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RESULTS OF A SEABIRD SURVEY AT THE SOUTHERN SERIBUAT ARCHIPELAGO, JOHOR, MALAYSIA

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ABSTRACT

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Thirty-one seabird species are found in Malaysia, and a few still breed on rocky outcrops and small islands in the southern Seribuat Archipelago. A century-long egg harvest by local fishermen in the area is believed to have caused extirpation of several breeding populations. To update the status of seabirds in the southern section of the Seribuat Archipelago, a two-day survey was conducted in August 2017. Twenty-two islands were selected and surveyed by boat observation and colony visits. In total, over 6 200 birds were counted, representing five tern species: Bridled Tern *Onychoprion anaethetus*, Black-naped Tern *Sterna sumatrana*, Great Crested Tern *Thalasseus bergii*, Roseate Tern *Sterna dougallii*, and the Lesser Crested Tern *T. bengalensis*. The first two species are confirmed breeders, whereas the remaining species are either passage migrants or unconfirmed breeders. The survey led to the rediscovery of a small population of Roseate Terns at Pulau Yu (one of the species' two historic breeding sites in Malaysia). The islands surveyed are not legally protected (except for the Pulau Tinggi group). The protection of selected sites is highly recommended to conserve these remaining seabird populations.

Keywords: breeding colonies, seabirds, egg harvest, conservation, Malaysia

INTRODUCTION

Thirty-one seabird species have been recorded in Peninsular Malaysia and Borneo (Birdlife International 2018), including several species of terns, shearwaters, tropicbirds, gannets, frigatebirds, boobies, gulls, and skuas. Few of these species breed in Malaysia; most are either winter visitors or passage migrants (Jeyarajasingam & Pearson 2012). Seabirds breeding in Peninsular Malaysia are confined to a small number of rocky outcrops and

small islands (Hamza *et al.* 2016, Hamza *et al.*, 2018). The present status of seabird colonies in many parts of Malaysian waters is not fully known due to a lack of monitoring and the impact of the historic egg and chick harvesting by local fishermen (Wells *et al.* 1999). Most of the seabird populations that once thrived in Malaysia have undergone severe declines in the past 40 to 50 years.

Seabirds inhabiting the Southern Seribuat Archipelago have not been studied recently. The last major surveys took place during the

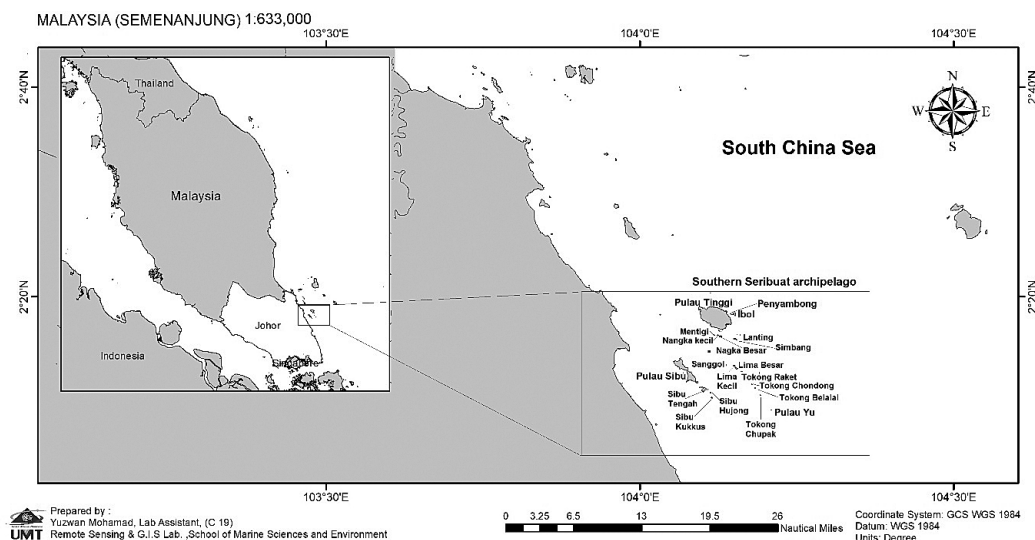


Fig. 1. The Seribuat Archipelago showing the survey area.

first half of the last century (Gibson-Hill 1950). Some unpublished surveys were conducted in July 2002 at Four Islands Reserve (comprising Pulau Lima Besar, Pulau Lima Kecil, Tokong Raket, and Tokong Condong) by the Department of Wildlife and National Parks (Perhilitan 2003). Since that date, no further surveys have been conducted.

In response to a request by the Malaysian Marine Parks Department (Jabatan Taman Laut), a scientific expedition was conducted by a multi-disciplinary team from Universiti Malaysia Terengganu at Pulau Sibul in July 2017. This expedition was followed by a two-day seabird survey on 10–11 August 2017, which covered all small islands located to the south of Pulau Tinggi and Pulau Sibul. Twenty-two sites were surveyed for signs of migratory and/or resident seabird breeding and/or roosting. The objectives of this study were to identify breeding sites of seabirds (mainly terns) and to investigate the conservation status of these birds in relation to human disturbance and pollution.

STUDY AREA AND METHODS

The Seribu Archipelago is composed of an ecologically diverse group of 62 islands. It is located in the southern section of the South China Sea (Grismer *et al.* 2006) in the coastal waters of

the Pahang and Johor states on the southeast coast of Peninsular Malaysia (Fig. 1). The islands range in size from 0.01 to 110 km² (Table 1) and extend from Pulau Cebuh in the north to Pulau Tokong Yu, 50 km to the south. The southern section of this archipelago extends from Pulau Tinggi (a National Marine Park) south to Pulau Tokong Yu. Both Pulau Tinggi and Pulau Sibul are inhabited by artisanal fishing communities and some tourist resorts, whereas the remaining islands are generally small in size and usually steep in height, thus explaining the lack of any human settlement (Appendix 1). These islands are, however, used as shelter or resting areas for fishermen in the region.

A two-day boat survey was conducted from 10–11 August 2017. The study area was predefined on a printed map, and the name and coordinates of each island were divided into three groups (following Grismer *et al.* 2006): Pulau Tinggi, Pulau Sibul, and Pulau Lima (Table 1). Sites (islands; Appendix 1) were observed using binoculars from the boat while navigating slowly at a close distance, following Walsh *et al.* (1995). Depending on each site's suitability for seabird nesting or roosting, and its accessibility, the survey team would either land or observe from the boat for at least 20 min, counting and identifying all bird species on or near the site. Counts of individual species were conducted by two observers and averaged. Information on topography and plant

TABLE 1
Island groups, geographic data, and suitability for breeding (B), roosting (R), and/or roosting and breeding (R/B) for seabirds at some small islands in the Seribu Archipelago

Island	Area (km ²)	Elevation (m)	Location	Suitability for seabird breeding/roosting
Tinggi	13.5	610	02°18'0"N, 140°07'0"E	R
Apil	0.04	13	02°16'7"N, 140°07'6"E	R
Mentigi	0.01	3	02°16'5"N, 140°07'1"E	R
Nangka Kecil	0.04	~15	02°16'5"N, 140°07'5"E	R
Nangka Besar	0.1	33	02°16'2"N, 140°07'5"E	R
Simbang	0.07	23	02°15'0"N, 140°09'2"E	R
Lanting	0.01	16	02°16'5"N, 140°09'4"E	R/B
Ibol	0.15	82	02°18'4"N, 140°09'2"E	R
Penyembong	0.04	17	02°18'4"N, 140°08'0"E	B
Sibu	4.81	155	02°13'0"N, 140°04'2"E	R
Sibu Tengah	0.45	74	02°11'1"N, 140°06'1"E	R
Papan	0.02	22	02°11'3"N, 140°05'7"E	R
Sibu Kukus	0.03	45	02°10'3"N, 140°06'7"E	R/B
Sibu Hujung	0.03	59	02°10'9"N, 140°06'6"E	R
Lima Besar	0.1	48	02°13'2"N, 140°09'0"E	R/B
Lima Kecil	0.04	41	02°13'4"N, 140°09'0"E	R
Tokong Sanggol (A1a)	0.01	22	02°13'4"N, 140°08'1"E	B
Tokong Raket	0.01	29	02°13'0"N, 140°09'6"E	B
Tokong Chondong	0.02	38	02°11'6"N, 140°10'6"E	B
Tokong Belalai	0.01	30	02°11'4"N, 140°10'6"E	B
Tokong Cupak	0.01	30	02°10'6"N, 140°11'1"E	B
Tokong Yu	0.01	28	02°07'4"N, 140°14'8"E	B

cover were documented using photographs taken with a Nikon P900 camera. Island area and elevation (Table 1) were obtained from Grismer *et al.* (2006).

RESULTS AND DISCUSSION

Twenty-two sites in the southern Seribu Archipelago were surveyed for seabirds (Table 1). Several sites were found to host significant numbers of seabirds belonging to five tern species (see Appendix 2): Black-naped Tern *Sterna sumatrana*, Bridled Tern *Onychoprion anaethetus*, Great Crested Tern *Thalasseus bergii*, Lesser Crested Tern *Thalasseus bengalensis*, and Roseate Tern *Sterna dougallii*. Two additional species, the White-bellied Sea Eagle *Haliaeetus leucogaster* and the Pacific Reef Egret *Egretta sacra*, were also observed. The observed aggregations represented both resident and migratory birds. Birds at 10 sites (45.5 %) showed signs of breeding; six of these sites were at the southernmost group of small islands (Table 2). Some sites were pooled together because of their proximity and the small number of birds present. Tokong Yu, followed by Tokong Raket, showed the highest abundance of seabirds; species richness was highest in Tokong Yu, followed by Tokong Lanting and Tokong Chupak (Table 2). Although egg poaching is common on most east coast islands of Peninsular Malaysia (Wells 1991, Jeyarajasingam & Pearson 2012, Hamza *et al.* 2016a), and the Johor Islands have been targeted for centuries by local egg collectors (Gibson-Hill 1950), few colonies are currently raided by locals in this region. Information obtained from local fishermen indicates that there is egg harvesting activity during May each year at both Pulau Lima Besar and Pulau Sibuk. Further studies are needed to determine the impact and magnitude of this poaching activity on the populations of Bridled and Black-naped

Terns. Some islands also host other avian species. For example, we observed the following at Pulau Lima Besar: eight Pied Imperial Pigeons *Ducula bicolor*, one Little Green Pigeon *Treron olax*, one Black-naped Oriole *Oriolus chinensis*, one Yellow-vented Bulbul *Pycnonotus goiavier*, several tens of Asian Glossy Starling *Aplonis panayensis*, and swiftlets *Aerodramus* spp. Surveys conducted in this area by the Malaysian Wildlife Department in 2002 (Perhilitan, 2003) recorded seabird species that were not observed during our survey, such as Lesser Frigatebird *Fregata ariel* and Little Tern *Sternula albifrons*.

The surveyed areas generally exhibited low levels of anthropogenic pollution, except for sparse plastic litter that had washed ashore at Pulau Sibuk, Pulau Lima, and Pulau Tinggi. The current impact of such plastic debris on seabirds in the area may not be significant, although floating plastic bags can be attractive to marine vertebrates such as seabirds, sea turtles, and marine mammals.

Additional surveys in May-June may result in counts that are higher than we obtained; the present survey was conducted at the end of the breeding season due to a logistical delay. Therefore, we may have underestimated the actual population size, as some early breeders may have already departed the area. Aggregations at sea also represent a significant proportion of uncounted groups—some seabirds use areas distant from the islands to forage. Annual surveys (including both islands and surrounding open waters) would allow for better estimation of the population size of recorded species and might result in observation of additional seabird species.

The following is an annotated description of the species identified at the study area (see Appendix 2 for photos):

TABLE 2
Seabird species abundance (individuals) at some small islands in the Seribu Archipelago, 10–11 August 2017

Species name ^a	BNT	BT	GCT	LCT	RS	PRE	WBSE	Total birds by site	No. of Species
Status ^b	R	R	R/M	M	R/M	R	R		
Pulau Ibol and Pulau Penyambong	73	0	0	0	0	1	0	74	2
Pulau Lanting	34	15	2	0	0	3	1	55	5
Pulau Menting, Nangka Kecil, Nangka Besar	34	0	18	0	0	0	0	52	2
Tokong Sangol	10	80	0	0	0	1	0	91	3
Pulau Lima Kecil and Lima Besar	20	0	0	0	0	1	1	22	3
Tokong Raket	2	1 200	0	0	0	0	0	1 202	2
Tokong Chondong	50	200	0	0	0	0	0	250	2
Tokong Gantang	0	0	0	0	0	1	0	1	1
Tokong Belalai	40	700	0	0	0	0	1	741	3
Tokong Cupak	65	10	35	0	13	0	0	123	4
Tokong Yu	1 100	2 200	200	10	110	0	2	3 622	6
Pulau Kukus	20	0	0	0	0	0	0	20	1
Total	1 448	4 405	255	10	123	7	5	6 253	

^a BNT = Black-naped Tern; BT = Bridled Tern; GCT = Great Crested Tern; LCT = Lesser Crested Tern; RS = Roseate Tern; PRE = Pacific Reef Egret; WBSE = White Belled Sea Eagle.

^b R = Resident, M = Migrant, R/M = Resident/Migrant.

Black-naped Tern

This species is the most common tern on the east coast of Peninsular Malaysia, where it nests (Hamza *et al.* 2016a, 2016b, 2018). It breeds from May to August and lays 1–2 eggs on bare rock with few nest decorations (i.e., small stones and seashells). Black-naped Terns usually nest and forage near shore in small groups (Fig. A1) (Wells 1991). This species was found at 12 of 13 sites surveyed (Table 2), with an abundance ranging from a few individuals to 1 100 birds at Pulau Yu; most birds were juveniles accompanied by adults still feeding them. Four nests (one with two eggs and three with one egg each) were observed at Pulau Penyembang (northeast Pulau Tinggi); some adults appeared to be incubating eggs at Pulau Lima Kecil, but the height of the cliff precluded census of the total number of nests. In general, this species is vulnerable to egg harvesting throughout the east coast zone of Peninsular Malaysia, particularly because their eggs are easily accessible on the bare rocks of the coastal islands.

Bridled Tern

Bridled Terns are resident breeders in Peninsular Malaysia's east coast waters (Wells 1991, Wells *et al.* 1999, Jeyarajasingam & Pearson 2012) and are as common as Black-naped Terns. However, this species is more frequent at islands that are more oceanic and isolated, with cliffs and moderate vegetation cover (Hamza *et al.* 2016a, 2018). This explains their larger numbers at the southernmost small islands compared to coastal sites. Bridled Terns breed from May to August (Fig. A2), and lay 1–2 eggs on bare rocks, in cliff crevices, or under grass and shrubs. The majority of eggs in a typical colony are well-hidden (Hamza *et al.* 2016b). The population, however, has suffered continuous egg harvesting by locals on many islands. The largest aggregations of this species were found at Pulau Yu ($n = 2200$) and Pulau Raket ($n = 1200$). Both juveniles and adults were observed; about 30 % of the observed population were juveniles or sub-adults. Bridled Terns were observed most frequently foraging in oceanic open waters, while Black-naped Terns foraged in shallower coastal waters. Some mixed flocks of the two species were seen; further studies should investigate dietary resource partitioning between these two tern species.

Great Crested Tern

Malaysia has two populations of this species—one is a winter visitor and the other is a resident breeder (Jeyarajasingam & Pearson 2012). During the current survey, Great Crested Terns were found at four sites, ranging from a few individuals up to 200 birds at Pulau Yu (Fig. A3). In all instances, the Great Crested Tern aggregations comprised both adult and juvenile birds, indicating that there is potential for breeding in the study area. Further surveys in May could confirm breeding sites and population size.

Lesser Crested Tern

This tern is a passage migrant to Malaysia (Jeyarajasingam & Pearson 2012). It is an uncommon and localized non-breeding visitor that is found in small numbers (Fig. A4). During this survey, we observed only 10 adults at Pulau Yu (Table 2). All birds observed were in non-breeding plumage: the entire forehead and crown was white, with any black limited to the crest and the area behind the eye. This species was not observed during recent east coast surveys in Terengganu and Pahang waters (Hamza *et al.*, 2016a, AH unpubl. data).

Roseate Tern

This species is very rare in Malaysia, with two known breeding sites in Pulau Tenggol (Terengganu) and Pulau Yu in Johor (Wells 1991). Hamza *et al.* (2016b) recorded a dozen birds at Pulau Ling (Terengganu) in breeding plumage (red bill and legs), indicating that they may have been en route to a breeding site in southern Terengganu (Fig. A5), where breeding had been recorded on a small island off Pulau Tenggol, Terengganu, and on Pulau Yu, Johor (Gibson-Hill 1950). During the current survey, we recorded 110 Roseate Terns at Pulau Yu, and 13 individuals at Pulau Cupak (Table 2); in both cases, Roseate Terns were associated with other tern species. Some birds were in breeding plumage (black cap, bright red bill with dark tip, and bright red legs), while others were in non-breeding plumage (darker bill). This is the first confirmation of Roseate Terns at Pulau Yu since the Gibson-Hill (1950) surveys in the late 1940's. The location of this remote island may prevent significant egg harvesting compared to more coastal islands in this region. Future surveys should aim to estimate the breeding population and set up conservation measures.

Pacific Reef Egret

This species spends most of its time foraging along coastal shores and breeding on island trees, exhibiting two different forms, dark and pale (Wells *et al.* 1999, Jeyarajasingam & Pearson 2012). The dark form, found in this survey, is distinguished by grey plumage with an inconspicuous narrow white mark on the throat. A colony of nine nests was reported by Hamza *et al.* (2016b) on a shrub at Pulau Ling in Terengganu. During the present survey, this species was observed at five sites as single birds or pairs, but no attempt was made to check possible breeding sites for nests.

White-bellied Sea Eagle

These resident large eagles, usually seen in pairs, are common on offshore islands and coastal areas in the study area. They nest in tall trees or on rocky ledges. In addition to one pair observed at Pulau Tinggi, other individuals were seen at four different sites; one pair was observed on the rocks of Pulau Yu next to the remains of a large fish that had been consumed.

CONCLUSIONS

This is the first comprehensive seabird survey of the southern Seribu Archipelago islands since the 1950s. The area contains several important seabird habitats, including islands, outcrops, and rich open waters for foraging. Four of the seabird species observed are resident, two are resident migrants (Malaysia has a resident population and receives another migrant population), and one is a passage migrant.

We recommend that the Malaysian Departments of Marine Parks and Wildlife Conservation, in addition to State Park authorities and local NGO's, coordinate future research activities to update the status of seabirds and enforce the protection of breeding and migratory seabirds and their habitats in the Seribu Archipelago. This should also be done in all other seabird hotspots in the Pahang and Terengganu states to the north. Because seabirds are indicators of healthy marine ecosystems, seabirds and their habitats should be considered in planning efforts for future marine parks. Egg harvesting from seabird colonies must also

be suppressed during peak breeding season (May–June). A study of the population genetic structure for some tern species (e.g., Black-naped Tern) is recommended to examine the potential impact of long-term egg harvesting on population genetic diversity. Education and awareness about seabirds should be included in plans for human settlement of both Pulau Sibul and Pulau Tinggi, Johor, as seabirds play vital roles in marine and terrestrial ecosystems. As this archipelago is a tourist destination in Malaysia, resorts should consider introduction of seabird/bird-watching in their products, employing local guides and fishers, following the standard guidelines. An additional survey during the peak breeding season (May–June) is required to confirm breeding of some species (Great Crested Tern, Roseate Tern) and to re-estimate the population size of each species.

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