

UPDATES ON SEABIRDS OF THE NORTHERN SERIBUAT ISLANDS, PAHANG, MALAYSIA

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ABSTRACT

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Because of a lack of systematic surveys since the 1950s, information on seabird diversity and the status of seabird colonies along the east coast of Peninsular Malaysia is mostly outdated. The Seribuat Archipelago is composed of many islands, which are located off Pahang state in the north and Johor state in the south. The northern section of the archipelago was surveyed during July–September 2017 to document active seabird colony sites and to assess species richness and the potential threats facing these colonies. Seven islands were found to host significant numbers of terns (Black-naped Terns *Sterna sumatrana*, Bridled Terns *Onychoprion anaethetus*, Greater Crested Terns *Thalasseus bergii*, Lesser Frigatebirds *Fregata ariel*, and other bird species). We provide details of each site and its suitability for seabirds. Pulau Labas and Pulau Tokong Bahara have the highest species richness (five species each), followed by Pulau Tokong Burung and Pulau Gut (four species each). Tokong Burung (made up of three islands) hosts the largest colony of Bridled Terns in the region, with more than 10000 pairs estimated, making it one of the largest colonies of the species in Southeast Asia. Egg harvesting by local fishermen, human disturbance, marine litter, and oil pollution are the main threats to seabirds in the Seribuat Archipelago. We make recommendations regarding measures needed for further protection of the area.

Key words: terns, breeding, conservation, Seribuat Archipelago, South China Sea

INTRODUCTION

Islands are preferred sites for both the roosting and breeding of seabirds, as they provide areas that are safe from predators and human disturbance (Mulder *et al.* 2011). Tropical islands are hotspots of biodiversity, including avifauna, primarily due to the availability of food resources and suitable climatic conditions. However, some islands (in the Pacific, for example) have been subject to severe pressure from humans, resulting in human-driven extinctions (Steadman 1995). Fossil records indicate that thousands of bird populations—particularly in seabirds such as petrels, shearwaters, boobies, and terns; and in land birds such as rails, pigeons, parrots—were lost on tropical Pacific islands after the arrival of people (Steadman 1999).

Three major categories of factors shape the current biogeography of birds on islands: abiotic factors (island size, topography, soil type, bedrock, isolation, sea level, and climate); biotic factors (an island's native plant and animal communities at first human contact); and cultural factors (socio-economic structure, demography, and cultural ecology of prehistoric peoples). The interactions between these factors can delay or promote extinctions in Pacific islands (Steadman and Martin 2003). The present diversity of birds on islands reflects the remnants of populations surviving in the face of long-term human pressures.

Malaysia is one of the tropical centers of global biodiversity (Keong 2015), with 31 recorded seabird species (Birdlife International 2019), including several species of terns (Sternidae),

frigatebirds (Fregatidae), boobies (Sulidae), gulls (Laridae), shearwaters (Procellariidae), tropicbirds (Phaethontidae), and skuas (Stercorariidae). Most seabirds in Malaysian waters are either winter visitors or passage migrants, except for a handful of species that are restricted to breeding on several rocky outcrops and small islands in both west and east coast waters (Gibson-Hill 1950, Jeyarajasingam & Pearson 2012, Wells 2010, Hamza *et al.* 2016a, Hamza *et al.* 2019). The avifaunal diversity of the rocky islands of east coast peninsular Malaysia have received limited attention (Hamza *et al.* 2018) compared to other taxa such as reptiles (Grismer *et al.* 2006), freshwater fish (Tan *et al.* 2015, Aqmal-Naser & Amirrudin 2018), and bats (Roslan *et al.* 2016).

Historic surveys by Gibson-Hill (1950), across what was then called the Malayan Peninsula, showed the importance of rocky outcrops in east coast waters for the breeding of several tern species, including Black-naped Terns *Sterna sumatrana*, Bridled Terns *Onychoprion anaethetus*, and Roseate Terns *Sterna dougallii*, in addition to other non-breeding species that roost or forage in the area during migration. There has been little systematic seabird monitoring since the 1950s. Egg and chick harvesting by local fishermen was common for decades (Wells 2010, Grismer *et al.* 2006) and is believed to have caused major population decreases and local extirpation of several colonies during the past 50–70 years (Hamza *et al.* 2016a). Recent surveys have enhanced our knowledge of the status of seabird colonies at several small islands in the state of Terengganu (Hamza *et al.* 2016a, 2016b, 2018). Surveys in the southern section of the Seribuat Archipelago (Hamza *et al.* 2019) identified four islands that host a significant diversity of terns,

including breeding and migratory species, and rediscovered a breeding population of over 120 Roseate Terns at Pulau Yu, whose status had been uncertain since the 1950s (Gibson-Hill 1950).

The northern section of the Seribuat Archipelago extends for more than 60 km, from the north at Pulau Cebeh to Pulau Gut, which is south of Tioman Island (Fig. 1). Bird diversity at Pulau Tioman (02°47.0'N, 104°10.0'E) is, by far, the most studied in this archipelago. Sodhi *et al.* (1999) reported 106 species on this island; most were forest birds and raptors, with a lower number of shorebirds and four to six seabird species. Pulau Tioman is located 41 km off the east coast of Peninsular Malaysia in the state of Pahang, in the South China Sea (Abdul 1999). It was declared a marine park in 1994 under the Fisheries Act of 1985, which was amended in 1993. The park boundaries also include several smaller islands/outcrops near Pulau Tioman: Pulau Tulai, Pulau Labas, Pulau Sepoi, Pulau Seribuat, Pulau Tokong Bahara, Pulau Gut, Pulau Cebeh, and Pulau Sembilan (Ng *et al.* 1999). A group of three rocky outcrops collectively called Tokong Burung (translated as 'Bird Temple'), located to the southwest of Tioman, is not currently included within the marine park boundaries (Abdul 1999). Human activities in the area include intensive tourism, diving, fishing, marine traffic, and human activity, with associated forms of land-based pollution. Egg harvesting by locals from the Bridled Tern colony on Pulau Tokong Burung was mentioned in old surveys (Gibson-Hill 1950) and more recently

by Grismer *et al.* (2006); however, more recent reports of egg harvesting in this colony are lacking.

We surveyed the islands of the northern section of Seribuat Archipelago that were suitable for seabird roosting or breeding, to complement a previous survey of the southern section (Hamza *et al.* 2019), with the goal of understanding the status of seabirds throughout the whole area. Here, we update information on species diversity and estimate the abundance of seabird species at all suitable islands/outcrops of the northern Seribuat Archipelago. We also describe the impacts of egg harvesting in this area, as well as other factors that threaten seabirds and their colonies.

STUDY SITES AND METHODS

The Seribuat Archipelago encompasses a diverse group of 62 islands, varying in size from 0.01 to 110 km², in the southern section of the South China Sea bordering the southeast coast of Peninsular Malaysia along the states of Johor and Pahang (Grismer *et al.* 2006; Fig. 1). The archipelago extends about 85 km south from Pulau Cebeh in the north to Pulau Tokong Yu. Five islands in the northern section of the archipelago were surveyed based on their suitability for seabird breeding and roosting; other islands that were not surveyed are covered by forest, with bare rocks on their coasts that are suitable as roost sites for foraging terns but provide limited habitat for nests (see Table 1 for details).

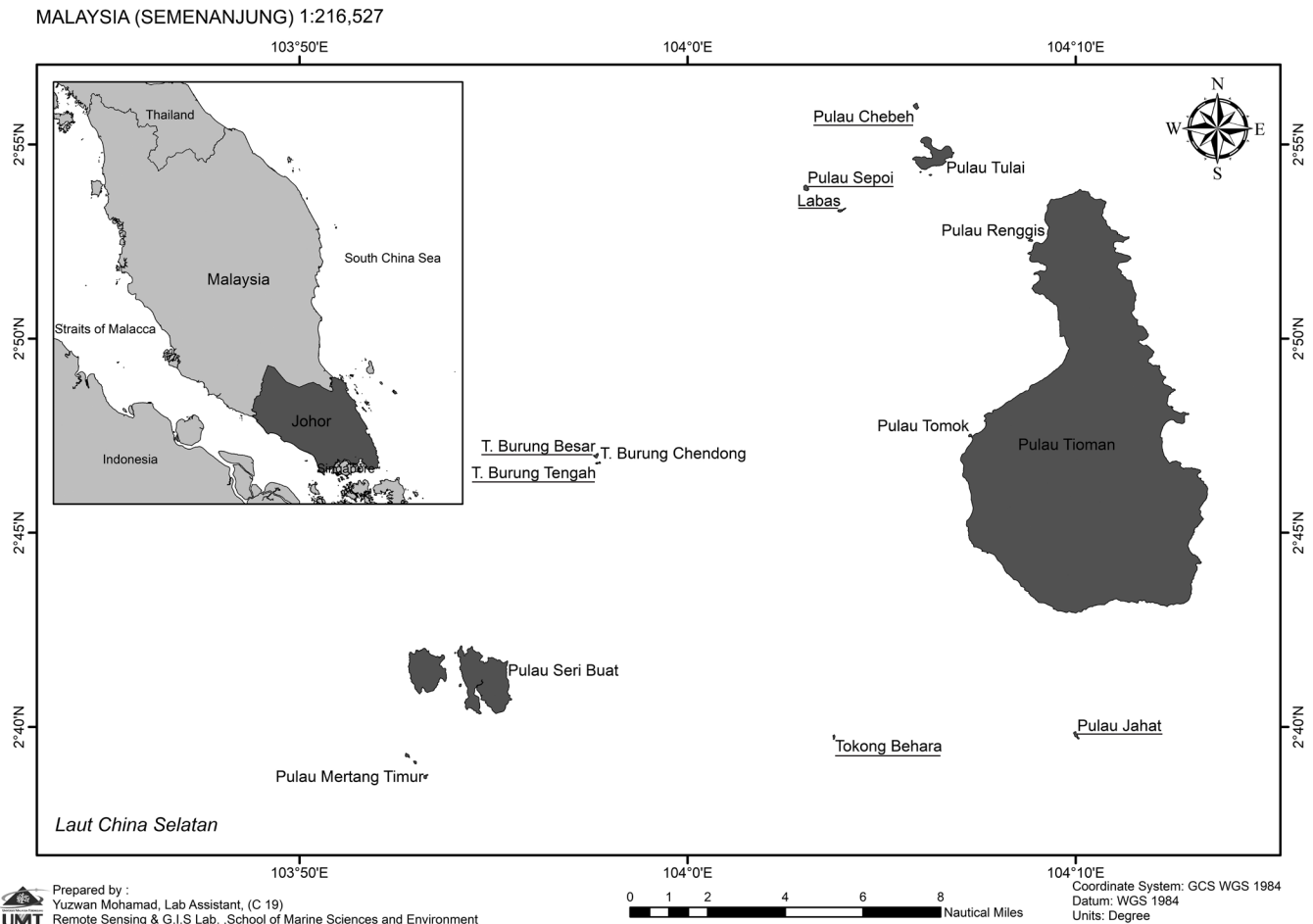


Fig. 1. Map of the Seribuat Archipelago showing the survey area (surveyed islands are underlined).

Three field surveys were conducted between mid-July and early September 2017 to identify important small islands for breeding or passage migrant seabirds. Islands hosting colonies or roosts of seabirds were initially shortlisted from the published literature (Gibson-Hill 1950, Wells 2010), followed by examination of satellite imagery from Google Maps[®]. Eleven islands were visited during the first and second surveys for ground authentication, and the four most suitable sites were surveyed in the third visit. During boat surveys, upon approaching the selected site, existing birds were carefully examined using binoculars and by direct observation. The boat moved slowly around the target site to collect information (Walsh *et al.* 1995). To identify and census all bird species, the survey team would either land on the island or continue observing the island from a distance, for at least 20 min (depending on accessibility), to identify and census all bird species. Counts were conducted by two observers, then averaged. Topography and plant cover were documented using photographs (Nikon P900 Camera). Island area and elevation (Table 1) were obtained from Grismer *et al.* (2006). Some information was also collected through interviews with boatmen and staff from the

Reef Check Malaysia Tioman office and the Juara Turtle Project on Tioman Island.

RESULTS AND DISCUSSION

Six seabird species (Black-naped Tern, Bridled Tern, Greater Crested Tern *Thalasseus bergii*, Lesser Frigatebird *Fregata ariel*, and White-bellied Sea Eagle *Haliaeetus leucogaster*, in addition to the resident Pacific Reef Heron *Egretta sacra* and some non-seabird species (e.g., the Pied Imperial Pigeon *Ducula bicolor*), were identified. Sites surveyed and their ornithological importance are detailed in Table 1.

Pulau Labas and Pulau Tokong Bahara had the highest diversity of seabirds (five species each), followed by Pulau Tokong Burung and Pulau Gut with four species each (Table 2). Most seabird species in this area are resident; the frigatebird is a migrant, and there are both resident and migrant Greater Crested Tern populations (Table 2). The three islands of Tokong Burung are important seabird sites, as they contain the largest colony of Bridled Terns in Malaysia. Accordingly, we recommend that the boundaries of the Pulau

TABLE 1
Description and ornithological importance of the main seabird sites surveyed in the northern Seribuat Archipelago (July–September 2017)

Site (area, elevation above sea level)	Description	Ornithological importance
Pulau Cebeh (0.05 km ² , 71 m)	A granitic pile of large boulders lying just to the north of Pulau Tulai. The interior is dense coastal forest with large trees and a deep leaf-litter and soil base. Middle and lower sides are bare rock.	Middle and lower edges are suitable breeding and roosting substrate for small numbers (about 25 pairs) of Black-naped Tern and fewer Bridled Tern.
Pulau Sepoi (0.03 km ² , 60 m)	A dome-shaped rocky outcrop composed of large granitic boulders. It lacks beaches, and its steep, rocky sides rise precipitously out of the water. The interior of the island is composed of dense coastal forest with medium-sized, drought-resistant trees.	Minor potential nesting site for Black-naped Tern and Bridled Tern, mainly found on the lower rocky edges of the island; areas at higher elevation are covered with thick shrubs and trees.
Pulau Labas (0.01 km ² , 20 m)	A large pile of granitic boulders. Lacks soil, although a few plants and some coconut palm trees are found at its center. Landing is difficult from all sides due to swell; however, during the last visit in September, the team was able to land at the western side of the island.	Major site for breeding Black-naped and Bridled tern and roosting Great Crested Tern, in addition to Lesser Frigatebird, which were observed kleptoparasitizing on two separate occasions on the first two species of terns. White Imperial Pigeons were also found to use the island as a roost using shrubs and coconut trees.
Tokong Burung (three small islands; 0.005–0.36 km ² , 32–54 m)	Consists of three islands midway between Pulau Seribuat and Pulau Tioman: Tokong Burung Besar, Tokong Burung Condong, and Tokong Burung Tengah. Pulau Seribuat is the largest island, and each pair of islands is separated from the other by < 100 m. Characterized by precipitous rocky peaks of underwater sea mounts (Grismer <i>et al.</i> 2006). Covered with short grasses and arid-adapted vegetation, with no shrubs or trees.	The three islands of Tokong Burung are a major breeding area for Bridled Tern. We estimate the population size at 15 000 birds—the largest in Malaysia and of regional importance for this species in Southeast Asia.
Pulau Gut (P. Jahat) (0.05 km ² , 30 m)	Located 5.4 km south of Pulau Tioman. A round pile of large granitic boulders supporting a low-growing forest and covered with grass. The boulders are white due to the accumulation of seabird guano.	The lower boulders are used as roosting and breeding sites for Bridled, Black-naped, and Greater Crested Terns. Nesting was not verified because we visited in late July.
Pulau Tokong Bahara (0.02 km ² , 54 m)	An isolated small island, midway between Pulau Seribuat and Pulau Tioman, south of the Tokong Burung group. Its general shape and interior are like the islands of the Tokong Burung group and the grasses on this island are also periodically burned to facilitate egg collecting according to Grismer <i>et al.</i> (2006).	Major site for breeding and roosting of Bridled Tern and to a lesser extent Black-naped Tern. Lesser Frigatebirds were also seen gliding above this island by the end of July.

TABLE 2

Seabird species abundance (no. of individuals) at seven small islands of the northern Seribuat Archipelago (July–September 2017)

Species name ^a :	BNT	BT	GCT	PRE	WBSE	LFB	Total	Species
Species status ^b :	R	R	R/M	R	R	M	Birds	richness
Pulau Labas	1000	2500	1000	0	2	350	4852	5
Pulau Tokong Bahara	0	5000	25	1	2	65	5093	5
Pulau Tokong (three islands)	0	15000	0	2	2	15	15019	4
Pulau Gut	300	600	0	0	2	1	903	4
Pulau Sepoi	10	10	0	0	0	0	20	2
Pulau Cebah	50	0	0	0	0	0	50	1
Total	1360	23 110	1025	3	8	431	25 937	1

^a BNT = Black-naped Tern; BT = Bridled Tern; GCT = Greater Crested Tern; PRE = Pacific Reef Egret; WBSE = White Belled Sea Eagle; LFB = Frigatebird.

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

Tioman Marine Park be extended to protect seabird breeding and underwater habitats in this region.

Egg harvesting by local fishermen remains a major issue for seabird conservation in this area (see the section on Bridled Tern below). A group of 14 eggs was found on the beach of Pulau Tokong Burung, most likely left by a local collector. Awareness campaigns and enforcement of conservation regulations are needed to manage this issue.

The surveyed areas generally showed higher levels of anthropogenic pollution compared to the southern section of the archipelago (Hamza *et al.* 2019). Marine litter from terrestrial sources and fishing operations (ghost nets) were common at many sites. Large floating tar balls were noted in 2017 on the open water, and these likely originated from ships and oil tankers crossing this area. Hydrocarbon pollution can cause direct or indirect mortality to several marine organisms via direct contact, ingestion, or assimilation; it can also lead to the accumulation of hydrocarbons in the food web (Warnock *et al.* 2015), in coral reef invertebrates, vertebrates such as fishes, sea turtles, dolphins, and breeding and foraging seabirds. Hydrocarbon pollution may also have negative effects on the local tourism industry.

The results of this study, together with published data on the southern islands of the Seribuat Archipelago (Hamza *et al.* 2019), should be used to understand the importance of this area to different populations of seabirds in the southeast waters of Peninsular Malaysia. The census of seabird aggregations at these islands and nearby waters should be repeated systematically. Annual surveys will permit better estimation of seabird population sizes and might uncover the presence of additional seabird species.

The following is an annotated description of species identified at the study area:

Black-naped Tern

The Black-naped Tern is the most common resident seabird species in the east coast waters of Peninsular Malaysia (Hamza *et al.* 2019) and is subject to significant egg harvesting pressure (Wells 2010,

Jeyarajasingam & Pearson 2012). It breeds from May to August, with one or two eggs laid on bare rock with a few nest decorations of small stones and seashells. Most birds nest on bare and partly vegetated rocky boulders and small islands, predominantly along the east coast of Peninsular Malaysia, from Pulau Perhentian in the north (Terengganu) to Pulau Yu in the south (Johor), including the Redang and Bidong archipelagos (Hamza *et al.* 2016a, 2019). Black-naped Terns (Fig. 2) were found at six of the seven surveyed sites, in numbers ranging from a few individuals up to 1000 birds at Pulau Labas (Table 2). This estimate does not include several hundreds of foraging birds in open waters during the survey time.

Bridled Tern

The Bridled Tern is a resident breeder of the study area (Jeyarajasingam & Pearson 2012) and tends to occupy oceanic environments and isolated islands with cliffs and moderate vegetation cover (Hamza *et al.* 2016a, 2016b). It breeds from May to August, laying one to two eggs on bare rocks, in cliff crevices,



Fig. 2. The Black-naped Tern, one of the most abundant breeding tern species along the east coast islands of Peninsular Malaysia. All photos taken by AH using a Nikon P900.

or under grass and shrubs. Most eggs in a typical colony are well hidden (Hamza *et al.* 2016a), but similar to Black-naped Terns, the population has suffered from several decades of egg harvesting by locals on many islands. In the present survey, eggs were found that were still being incubated in early September at Pulau Tokong Burung (Fig. 3). Egg harvesting at this site is still practiced; local fisherman from Pulau Tioman visit the site in May, setting fire to the grassy cover of some of the three islands. This provides barren area for incoming breeding birds, and forces the terns to lay freshly synchronized clutches, which are later harvested (Grismer *et al.* 2006). One fisherman informed us that they can collect up to 6000 eggs in a single day. This practice is conducted once per year, early enough that Bridled Terns can replace clutches. The long-term effects of this practice on population genetic structure requires further investigation. Replacement laying appears to be an alternative survival strategy for these birds, as indicated by the presence of active nests in September, which falls at the end of the breeding season. However, breeding success and juvenile survival rates from replacement clutches are lower in other species, such as the Sooty Tern *Onychoprion fuscatus* (Feare 1976). The estimated population size of the Bridled Tern in Pulau Tokong Burung ranges from 12000 to 15000 individuals, followed by Tokong Bahara with

5000 to 6000 individuals (Table 2). Pulau Tokong Burung could be of sub-regional importance, as it hosts the largest colony of Bridled Tern in Peninsular Malaysian waters. Although the species is considered a resident breeder (Jeyarajasingam & Pearson 2012), its post-breeding movements are not well known, and many locals have confirmed that there are no Bridled Terns on the three islands (or on nearby islands) during the monsoon season from November to late February. It is possible that Bridled Terns migrate south to Indonesia, or even to Australia, similar to the western Pacific/southeast Asian populations of Little Tern *Sternula albifrons sinensis*. Tracking studies will be important to reveal the post-breeding movements of these birds.

Greater Crested Tern

The Greater Crested Tern is a winter visitor to the study area, with a resident breeding population in Malaysia. It was found at two sites (Table 2), Pulau Labas and Pulau Gut (1000 and 600 birds, respectively). All groups included both adults and juveniles (Fig. 4), indicating recent breeding activity. Additional surveys during April/May will be necessary to confirm the exact locations of colonies and the breeding population.

There were no observations of either Roseate Terns *Sterna dougallii* or Lesser Crested Terns *Thalasseus bengalensis* in the study area, but these species were reported at the southern section of the Seribu Archipelago (Hamza *et al.* 2019).

Lesser Frigatebird

The Lesser Frigatebird, a large seabird, is a wintering migrant of the study area, breeding mainly at Christmas Island in the Indian Ocean south of Java (Jeyarajasingam & Pearson 2012). This species was observed during all three trips of this survey. The literature refers to Pulau Ringgis (close to Tioman's southwest coast) as a major roosting site for this species in Malaysia; however, during the present study, all encounters with this species were either on open



Fig. 3. The Bridled Tern colony at Tokong Burung. These three islands host one of the largest colonies of this species in southeast Asia.



Fig. 4. Aggregation of roosting adult and juvenile Greater Crested Tern on Pulau Labas.

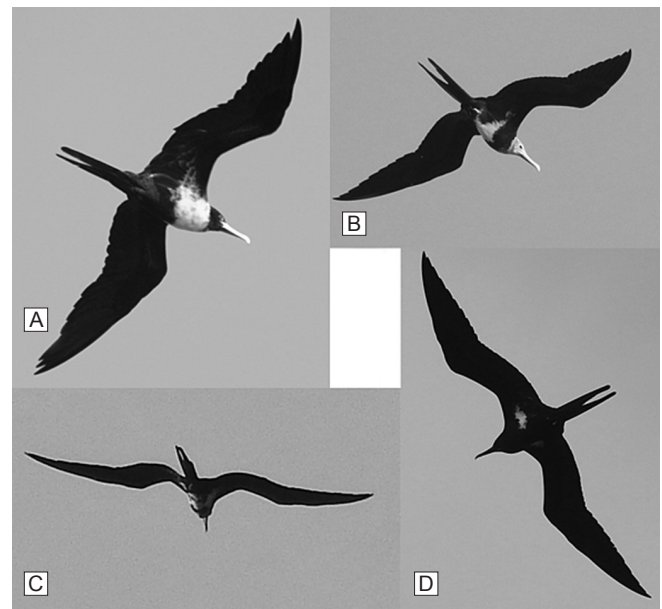


Fig. 5. (A) Adult female, (B) juvenile, and (C & D) male (two different ages) Lesser Frigatebirds.

water between Mersing Jetty on the mainland and Pulau Tioman (three birds observed from the ferry near Pulau Tokong Bahara), or near Pulau Labas (20 birds observed on 18 July). The largest group of frigatebirds, including first-year birds, was 350 on 31 July 2017, seen gliding at high altitudes between Pulau Tioman and Pulau Labas. Another 65 and 10 birds were observed the following day to the northwest of Pulau Tokong Bahara and near Tokong Burung Besar, respectively (Table 2). The groups were a mixture of different plumages and sexes (Figs. 5B, C). The frigatebird's kleptoparasitic foraging strategy was observed at Pulau Labas on 31 July, attacking both Black-naped and Bridled terns.

White-bellied Sea Eagle

The White-bellied Sea Eagle is a resident large eagle, usually found in pairs, that is common on most offshore islands and coastal areas. This species nests in tall trees or on rocky ledges. Two birds were observed gliding over Pulau Labas on 17 July, and a single bird was seen on roost, then gliding over Pulau Tokong Condong on 17 July and 01 August. At the time of this second observation, we found the wings of nine juveniles and one adult Bridled Tern with some large fish bone remains on a small rock off Pulau Tokong Burung Besar. Eagles may use both young birds and fish as their main diet in this area (Figs. 6A, B). An additional two pairs of eagles were observed at both Pulau Tokong Bahara and Pulau Gut (Table 2). Although no nests were found at these locations, a few nests containing incubating adults were located further south in Tanjung Leman on high trees facing the ferry terminal.

Pacific Reef Heron

The Pacific Reef Heron is a resident heron mostly associated with small islands (Wells 2010). Egrets are not typical seabirds, but this species spends most of its time foraging in coastal waters and breeding on island trees (Hamza *et al.* 2016b). In Pulau Tokong Bahara, up to three birds were recorded at five sites during this survey (Table 2).

CONCLUSIONS AND RECOMMENDATIONS

This study presents the first update on seabirds, their colonies, and aggregation sites in the northern section of the Seribuat Archipelago since the historic surveys conducted nearly 70 years ago (Gibson-Hill 1950). Several sites were found to be important hotspots of seabird biodiversity in the region, both in terms of species richness and abundance. Some of these islands are of regional importance as seabird breeding sites (i.e., the Tokong Burung Group) and should be proposed as new Important Bird Areas (IBAs). Surrounding waters should be designated as Marine Protected Areas, which can



Fig. 6. (A) The remains of Bridled Terns and (B) fish, likely eaten by a White-bellied Sea Eagle at Pulau Tokong Burung Besar.

be annexed to Pulau Tioman Marine Park. Lesser Frigatebirds use the area as a western Pacific non-breeding range. Egg harvesting by local fishermen coming from Pulau Tioman (the main human settlement in the area) is still practiced every year in late May. The impact of this harvesting on population size and genetic variability should be studied further, as Bridled Terns are forced to lay replacement clutches. Although no effort was made to assess the potential presence and impact of mammalian predators on both eggs and nestlings in this study (except the case of human egg harvesting at the Tokong Burung Islands), the potential impact of predators cannot be excluded. Rats, in particular, can swim between nearby islands, especially on sites located in proximity to human settlements. However, we found no sign of rat predation of eggs on the islands that we explored by foot. There were nine juvenile Bridled Tern remains at Tokong Burung, which we attributed to the White Belled Sea Eagle. A comprehensive assessment of predators should be conducted to support better management of these seabird colonies. Awareness campaigns, education for locals, and enforcement of regulations should be undertaken to conserve the remaining colonies of terns and other seabirds in the area. Authorities such as the State and National Marine Parks Authority should consider management options for the colonies of seabirds in this section of the archipelago. Management plans should consider alternatives to dealing with the issue of egg harvesting, such as temporal bans or a regulated harvest, if locals depend on eggs as a source of protein during the monsoon seasons, as occurs in other tropical societies such as the Seychelles (Feare 1976). Training of marine park rangers on seabird colony monitoring and management protocols is also needed. Another survey in early May will further highlight the current breeding status of some species, such as the Greater Crested Tern.

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