

**A REPORT ON THE WETLAND AVIFAUNA OF
SOUTH SULAWESI**

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Summary

The bird communities of the wetlands in South Sulawesi are discussed from results and observations made from an ecological survey undertaken over seven months in the province. The present status of the surveyed wetland habitats is listed. The bird communities observed in these wetlands are then reported and discussed. Annotations are made on selected species. Results from frequent surveys in the Tempe lake system indicate it to be a wetland habitat of international importance according to the Ramsar Convention, mainly because of large concentrations of birds including 10,000+ Garganey¹, 5,000 Glossy Ibis and 26,000 Great/Clamorous Reed-Warbler. New distribution recordings are made for the Maleo, the Woolly-necked Stork and the Grey-headed Fish-Eagle. Threats to the bird populations are discussed which include threats from pesticide use, live bird trading, hunting and loss of habitat.

Ringkasan

Komunitas burung di daerah lahan basah Sulawesi Selatan didiskusikan, berdasarkan hasil yang diperoleh dari pengamatan ekologis yang dilaksanakan selama lebih dari 7 bulan di propinsi tersebut. Dicatat pula, status terakhir dari habitat lahan basah yang diamati. Komunitas burung yang diamati di daerah lahan basah tersebut, kemudian dilaporkan dan didiskusikan. Berbagai keterangan juga diberikan kepada jenis-jenis tertentu. Hasil dari pengamatan yang panjang di Danau Tempe dan sekitarnya, menunjukkan bahwa habitat tersebut mempunyai kepentingan secara internasional sesuai dengan ketentuan yang tertuang dalam Konvensi Ramsar, terutama karena di daerah tersebut ditemukan sejumlah besar burung air, diantaranya lebih dari 10.000 ekor Itik alis putih, 5.000 ekor Roko-roko dan 26.000 ekor Kerak bassi ramai. Diperoleh catatan terbaru tentang penyebaran jenis-jenis Maleo, Sandang Lawe dan Elang Ikan kepala kelabu. Ancaman terhadap populasi burung didiskusikan, yang meliputi ancaman dari penggunaan pestisida, perdagangan burung, perburuan dan penyusutan habitat.

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1. Scientific names are listed in the Appendix. Both scientific and english nomenclature follow White & Bruce(1986).

Introduction

The special position of Sulawesi has resulted in a rich biogeographical history. Most of the ornithological work in Sulawesi in the past has been concentrated on identifying and describing the species composition of the island. Particularly valuable were the now historical works of Wallace (1869), Stresemann (1939), and Coomans De Ruiter (1948, 1951, 1954). However, only general reference to special sites of interest was made in these reports.

Only a handful of additional reports have been published latterly, although these reports do refer to some key sites. Escott and Holmes (1980) reported new sightings, many of which were recorded in wetland areas. Holmes and Wood (1980) made an ornithological study of the area surrounding the Matano lake system. Although the lakes themselves were not surveyed, the report has become particularly relevant as the area has since been increasingly disturbed by mining development. This demonstrates the need for inventory work as many key sites are now similarly under threat.

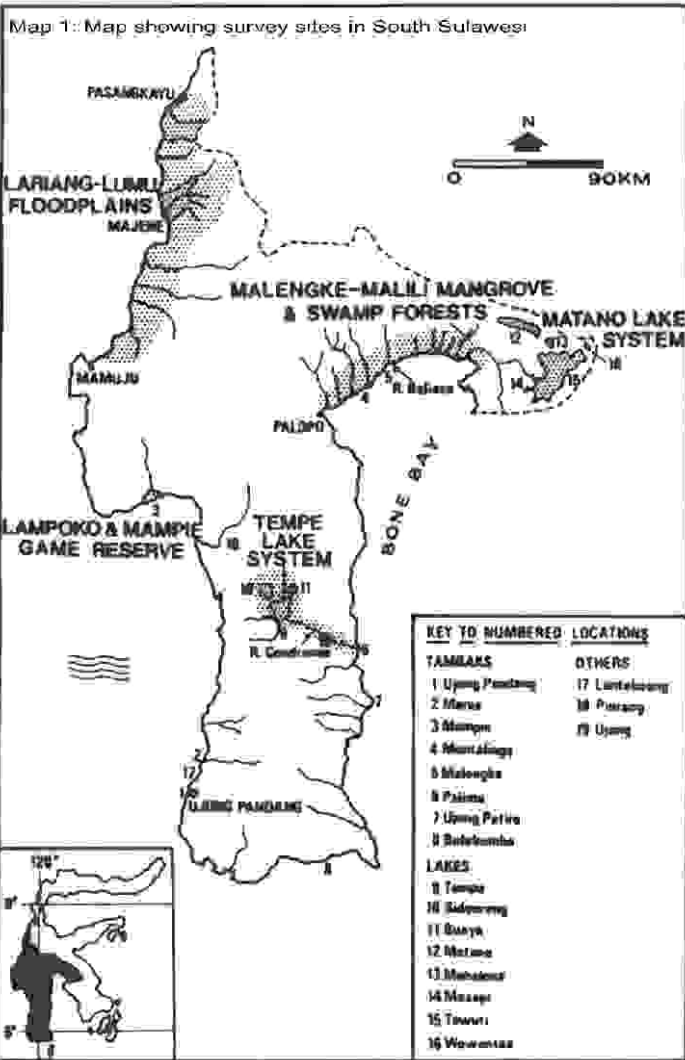
The Interwader survey report of four wetland areas in South Sulawesi (Uttley, 1987) was helpful in the selection of sites for the present study. The observations reported in this paper originate from a major follow-up to the Interwader survey.

South Sulawesi is the most developed province of this island and future development is likely to maximise on the potential of areas which presently are considered "under-used", including wetlands.

The present survey was conducted by the Asian Wetland Bureau (formerly Interwader), in cooperation with the Directorate General of Forest Protection and Nature Conservation (PHPA), Kanwil Kehutanan South Sulawesi and the Environmental Studies Centre (PSL) of University of Hassanudin, to evaluate the conservation importance of the wetlands in South Sulawesi. The aims of the survey were to investigate the status of the wetlands and to assess the impacts that development projects may have on these areas. Fieldwork was carried out between July 1989 and January 1990.

Methods

The major wetlands of South Sulawesi which have already been described (Silvius *et al.*, 1987), plus some new unsurveyed wetlands, were studied by the team (a list of the team members is provided at the end of the report). Bird observations were conducted simultaneously with the other tasks of the project. The sites were mainly selected from analysis of aerial photographs and maps. The surveys were undertaken by foot, boats (ranging from dug-out canoe to sea-going vessels) and from the air (helicopter and aeroplane), and additional information was obtained through interviews with local people. A hide was used at one site (Lake Tempe). A total of 58 days was spent in the field. The first aerial survey covered the Lariang-Lumu floodplain area (where 300km of flight lines were flown by helicopter) and the second was conducted between Ujung Pandang and Malili (using a regular charter flight making slight deviations from the normal flight route), allowing closer inspection of the Tempe and Malili Lake systems and much of the coastline.



Results and Observations

The wetlands¹

Table 1. Wetland habitats surveyed in South Sulawesi

Wetland Habitat	Area present	Date Surveyed	Status
Peatswamp Forest	Lariang-Lumu Floodplains	9-19/8/89 Aerial survey no.1 1-2/12/89	Originally present for 110,000 ha. Now reduced to 75,000 ha largely due to land reclaimed for transmigration settlements and logging activities in the Lumu area. This area contains the most extensive area of peatswamp forest in Sulawesi.
Freshwater Swamp Forest	Lariang-Lumu Floodplains	See above	Once extensive throughout the province (200,000 ha) but now only 15,000 ha remains mainly situated behind the mangrove forests in the Malengke-Malili area. Of this forest only 2000 ha can be considered undisturbed (due to protection in the Malili area by local law for traditional cemetery sites). The majority of the swamps have been successively converted to ricefields. Only small areas of the forest exist outside this region.
	Malengke-Malili Area	18/12/89 - 22/12/89	
	Matano Lake System	7-18/12/89	
Mangrove Forest	Lariang-Lumu Floodplains	See above	Once present along most of the coast (100,000 ha) but cleared largely for brackish fish ponds (Tambaks). 34,000 ha remain of which only 23,000 is not degraded. Major areas are 8,000 ha at Lariang-Lumu and 23,000 ha in Malengke. Elsewhere mangrove forest still stands as either small isolated clumps such as at Mampie or as a thin (usually less than 50 m) line along the coastline.
	Malengke-Malili area	See above	
	Mampie Game Reserve	18-19/8/89 13/1/90	
Mudflat and Tambaks (brackish water fish-pond)	For Tambaks visited see Table 3 and Map 1	See table 3	Very little natural mudflats occur. One extensive site only, at the mouth of River Baliase (Uttley, 1987). Areas of mudflat now exist in the form of tambaks which when empty can present suitable feeding areas. The area of tambaks is estimated to be 73,000 ha in 1988 (Baruadi, 1990). Some of these ponds have mangrove shrubs on their banks, or are surrounded by narrow strips of mangrove forest, as found at Mampie Game Reserve.

1. Full details of the habitats are reported by Giesen (1990).

Table 1. Continued..

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Floodplain Lake	Lake Tempe System	8-18/9/89 + At least each month	Lakes Tempe, Sidenreng and Buaya. Extreme seasonal variances in the lake produce dramatic habitat changes. See main text.
Lotus Swamps	Lampoko Game Reserve. River Cendrenae.	19/10/89 1/11/89	Dominated by Lotus <i>Nelumbo nucifera</i> , these flooded (shallow), highly vegetated swamps originate when swamp forest has been cut but is unsuitable for ricefields. Occurs on several thousand hectares (peak flood) on the banks of the Cendrenae River. Also occurs in Lampoko Game Reserve (>2000 ha)
Tectonic Lakes	Matano Lake System	7-18/12/89	Three main lakes, highly oligotrophic and deep. Matano (600m deep, area of 16,408 ha), Towuti (200m deep and 56,108 ha), and Mahalona (70m deep and 2,440 ha). Also two shallower small lakes - Wowantoa and Masapi, Each lake is bordered by steep- sided forested hills. The lakes are designated as recreation parks. A large of Lake Matano and is the cause of considerable air pollution and deforestation.

Wetland habitat use by birds

Peatswamp and Freshwater swamp Forest

The aerial survey of the Lariang-Lumu floodplains revealed a high density of birds present in the peatswamp forests of that area. Knobbed Hornbills and White and/or Pied Imperial Pigeons were very common. Many smaller birds unidentifiable from the helicopter were frequently seen in the canopy. Observations made from the ground survey showed that (he species composition of the forest comprises a high number of birds endemic to Sulawesi (8 of the 17 species observed were endemic). This is significant as only a minority of the endemic species in Sulawesi occur in lowland areas (White & Bruce, 1986). The swamp and mangrove forests are the last substantial lowland forests in South Sulawesi, and probably the most important in the whole of Sulawesi.

Observations from the ground survey in both the peat and freshwater swamp forests indicated that the greatest numbers of birds and diversity of species was at the edge of the forest bordering clearings or rivers. The birds were active at these sites throughout the day. Noisy active mixed species flocks comprising Ornate Lory, White-rumped Cuckoo-Shrike, Pied Triller, Hair-crested Drongo, White-breasted Woodswallow, and White-necked Myna were common at the forest edge. Woolly-necked Stork, Green Imperial Pigeon, White and/or Pied Imperial Pigeon, Slender-billed Crow, and the Finch-

billed Myna were also regularly observed at the forest edge. At highly disturbed sites where the forest had been affected by logging, and open pools of water, Grey Teal, Diving Tree-Duck, Collared Kingfisher and Purple-winged Roller (one pair at nest was observed on 23 December 1989) were common.

Mangrove Forest

A total of 35 bird species was observed within or at the edge of the forest. Table 2 presents an overview of these species and their habitat use. Frigatebirds were found roosting in a breeding colony of Little Egrets in a mangrove stand of the Mampie Game Reserve. This was the only heronry found. The heronry in the Cendrenae Delta, reported by Uttley (1987) to be of international importance, was not found. While this heronry may easily have been overlooked, there has been extensive clearing of the mangrove forest in this delta for tambak construction and it may have been destroyed.

Freshwater swamp (Lotus swamp)

The Lotus swamps were found to support a bird community similar to that found in the lake-side vegetation of the floodplain lakes. There was a high species diversity and density of birds. The results from one survey of a hectare (approximately) of swamp at Lake Ujung over a period of one hour found 30 species and over 200 individual birds in total (Table 3). There was high activity throughout the day. Comb-crested Jacanas were always abundant and typical of this habitat. In addition. Purple Heron, Yellow Bittern, Cinnamon Bittern, Dusky Moorhen, Purple Swamphen and Great/Clamorous Reed-Warblers were very common.

Mudflats and Tambaks

The majority of the mudflats that were visited by the team held small numbers of waders, but the diversity was usually low. Most frequently observed were Whimbrel and Common Sandpiper, in addition to Common Redshank and Grey-tailed Tattler. Twelve Great Knot were observed at one site in January. Whimbrel and Common Redshank were commonly observed roosting in the mangrove trees at high tide.

Table 4 gives a list of the species and numbers counted for the tambaks visited. The sight-ings of 3,000 Glossy Ibis, 450 Rufous-necked Stint and 48 Ruff using the tambaks are noteworthy.

The use of tambaks was unpredictable, with birds present and absent on consecutive days. Although all tambaks appeared similar they were not all occupied by birds and some were rarely visited. Larger waterbirds such as herons and egrets seemed to prefer tambaks close to or bordered by mangrove trees. Purple Herons, Little Egrets and Black Bitterns were common in tambaks that were in the mid-stage of construction i.e. the dykes had been constructed but the felled trees had not yet been cleared. Woolly-necked Storks were also frequently observed in these recently.

Table 2. Bird species observed within or at the edge of mangrove forests with indications to their use of the forests, (as observed)

Species observed	Nesting	Roosting	Feeding
Little Pied Cormorant		*	*
Lesser Frigatebird		*	
Great Frigatebird		*	
Purple Heron			*
Great-billed Heron		*	
Pied Heron	4		*
Little Heron		*	*
Little Egret	1+4		*
Great Egret	2+4	*	*
Nankeen Night-Heron	*+4		*
Yellow Bittern			*
Black Bittern		*	*
Woolly-necked Stork			*
Milky Stork		*	*
Whimbrel		*	
Common Redshank		*	
Common Sandpiper		*	*
Pink-necked Green Pigeon	?	*	*
P/White Imperial Pigeon		*	
Green Imperial Pigeon		*	*
Bay Coucal		*	*
Sulawesi Hanging-Parrot		*	?
Collared Kingfisher		*	*
Great-billed Kingfisher			*
Knobbed Hornbill			*
Pacific Swallow			3
Sulawesi Cicadabird			*
Pied Triller		*	*
Hair-crested Drongo		?	*
Slender-billed Crow			*
Golden-bellied Flyeater			*
Olive-backed Sunbird			*
Lemon-bellied white-eye			*
Javan Sparrow	.		*

Notes:-

1. 500 nesting birds found in the mangroves within the Mampie Game Reserve together with roosting Frigatebirds.
2. A group of 500 + individuals seen congregating in the mangroves close to Palopo Bay, the large majority in full breeding plumage.
3. Aerial visitors feeding over the canopy and along rivers.
4. Observed (Uttley, 1987) to be breeding in the Nipah forest at the Cendrenae Delta; Cattle Egret and Black-capped Night-Heron were also breeding at this site.

Table 3. Results of observations of the birds found in a one hectare segment of Lake Ujung over the period of one hour. 1 November 1989.

Species	Total observed	Species	Total observed
Little Pied cormorant	8	Whiskered Tern	33
Javan Pond-Heron	++	White-winged Black Tern	++
Purple Heron	6+1 juv.	Spotted Dove	2
Little Egret	3	Plaintive Cuckoo	1
Short-billed Egret	1	White-bellied Swiftlet	12
Cinnamon Bittern	2	Collared Kingfisher	1
Yellow Bittern	1	Pacific Swallow	++
Diving Tree-Duck	24	Slender-billed Crow	2
Black Kite	4	Great/Clamorous	++
Brahminy Kite	1	Reed-Warbler	
Buff-banded Rail	3	Pied Bushchat	4
Barred Rail	1	White-breasted	4
Purple Swampphen	8	Woodswallow	
Dusky Moorhen	6	Olive-backed Sunbird	8
Comb-crested Jacana	36	Scaly-breasted Munia	++
White-breasted Waterhen	1	Chestnut Munia	++
++ common but not counted		Total	178+

constructed tambaks and species normally observed residing in the mangrove forest were frequently observed in adjacent tambaks, including Sulawesi Hanging-Parrot, Golden-bellied Flyeater (common at all locations) and Lemon-bellied White-eye.

Floodplain Lakes

The Tempe lake system is a "Foodplain system" that comprises three lakes: Tempe, Buaya and Sidenreng. The lakes are connected by a series of rivers which flow to Lake Tempe, and they are shallow to moderately deep (1 - 5m), eutrophic lakes. The dynamic nature of floodplain lakes is exemplified by the dramatic seasonal changes in the water levels, from almost dry at the end of the dry season, resulting in three small separate lakes, to almost one continuous sheet of water in the wet season. The minimum and maximum dimensions of the lakes are shown in Table 5. The lakes are known to be silting up; present survey data revealed a siltation rate of 1 to 3cm per year.

Lake Tempe is the largest and most dynamic lake with each third part of the year characterised by a different dominant habitat type (lake-side vegetation, mudflat and bungkas) producing dramatic changes in the landscape. (See Figure 1).

Lake Buaya is dominated by lake-side vegetation throughout the year. Areas of exposed mud and bungkas (see below) exist but they are limited in extent and their presence is less critical to bird species.

Lake Sidenreng does not contain bungkas (because of strong wave action) and has very little lake-side vegetation (it has been cleared for ricefields). Exposed mud is the dominant habitat derived from the receding water level, and from derelict ricefields that are planted up to the water's edge but disrupted by flooding.

Bungkas are mats of floating vegetation artificially constructed by tying vegetation to bamboo poles (or coconut palm fronds) to increase and facilitate the fish catch from the lakes. They range in diameter from 20 to 200m. Fish are attracted to these sites for food, protection and breeding. For the next eight months of the year the bungka vegetation develops and matures. In October, when the water level has dropped low enough (normally to 1.25m deep), the fishermen harvest them by surrounding the bungkas with fencing. The fish once trapped are collected as the vegetation is removed. The bungkas are totally destroyed in this process and reconstruction starts around February. However bungkas may be left for 2-3 years without harvest, if water levels fail to drop below 1.25m depth.

Lake Tempe was said by adventurer and later Rajah of Sarawak James Brooke in 1840 "to abound with aquatic birds" (*vide* Whitten *et al*, 1987), a statement that was corroborated by Uttley (1987) who described the lakes as having the largest concentration of waterbirds in Sulawesi. The results of the present survey found that the density and dimension of bird use within this lake system qualifies it as the richest site for waterbirds in Sulawesi and a wetland of international importance according to the Ramsar Convention.

There is a high level of human activity around and on the lake, that is bordered by an extensive area of rich, seasonally flooded agricultural land. The fish productivity of the lakes is extremely high (17,000 wet tonnes of fish in 1987 valued at US\$5 million) and a large number of fishermen (6000 on Lake Tempe alone) are active throughout the year (Baruadi, 1989).

All activity on and around the lakes is dominated by the seasonal changes. The bird community is highly variable through the year in response to the changes in availability of certain habitats and food sources; this results in the arrival of large flocks of birds at certain seasons.

A total of 40 waterbird species was recorded in addition to 17 other species closely associated with the lakes and connecting rivers. The species observed within the different habitats are listed in Table 8.

CONTINUED TABLE 4

SPECIES	Ujung Pandang 27/11/89	Maros 19/11/89	Mampole reserve		Montalunga 21/12/89	Malengke 22/12/89	Bulukumba 3/11/89	Ujung Patiro 1/11/89	Palima 1/11/89
			18-19/10/89	15/1/89					
Grey-tailed Tattler	-	-	-	74	28	12	-	-	-
Common Redshank	28	100+	++	348	56	31	7	11	26+
Marsh Sandpiper	42	-	16	21	-	-	-	-	-
Common Greenshank	31	75+	-	-	-	-	-	3	-
Nood Sandpiper	-	150+	34	239	-	-	-	62	-
Terek Sandpiper	-	-	-	19	-	-	8	-	-
Common Sandpiper	4	22	16	21	5	7	4	8	4
Dunlin	-	15+	-	-	-	-	-	-	-
Snipe sp.	-	16+	-	-	-	-	-	-	-
Great Knot	12	-	-	-	-	-	-	-	-
Common Knot	-	-	-	286	-	-	-	-	-
Rufous-necked Stint	450+	-	-	261	-	-	-	-	-
Long-toed Stint	-	28	12	-	-	-	-	-	-
Curlew Sandpiper	-	120+	-	421	-	-	-	-	-
Sanderling	-	-	-	112	-	-	-	-	-
Ruff	-	-	-	48	-	-	-	-	-
White-headed Stilt	8	52	58	59	-	-	250+	-	-
Oriental Pratincole	-	6	-	-	-	-	-	-	-
Whiskered Tern	40+	300+	**	-	-	-	-	**	100+
White-winged Black Tern	20+	50+	*	-	-	-	50+	20+	50+
Lesser Crested Tern	-	8	-	-	-	-	-	-	-
Little Tern	2+	16	-	-	-	-	-	-	-
Gull-billed Tern	2	-	-	-	-	-	-	-	-

* = Observed but not counted. ** = common but not counted 500+ = minimum estimate

Table 5. Lake dimensions in the Tempo lake system (ha).

	Av. Area	Av. Max. Area (wet season)	Av. Min. Area (dry season)	Area Change	% Change
L. Tempe	13000	21000	4300	16700	79.5
L. Buaya	300	2000	200	1800	90
L. Sidenreng	3000	5000	500	4500	90
Total	16300	28000	5000	23000	81
Wet season maximum = 35000			Dry season minimum = 1000		

Source: Giesen (1990)

Bungka dominance period. In the period of March-September most habitats are extensively flooded, resulting in a high density and diversity of birds in the floating vegetation of the bungkas, varying from bungka to bungka (probably related to the degree of succession or maturity of the vegetation). Typically observed were Purple Heron, Javan Pond-Heron, Purple Swamphen, Dusky Moorhen and Blue-tailed Bee-eaters.

One bungka was found to be particularly rich in birdlife, and was surveyed using a hide. This large bungka (approximately 3 ha) had not been harvested for two years and the vegetation was dense and high. There were open areas of water in the centre. Observations were made over a 24-hour period (Table 6).

A total of over 1000 birds of 26 species was observed. This bungka was exceptional as no other bungka contained such high numbers. It was destroyed in October at harvest. One Little Grebe with a chick and Nankeen Night-Herons raising two chicks on the nests were observed in the bungka. Rats appeared abundant within the vegetation and were possibly the main attraction for the Brahminy Kites. The avifauna of the bungkas was largely similar to that of the lake-side vegetation (described below), and presumably there is a strong interaction between both communities.

Mudflat dominance period. (October to December). When the water recedes and the mudflats become exposed, large numbers of birds arrived at the lakes. These were predominantly Glossy Ibis and Garganey. The populations of these species grew simultaneously with the area of mudflat, and correspondingly dropped when the mudflats were overgrown by vegetation. At the peak, numbers were estimated to be 5,000 Glossy Ibis and 10,000 Garganey. Relatively small numbers of waders first arrived in late September, with Wood Sandpiper the most common, together with low numbers of Pacific Golden Plover. 26 Grey Plover were observed in January.

Table 6. Bird observations from the hide of one large bungka over a 24-hour period. (15-16 September 1989).

Permanent Residents		Daylight Visitors		Night-time Visitors	
Little Grebe	(25)	Great-billed Heron	1	Little Black	57
Purple Heron	(47)	Pied Heron	34	Cormorant Little Pied	103
Black Bittern	(3)	Javan Pond-Heron	++	Cormorant Little Egret	202
Diving Tree-Duck	(204)	Cinnamon Bittern	1	Short-billed Egret	8
Pacific Black Duck	(32)	Brahminy Kite	7	Great Egret	14
Grey Teal	(52)	White-headed Stilt	8	Nankeen Night Heron	23
Barred Rail	(28)	Pacific Swallow	++	Yellow Bittern	2
White-breasted	(50)			Blue-tailed	++
Waterhen Purple Swampphen	(54)			Bee-eatar	
Dusky Moorhen	(70)				
Great/clamorous	++				
Reed-Marbler					

Note: Numbers in brackets show count results (estimates) + + » abundant but no count made

Several other species feed in the shallow water adjacent to the mudflats including Little Egret, Grey Teal, Pacific Black Duck and White-headed Stilt, and their numbers are also directly related to the abundance of the mudflats.

Lake-side vegetation dominance period. Lake vegetation is present throughout the year. At the edge of the lake *Ipomoea aquatica* is the dominant plant species. Away from the water's edge this species is succeeded by *Sesbania javanica*. Full details of the vegetation is presented by Giesen (1990). In Lake Buaya the vegetation dominates in all seasons whereas in Lake Tempe it is dominant only from November until March. In Lake Siden-reng it is mainly present between December and March and almost absent during the rest of the year. This habitat appeared to support the highest concentrations of waterbirds (with exception of the bungka described above). The species observed within this habitat (Table 8) are present throughout the year particularly at the mouths of the connecting rivers. As the habitat area expands significantly in December the total number of birds sharply increases. Many of the birds may arrive from the lotus swamps along the Cendrenae River to the south-east of the lakes and others may arrive from the bungkas. This remains to be confirmed. Conservative estimates of bird concentrations (per hectare) within this habitat are provided in Table 7. Evidence of breeding was not found but strongly suspected. Indrawan (1990) reported a Dusky Moorhen nest with chicks in January 1990.

In order to obtain an estimate of the total bird population, the following steps were taken: minimum estimates of species concentrations were made at several sites. The entire perimeter was observed but not surveyed. Three different zones of bird concentrations were discerned within the vegetation. The total area of each zone was then evaluated from observations and maps, and the total population and the average minimum concentrations calculated for the entire lake (Table 7).

Table 7. Concentrations of some bird species in lake-side vegetation of Lake Tempe (= part of lake system only) in January 1990.

Species	Individuals/ha	Total estimated
Purple Heron	1	4000
Javan Pond-Heron	2	5300
Yellow Bittern	0.5	1600
Diving Tree-Duck	2	5200
Purple Swamphen	2	5700
Dusky Moorhen	3	8900
Common Moorhen	1	2150
Blue-tailed Bee-eater	2	6100
Great/Clamorous		
Reed-Warbler	8	26500

Yellow Wagtails were also observed in high numbers within this habitat. Cattle Egret and Javan Pond-Heron were common in adjacent flooded grassland and ricefields. The Rivers Tokade and Cendrenae which connect Lake Tempe to Lake Buaya are steeply banked and bordered by habitations and plantations. The species observed on these rivers are listed in Table 8 under River habitat.

Tectonic lakes

The lakes were found to be poor in bird species diversity. Little Grebe was abundant on each lake. One group of 83 individuals was observed on Lake Towuti adjacent to the sedge swamps. Diving Tree-Ducks were the most abundant species on the lakes, often observed in the sedge vegetation or on the adjacent open water. A group of over 200 was sighted together with the 83 Little Grebes mentioned above. Along the steep sides of the lakes with over-hanging forest vegetation. Darters were common, being regularly observed at approximate intervals of one individual per 500m of shoreline. Blue-eared Kingfishers were similarly common. Also observed in this habitat were Great-billed Kingfishers (rare), Grey Teal (no more than 30 individuals per lake), Common Sandpipers and, on Lake Matano, two Little Herons. The greatest numbers of waterbirds were observed in the shallow places on the lake edge dominated by sedges and rushes created after the clearing of the swamp forest. These sedge swamps were commonly found close to human habitations and are present on each lake. The birds commonly observed in this vegetation were Purple Heron, Common and Dusky Moorhen, Purple Swamphen, and Great/Clamorous Reed-Warbler. One Little Pied Cormorant was observed on Lake Towuti.

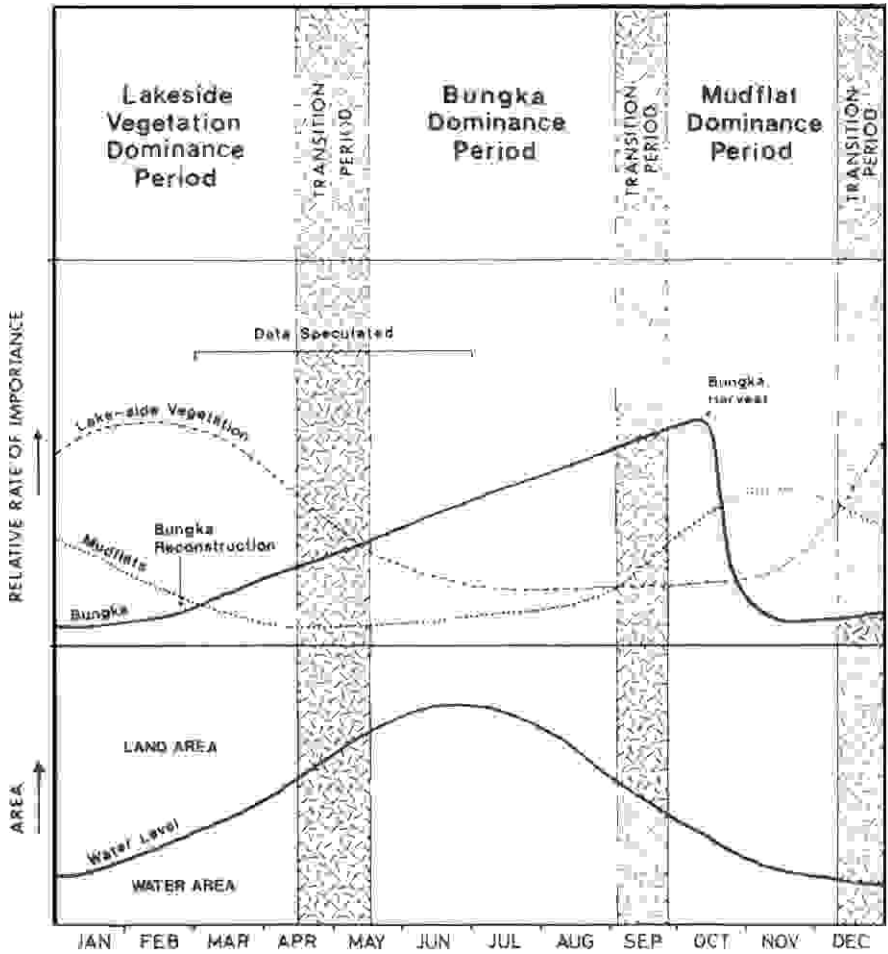


Figure 1: Relative Rate of Importance to Waterbirds of various habitats in relation to water level in Tempo Lake System

Table 8. Bird Species observed within each habitat type contained in the Lake Tempe system.

Mature bungka	Lakeside Vegetation	Exposed Mud
Little Grebe	Purple Heron	Little Egret
Little Black Cormorant	Javan Pond Heron	Glossy Ibis
Little Pied Cormorant	Short-billed Egret	Grey Teal
Darter	Great Egret	Garganey
Purple Heron	Yellow Bittern	Pacific Golden plover
Pied Heron	Cinnamon Bittern	Grey Plover
Javan Pond-Heron	Black Bittern	Wood Sandpiper
Little Egret	Milky Stork	Common Sandpiper
Short-billed Egret	Diving Tree-Duck	White-headed Stilt
Great Egret	Pacific Black Duck	Whiskered Tern
Black-crowned Night-Heron	Garganey	White-winged Black Tern
Nankeen Night-heron	Osprey	
Yellow Bittern	Spotted Harrier	River
Black Bittern	Purple Swampphen	
Diving Tree-Duck	Dusky Moorhen	Purple Heron
Pacific Black Duck	Common Moorhen	Little Heron
Grey Teal	Comb-crested Jacana	Common Kingfisher
Brahminy Kite	Snipe sp.	Collared Kingfisher
Barred Rail	Pacific Swallow	Dollarbird
White-breasted Waterhen	Barn Swallow	Pacific Swallow
Purple Swampphen	Great/Clamorous	Uniform Swiftlet
Dusky Moorhen	Reed-warbler	Slender-billed Crow
Common Moorhen	Yellow wagtail	Petchora Pipit
White-headed Stilt	Pale-paced Munia	W/b Woodswallow
Blue-tailed Bee-eater	Chesnut Munia	Brown-throated Sunbird

Raptors were very common and frequently seen hunting over the lakes. At least one pair of White-bellied Sea-Eagles was present on each lake. Brahminy Kite was common near to the larger villages. One Grey-headed Fish-Eagle was positively identified on Lake Towuti (see also King *et al*, 1990). Lesser Fish-Eagles were common on each lake. One pair of Fish-Eagles was observed "squabbling" over a nest at the edge of the forest 500m from Lake Mahalona, but it was not possible to get close to the area and so specific identification was not made; the birds were loudly vocalising and screeching which was detectable from 1km away.

Sulawesi Serpent-Eagles were often observed soaring over the lake-edge forest. Barred Honey-Buzzards were observed on several occasions flying over the roads south of Lake Matano. Two birds of this species shot dead were seen being carried home by hunters.

Although no Maleo birds were sighted, evidence of their presence in the area was found in the form of their diggings, and fresh tracks were seen. Locals report of the taking of Maleo eggs. Numerous nest diggings were found within the black sand on the north shores of Lake Towuti and Matano, showing the need for more surveys of this species' distribution. Small pockets of swamp forest are present at each lake but these still await survey.

Annotated checklist of selected species

A full list of birds and locations with an indication of their abundance is given in the Appendix. The following notes provide details on some species of special interest.

Red-throated Little Grebe: Observed with a chick in Lake Teaape on 31 October 1989.

Australian Pelican: PHPA officers of the Mampie Game Reserve reported sighting 26 Australian Pelicans in the reserve (no date available) which may perhaps refer to the influx of this species reported by Somadikarta & Holmes (1979) and Escott & Holmes (1980). In addition they also reported that small groups of up to 5 individuals are present in the reserve at irregular intervals.

Purple Heron: Common in all wet areas. In the Lake Tempe system it was abundant. The population at Lake Tempe was estimated to be c.4000 individuals in January 1990.

Great-billed Heron: Commonly sighted in the Lariang-Lumu area along rivers or on the coastline. One individual was observed at Lake Tempe in July 1989.

Javan Pond-Heron: Observed in breeding plumage throughout the survey period, corresponding with the findings of Vermeulen and Spaans (1987) in North Sulawesi.

Cattle Egret: Frequently feeding in ricefields in January 1990 throughout the prownee, in flocks of over 100 individuals in full breeding plumage.

Pacific Reef-Egret: Always white phase, with the exception of one black phase individual in a tambak at Malangke.

Great Egret: Observed in tambaks, on Lake Tempe, and in the mangroves in the Malengke-Malili area, in intermediate or non-breeding plumage. Over 500 Great Egrets (in flocks of c.50 individuals), were seen congregating from all directions in a mangrove forest on the northern edge of PaJopo Bay at dusk in late December.

Black-capped Night-Heron: One individual on Lake Tempe in July 1989. Uttley (1987) recorded this species at Lake Buaya, in the Tempe lake system, and in the Cendrenae delta.

Nankeen Night-Heron: Observed with chides in lake Tempe, September 1989.

Black Bittern: Two variants of this species were observed. Assumed nominate *flavicollis* was regularly observed in the Tempe lake system between August and January. It was normally observed creeping amongst the vegetation, 'typical for a bittern. One individual was observed at a bungka amongst the vegetation in September and was again observed at exactly the same site in November. Another variant was frequently observed in the Malengke-Malili mangrove forests in December, particularly in disturbed forest such as where new tambaks were being constructed. This variant had similar markings to the other but was much paler, appearing pale grey/blue. Its behaviour was entirely different to the individuals observed in the Tempe lake system; when alarmed, it did not skulk down into the vegetation but flew up onto a branch and froze.

Milky Stork: A total of only 4 Milky Storks was recorded. Two adults and a juvenile observed on Lake Tempe in January 1990 constitute the first record for this lake system. Strong reports of the presence of this bird in the Mampie Game Reserve from the local villagers and PHPA officers could not be confirmed. A visit was made to the Cendrenae Delta where Uttley (1987) sighted 33 birds, but only one individual was observed. Uttley also reported a maximum of 26 at Lantebeong tambaks. The sighting of 22 birds in that area in February 1990 by P. Erfemeijer (pers.comm) confirms that a population still exists there. The repeated sightings of this species further supports indications of its resident status in South Sulawesi.

Woolly-necked Stork: The species was observed in the Lariang-Lumu area in groups of 5-20 individuals. A flock of 52 individuals (observed flying south at Pinrang in January) is the largest group recorded.

Glossy Ibis: This species was observed at three locations: a group of 12 individuals in rice-fields near to Watambone and larger flocks at Lake Tempe and at the Mampie Game Reserve. In July 1989, at the Tempe lake system, a total of less than 50 were present, mainly in drained ricefields west of Lake Sidenreng. By September, however, the numbers had risen to over 1,000, in October 3,000, and by November a maximum count of over 5,000 individuals was established. The birds fed throughout the day on the mudflats and adjacent shallow water. At dusk they gathered and flew in long "V" formations to a presumed roost in the west. In spite of several searches, the site of this roost was never discovered. After November the numbers slowly decreased until January when 338 birds were counted on Lake Tempe. The present survey also discovered more than 3,000 Glossy Ibis in the Mampie Game Reserve in January 1990. The local wardens explained that such numbers are present in the reserve throughout most of the year but that the species is almost absent between October and December. This coincides with their presence on the Tempe lakes, which may indicate a local migration of the species. Breeding was not confirmed at either site. However, two birds on Lake Tempe were seen behaving in a way that

might indicate a courtship dance: the two birds first faced each other then dropped their heads until their bills touched the water; together they then moved their heads from side-to-side in a sweeping motion. Unfortunately the birds were disturbed at this point and flew away.

Garganey: Few records of this bird are available for Indonesia but White & Bruce (1986) speculate that the bird must occur regularly in Wallacea. This species was observed on Lake Tempe only. The birds began to arrive in September in small numbers but by November their numbers were estimated at over 10,000 individuals. After November, the numbers slowly decreased until in January, only 650 Garganey were counted. It is not known where the majority left to, however Uttley (1987) reported 1,200 Garganey in the Nipah forests at the mouth of the Cendrenae River in late March. It would appear that Lake Tempe is a major staging point and winter destination. It may be the furthest point for the majority of the species as very few records of significant numbers exist further south (White & Bruce, 1986).

Grey-headed Fish-Eagle: This species was positively identified on Lake Towuti, which substantiates the sightings of Holmes and Wood (1980) on Lake Matano, and King *et al* (1990).

Maleo: Although Maleo were not observed, their presence was confirmed by their nest diggings and eggs. These findings confirm and add to those listed by Dekker (1990). The diggings were found along the coastline in the Lariang-Lumu area and on the north shores of Lake Matano and Lake Towuti. The coastal nesting sites were discovered in two locations, Pasangkayu and Majene (Pasangkayu District). At Pasangkayu the diggings stretched along the beach for 500m, and at Majene less than 50m. The nests had been dug on the high water mark which was backed by dense although disturbed mangrove forest. An egg was found by one young boy after a very short search. Nest diggings at the Matano lake system were similarly situated on the shore in black sand at the high water mark backed by dense forest. No previous records exist of Maleo nesting on lake shores (see Dekker, 1990). Both coastal sites were located on the edge of a village and were well known and exploited by the villagers.

Barred Rail. A rail was frequently observed in the Tempe lake system and was also recorded amongst a small clump of vegetation in the tambaks at Mampie and Maros; observed specimens display some differences from descriptions given by White & Bruce (1986), and may represent an as yet undescribed sub-species.

As with most Barred Rail the upperparts were plain olive brown while the breast was faintly barred black and grey. However, this barring was very inconspicuous and often could not be distinguished unless the bird moved into suitable light. Therefore the underparts often appeared dark grey. The barring faded away towards the rump which was uniform grey. The bill was dark grey to black. The birds also differed in having a white eyeline that passed through and slightly above the eye (whereas the Barred Rail has a white moustache, i.e. under the eye), the throat was brown, not black as is usual in the Barred Rail.

Dusky Moorhen: Observed to be far more common than the Common Moorhen, supporting the observations of Stresemann (1939) and contradicting later findings as discussed by White & Bruce (1986). Although the Dusky Moorhen was observed in many situations and habitats, the Common Moorhen was rarely observed out of the tall lake-side vegetation. The two species were distinguished by assuming that the white on the flanks is diagnostic of the Common Moorhen. However, White & Bruce (1986) indicate that this feature may not be conclusive. One bird studied in the hand showed no white whatsoever in the flanks. There appeared to be wide variation in the leg colours, which also seems to be an unreliable feature for identification.

Dunlin: There was an unconfirmed sighting of 15 Dunlin in a single tambak at Maros on 19 November 1989, within a group of Curlew Sandpiper with which they were compared. They were smaller and the bill appeared less down-curved. This sighting would indicate a considerable extension to its known winter range, but unfortunately no detailed fieldnotes were made at the time. Further unconfirmed reports were made by Escott and Holmes (1980) in Ujung Pandang in September 1976 (also at Palu in October 1978).

Snipe-billed Dowitcher: One individual recorded in the tambaks near Ujung Pandang on 27 November 1989 constitutes the first record of this species for Sulawesi, and for Wallacea (White & Bruce, 1986).

Ruff: A flock of 48 Ruff in the tambaks in the Mampie Game Reserve on 15 January 1989, together with a large flock of mixed waders, is the largest group recorded in Indonesia (White & Bruce, 1986).

Oriental Pratincole: 6 individuals were observed on 19 November 1989 in tambaks at Maros further confirming it as a visitor to Sulawesi (White & Bruce, 1986).

Common and Blue-eared Kingfishers: Due to the similarity between these species in Sulawesi, identification was not always possible. Where listed in this report as the Blue-eared, the blue on the back was recognised to be much darker than those listed as the Common Kingfisher. It was also observed that the call of the kingfisher listed as the Blue-eared in the Matano Lake system differs from that of a Common Kingfisher, an observation also made by Holmes and Wood (1980).

Great-billed Kingfisher: Observed in the Lariang-Lumu area where it is common at the edge of mangroves. It was also sighted on Lake Matano and at the edge of a swamp forest near to Lake Towuti. The colours are brighter and cleaner in the field than portrayed by Whitten *et al* (1987) where the paintings were made from old museum skins, the back being entirely white. These are the first reported records of the species in South Sulawesi though one was seen at the mouth of the S. Lariang in October 1978 (D.A. Holmes, pers. Comm.)

Great or Clamorous Reed-Warbler: High concentrations of Reed-Warblers were found in all areas with shrub vegetation close to water, such as within mangrove shrubs along tambak levees or in the lake-side vegetation of the Tempe lake system. The population at Lake Tempe was estimated to be over 26,000 individuals in January. The birds were observed to be constantly calling, particularly from the tops of the vegetation, suggesting territorial behaviour, although no substantial evidence of breeding or

resident status was found. Definitive identification was not possible, however,, and descriptions in the hand are required.

Yellow Wagtail: This species first arrived in small numbers in September, and by November occurred in high concentrations, in the lake-side vegetation and ricefields of the Tempe lake system. On two consecutive days at dusk, the wagtails were observed crossing Lake Tempe at different locations flying south-east in long continuous lines. The crossing lasted for approximately 30 minutes with the total number estimated at over 4000. It was also frequently observed in high concentrations in ricefields between Seng-kang and Watambone. The juvenile: adult ratio was approximately 2:1.

Threats

The wetland birds face threats to their populations from a variety of sources, the principal threat being the ever-increasing human population. Four major threats have been identified:

Pesticide use:

Pesticide use in tambaks and in agricultural land surrounding the Tempe lake system affects the populations of many species. Thiodan (active ingredient Endosulfan), a highly toxic organo-chlorine insecticide, and other such pesticides are widely used to cleanse tambaks of unwanted predators and competitors.

Although birds are not intended as a target, frequent reports by tambak owners told of birds walking around "as if drunk" and many eventually dying, after feeding on fish recently killed with Thiodan. The use of these pesticides is of great concern, particularly as this poisoning was observed in the Mampie Game Reserve where the breeding Little Egrets feed. Alternative less toxic poisons are available such as Saponin (made from tea leaves) and rotenones which, although cheaper and safe to use, are not preferred by the tambak owners as they do not show an immediate dramatic effect. Intensive pesticide use in the agricultural land surrounding the Tempe lake system is also of concern as notorious pesticides such as DDT and Gramoxone are still widely used. According to local reports, the use of powerful rodenticides has culminated in a dramatic decline of the raptor population of the area.

Acid rain:

Acid rain (pH 4.5) was recorded in the present survey in the Matano lake system. Sulphur

dioxide emissions of the nickel refinery beside Lake Matano may be responsible for this. The acid rain has been blamed for the reported dramatic reductions in yield of the local clove plantations. Fruit production in the forests may also be at risk, which would reduce the food available for many frugivorous birds.

Hunting:

Bird hunting was widely reported and witnessed throughout the province. It is practised both for recreation and for extra food and income. One hunter was encountered trying to shoot hornbills, in swamp forest neighbouring Malangke village, in order to sell their casques to foreign tourists in Tana Toraja. Bird hunting using traditional methods (such as luring the birds into nets using imitative whistles) was only reported in the area surrounding the Tempe lake system, where high numbers of birds are obtained from the ricefields and lake-side vegetation to supply local restaurants. The area has a reputation throughout the province for menus comprising wild bird dishes. Residents of one village beside Lake Sidenreng reported capturing annually over 6,500 birds, mainly Dusky Moorhen.

Rifles are expensive and not widely used, but air rifles are common. Many protected species are killed in this way. Woolly-necked Stork were particularly favoured. Recreational hunting is widespread and varies from young children shooting with catapults to adults with rifles. Most such hunting occurs on Sundays and holidays, and there were many reports from coastal villagers of regular visits by shooting teams from the cities, who hunt birds often indiscriminately.

Knowledge of hunting legislation and protected species is limited. It is probable that the harvest of birds for food could be sustained once acceptable levels are established, but recreational hunting must be abated. This can only be achieved through increased education combined with stricter and more efficient law enforcement.

Live bird trading:

Live bird trading, both legal and illegal, is intense within the province. The existing legislation and its inadequate enforcement appears ineffective, and provides too many loopholes for malpractice. The present status of the Yellow-crested Cockatoo *Cacatua sulphurea* is one example. It is reported to be the most commonly traded species in the province. Trading quotas are still high (1,800 individuals from South Sulawesi per year) even though for South Sulawesi there are almost no recent official records of this species in the wild. The bird was never recorded during the present survey, nor was it seen as a cage bird, and it would appear that it is now very rare in the province. Therefore the birds traded in the province probably derive from other provinces giving a false impression of their status and abusing the trading quota system.

Habitat loss:

The greatest general threat is the loss of habitat. The ever-pressing need to open new areas, such as swamp forest, for transmigration and agriculture, and to clear mangroves for tambak development, is continuously reducing the extent of the remaining forests. The on-going construction of a road from Mamuju to Pasangkayu, and beyond to Palu, as a branch of the Trans-Sulawesi Highway, will result in rapid settlement and agricultural development in the Lariang-Lumu plains, and conservation priorities need to be established urgently in this region (D.A. Holmes, pers. comm.). Further destruction of the forest will seriously threaten the survival of the endemic lowland species. Plans of P.T. INCO to alter the hydrology of the Matano lake system will also threaten the adjacent habitats; raising the level of Lake Towuti would drown both the sedge swamps and the Maleo nesting sites.

Conclusion

Significant new findings of the wetland avifauna of South Sulawesi were made during the survey, and they illustrate the importance of this type of survey, and the need for continual monitoring.

Six major wetland sites were identified in the province, each with its own unique species community. The avifauna of two wetlands was particularly notable, the peatswamps and mangrove forests of the Lariang-Lumu area and the Tempe lake system. Both sites are in urgent need of intensive research.

New data were collected on the distribution of certain species and surprising observations were made on the status of some, particularly the Glossy Ibis and Garganey. The new Maleo localities, particularly on the lake shores, are notable records. The province's wetlands may play a greater role for migrating birds than previously appreciated.

The wetlands contain important bird communities which are facing serious threats, particularly from the continual reclamation of land to cater for human population growth. The pressure from development activities is now placing ever-increasing importance on the remaining natural areas, and many aspects of nature conservation now require our urgent attention.

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Details of habitat status, where not otherwise referenced, are derived from observations of Wim Giesen in the field. Habitat areas have been calculated from aerial photographs taken in 1982 and, where relevant, updated with data from the present survey.

Other members of the team were: Wim Giesen (project leader, wetland ecologist), Syamsul Arifin Lias (soil scientist, PSL-Hasanuddin University), Eugene Verhagen (limnologist, University of Nijmegen, The Netherlands), Sukotjo (PHPA counterpart), Nurhakim Tangim (counterpart, Kanwil Kehutanan), Rudin Baruadi (socio-economist, Hasanuddin University).

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Species	1	2	3	4	5	6	7	8
Black Kite <i>Milvus migrans</i>					c		c	
Brahminy Kite <i>Haliastur indus</i>	c	c	c		c	c	c	c
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	c	c			c	r		
Lesser Fish-Eagle <i>Ichthyophaga humilis</i>					r			
Grey-headed Fishing Eagle <i>Ichthyophaga ichthyaetus</i>					r			
Sulawesi Serpent-Eagle <i>Spilornis rufigpectus</i>					c			
Spotted Harrier <i>Circus assimilis</i>						r		
Diving Tree-Duck <i>Dendrocygna arcuata</i>			c	c	a	c		
Grey Teal <i>Anas gibberifrons</i>			c	c	c	c	c	c
Pacific Black Duck <i>Anas superciliosa</i>						c		
Garganey <i>Anas querquedula</i>						a		
Maleo <i>Macrocephalon maleo</i>			r	r				
Buff-banded Rail <i>Gallirallus philippensis</i>						c		r
Barred Rail <i>Gallirallus torquatus</i>						c		r
White-breasted Waterhen <i>Amaurornis phoenicurus</i>						c	r	
Purple Swampphen <i>Phorphirio porphyrio</i>					c	a	a	
Common Moorhen <i>Gallinula chloropus</i>						r	c	c
Dusky Moorhen <i>Gallinula tenebrosa</i>					c	a	a	
Comb-crested Jacana <i>Irediparra gallinacea</i>						r	a	
Pacific Golden Plover <i>Pluvialis fulva</i>						c	r	c
Grey Plover <i>Pluvialis squatarola</i>						r		c
Greater Sand-Plover <i>Charadius leschenaultii</i>								c
Mongolian Plover <i>Charadius mongolus</i>								r
Little Ringed Plover <i>Cliurudius dubius</i>								r
Great Knot <i>Calidris tenuirostris</i>						r		r
Common Knot <i>Calidris canutus</i>								r
Rufous-necked Stint <i>Calidris ruficollis</i>								a
Long-toed Stint <i>Calidris subminuta</i>								c
Curlew Sandpiper <i>Calidris ferruginea</i>								c
[Dunlin <i>Calidris alpina</i>]								r
Sanderling <i>Calidris alba</i>								r
Ruff <i>Philomachus pugnax</i>								c
Common Redshank <i>Tringa totanus</i>			c					a
Common Greenshank <i>Tringa nebularia</i>								c
Marsh Sandpiper <i>Tringa stagnatilis</i>								r
Wood Sandpiper <i>Tninga glareola</i>						c		c
Terek Sandpiper <i>Xenus cinereus</i>								c
Grey-tailed Tattler <i>Heteroscelus brevipes</i>			c					c

Species	1	2	3	4	5	6	7	8
Common Sandpiper <i>Actitis hypoleucos</i>		c	c	c		c	c	c
Little Curlew <i>Numenius minutus</i>								r
Whimbrel <i>Numenius phaeopus</i>		c	c					c
Far Eastern Curlew <i>Numenius madagascariensis</i>								r
Snipe-billed Dowitcher <i>Limnodromus semipalmatus</i>								r
Black-tailed Godwit <i>Limosa limosa</i>								r
Snipe sp. <i>Gallinago</i> sp.						a	c	r
White-headed Stilt <i>Himantopus leucocephalus</i>						a		a
Oriental Pratincole <i>Glareola maldivarum</i>								r
Whiskered Tern <i>Clidonias hybridus</i>			c		r	a	c	c
White-winged Black Tern <i>Clidonias leucopterus</i>						c	c	c
Gull-billed Tern <i>Gelochelidon nilotica</i>	r							r
Little Tern <i>Sterna albifrons</i>	r		r					r
Lesser Crested Tern <i>Sterna bengalensis</i>								r
Spotted Dove <i>Streptopelia chinensis</i>		c				c	c	c
Slender-billed Cuckoo-Dove <i>Mucropygia amboinensis</i>		r						
Pink-necked Green-Pigeon <i>Treron vernans</i>		c						
Green Imperial Pigeon <i>Ducula aenea</i>		c	c					
Pied/White Imperial Pigeon <i>Ducula bicolor/luctuosa</i>				a				
Ornate Lorikeet <i>Trichoglossus ornatus</i>				c				
Sulawesi Hanging-Parrot <i>Loriculus stigmatus</i>	c							
Blue-backed Parrot <i>Tanygnathus sumatranus</i>				r				
Plaintive Cuckoo <i>Cuculus merulinus</i>							c	
Black-billed Koel <i>Eudynamis melanorynca</i>			c					
Fiery-billed Malkoha <i>Phaenicophaeus calyoryncus</i>			r					
Bay Coucal <i>Centropus celcbensis</i>		r						
Savanna Nightjar <i>Caprimulgus affinis</i>							c	c
White-bellied Swiftlet <i>Collocalia esculenta</i>			r			r	c	
Uniform Swiftlet <i>Aerodramus vanikorensis</i>						a	a	a
Collared Kingfisher <i>Halcyon chloris</i>		c	c	r	a	a	a	a
Sacred Kingfisher <i>Halcyon sancta</i>								r
Great-billed Kingfisher <i>Halcyon melanoryncha</i>		r	r		r			
Blue-eared Kingfisher <i>Alcedo meninting</i>		c			a			
Common Kingfisher <i>Alcedo atthis</i>			c					
Rainbow Bee-eater <i>Merops ornatus</i>			r					
Blue-tailed Bee-eater <i>Merops superciliosus</i>							a	c
Purple-bearded Bee-eater <i>Merops forsteni</i>			r					
Purple-winged Roller <i>Coracias temminckii</i>			r	c				
Dollarbird <i>Eurystomus orientalis</i>			r				c	
Sulawesi Hornbill <i>Penelopides exarhatus</i>				a				

Species	1	2	3	4	5	6	7	8
Knobbed Hornbill <i>Rhyticeros cassidix</i>		c		a				
Ashy Woodpecker <i>Mulleripicus fulvus</i>	r							
Barn Swallow <i>Hirundo rustica</i>		c				e	c	
Pacific Swallow <i>Hirundo tahitica</i>			a		a	a	a	a
Pied Cuckoo-Shrike <i>Coracias bicolor</i>				r				
White-rumped Cuckoo-Shrike <i>Coracina leucopygia</i>				c				
Sulawesi Cicadabird <i>Coracina morio</i>	r							
Pied Triller <i>Lalage nigra</i>		c						
White-Winged Triller <i>Lalage sueurii</i>							r	
Sooty-headed Bulbul <i>Pycnonotus aurigaster</i>							c	
Hair-crested Drongo <i>Dicrurus hottentotus</i>		c	c	a				
Slender-billed Crow <i>Corvus enca</i>		c	c	c	r	r	c	c
Pied Bushchat <i>Saxicola caprata</i>							c	
Golden-bellied Flyeater <i>Gerygone sulphurea</i>		c			c	c	c	c
Eastern Great Reed-Warbler <i>Acrocephalus orientalis</i> /								
Clamorous Reed-Warbler <i>A. stentorius</i>					c	a	a	r
Zitting Cisticola <i>Cisticola juncidis</i>							c	a
Golden-headed Cisticola <i>Cisticola exilllis</i>							c	
Rufous-throated Flycatcher <i>Ficedula rufigula</i>				r				
Common Pipit <i>Anthus novaeseelandiae</i>						r	c	
Yellow Wagtail <i>Motacilla flava</i>						a	c	
White-breasted Woodswallow <i>Artamus leucorhynchus</i>		c			c	c	c	c
Short-tailed Starling <i>Aplonis</i> sp.			c					
White-vented Myna <i>Acridotheres javanicus</i>							c	
Sulawesi Crested Myna <i>Basilornis celebensis</i>			c					
White-necked Myna <i>Streptocitta albigollis</i>				c				
Finch-billed Myna <i>Scissirostrum dubium</i>				c	c			
Brown-throated Sunbird <i>Antreptes malacensis</i>		c	c	c		c	c	
Black Sunbird <i>Nectarinia aspasia</i>							c	
Olive-backed Sunbird <i>Nectarinia jugularis</i>		c	c	c		c	c	
Lemon-bellied White-eye <i>Zosterops chloris</i>		c						
Scaly-breasted Munia <i>Lonchura punctulata</i>							c	
Chestnut Munia <i>Lonchura malacca</i>							c	
Pale-headed Munia <i>Lonchura pallida</i>						c		
Java Sparrow <i>Padda oryzivora</i>		c						