrot			20 <sup>†</sup>	1
Pacific Golden Plover		120,000	425	240
Ruddy Turnstone		30,000	132–310	60
White-bellied Sea-Eagle			150–200**	2
Wood Sandpiper		130,000	1–50	260

\* Estimates from Wetland International also apply to parts of Asia or the Pacific, and these species are treated as for the migratory shorebirds.

\*\* Estimates for Magpie Goose and White-bellied Sea-Eagle are based on the isolated south-eastern Australian population (P. Menkhorst unpublished data).

† Estimate for the Orange-bellied Parrot is based on recovery team monitoring data.

## 4 Discussion

### Threatened species rankings

The question of whether to apply conservation status rankings at the State or National level was given careful consideration. It is unlikely that distinct Victorian populations exist for most Victorian waterbird species, rather, most are part of larger, mobile populations that move widely across south-eastern Australia, according to climatic conditions (Orange-bellied Parrot, Little Tern, Fairy Tern and Hooded Plover are likely exceptions to this). Therefore, it could be argued that the taxon level, rather than the State of Victoria, is the appropriate scale at which to assess conservation status for the current purpose. On the other hand, a State-level assessment provides a more nuanced and informed assessment of local conservation status and better reflects current understandings of conservation status in south-eastern Australia than do the existing national and global assessments. Adopting the State-level assessment is also more inclusive, allowing the assessment of 40 taxa compared to 17 taxa for the nationwide list (Table 1), thereby reducing the risk of failing to assess sensitive species. It also best accords with the FFG Act which requires conservation management to be focussed at the State level.

For these reasons, a combined score was used – the sum of scores for the rankings arrived at in the DELWP Conservation Status Assessment process (2018–2019) and those of Garnett and Baker (2021). Both used the IUCN Red List criteria and categories but applied them at the state and national levels respectively. Both assessments were applied specifically to the most relevant Australian taxon of each species, such as local subspecies and, in the case of migratory shorebirds, each used the most current data from the East Asian-Australasian Flyway population (Hansen et al 2016).

### Characteristics of susceptible species

Species that ranked highest for susceptibility to disturbance encompassed a range of taxonomic groups (11 Families) and ecological niches. The top 20 species in Table 3 include four members of each of two families: Ardeidae (herons, egrets, bitterns) and Laridae (gulls and terns) and eight members of the Scolopacidae (sandpipers and relatives). The egrets and terns scored highly because they are listed threatened species, obligate diurnal feeders, high in the food chain, and colony-breeders. Shorebirds that ranked in the top 20 are listed threatened species, occur in flocks, and are trans-equatorial migrants that need to dramatically increase body weight prior to departure in autumn. Five species of duck make up almost half of the remaining taxa, all are listed as threatened.

### Application of disturbance rankings

The result of this scoring process is a list of waterbird species ranked for the potential for their south-eastern Australian population to be adversely affected by disturbance caused by the activities of duck hunters. The purpose of this list is to identify species of most concern so that they can be prioritised for attention in the lead-up to the duck hunting season; for example, they should be carefully counted in the annual Duck Season Priority Waterbird Count and monitored through the course of the hunting season.

It is anticipated that the presence of a single species at the trigger number would lead to consideration of targeted management action. If more than one species reached the trigger number at a given wetland and time then the case for targeted management action would be stronger, depending on the rank of the species concerned (Table 3). When a species reaches the trigger number simultaneously at more than one wetland, each wetland should be considered independently of the others to allow for local circumstances to be considered, for example, hunting intensity and refuge availability.

The application of these disturbance rankings and population triggers is unlikely to significantly hinder duck hunting opportunities. Given that many of the species in Table 3 do not occur in large numbers in Victoria, they are unlikely to ever trigger a management response. Other species in Table 3 that can have large populations in south-eastern Australia tend to occur across many different wetlands and are therefore unlikely to reach the trigger number at any given wetland and time. In the three years that the original disturbance rankings were applied to the management of a Victorian duck hunting season (2020, 2021, 2022), management action due to potential disturbance was triggered by the presence of two species (Australasian Bittern and Brolga) on a total of five wetlands, and colony breeding by two species (Royal Spoonbill and Pied Cormorant) resulted in the partial closure of another wetland.



## Treatment of Blue-billed Duck and Freckled Duck

In the case of the Blue-billed Duck and Freckled Duck, which have long been listed as threatened species in Victoria and are known to be susceptible to non-target mortality during duck season (Loyn 1989), trigger numbers to prompt management action have been in place for many years. The triggers are based on flock size and are aimed at reducing the risk of mortality rather than disturbance. Current thresholds are: Blue-billed Duck – 50 individuals on a small wetland and 150 individuals on a large wetland; Freckled Duck – a flock of 20 or more (S. Toop, GMA pers. comm.).

## Differences in outcomes between the first (2019) and second assessments

Comparing Table 3 and Appendix 2 in the original report (Menkhorst 2019) with those presented here (in Table 3 and Appendix 3) identifies the following main differences.

- 1 The number of species of concern has decreased by 23% from 39 to 32. This is because 9 species formerly classified as Near Threatened were removed from consideration, but 2 species excluded last time because they are game birds (Australasian Shoveler, Hardhead) have been considered here because they are now formally listed as threatened species under the FFG Act.
- 2 Species that rose in the rankings tended to be migratory shorebirds whose conservation status has been upgraded at both Commonwealth and state levels.
- 3 The species that fell most in the ranking is the Blue-billed Duck, because its conservation status changed from EN to VU at state level and from Near Threatened to Least Concern at national level.

## Conclusions and implications

- 1 This report provides a transparent process for determining bird species most likely to be negatively affected by disturbance from duck hunting activities. It incorporates the latest information on conservation status and population estimates for the region.
- 2 The species susceptibility ranking, combined with the recommendations of significant population numbers, provides a clearer and more defensible basis for decisions about the need for further management interventions at individual wetlands.
- 3 In the case of the Blue-billed Duck and Freckled Duck, the traditional trigger numbers, based on risk of mortality, should be retained.
- 4 An important need for this process to function well is to have an adequate workforce sufficiently skilled in waterbird identification and counting, so that the community can have confidence that coverage of the important hunting wetlands, and the waterbird populations present, is adequate for informed decision making.

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## 6 Appendices

### Appendix 1. List of Victorian waterbird species

\* - fully marine species; # - rare or vagrant species in Victoria. Taxonomy and nomenclature follow Menkhorst et al. (2019).

English name	Scientific name
	<b>ANSERIFORMES</b>
<b>Magpie Goose</b>	<b>Anseranatidae</b>
Magpie Goose	<i>Anseranas semipalmata</i>
<b>Ducks, geese and swans</b>	<b>Anatidae</b>
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>
Wandering Whistling-Duck#	<i>Dendrocygna arcuata</i>
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>
Black Swan	<i>Cygnus atratus</i>
Freckled Duck	<i>Stictonetta naevosa</i>
Australian Shelduck	<i>Tadorna tadornoides</i>
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Cotton Pygmy-goose#	<i>Nettapus coromandelianus</i>
Northern Mallard	<i>Anas platyrhynchos</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Australasian Shoveler	<i>Anas rhynchotis</i>
Northern Shoveler#	<i>Anas clypeata</i>
Grey Teal	<i>Anas gracilis</i>
Chestnut Teal	<i>Anas castanea</i>
Garganey#	<i>Anas querquedula</i>
Hardhead	<i>Aythya australis</i>
Blue-billed Duck	<i>Oxyura australis</i>
Musk Duck	<i>Biziura lobata</i>
	<b>PODICIPEDIFORMES</b>
<b>Grebes</b>	<b>Podicipedidae</b>
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>
Great Crested Grebe	<i>Podiceps cristatus</i>
	<b>CICONIIFORMES</b>
<b>Storks</b>	<b>Ciconiidae</b>
Black-necked Stork#	<i>Ephippiorhynchus asiaticus</i>
	<b>PELECANIFORMES</b>
<b>Ibises and spoonbills</b>	<b>Threskiornithidae</b>
Australian White Ibis	<i>Threskiornis molucca</i>
Straw-necked Ibis	<i>Threskiornis spinicollis</i>
Glossy Ibis	<i>Plegadis falcinellus</i>

English name	Scientific name
Royal Spoonbill	<i>Platalea regia</i>
Yellow-billed Spoonbill	<i>Platalea flavipes</i>
<b>Herons and bitterns</b>	<b>Ardeidae</b>
Australasian Bittern	<i>Botaurus poiciloptilus</i>
Australian Little Bittern	<i>Ixobrychus dubius</i>
Black Bittern#	<i>Ixobrychus flavicollis</i>
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>
Striated Heron#	<i>Butorides striata</i>
Eastern Cattle Egret	<i>Bubulcus coromandus</i>
White-necked Heron	<i>Ardea pacifica</i>
Great Egret	<i>Ardea alba</i>
Intermediate Egret	<i>Egretta intermedia</i>
Pied Heron#	<i>Egretta picata</i>
White-faced Heron	<i>Egretta novaehollandiae</i>
Little Egret	<i>Egretta garzetta</i>
Eastern Reef Egret	<i>Egretta sacra</i>
<b>Pelicans</b>	<b>Pelecanidae</b>
Australian Pelican	<i>Pelecanus conspicillatus</i>
	<b>SULIFORMES</b>
<b>Cormorants and shags</b>	<b>Phalacrocoracidae</b>
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>
Black-faced Cormorant*	<i>Phalacrocorax fuscescens</i>
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>
Pied Cormorant	<i>Phalacrocorax varius</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
<b>Darters</b>	<b>Anhingidae</b>
Australasian Darter	<i>Anhinga novaehollandiae</i>
	<b>ACCIPITRIFORMES</b>
<b>Ospreys</b>	<b>Pandionidae</b>
Eastern Osprey#	<i>Pandion cristatus</i>
<b>Kites, hawks and eagles</b>	<b>Accipitridae</b>
Swamp Harrier	<i>Circus approximans</i>
Black Kite	<i>Milvus migrans</i>
Whistling Kite	<i>Haliastur sphenurus</i>
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>
	<b>GRUIFORMES</b>
<b>Rails, crakes and coots</b>	<b>Rallidae</b>
Buff-banded Rail	<i>Gallirallus philippensis</i>
Lewin's Rail	<i>Lewinia pectoralis</i>
Baillon's Crake	<i>Porzana pusilla</i>
Australian Spotted Crake	<i>Porzana fluminea</i>
Spotless Crake	<i>Porzana tabuensis</i>

English name	Scientific name
Australasian Swamphen	<i>Porphyrio melanotus</i>
Dusky Moorhen	<i>Gallinula tenebrosa</i>
Black-tailed Native-hen	<i>Tribonyx ventralis</i>
Eurasian Coot	<i>Fulica atra</i>
<b>Cranes</b>	<b>Gruidae</b>
Brolga	<i>Grus rubicunda</i>
	<b>CHARADRIIFORMES</b>
<b>Stilts and avocets</b>	<b>Recurvirostridae</b>
White-headed Stilt	<i>Himantopus leucocephalus</i>
Banded Stilt	<i>Cladorhynchus leucocephalus</i>
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>
<b>Plovers</b>	<b>Charadriidae</b>
Banded Lapwing	<i>Vanellus tricolor</i>
Masked Lapwing	<i>Vanellus miles</i>
Red-kneed Dotterel	<i>Erythronyctes alpestris</i>
Pacific Golden Plover	<i>Pluvialis fulva</i>
American Golden Plover <sup>#</sup>	<i>Pluvialis dominica</i>
Grey Plover <sup>*</sup>	<i>Pluvialis squatarola</i>
Ringed Plover <sup>#</sup>	<i>Charadrius hiaticula</i>
Red-capped Plover	<i>Charadrius ruficapillus</i>
Double-banded Plover	<i>Charadrius bicinctus</i>
Lesser Sand Plover <sup>**</sup>	<i>Charadrius mongolus</i>
Greater Sand Plover <sup>**</sup>	<i>Charadrius leschenaultii</i>
Oriental Plover <sup>#</sup>	<i>Charadrius veredus</i>
Hooded Plover	<i>Thinornis cucullatus</i>
Black-fronted Dotterel	<i>Elseya melanops</i>
<b>Painted-snipes</b>	<b>Rostratulidae</b>
Australian Painted-snipe	<i>Rostratula australis</i>
<b>Sandpipers and snipes</b>	<b>Scolopacidae</b>
Latham's Snipe	<i>Gallinago hardwickii</i>
Short-billed Dowitcher <sup>#</sup>	<i>Limnodromus griseus</i>
Asian Dowitcher <sup>**</sup>	<i>Limnodromus semipalmatus</i>
Black-tailed Godwit	<i>Limosa limosa</i>
Hudsonian Godwit <sup>**</sup>	<i>Limosa haemastica</i>
Bar-tailed Godwit	<i>Limosa lapponica</i>
Little Curlew	<i>Numenius minutus</i>
Eastern Whimbrel <sup>*</sup>	<i>Numenius phaeopus</i>
Hudsonian Whimbrel <sup>**</sup>	<i>Numenius hudsonicus</i>
Eastern Curlew <sup>*</sup>	<i>Numenius madagascariensis</i>
Spotted Redshank <sup>#</sup>	<i>Tringa erythropus</i>
Marsh Sandpiper	<i>Tringa stagnatilis</i>
Common Greenshank	<i>Tringa nebularia</i>

English name	Scientific name
Lesser Yellowlegs#	<i>Tringa flavipes</i>
Wood Sandpiper	<i>Tringa glareola</i>
Grey-tailed Tattler*	<i>Tringa brevipes</i>
Wandering Tattler**	<i>Tringa incana</i>
Terek Sandpiper*	<i>Xenus cinereus</i>
Common Sandpiper	<i>Actitis hypoleucos</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Great Knot*	<i>Calidris tenuirostris</i>
Red Knot	<i>Calidris canutus</i>
Sanderling*	<i>Calidris alba</i>
Red-necked Stint	<i>Calidris ruficollis</i>
Little Stint	<i>Calidris minuta</i>
Long-toed Stint	<i>Calidris subminuta</i>
White-rumped Sandpiper#	<i>Calidris fuscicollis</i>
Baird's Sandpiper#	<i>Calidris bairdii</i>
Pectoral Sandpiper	<i>Calidris melanotos</i>
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>
Curlew Sandpiper	<i>Calidris ferruginea</i>
Stilt Sandpiper#	<i>Calidris himantopus</i>
Broad-billed Sandpiper**	<i>Limicola falcinellus</i>
Buff-breasted Sandpiper#	<i>Tryngites subruficollis</i>
Ruff#	<i>Philomachus pugnax</i>
Wilson's Phalarope#	<i>Steganopus tricolor</i>
Red-necked Phalarope	<i>Phalaropus lobatus</i>
Grey Phalarope#	<i>Phalaropus fulicarius</i>
<b>Pratincoles and coursers</b>	<b>Glareolidae</b>
Australian Pratincole	<i>Stiltia isabella</i>
Oriental Pratincole#	<i>Glareola maldivarum</i>
<b>Gulls, terns and skimmers</b>	<b>Laridae</b>
Silver Gull	<i>Chroicocephalus novaehollandiae</i>
Franklin's Gull#	<i>Leucophaeus pipixcan</i>
Pacific Gull	<i>Larus pacificus</i>
Australian Gull-billed Tern	<i>Gelochelidon macrotarsa</i>
Common Gull-billed Tern**	<i>Gelochelidon nilotica</i>
Caspian Tern	<i>Hydroprogne caspia</i>
Crested Tern	<i>Thalasseus bergii</i>
Little Tern	<i>Sternula albifrons</i>
Fairy Tern	<i>Sternula nereis</i>
Common Tern	<i>Sterna hirundo</i>
Arctic Tern*	<i>Sterna paradisaea</i>
Whiskered Tern	<i>Chlidonias hybrida</i>
White-winged Black Tern	<i>Chlidonias leucopterus</i>

English name	Scientific name
	<b>CORACIIFORMES</b>
<b>Kingfishers</b>	<b>Alcedinidae</b>
Sacred Kingfisher	<i>Todiramphus sanctus</i>
Azure Kingfisher	<i>Ceyx azureus</i>
	<b>PSITTACIFORMES</b>
<b>Parrots</b>	<b>Psittacidae</b>
Orange-bellied Parrot	<i>Neophema chrysogaster</i>
	<b>PASSERIFORMES</b>
<b>Woodswallows, butcherbirds and allies</b>	<b>Artamidae</b>
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>
<b>Monarchs</b>	<b>Monarchidae</b>
Magpie-lark	<i>Grallina cyanoleuca</i>
<b>Swallows and martins</b>	<b>Hirundinidae</b>
Welcome Swallow	<i>Hirundo neoxena</i>
Fairy Martin	<i>Petrochelidon ariel</i>
Tree Martin	<i>Petrochelidon nigricans</i>
<b>Reed-Warblers and allies</b>	<b>Acrocephalidae</b>
Australian Reed-Warbler	<i>Acrocephalus australis</i>
<b>Grassbirds and allies</b>	<b>Locustellidae</b>
Tawny Grassbird	<i>Megalurus timoriensis</i>
Little Grassbird	<i>Megalurus gramineus</i>
<b>Cisticolas and allies</b>	<b>Cisticolidae</b>
Golden-headed Cisticola	<i>Cisticola exilis</i>

## Appendix 2. Waterbird species that may breed colonially at wetlands open to hunting in Victoria

English name	Scientific name
Australasian Darter	<i>Anhinga novaehollandiae</i>
Australian Painted-snipe	<i>Rostratula australis</i>
Australian Pelican	<i>Pelecanus conspicillatus</i>
Australian White Ibis	<i>Threskiornis molucca</i>
Caspian Tern	<i>Hydroprogne caspia</i>
Eastern Cattle Egret	<i>Bubulcus coromandus</i>
Fairy Tern	<i>Sternula nereis</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Great Egret	<i>Ardea alba</i>
Gull-billed Tern	<i>Gelochelidon nilotica</i>
Intermediate Egret	<i>Egretta intermedia</i>
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>
Little Egret	<i>Egretta garzetta</i>
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>
Little Tern	<i>Sternula albifrons</i>
Magpie Goose	<i>Anseranas semipalmata</i>
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>
Pied Cormorant	<i>Phalacrocorax varius</i>
Pied Stilt	<i>Himantopus leucocephalus</i>
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>
Royal Spoonbill	<i>Platalea regia</i>
Silver Gull	<i>Chroicocephalus novaehollandiae</i>
Straw-necked Ibis	<i>Threskiornis spinicollis</i>
Whiskered Tern	<i>Chlidonias hybrida</i>
Yellow-billed Spoonbill	<i>Platalea flavipes</i>



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