Bio Palembanica 2(2): 77-86 (2025)
This journal is available online at: https://ejournal.uigm.ac.id/

New Bird Records from the Tempe Floodplain Lake System, South Sulawesi, and A Review of Wetland Bird and Raptor Species Recorded since 1985

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Received 2 November 2025 | Accepted by *M. Iqbal*: 10 December 2025 | Published online 27 December 2025.

Abstract
The Tempe floodplain lake system in South Sulawesi is one of Sulawesi's most important wetland complexes for waterbirds. This paper consolidates records from 1985–2025, including published surveys, eBird data, and new field observations made in November 2023. A total of 69 waterbird and raptor species are now documented for the lake system, with four species newly recorded in 2023. Historical counts contrast sharply with much smaller numbers observed in recent years, suggesting possible population declines. Supplementary evidence from online hunting videos revealed that at least 19 waterbird species are currently targeted by recreational shooters using modern air rifles, highlighting a likely increase in hunting pressure since the 1990s. These findings support earlier concerns about the sustainability of bird harvesting in the Tempe wetlands and indicate a need for renewed monitoring and stronger management of hunting activities. The study demonstrates the value of integrating conventional field data with verified citizen-science and digital media sources to reassess the conservation status of under-studied tropical wetland ecosystems.

Keywords: avifaunal diversity, Danau Tempe, hunting pressure, Wallacea, wetland birds.

Introduction

The Tempe floodplain system (04°06′25″ S, 119°57′37″ E) consists of three shallow, interconnected eutrophic lakes, Tempe, Sidenreng, and Buaya, in South Sulawesi, Indonesia (Whitten 1987). Forming a single hydrological unit within the Welannae–Cenranae Basin, the lakes span Wajo, Soppeng, and Sidrap regencies. Water levels fluctuate seasonally, flooding up to 47,800 ha in the wet season and exposing extensive mudflats in the dry season (Baltzer 1990; Jumiati *et al.* 2024), with major implications for bird habitats (Baltzer 1990; Giesen 1990, 1997). Uttley (1987) first emphasized the site's significance for wetland birds, recording large numbers of herons and waterfowl in April 1986 under high-water conditions, and documenting 28 wetland species, the richest lake avifauna known in Sulawesi at the time. Earlier, Warren and Warren (1985) had noted 19 wetland birds and raptors, information later entered into eBird and contributing additional site records.

Between July 1989 and January 1990, ornithologists from the Asian Wetland Bureau, PHPA, and Universitas Hasanuddin surveyed all three lakes, recording 57 bird species, including 47 wetland species and raptors (Baltzer 1990). Key observations included large counts of Garganey *Spatula querquedula* (10.000), Glossy Ibis *Plegadis falcinellus* (5.000), Purple Heron *Ardea purpurea* (4.000), Clamorous Reed Warbler *Acrocephalus stentoreus* (26.000), and the Milky Stork *Mycteria cinerea*, now classified as globally Endangered (IUCN 2025). Earlier, Warren and Warren (1985) reported five species not seen in later surveys, such as Little Tern *Sterna albifrons*, Sulawesi Dwarf Kingfisher *Ceyx fallax*, Sacred Kingfisher *Todiramphus chloris*, and Spotted Kestrel *Falco moluccensis*. Silvius (1994) then added Beach Thick-knee *Rostratula benghalensis* to the site list. Most recently, Bashari & Langrand (2017) recorded 47 species during March 2016 surveys, including 28 wetland species and raptors, and added three new species to the Tempe avifauna: Black Kite *Milvis migrans*, Black-winged Kite *Elanus caeruleus*, and Zitting Cisticola *Cisticola juncidis*.

This paper updates the avifaunal record for the Tempe floodplain lakes by integrating observations from fieldwork in November 2023 with verified eBird and grey literature records available up to November 2025. These data help track species presence and change over time. Danau Tempe and parts of the floodplain were designated an IBA in 2004 (BirdLife International 2025) and a KBA in 2014 (Key Biodiversity Areas Partnership 2025) based on hosting over 20.000 wetland birds, an internationally important *Ardea purpurea* population, and the globally Endangered *Mycteria cinerea* (Bashari & Langrand 2017; BirdLife International 2025). Updated checklists and census information (most recently from 2016) are critical for conservation planning (BirdLife International 2025). Species names follow the IUCN Red List (2025).

Methods

Data Collection

Field observations of wetland birds were conducted from 11 to 13 November 2023 at Danau Tempe by using a slow-moving boat and from shoreline scanning (Fig. 1). Observations at Danau Buaya were made from the shoreline. The principal observer (AC) is a professional ornithologist with more than 40 years of experience, specialising in the study of wetland bird populations in New Zealand and across East Asian–Australasian Flyway countries. The additional team members (AWS. and AS) are experienced Indonesian birders with prior wetland bird survey experience in Sumatra, Java, and Bali. The Field work took place between 07:30 and 16:00 hours each day and focused on the eastern and northeastern shorelines of Danau Tempe, as well as the southeastern margin of Danau Buaya. Although the survey period coincided with the dry season, the areas visited consisted largely of open water interspersed with flooded marshes and small patches of exposed mud along the lake margins (Fig. 2).

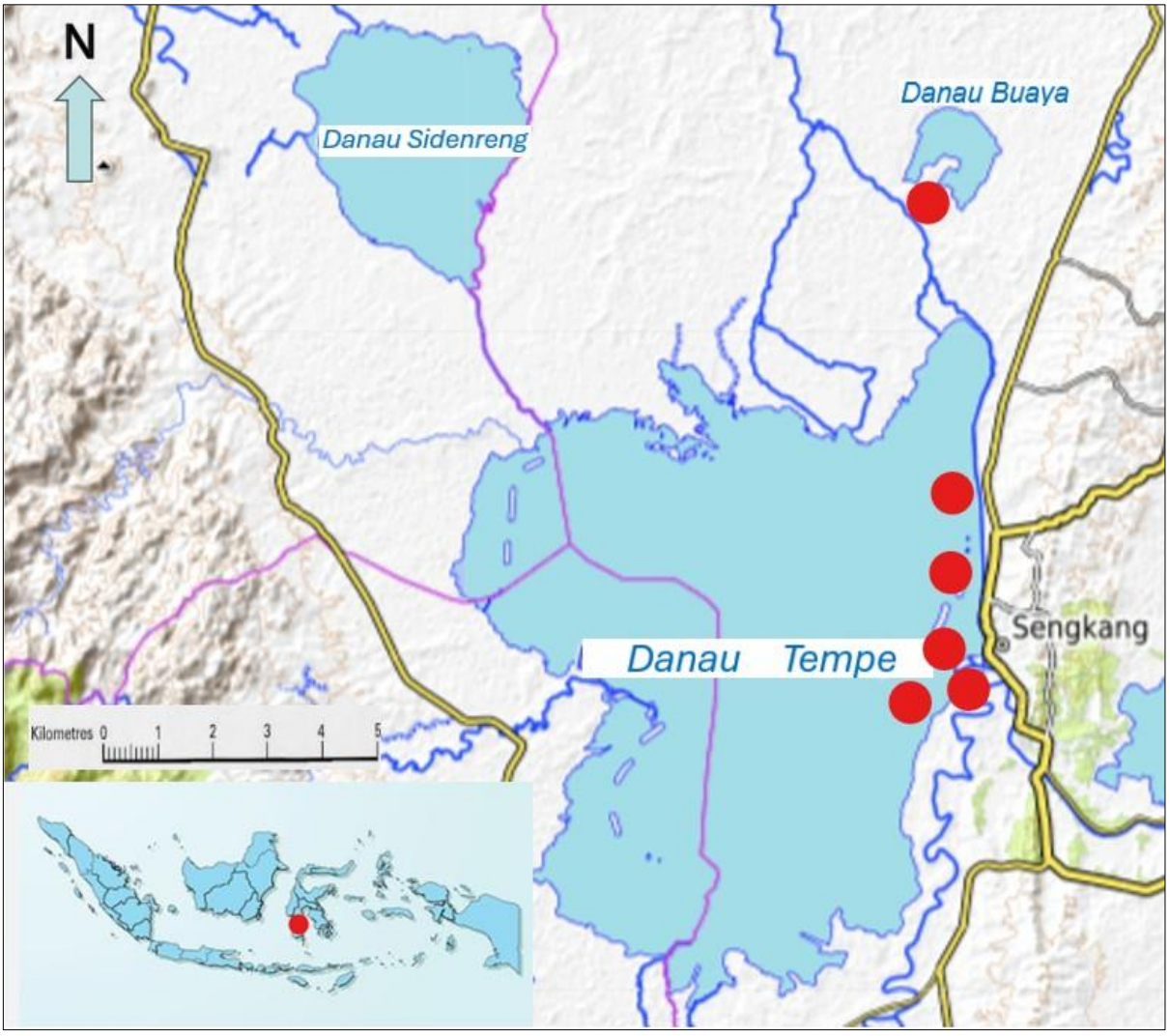


Figure 1. Map of the Tempe floodplain lake system with survey locations indicated by red circles.



Figure 2. Eastern shore of Danau Tempe, showing typical habitats present during the November 2023 survey – lake edge characterised by small patches of mud and very shallow water, scattered woody debris, and shoreline vegetation of various heights. (Photograph: Andrew Crossland).

Wetland birds were primarily observed foraging and roosting on exposed mudflats and short grasslands, with smaller numbers utilising extensive floating mats of Water Hyacinth *Eichhornia crassipes* and "bungka", large floating rafts of vegetation constructed by local fishermen to trap fish as water levels decline (Giesen 1997; Jumiati 2024). Additional birds were recorded flying over the lakes and marshes or roosting on wooden fishing poles, debris and floating logs.

To develop a more comprehensive understanding of the avian biodiversity of the Tempe lake system, we also compiled supplementary records from external sources. These included verified entries from eBird (www.ebird.org) and species observations extracted from publicly available travel and hunting videos hosted on YouTube (www.youtube.com). The high-resolution quality of many of these videos provided a valuable supplementary source of occurrence data in the absence additional direct ornithological research data. We systematically reviewed c.20 videos and included avian records where an individual bird filmed on the video footage could be clearly identified to species. This included birds clearly visible in the background, individuals filmed directly through optical hunter targeting devices, and deceased specimens shown on video. Only individual birds credibly filmed on the Tempe floodplain lake system were included in the data set**.**

Results

November 2023 Field survey. Our field observations recorded 41 wetland bird species (Appendix 1), including four new species records: Greater Painted Snipe *Rostratula benghalensis*, Javan Plover *Charadrius javanicus*, Siberian/Tibetan Plover *Charadrius mongolus/atrifrons*, and Oriental Pratincole *Glareola maldivarum*.

eBird checklist records 2002-2025. Fourteen eBird checklists submitted by ten ornithologists collectively recorded 45 wetland bird species (Appendix 1). These included five additions to the documented avifauna: Pacific Reef Heron *Egretta sacra*, Common Gull-billed Tern *Gelochelidon nilotica* , Little Ringed Plover *Charadrius dubius*, Little Black Cormorant *Phalacrocorax sulcirostris* and Common Tern *Sterna hirundo* (Greenfelder 2004; Cholette 2012; Dewantara 2021).

Online travel and hunting video footage 2014-2025. Some 27 wetland bird species were clearly identifiable in video footage published online via youtube.com (Appendix 1). No new species records were detected from the available video footage, but the occurrence of two species recorded only once previously by ornithologists making field observations were reconfirmed from hunting videos, Pied Heron *Egretta picata* and Little Black Cormorant *Phalacrocorax sulcirostris.*

Table 1. Summary of wetland bird and raptor species inventories for the Tempe floodplain lake system, South Sulawesi, 1985–2025.

Date	Apr 1985	Apr1986	Jul 1989-Jan 1990	Mar 2016	2014 - 2025	Nov 2023	2002 - 2025
Number sp.	19	28	47 + 1	28	27	41	45
New records	19	19	19	3	0	4	5
Cumulative total	19	38	57	58	65	69	65
Sources:	Warren & Warren (1985)	Uttley (1987)	Baltzer (1990), Silvius (1994)	Bashari & Langrand (2017)	Hunting and travel videos	This study	eBird records

New Species records

Greater Painted Snipe *Rostratula benghalensis*

We counted a total of 36 Greater Painted Snipe on the lake edge west of Sengkang on Danau Tempe between 07:30–12:30 hrs on 13 November 2023. The majority were males. Although some birds were solitary, most were observed in small groups of two to five individuals (Fig. 3). They were actively foraging along muddy lake edges within one metre of vegetative cover or within relatively open grassy and sedge-dominated areas, generally less than 30 cm in height. This species is very widely distributed, including the Greater Sundas and Wallacea (Hermawan *et al.* 2013; Taufiqurrahman *et al.* 2022).

Javan Plover *Charadrius javanicus.*

A single Javan Plover was observed foraging among other shorebirds near the lake outlet at Sungai Walanae on 13 November 2023 (Fig. 4). In recent years, this species has been reported with increasing frequency across Indonesia and Sulawesi (Iqbal *et al.* 2013b, c). In Sulawesi, it is found primarily in coastal lowlands near Makassar, but also at several inland sites and at the mouth of the Sungai Walanae on the eastern coast at Teluk Bone (eBird 2025).

Siberian/Tibetan Plover *Charadrius mongolus/atrifrons*

A group of eight sandplovers in non-breeding plumage were seen feeding together on a patch of muddy shoreline near Sengkang town, Danau Tempe, on 13 November 2023. Based on size, bill structure, and plumage characteristics, the individuals were identified as either Siberian or Tibetan Sandplovers; however, they departed before photographs could be obtained to confirm species-level identification. To our knowledge, there are no previous records of sandplovers on Danau Tempe or the other lakes.

Oriental Pratincole *Glareola maldivarum*

On 13 November 2023, a small flock of 14 pratincoles was flushed from a roost site within short grass near the lake outlet, Sungai Walanae (Fig. 5). The flock was subsequently followed by boat and relocated to a muddy open patch surrounded by marshland less than 100 m downstream, permitting a close approach for observation. They were all confirmed to be *Glareola maldivarum*. The species occurs broadly across Indonesia and has previously been reported breeding in Aceh, northern Sumatra (Iqbal *et al.* 2013a; Taufiqurrahman *et al.* 2022). The record of *Glareola maldivarum* appears to represent the first occurrence at the Tempe floodplain lakes, although both this species and the Australian Pratincole *Glareola isabella* are known from multiple locations elsewhere in Sulawesi and the Wallacean region, albeit typically in low numbers (eBird 2025b, c).

Discussion

In total, some 69 wetland bird and raptor species have been recorded across the interconnected floodplain wetlands of Danau Tempe, Danau Sidenreng, and Danau Buaya (Table 1; Appendix 1). These

data corroborate the assessment by Uttley (1987) that this wetland complex supports the most diverse avifauna of any lake system in Sulawesi. Species inventories compiled at different times since 1985 confirm that egrets, herons, bitterns, ibis, gallinules, native waterfowl, marsh terns and stilts have remained the dominant avifauna over the 40 year span of records. Information on raptors is more difficult to assess due to the scarcity of records and the likelihood that observers did not document these species as consistently as wetland birds. In addition, the tendency of individual raptors to range between lake margins and inland habitats further complicates the ability to obtain systematic observations.



Figure 3. Three Greater Painted-snipes *Rostratula benghalensis* exhibiting differing behavioural responses to the approach of a small boat. The left individual is crouched behind vegetation, the central bird is standing and has ceased feeding, and the right individual is crouched low in shallow water (Photograph: Andrew Crossland).



Figure 4. Javan Plover *Charadrius javanicus* with recently fledged juvenile pied stilt. (Photograph: Andrew Crossland).



Figure 5. A total of 14 Oriental Pratincoles *Glareola maldivarum* were in a mix of breeding and non-breeding plumage (Photograph: Andi Sitorus).

A number of species recorded in the earlier surveys during the 1980s and 1990s have not been reported in more recent years. These include several species with IUCN threatened or near threatened status including Little Grebe *Tachybaptus ruficollis*, Milky Stork *Mycteria cinerea*, Schrenck's Bittern *Ixobrychus eurhythmus*, Beach Thick-knee and Great Knot *Calidris tenuirostris*. Additional species not reported since 1989/90 include Oriental Darter *Anhinga melanogaster*, Osprey *Pandion haliaetus*, White-bellied Sea-eagle *Icthyophaga leucogaster* and Brahminy Kite *Haliastur indus*. Other species have shown what appear to be substantial declines. Baltzer (1990) assessed the *Ardea purpurea* population on Danau Tempe at *c.* 4000 birds in January 1990, with more birds uncounted on the other two lakes. Bashari & Langrand (2017) cited an Asian Waterbird Census total of 1522 – also in 1990 (Wei *et al.* 2009) and contrasted this with their total of just 12 birds in March 2016. Our survey of the eastern side of Danau Tempe in November 2023 found 23 *A. purpurea*, supporting Bashari & Langrand's claim of a substantial decline. Both Garganey *Anas querquedula* and Comb-crested Jacana *Irediparra gallinacea* were described as abundant in the 1990s (Giesen 1997), yet subsequent records have been sparse, limited to one eBird observation of *Anas querquedula* in October 2004 (Greenfelder 2004) and three *Irediparra gallinacea* records from 2004, 2012, and 2016 (Greenfelder 2004; Cholette 2012; Stephens 2016). This may be a genuine population decline or may instead be an artefact of observational bias where most observers have recorded birds seen around Sengkang on the eastern shores of Danau Tempe rather than in other parts of the floodplain. For example, the sedge swamps on the western shoreline of Danau Sidenreng, described by Giesen (1997) as supporting thousands of Garganey, have received very little recent survey coverage.

Hunting is likely a contributing factor in apparent wetland bird declines. Both Baltzer (1990) and Giesen (1997) raised early concerns regarding the potential impact of hunting on bird populations, though they concluded that levels of take appeared sustainable at that time. However, recent online hunting footage indicates that the scale and efficiency of hunting have increased markedly. The widespread use of high-powered airguns with precision optics allows hunters to kill birds with exceptional accuracy, transforming what was once a low-yield activity reliant on nets, catapults, and small-calibre firearms into a highly effective form of sniping. Baltzer (1990) reported that hunting was undertaken for subsistence and supplementary income purposes with recreational hunting concentrated

on weekends and holidays, occasionally involving visiting shooting parties from nearby cities. Recent social media evidence suggests this practice has expanded, with 19 wetland bird species confirmed as targets on the online hunting videos reviewed. These targeted species include: Purple Heron, Pied Heron, Great White Egret *Ardea alba*, Little Egret *Egretta garzetta*, Cattle Egret *Bubulcus ibis*, Javan Pond Heron *Ardeola speciosa*, Black-crowned Night Heron *Nycticorax nycticorax*, Nankeen Night Heron *Nycticorax caledonicus*, Yellow Bittern *Ixobrychus sinensis*, Glossy Ibis *Plegadis falcinellus*, Little Black Cormorant, Wandering Whistling Duck *Dendrocygna arcuata*, Pacific Black Duck *Anas superciliosa*, Sunda Teal *Anas gibberfrons*, White-breasted Waterhen *Amaurornis phoenicurus*, Dusky Moorhen *Gallinula tenebros*, Common Moorhen *Gallinula chloropus*, Purple (Black-backed) Swamphen *Porphyrio porphyrio indicus*, and Black-winged Stilt *Himantopus himantopus* (Azwhar 2021; Ogi 2021; Syamsul 2021a, b; Penembakdaun 2023; Arya45Sibolata 2025; Chanelwawanghunter7835 2025). This list seems to confirm comments by Baltzer (1990) that local knowledge of hunting legislation, which species are protected, and the ecological importance of wetland birds is limited.

Bird monitoring work is no doubt required to establish population levels of legally hunted species and harvest limits to enable local communities to continue sustainable harvest. However, law enforcement would seem necessary to reduce the heavy impact of recreational hunters equipped with precision weapons and using airboats and other craft to hunt bird populations at what appear to be unsustainable levels. We suggest that systematic bird surveys across all sectors of the Danau Tempe, Sidenreng and Buaya wetland complex would be valuable to establish baseline population levels and to monitor hunting pressure.

Birdlife on Danau Tempe and the other lakes face further pressure from habitat degradation, notably from sedimentation (Tantu *et al.* 2017), alterations to natural hydrological cycles due to water management interventions, loss of marginal vegetation, and the proliferation of invasive aquatic plants such as water hyacinth and Water Spinach *Ipomoea aquatica* (Giesen 1994, 1997). Systematic monitoring is needed to assess the long-term impacts of these pressures on wetland bird populations. Fortunately, non-hunting human activities appear to exert minimal disturbance for most species observed in this study. Birds and local people appeared to generally coexist without apparent displacement, and a high degree of habituation to human presence was noted in some species, particularly piscivorous birds, which exploit feeding and roosting opportunities associated with floating *bangka* rafts and fishing structures.

Acknowledgments

We thank local boat operators and residents at Danau Tempe and Danau Buaya for their hospitality and for sharing their knowledge about wetland birds and the natural resources of the lakes. Thanks to David Melville for providing a very-hard-to-find past survey report from the 1980s, and to Scott Butcher and Phil Crutchley for reviewing earlier versions of the manuscript. Thanks also to the editor and reviewers of Bio Palembanica for providing valuable editorial input into improvements of this paper.

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Appendix 1. Wetland Bird and Raptor Species Inventories for the Tempe floodplain lakes, South Sulawesi, 1985 to 2025. Note for sources in the table: 1 (Warren & Warren 1985), 2 (Uttley 1987), 3 (Baltzer 1990, and Silvius 1994), 4 (Bashari & Langrand 2017), 5 (This study in November 2023), 6 (eBird 2025), and 7 (hunting and travel videos, with * hunter-targeted species in 2014 - 2025).

Species (IUCN Status)	**Sources**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Tachybaptus ruficollis		X	X				
Mycteria cinerea (Endangered)			X				
Ciconia episcopus (Near Threatened)		X				X	
Ardea sumatrana			X	X			
Ardea purpurea	X	X	X	X	X	X	X *
Egretta picata			X				X *
Ardea alba	X	X	X	X	X	X	X *
Ardea intermedia			X		X	X	
Egretta garzetta	X	X	X	X	X	X	X *
Egretta sacra						X	
Bubulcus ibis	X	X		X	X	X	X *
Ardeola speciosa		X	X	X	X	X	X *
Butorides striata			X	X		X	
Nycticorax nycticorax		X	X	X		X	X *
Nycticorax caledonicus		X	X	X		X	X *
Ixobrychus sinensis		X	X	X	X	X	X *
Ixobrychus cinnamomeus		X	X	X		X	
Ixobrychus flavicollis		X	X	X		X	
Ixobrychus eurhythmus (Near Threatened)		X					
Plegadis falcinellus		X	X		X	X	X *
Microcarbo melanoleucos	X	X	X			X	
Phalacrocorax sulcirostris						X	X *
Anhinga melanogaster		X	X				
Pandion haliaetus			X				
Milvis migrans				X	X	X	X

Haliastur indus	X		X				
Elanus caeruleus				X	X	X	X
Icthyophaga leucogaster			X				
Circus assimilis			X		X		
Dendrocygna arcuata		X	X	X	X	X	X *
Anas superciliosa	X	X	X	X	X	X	X *
Anas gibberfrons	X	X	X	X	X	X	X *
Spatula querquedula			X			X	
Hypotaenidia torquata			X	X	X	X	
Hypotaenidia philippensis			X			X	
Amaurornis phoenicurus		X	X	X	X	X	X *
Gallinula tenebrosa			X		X	X	X *
Gallinula chloropus		X	X		X	X	X *
Porphyrio porphyrio	X	X	X	X	X	X	X *
Irediparra gallinacea		X	X			X	
Esacus magnirostris (Near Threatened)			X				
Rostratula benghalensis					X		
Pluvialis squatarola			X		X		
Pluvialis fulva			X		X		X
Charadrius dubius					X	X	
Charadrius javanicus					X		
Charadrius atrifrons					X		
Tringa glareola		X	X		X		X
Actitis hypoleucos		X	X	X	X	X	X
Gallinago sp.			X				
Calidris tenuirostris (Endangered)			X				
Calidris subminuta		X			X		
Himantopus himantopus	X		X		X	X	X*
Glareola maldivarum					X		
Chlidonias hybrida	X	X	X	X	X	X	X
Chlidonias leucopterus		X	X		X	X	X
Gelochelidon nilotica						X	
Sterna hirundo					X	X	
Sterna albifrons	X						
Alcedo atthis	X				X	X	
Ceyx fallax	X						
Todiramphus sanctus	X				X		
Todiramphus chloris	X		X	X	X	X	
Falco moluccensis	X			X		X	
Artamus leucoryn	X		X	X	X	X	
Hirundo rustica			X		X	X	X
Hirundo tahitica			X	X	X	X	
Acrocephalus australis	X		X	X	X	X	
Cisticola juncidis				X	X	X	
Total (69 species)	**19**	**28**	**47 + 1**	**28**	**41**	**45**	**27**