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ANNOTATED CHECKLIST OF AVIFAUNA IN PULAU BIDONG, MALAYSIA

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Abstract: Avian diversity study focusing on islands in Malaysia is generally scarce compared to the unsurprisingly wealth of information on mainland birds. Similarly, Pulau Bidong is one of these islands with scarce ornithological information. It is located to the northwest of Kuala Terengganu, East Coast Peninsular Malaysia. A series of field surveys were conducted on the island between August 2014 and August 2016, using both point counts and mist netting methods to assess the bird species diversity at coastal area and within the forest canopy of the island. Unpublished data from 2006 were also added as it covers the Bidong trail area. Our results indicate that the total count is 26 species, belonging to 18 families and 23 genera. This species list is not exhaustive because the survey did not cover the main migration season from October to February, when it coincides with the monsoon season and rough weather. Further surveys will be needed to cover the nearby small islands in the archipelago.

Keywords: Pulau Bidong, South China Sea. Island, bird diversity

Introduction

Islands have fascinated biologists for a long time. Birds found on islands were the main model of several ecological theories such as the Origin of Species, and the theory of Island Biogeography (MacArthur and Wilson 1967). But islands are known to host a much smaller diversity of bird species per area compared to the same area on continental land. This was explained by several factors, among them, the limited habitat diversity and, consequently, lower niche capacity of islands. Resources for feeding and breeding are less compared to the mainland (Lack 1970) as the area available for each species establishment on islands, making the conservation of large-area islands much worth it in terms of long-term planning (Koh *et al.*, 2002). This would not minimise the importance of small islands, as they can serve as fuelling stations for migratory birds and centres of endemism for other species, as previously found on similar forested islands in Southeast Asia (Turner *et al.*, 2002).

Along the Malaysian coast, several small, heavily forested islands can be found. These islands have a very important ecological role (Cronk 1997). The state of Terengganu has some 17 islands of different sizes and morphology (Teh 2000). Some of them are inhabited such as Pulau Redang and Pulau Perhentian, while others are mainly used for tourism (e.g. Pulau Lang Tengah and Pulau Kapas) or uninhabited islands (Pulau Bidong archipelago).

Information on biological diversity of birds on Malaysian islands varies greatly. Some islands have received extensive floral and faunal research, such as Pulau Langkawi (Abdullah 2006) Pulau Tioman (Ng *et al.*, 1999, Sodhi *et al.*, 1999), and Pulau Perhentian (Tamblyn *et al.*, 2005), others lack such extensive surveys except for a few old reports of short expeditions (Bonhote 1901, Gibson-Hill 1952).

This applies on most islands located off the east coast of Peninsular Malaysia. However, there were some surveys conducted on other organisms and plants on Pulau Bidong, for

example, Algae (Armugam, 1981, Khor, 2002), butterflies (Rosmidi *et al.*, 2017), Dipterocarp trees (Pesiu *et al.*, 2016), bats (Roslan 2016), crustaceans (Nakajima *et al.*, 2013), fish (Jeropakal, 1998, Lorenzo *et al.*, 2016) and reptiles (Grismer *et al.*, 2014).

European explorers used to shoot and collect bird specimens / skins for private or museum collections. First surveys of birds at Pulau Bidong dates back to Skeat Expedition during December 1899 (Gibson-Hill, 1952). During that expedition in Pulau Bidong, they collected six specimens of birds belonging to five species. Later Kloss expedition spent two days on the island during August 1910 and collected four additional bird species. Nearly four decades later, Gibson-Hill visited Pulau Bidong on August 9th 1949, and added three additional bird species to previous lists (Gibson-Hill, 1952). Since then, there has been no updates on the birds of Pulau Bidong. Furthermore, birds on Pulau Bidong were not mentioned anywhere in major field guides to the bird of Peninsular Malaysia (Wells *et al.*, 1999, Jeyarajasingam

and Pearson, 2012), clearly due to scarcity of data. Recent seabird surveys were conducted on several east coast islands (Hamza *et al.*, 2016a, Hamza *et al.*, 2016b), but it did not include Pulau Bidong. This paper presents an annotation of birds species present on Pulau Bidong between 2006 and 2016.

Site Description

Pulau Bidong is the largest island within a small archipelago (Figure 1), with a surface area of one kilometre square, and an elevation of 321 m above sea level. It is located 18 nautical miles (later nmi) to the northwest of Kuala Terengganu, and 8 nmi southeast of Pulau Redang, Terengganu. Less than 1 nmi to the south, there is a smaller islet called Pulau Kapak and over 1.8 nmi to the north another islet called Pulau Gelok, while at over 8 nmi to the East of Pulau Bidong lies two other islets of Pulau Yu Besar and Pulau Yu Kecil. Most of those islands are much smaller in size that Pulau Bidong.

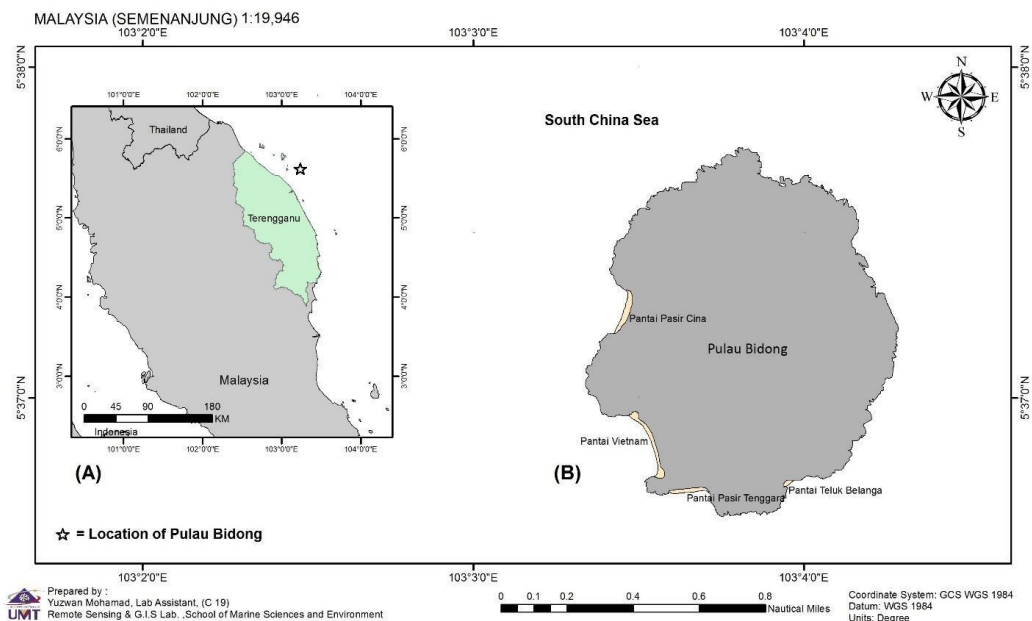


Figure 1: Location of Pulau Bidong Terengganu, Malaysia (A), Location of Pantai Pasir Cina and Pantai Vietnam (B).

Pulau Bidong (formerly known as Pulau Bidong Laut) is an uninhabited island (Figure 1), covered with secondary forests, with a total area of 260 hectares. It has two bays with sandy beaches and coastal forest cover on its West and Southwest fronts. Pantai Pasir Cina (0.15 nmi) on the west of the island is used as a research station for Universiti Malaysia Terengganu since 2009. From this beach, there is a 4 km hiking trail leading to the second beach called locally Pantai Vietnam (0.22 nmi), where Vietnamese refugees landed and settled on the island in 1975. Most of the birds sighted and listed in the present article were located on either of these two beach sites or along the forest trail that extends between the two beaches.

Methods

Surveys were conducted using binoculars 8 x 40 to identify bird species (and vocalizations when birds cannot be seen) during May 2006, August 2014, May and August 2015 and August 2016 (Table 1) at the two beach areas and adjacent forest, i.e. Pantai Pasir Cina and Pantai Vietnam (point count, three points each), with 100 m between each two stations. Data were also collected in 2006 along the 4 km long Bidong hiking trail (line transect). Observation radius varies according to point count location, in beach area it can extend to several hundreds of meters on the seaside to count all seabirds and other wading birds, whilst on the other side of the beach, dense vegetation allows limited observation radius, and vocalization of some species were used as records for these species. This trail was selected as it connects the two beach areas of the island, extending through dense forest. Surveys were conducted during early morning (0700-1000 hours) and late afternoon (1700-1900 hours), when bird activity is optimal. Two mist-nets on 3 m poles were erected for four full days in 2006 and in May 2015 at the Pantai Pasir Cina (UMT Research station site), covering the understory level of the canopy. These were elevated 50 cm from the ground, and the canopy height varied from 15-30 m. Mist-nets were checked every two hours and

closed before dusk. Birds were identified and released immediately. As this survey was not intended to estimate population size of different species encountered, species accumulation curve and sample-based Cole-Rarefaction was used to test sampling completeness, using Estimate S software (version 9.1.0).

Results and Discussion

A total of 26 species belonging to 18 families and 23 genera were recorded at Pulau Bidong. The most represented family was Nectariniidae (Sunbirds and Spiderhunters) with five species followed by Apodidae (Swifts) with three species, the rest of the families were represented by a single or two species (Table 1). Sixteen species were resident (61.54%) while five species were resident/migrant (19.23%) and the other five species were migrant (19.23%). Although effort was made to record all bird species on Pulau Bidong, these results cannot be considered comprehensive as it covered a small area of the island and more species are expected to use the island during migration season, which coincide with monsoon rainy season. Feeding guilds varied among species (Table 1), several species were nectarivores, while others depended on forest fruiting as food source or insects, with fish and crustaceans for other species. This indicates the diverse habitat and species resource partition on the island ecosystem where competition on limited food and shelter resources can represent limiting factors to the carrying capacity of the ecosystem in terms of species diversity and richness. In a recent study, Pesiu *et al.*, (2016) reported 55 tree species that were found at Pulau Bidong, several of them were flowering and fruiting, which provide the main food source for several bird species listed in the present study. Although there is no permanent human settlements currently on the island, past human presence could have caused local extinctions for some species, due to heavy logging, while other species were introduced to the island. An assessment of the native and introduced flora is needed to compare the vegetation cover of Pulau Bidong in the past with the present situation.

To check for completeness of results, species accumulation curve with Cole Rarefaction were used to determine whether sampling size of bird species obtained from Pulau Bidong was representative to the actual number of species (completeness) on the island. Figure (2) shows the species curve did not reach an asymptote, which indicates that other species are expected

to be added to our list in future surveys. Sampling effort especially using mist-netting was not sufficient to account for all canopy avifauna. The limitation of sampling months outside migration season also can justify these limitations in results. As this is the first checklist for Pulau Bidong, future surveys can yield a complete checklist of bird species.

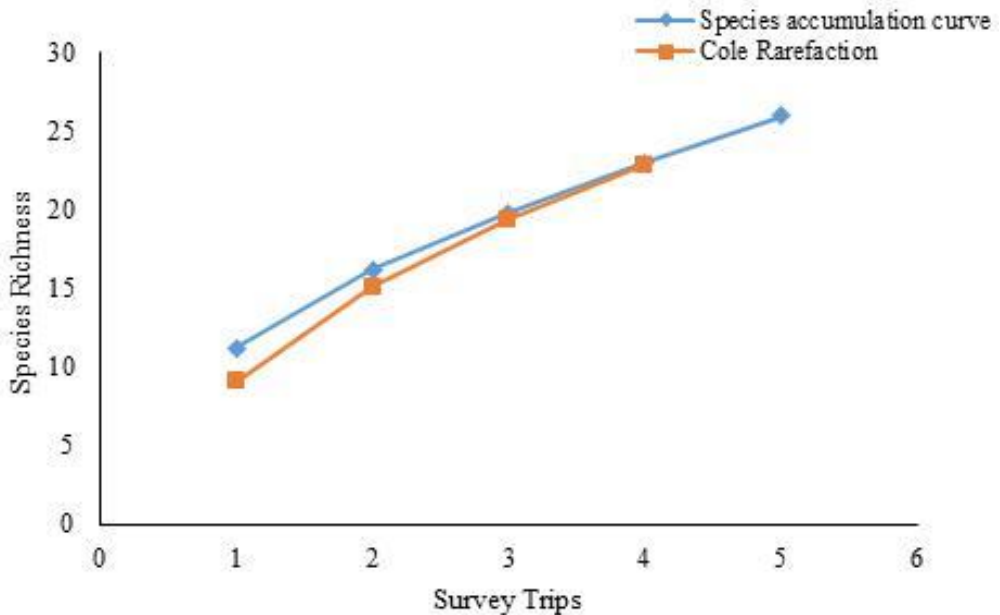


Figure 2: Species accumulation curve and sample-based rarefaction curve of birds recorded from Pulau Bidong, Terengganu.

Species accounts

Pacific Reef Egret *Egretta sacra* (Ardeidae)

This species is a resident breeder, rocky shore water bird, common in coastal and offshore small islands (Jeyarajasingam & Pearson 2012). The dark morph was observed in Pulau Bidong and other small islands to the southwest of Pulau Redang (Hamza *et al.*, 2016b). The species was observed in all five surveys on Pulau Bidong. The bird was observed feeding on in shallow waters at both sandy and rocky shores, either individually, in pairs or up to six individuals roosting on the rocky shore at the north edge of Pasir Cina beach. In Pantai Vietnam, numbers can reach to 20 birds; some birds were also

observed roosting on abandoned aquaculture cages off the coast of Pulau Bidong, apparently for feeding. This species has been mentioned in checklists of both expeditions of Kloss 1899-1900 (Bonhote, 1910) and Gibson-Hill in 1949 (Gibson-Hill, 1952). No breeding activity was reported from Pulau Bidong, but the species was found to utilise small islands off Pulau Redang for breeding (Hamza *et al.*, 2016a), (App. 1a).

Cattle Egret *Bubulcus ibis* (Ardeidae)

A resident migrant and an uncommon resident to fairly common winter visitor at low elevations (Jeyarajasingam & Pearson, 2012), a single bird was reported during the last trip in August 2016, the bird was observed for about 20 minutes

feeding at a small area of grassland at Pantai Vietnam, then flew and roosted on the trees. It is likely that this was an early migrant individual. No additional individuals were observed. The species is quite common in paddy fields in Terengganu (Batu Rakit and Hulu Terengganu) where groups of Cattle Egrets were seen flocking/roosting among trees and feeding areas (Hamza, personal observations), (App. 1b).

White-bellied Sea Eagle *Haliaeetus leucogaster* (Accipitridae)

This species is a resident breeder, usually seen single or as a couple, soaring or flying near the sea surface for food. Fairly common resident at low elevations in coastal districts, including most offshore islands (Jeyarajasingam & Pearson, 2012), the species was not listed in earlier surveys either by Skeat list (Bonhote, 1910) or Gibson-Hill (1952). In contrast, it was observed in all recent surveys (Table 1). It is not confirmed whether the pair seen at Pulau Bidong were mainland or islands breeders.

Common Sandpiper *Actitis hypoleucos* (Scolopacidae)

Widespread passage migrant and winter visitor at low elevation areas of Peninsular Malaysia (Jeyarajasingam & Pearson, 2012), the bird is fairly common in most coastal areas of the East coast, associated with shallow coastal marine and fresh water bodies, paddy fields and other wetland types. Usually observed in small numbers (singles or couples), feeding at water edges. In Pulau Bidong, the common sandpiper was mentioned in old surveys of Pulau Bidong (Bonhote, 1910; Gibson-Hill, 1952). In the present study, the Common Sandpiper was observed once in 2016, two individuals were seen feeding near the jetty at Pantai Vietnam, indicating that they were early migrants using the island as a stopover site. On the mainland, the species is frequently seen singly or a few individuals feeding at the paddy fields of the Terengganu coastal area (Hamza, personal observations), (App. 1c)

Greater Sand Plover *Charadrius leschenaultia* (Charadriidae)

A common passage migrant and winter visitor at low elevations (Jeyarajasingam & Pearson, 2012). Habitats preferred are mudflats, sandy shores and brackish ponds. In Pulau Bidong the species was observed as one individual feeding on the sandy beach during August 2014 at Pantai Pasir Cina, (App. 1d).

Black-naped Tern *Sterna sumatrana* (Laridae)

Locally common offshore resident breeder (Jeyarajasingam & Pearson, 2012). This species still breeds on smaller islets off Pulau Redang and Pulau Perhentian Kecil (Hamza et al., 2016a, Hamza et al., 2016b). Historically the species was listed as resident in both Pulau Bidong and Pulau Redang but not from Pulau Perhentian in 1949 (Gibson-Hill 1952). Currently no breeding activity was ever reported at or near Pulau Bidong, although a suitable breeding habitat is available at the small islet of Tengkorak to the north of Pulau Bidong. The species was observed feeding and roosting along the coastal waters of Bidong. These individuals (up to 70) are known to breed and travel from Pulau Redang population or on the move south to avoid the harsh weather of the monsoon season.

Bridled Tern *Onychoprion anaethetus* (Laridae)

A resident breeder in the strait of Melaka and South China Sea (Jeyarajasingam & Pearson, 2012). It prefers rocky stalks located distant from the mainland or larger islands (Hamza et al., 2016a), to hide their eggs in crevices and under boulders. Feeds mainly at oceanic waters and rarely seen in coastal waters. In Pulau Bidong, a few individuals were seen feeding at open seawaters to the west and southwest of the island, believed to be individuals from the Pulau Rdang breeding population, (App. 1f)

**Pied Imperial Pigeon *Ducula bicolor*
(Columbidae)**

A resident bird particularly on small coastal and offshore islands in both east and west coasts of Peninsular Malaysia (Jeyarajasingam & Pearson, 2012). It was also reported on the coastal mainland areas of Kuala Terengganu (McAfee, 2017), Perhentian Islands (David *et al.*, 2016), Pulau Bidong and by Gibson-Hill (1952) in other areas. The species population is decreasing due to hunting pressure (Tamblyn 2005). Our observations confirmed that these pigeons are frequently observed roosting and feeding on the top forest canopy on the island. Groups of up to 30 individuals were observed heading west towards the mainland during the early morning in both 2015 and 2016, (App. 1g).

**Asian Koel *Eudynamis scolopaceus*
(Cuculidae)**

Common and widespread resident, passage migrant and winter visitor principally at low elevations (Jeyarajasingam and Pearson 2012), the northern populations are migrant. It is not clear whether a single bird reported in May 2006 was migrant or resident, as no more birds were observed afterwards. However, the species was listed by Kloss (1911) but not mentioned by Gibson-Hill (1952), indicating that it is not quite common in Pulau Bidong.

House Swift *Apus Apus affinis* (Apodidae)

Abundant resident species (Jeyarajasingam & Pearson 2012), forage in groups at forest edges and top canopies. Usually active most of the day and seen more frequently on top canopy at Pantai Vietnam beach area. Can use buildings and bridges as nest sites, however, naturally it nests in cave mouths or in crevices on cliff faces.

Silver-rumped spine-tail *Rhaphidura leucopyialis* (Apodidae)

Common resident swiftlet species, distribution

extends from Myanmar to southern Peninsular Malaysia, mainly from low elevations up to 1200 m (Jeyarajasingam & Pearson 2012). In Pulau Bidong, usually observed at dawn flying with very distinctive paddle-shaped wings and fluttery flight low over forests in small groups.

**Collared Kingfisher *Todiramphus chloris*
(Alcedinidae)**

In Malaysia, a three populations of this species can be found, resident, passage migrant and winter visitor along the coastal plains (Jeyarajasingam & Pearson 2012). It was observed in all surveys, except in May 2015. Usually seen perching on low trees near the water is edge, or catching fish from shallow waters in the Pantai Vietnam area, (App. 1h).

**Asian Dollarbird *Eurystomus orientalis*
(Coraciidae)**

Common resident, passage migrant and winter visitor throughout Peninsular Malaysia (Jeyarajasingam & Pearson 2012). In Pulau Bidong, one bird was observed at the Pantai Vietnam area, at the top of one tree. The species also can be seen in coconut plantations on the east coast mainland beach. In Setiu, Terengganu, several couples were observed in October 2016 on the top of dead coconut tree trunks in an apparent preparation for nesting. Furthermore, about 20 individuals of Dollarbirds were observed at the same habitat in Pulau Sibul, Johor, during April 2017 (Hamza and Mamat, 2017) indicating the wide distribution of the population.

**White-nest swiftlet *Aerodramus fuciphaga*
(Apodidae)**

Very common small bird, breeds naturally in limestone caves and crevices, but adapted to man-made structures in urban areas. Nest made of Saliva is harvested and exported to the Chinese market as a delicacy food and source of pharmaceutical products.

Swiftlets forage for insects (i.e. diptera, homoptera, hymenoptera, coleoptera) at the canopy tops in forest edges and sometimes are seen flying lower at dusk at Pantai Vietnam, feeding on flying insects. The species was observed in the 2014, 2015 and 2016 surveys.

Barn Swallow *Hirundo rustica* (Hirundinidae)

Abundant passage migrant, migrates to Malaysia from East Asia, where it breeds. Many first winter birds spent their year in Malaysia and other tropical countries using diverse habitats. In Pulau Bidong, it is usually observed feeding insects during flight at the top canopy. The numbers can reach a few hundred in one area, especially during daybreak and dusk.

Pacific Swallow *Hirundo tahitica* (Hirundinidae)

Abundant resident bird at low elevations up to 1800 m, less common than Barn swallow with which it shares roosting sites. Very adapted to human constructions where it can be seen nesting at abandoned buildings (Jeyarajasingam & Pearson 2012). Observed in Pulau Bidong feeding in small groups at the top canopy in both May and August 2015 and during the August 2016 trips.

Grey Wagtail *Motacilla cinerea* (Motacillidae)

Common winter visitor, less common than Yellow Wagtail, common in highlands, usually feeds at the margins and grassy areas (Jeyarajasingam & Pearson 2012). In Pulau Bidong, a single individual was observed in August 2016, feeding on the sandy shore of the Pantai Vietnam site. This species is known to feed on small invertebrates picked from open surfaces and the water is edges (Wells *et al.*, 1999). Historic records did not mention this species in Pulau Bidong (Gibson-Hill 1952), although it was reported from Pulau Perhentian, Pulau Redang and Pulau Tioman (Wells *et al.*, 1999).

Arctic Warbler *Phylloscopus borealis* (Sylviidae)

Common and widespread passage migrant and winter visitor, the most common warbler species in Malaysia (Jeyarajasingam & Pearson 2012). Feeding on insects, it frequents the canopy and crowns of smaller trees. It was observed at the trail from the UMT station to Pantai Vietnam site in 2016. This bird would be on the route to breeding areas when observed in May and very rare until September-November where the number of migrant passages surge in the Malay Peninsula (Wells *et al.*, 1999).

Ruby-checked Sunbird *Chalcoparia singalensis* (Nectariniidae)

Fairly common resident from low elevations up to 900 m (Jeyarajasingam & Pearson 2012), feeding on insects but rarely on nectar and moves between flowers at top and middle story forest layers searching for insects. Two birds caught in mist net during the May-June 2015 trip.

Brown-throated Sunbird *Anthreptes malacensis* (Nectariniidae)

Nectarivore feeder, attracted to flower nectar of lower canopy shrubs (Jeyarajasingam & Pearson 2012). Common and widespread resident at low elevations, reported from several islands including Langkawi, Pulau Pinang, Pulau Tioman, Pulau Pangkor, Pulau Pemanggil and Pulau Aur. In Terengganu sighted in Pulau Kapas (Jeyarajasingam & Pearson 2012). It was observed in the May-June 2015 trip as well as in the August 2015 and 2016 trips on Pulau Bidong.

Purple-throated Sunbird *Leptocoma sperata* (Nectariniidae)

Common resident at low elevations along the coastal plains, it can inhabit higher altitudes both inland and on islands. Inhabits lower story forests and forest edges (Jeyarajasingam &

Pearson 2012). A Nectarivore feeder, usually heard singing rather than seen. This species was observed in 2006, 2015 and 2016, mainly at the forest edges in Pulau Bidong.

**Olive-backed Sunbird *Nectarinia jugularis*
(Nectariniidae)**

Another resident sunbird species, common garden bird, occurs in similar habitats to the purple-throated sunbird (above), but more common in gardens to feed on potted flowers (Jeyarajasingam and Pearson 2012). Only observed once in 2006, however, we believe it is still occurring in Bidong, but was not observed during subsequent surveys.

**Little Spiderhunter *Arachnothera longirostra*
(Nectariniidae)**

Common forest edge and garden species (Jeyarajasingam & Pearson 2012). The bird was observed twice on Pulau Bidong during the 2006 and 2016 surveys, while on mainland Terengganu, it is a fairly common garden bird.

**Orange-bellied Flowerpecker *Dicaeum trigonostigma*
(Dicaeidae)**

Another common forest edge specialist species. This species are among the Frugivores in both natural forest edges and gardens (Jeyarajasingam & Pearson 2012). The only species of this family recorded in Pulau Bidong, however, was only observed once in the May-June 2015 survey, possibly more common on the mainland than in Pulau Bidong.

**Black-naped Oriole *Oriolus chinensis*
(Oriolidae)**

An abundant widespread resident species with additional migrant population which

arrives in Malaysia during autumn migration. It successfully adapted to several habitats, including urban gardens. The resident breeder subspecies *O. c. maculatus*, have greater black color on wings compared to the migrant subspecies *O. c. diffuses* (Jeyarajasingam & Pearson 2012). The resident population mainly inhabit gardens, wooded shrubs and mangrove edges, while the migrant population inhabits mangroves, forest canopy and edges. The migrant individuals are likely those we observed at top canopy edges in Pulau Bidong during both 2006 and 2016 trips. In the later trip, about seven individuals were seen feeding on a fruiting tree at the edge of the Pantai Vietnam side of Pulau Bidong.

**Asian Glossy Starling *Aplonis panayensis*
(Sturnidae)**

Fairly common resident starling in both the peninsula and islands, inhabiting mangroves, open country, the forest edges, plantations, gardens and cities. Lives in groups and nests in a variety of man-made habitats, including under concrete jetties, bridges and even in discarded fishing polystyrene foam, as observed in Pulau Sibul (Hamza and Mamat, 2017). Asian Glossy starlings on Pulau Bidong were observed only in 2006. It is a fairly common species in Pulau Redang and on mainland Terengganu, where it was adapted to live in urban habitats, inhabiting high buildings and roosts at night or even foraging for flying insects near large lighted areas in Kuala Terengganu (Hamza, personal observations).

Table 1: The checklist of bird survey recorded on Pulau Bidong and their distributional status. Feeding Guilds: C = Carnivores, P = Piscivores, F = Frugivores, I = Insectivore, N = Nectarivore. R=Resident, M= Migrant, IUCN, 2017 = International Union for Conservation of Nature and Natural Resources version 2017-2, LC = Least Concern, TP = Totally Protected, N/A = Not Available, WCA, 2010 = Wildlife Conservation Act 2010.

Family	Common Name	Species name	Method	Feeding guild	May 2006	Aug 2014	May June 2015	Aug 2015	Aug 2016	Distribution Status	IUCN 2017	WCA 2010
Ardeidae	Pacific Reef Egret	Egretta sacra	O	C	+	+	+	+	+	R	LC	TP
	Cattle Egret	Bubulcus ibis	O	C					+	R,M	LC	TP
Accipitridae	White-bellied Sea Eagle	Haliaeetus leucogaster	O	P	+	+	+	+	+	R	LC	TP
Scolopacidae	Common Sandpiper	Actitis hypoleucos	O	C					+	M	LC	TP
Charadriidae	Greater sand plover	Charadrius leschenaultii	O	C			+			M	LC	TP
Laridae	Black-naped Tern	Sterna sumatrana	O	P	+	+		+	+	R	LC	TP
	Bridled Tern	Onychoprion anaethetus	O	P	+			+	+	R	LC	TP
Columbidae	Pied Imperial Pigeon	Ducula bicolor	O	F	+	+	+	+	+	R	LC	TP
Cuculidae	Asian Koel	Eudynamis scolopaceus	V	F	+					R,M	LC	TP
Apodidae	House Swift	Apus affinis	O	I	+	+		+		R	LC	TP
	Silver-rumped Needletail	Rhaphidura leucopygialis	O	I/N	+					R	LC	TP
	White nest Swiftlet	Aerodramus fuciphaga	O	I		+		+		R	N/A	N/A
Alcedinidae	Collared Kingfisher	Todiramphus chloris	O	C/P	+	+		+	+	R,M	LC	TP
Coraciidae	Dollarbird	Eurystomus orientalis	O	I					+	R,M	LC	TP
Hirundinidae	Barn Swallow	Hirundo rustica	O	I					+	M	LC	TP
	Pacific Swallow	Hirundo tahitica	O	I			+	+	+	R	LC	TP
Motacillidae	Grey Wagtail	Motacilla cinerea	O	C/I					+	M	LC	TP
Sylviidae	Arctic Warbler	Phylloscopus borealis	O	I	+					M	LC	TP
Nectariniidae	Ruby-cheeked Sunbird	Anthreptes singalensis	M	N			+			R	LC	TP
	Brown-throated Sunbird	Anthreptes malacensis	M/V	N			+		+	R	LC	TP
	Purple-throated Sunbird	Nectarinia sperata	M/V	N	+		+		+	R	LC	TP
	Olive-backed Sunbird	Nectarinia jugularis	O	N	+					R	LC	TP
	Little Spiderhunter	Arachnothera longirostra	O	I	+				+	R	LC	TP
Dicaeidae	Orange-bellied Flower-pecker	Dicaeum trigonostigma	O/M	N			+			R	LC	TP
Oriolidae	Black-naped Oriole	Oriolus chinensis	O	F/I	+				+	R,M	LC	TP
Sturnidae	Asian Glossy Starling	Aplonis panayensis	O	I	+					R	LC	N/A

Conclusion

Pulau Bidong harbours a total of 26 bird species, which represent 53.85 % more species than previously collected by Kloss (1910) and Gibson-Hill (1952). The diverse habitats in this island resulted in species resource partitioning where each species is restricted to a specific feeding guild, such as Nectarivore and Frugivores, with limited number of insectivores and Piscivores. The presence of Vietnamese refugees between 1978 and 1991 can be one of the factors which may have influenced the low number of faunal species on the island compared to other islands in the region. An assessment of native and introduced flora and fauna should be conducted in both Pulau Bidong and the nearby islands to quantify that impact. More surveys during migration season, and extended point counts and mist-netting to other sides of Pulau Bidong and the nearby smaller islands would certainly add more bird species that were not reported in the present study.

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References

- Abdullah, F. (2006). Diversity of beetles in the North East Langkawi Islands, Malaysia. *Malayan Nature Journal* 57: 419-431.
- Armugam, P. (1981). Algal distribution in a Malaysian coral reef at Pulau Bidong Laut. *Pertanika* 4(1):99-102.

- MacArthur, R. H., & E. O. Wilson. (1967). *The Theory of Island Biogeography*. Princeton University Press, Princeton
- Bonhote, J. L. J. (1901). On the Birds collected during the "Skeat Expedition" to the Malay Peninsula, 1899-1900. Zoological Society of London.
- Cronk, Q. C. B. (1997). Islands: stability, diversity, conservation. *Biodiversity and Conservation* 6: 477-493
- David, G., A. Roslan, M. Mamat, M. T. Abdullah, & A. Hamza. (2016). A Brief Survey on Birds from Pulau Perhentian Besar, Terengganu. *Journal of Sustainability Science and Management*. The International Seminar on the Straits of Malacca and the South China Sea:11-18.
- Gibson-Hill, C. A. (1952). Ornithological Notes from the Raffles Museum 15, Notes on the Avifauna of Great Redang Island (Terengganu). *Bulletin of Raffles Museum*. 24:220-240.
- Grismer, L. L., P. L. Wood Jr, A. B. Ahmad, A. S.-I. Sumarli, J. J. Vazquez, L. H. Ismail, R. Nance, M. A. B. Mohd-Amin, M. N. Othman, & S. A. Rizaijessika. (2014). A new species of insular Rock Gecko (genus *Cnemaspis* Strauch 1887) from the Bidong Archipelago, Terengganu, Peninsular Malaysia. *Zootaxa* 3755:447-456.
- Hamza, A. & I.B.H. Mamat. (2017). Seabird Survey of Southern Seribu Archipelago islands, Johor. Technical Report submitted to Department of Marine Parks Malaysia. Pp23.
- Hamza, A., C. Wong, & A. Ahmad. (2016a). Pulau Ling: an important seabird hotspot on the east coast of Peninsular Malaysia. *Journal of Asia-Pacific Biodiversity* 9:437-442.
- Hamza, A. A., C. H. Wong, & A. Ahmad. (2016b). Rediscovery of least known

- breeding sites for seabirds in East Coast Peninsular Malaysia. *Malayan Nature Journal* 68:121-129.
- Jeropakal, A. J. (1998). A study on clownfish (*Amphiprion* sp.) diversity and associate with sea anemone in some selected sites in Pulau Bidong and Pulau Redang. B.Sc. Thesis. Fakulti Perikanan dan Akua-Industri. Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM).
- Jeyarajasingam, A. & A. Pearson. (2012). A Field Guide to the Birds of Peninsular Malaysia and Singapore. Oxford University Press.
- Khor, H. M. (2002). Composition and distribution of corals and macroalgae in Pulau Bidong and the island's proposed management plan. Master thesis. Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM).
- Kloss, C. (1911). On a collection of mammals and other vertebrates from the Terengganu Archipelago. *Journal of the Federated Malay States Museums* 4:175-212.
- Koh, L. P., N. S. Sodhi, H. T. W. Tan, and K. S. H. Peh. (2002). Factors affecting the distribution of vascular plants, springtails, butterflies and birds on small tropical islands. *Journal of Biogeography* 29:93-108.
- Lack, D. (1970). Island Birds. *Biotropica* 2:29-31.
- Lorenzo, B., M. Kochzius, D. Cardenosa, P. Borsa, M. A. Ambak, & J. Joseph. (2016). Connectivity and population structure of blacktip reef sharks, *Carcharhinus melanopterus*, in two islands in Terengganu, Malaysia. Book of Abstracts: Vliz Marine Scientist Day Vives, Brugge 12 February 2016. Accessed 11 August 2017 at http://pure.ilvo.vlaanderen.be/portal/files/4227992/VLIZ_2016_Book_of_abstracts.pdf#page=32.
- Nakajima, R., T. Yoshida, B. Azman, H. Yamazaki, T. Toda, B. Othman, K. Zaleha, & A. Effendy. (2013). A Preliminary Study of Small Scavenging Crustaceans Collected By Baited Traps In a Coral Reef of Bidong Island, Malaysia. *Malaysian Journal of Science* 32:59-66.
- Ng, P. K., H. Yong, & N. Sodhi. (1999). Biodiversity research on Pulau Tioman, Peninsular Malaysia: a historical perspective. *The Raffles Bulletin of Zoology* 6:5-10.
- Pesiu, E., M. T. Abdullah, J. Salim, & M. R. Salam. (2016). Tree Species Composition In Pulau Bidong and Pulau Redang. *Journal of Sustainability Science and Management Special Issue* 48-50.
- Roslan, A., G., David & N. I. Ahmad. (2016). Notes of Bats in Pulau Bidong and Pulau Perhentian Besar, Terengganu, Malaysia. *Journal of Sustainability Science and Management: The International Seminar on the Straits of Malacca and the South China Sea* 2016: 2026-2035.
- Rosmidi, F.-H., M.-A. Zahidin, A. Adanan, A. Azizah, E. Pesiu, & M. T. Abdullah. (2017). Checklist of Butterflies in Pulau Perhentian and Pulau Bidong, Terengganu. *Journal of Sustainability Science and Management* 12:40-48.
- Sodhi, N. S., C. Briffett, B. P. Y. Lee, & R. Subaraj. (1999). An annotated checklist of the birds of Pulau Tioman, Peninsular Malaysia. *The Raffles Bulletin of Zoology. Supplement No. 6*: 125-130.
- Tamblyn, A., Turner, C., O'Malley, R., Hughes, T., Hardingham, & S., Roberts, H. (2005). Malaysian Tropical Forest Conservation Project. Report of the Perhentian Phase. London, United Kingdom.
- Teh, T. (2000). Sustainable development and environmental management of Malaysian islands. *Islands in Malaysia: Issues and*

challenges:319-340.

Turner, C., T. King, R. O'Malley, M. Cummings,
& P. Raines. (2002). Danjungan Island
Biodiversity Survey: Terrestrial. Final
Report. Coral Cay Conservation Ltd.,
London, unpublished report.

Wells, D., P. D. Round, & U. Treesucon. (1999).
The Birds of the Thai-Malay Peninsula :
covering Burma and Thailand south of the
eleventh parallel, Peninsular Malaysia and
Singapore. Academic Press, San Diego.



a. Pacific Reef Egret



b. Cattle Egret



c. Common Sandpiper



d. Greater sand plover



e. Black-naped Tern



f. Bridled Tern



g. Pied Imperial Pigeon



h. Collared Kingfisher



i. Olive-backed Sunbird



j. Black-naped Oriole



k. Asian Glossy Starling