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# Species Composition and Diversity of Birds for Potential Environmental and Biological Sensitive Areas in Langkawi, Kedah

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### ABSTRACT

Langkawi which was recognised in 2007 as Southeast Asia's first UNESCO Global Geopark for its exceptional Palaeozoic geological record, is also a major tourist destination in Malaysia. Rapid coastal development for tourism, however, is altering critical habitats for coastal birds. To address the absence of baseline data, this study conducted a comprehensive, three-day survey of coastal bird populations across Langkawi. Bird observations and photographic documentation were conducted during peak activity periods (morning and evening), recording 1,055 individuals from 66 species in 30 families. Ardeidae was the most species-rich family (eight species), while the Brahminy Kite (*Haliastur indus*) was the most abundant (149 sightings). The survey documented two threatened species on the IUCN Red List namely the Great Hornbill (*Buceros bicornis*) and the near threatened Brown-winged Kingfisher (*Pelargopsis amauroptera*). Overall, coastal bird biodiversity was high (Shannon Index,  $H'=3.45$ ; Simpson Index,  $1-D=0.95$ ). The western coastal area near Cenang exhibited the highest diversity ( $H'=3.27$ , 44 species), followed by the northern region encompassing Tanjung Rhu and Kilim Karst Geoforest Park ( $H'=3.24$ , 34 species). These results underscore Langkawi's important role as a habitat for coastal and threatened birds and provide a crucial baseline for identifying Environmental and Biological Sensitive Areas (EBSAs) and may contribute toward sustainable coastal management strategies.

**Keywords:** avifauna; coastal birds; species richness; biodiversity; EBSAs

## 1. Introduction

Langkawi, an archipelago of 99 islands, represents both ecological richness and developmental challenge. While its tourism industry drives local economic growth, extensive land development has altered coastal habitats, placing pressure on biodiversity [1], especially for coastal birds.

According to previous studies, Langkawi hosts 238 bird species [2], which takes up around 30% of the bird species in Malaysia. As Southeast Asia's first UNESCO Global Geopark since 2007 [3], biodiversity conservation has been recognized as an essential aspect in the process of development [4]. At present, Langkawi lacks comprehensive surveys on its bird populations. In fact, as Mokhter et al. [5] highlighted, island bird surveys in Peninsular Malaysia remain notably scarce compared to those in mainland and Borneo regions.

To address this gap, this study aimed to assess the species composition and diversity of birds across selected coastal habitats, identify key habitats important for the conservation of coastal and

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migratory species, and provide baseline information to support the identification of potential Environmental and Biological Sensitive Areas (EBSAs). Through this work, the study hoped to contribute toward evidence-based management strategies that align biodiversity conservation with sustainable coastal development in Langkawi.

## 2. Methodology

The survey was conducted across coastal areas on Langkawi, covering the area of latitude 6° 15'N–6° 29'N and longitude 99° 37'E–99° 57'E [6], using direct observation methods [7] assisted by photography to record birds. A team of four people, 2 of which are experienced observers, carried out the survey during active hours of birds in the morning at 0700 until about 1100, and also in the evening at 1500 to 1900 from 31 July to 2 August in 2025, with the aid of an 8x40 binocular and DSLR cameras. Surveys were conducted on boat and vehicle, and on foot, while driving or walking very slowly (< 1 km/h) with stops when encountering birds [8]. All birds seen or heard within 25 m were recorded. Most of the survey areas were coastal zones with a few man-made wetlands such as ash ponds and major riversides.

A few guidebooks were used to identify bird species according to morphological characteristics, such as Jeyarajasingam [9], accompanied by the MyBIS website database (<http://www.mybis.gov.my/>) to confirm the latest nomenclature information.

Several diversity indices were calculated to reflect the overall bird diversity on the island, including Shannon Diversity Index, Simpson Diversity Index and the Chao-1 estimator. Simpson Diversity Index was computed to account for the species relative abundance, while the Chao-1 estimator for species richness was used to lower the influence of passive sampling. Moreover, the recorded data were separated into 4 groups according to their location. Diversity indices mentioned above were computed independently for each group for comparison, to identify the key habitats important for the conservation of coastal and migratory species.

## 3. Results & Discussion

The study documented 1,055 individuals from 66 species in 30 families. Among all, Ardeidae was the most species-rich family (eight species), while Accipitridae, consisting of two species, accounted for the greatest number of observation (242 sightings). The two species under Accipitridae, Brahminy Kite (*Haliastur indus*) and White-bellied Sea-Eagle (*Haliaeetus leucogaster*), ranked the first two in terms of species abundance among all, with 149 and 93 sightings, respectively. These findings might have been due to the large number of eagle-feeding tours around the island, which provide stable food for them.

Overall, the species diversity was high, supported by a Shannon Index value of  $H'=3.45$ . and a Simpson Index value of  $1-D=0.95$  indicating a relatively even species distribution. Furthermore, to correct the effect of passive sampling, Chao-1 estimator was also computed to estimate the actual species richness, which was 76.99, which indicated that potentially the species richness can reach nearly 77 species. Among all species discovered, two were important IUCN Red List Species namely the vulnerable Great Hornbill (*Buceros bicornis*) and the near threatened Brown-winged Kingfisher (*Pelargopsis amauroptera*).

In the survey, all birds were recorded despite their usual residential habitat. If waterbirds, which are defined as the bird species who rely on aquatic habitat or have close association with coastal wetland like raptors and kingfishers [10], were extracted from the list separately, there were 23

species with 520 individuals recorded, including 1 duck species, 2 raptors, 1 grebe, 3 kingfishers, 8 herons and egrets, and 5 waders (stilts, plovers, sandpipers and allies).

Based on the comparisons with previous research (Table 1), this short survey showed that the Langkawi coast is hosting abundant bird species.

**Table 1**  
 Comparison of various studies on birds in Malaysia

Location	State	Reference	Total species
<b>Comparison of both terrestrial and shorebirds</b>			
Pulau Perhentian Besar	Terengganu	David et al. [11]	11
Pulau bidong	Terengganu	Hamza et al. [12]	26
Pulau Tinggi	Johor	Mokhter et al.[5]	37
Langkawi coastal area	Kedah	This study	66
<b>Comparison of number of Shorebird species</b>			
Tanjung Piai National Park, Pontian Kechil Coast, and Muar Coast	Johor	Fauzi et al. [7]	17
7 sites in Sabah	Sabah	See et al. [13]	36
6 sites in Sarawak	Sarawak	See et al. [13]	37
Langkawi coastal area	Kedah	This study	23
Teluk Air Tawar	Penang	Razak and Rahman [14]	23

In order to identify key coastal habitat on Langkawi, records from 10 sites were separated into 4 groups according to their location proximity and similarity of landscape, representing different areas on the island. Sites included in the western area were distinguished by coastal wetlands with flat, water-saturated substrates and dominated by shoreline shrubs. The northern areas were characterized by mangrove ecosystem, while the southern area mainly encompassing open water areas surrounding Pulau Singa Besar and Pulau Dayang Bunting, and the sites at the seaside of the same nearshore waters. The middle area was not directly located at the coast of the island, but included sites at the bank of main waterbodies like rivers, lakes and streams.



**Fig. 1.** The Langkawi Map with grouped study areas

The western area near Cenang area exhibited the highest diversity with 44 recorded species (Shannon Index,  $H'=3.27$ ), followed by the northern area, where 37 species were found (Shannon Index,  $H'=3.239$ ) (Table 2). In the southern area, even though more individuals were spotted compared to the northern area, the number of species richness was relatively low, with most individuals contributed by the two raptor species.

**Table 2**  
Diversity indices of different areas

	Western	Northern	Middle	Southern
Abundance	440	185	85	345
Num. of Species	44	34	20	21
Num. of Waterbird species	22	9	2	5
Shannon H	3.27	3.239	2.645	2.086
Simpson_1-D	0.9456	0.9494	0.8989	0.8021
Chao-1	51.18	37.48	25.19	24.99

Impressively, there were 22 waterbird species found in the western area, which meant that only one waterbird species from this survey was absent from this area. The number of potential species found here could be more according to a Chao-1 index value of 51.18. This result strongly demonstrated the significance of this area as a coastal habitat for waterbirds in Langkawi. However, according to Samat and Harun [15], the western area had undergone severe developments in the past decades, with paddy fields and forests turned into urban construction and human settlements. More attention should be paid to the conservation of the wetland in the west of Langkawi, especially when it comes to development plans.

#### 4. Conclusions

This brief survey has provided the baseline information for the composition and diversity of birds across the Langkawi coast. It has shown a variety in bird species it hosts and pointed out the western area near Cenang as the most outstanding habitat for birds especially for waterbird. The results not only contribute to the identification of EBSA, but also underscore the importance of further conservation of the wetland habitat within the area. Further survey is recommended during the migratory season in order to define Langkawi's importance for migratory birds.

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