

The Distribution of Nesting White-bellied Sea-eagle (*Haliaeetus leucogaster*) in Penang National Park, Malaysia: Conservation and Management Issues

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Abstrak: Taman Negara Pulau Pinang adalah satu-satunya kawasan di Pulau Pinang yang mempunyai populasi Helang Siput (WBSE) *Haliaeetus leucogaster*; bagaimanapun, tempat bersarang WBSE masih belum dikaji secara meluas. Informasi terhadap lokasi tempat bersarang WBSE adalah penting untuk kerja pemuliharaan oleh pihak berkuasa tempatan, objektif kajian ini ialah menentukan taburan tempat bersarang WBSE di hutan dipterokap pantai, Taman Negara Pulau Pinang. Tinjauan telah dijalankan daripada Disember 2007 hingga Julai 2008 dan Oktober 2008 hingga April 2009, meliputi musim membiak spesies ini (September–Julai). Tempat bersarang diperhatikan daripada sebuah bot dan tinjauan dijalankan disepanjang pinggir laut yang boleh dimasuki. Tinjauan tempat bersarang telah dijalankan selama tiga hari/sebulan daripada 0900 hingga 1500, dan tinjauan dikawasan laut Taman Negara Pulau Pinang telah dilakukan dengan menggunakan sebuah bot. Sejumlah 34 tempat sarang WBSE telah ditempatkan. Kebanyakan sarang yang diduduki (tujuh sarang) telah dijumpai di kawasan Muka Head dan Pantai Kerachut, yang menunjukkan konsentrasi kepadatan habitat yang tinggi yang diduduki oleh WBSE di Taman Negara Pulau Pinang. WBSE cenderung untuk membina sarangnya disekitar Muka Head, kerana kekerapan pusaran pada jasad air disekitar kawasan tersebut. Haiwan akuatik, seperti ular air dan ikan, dikejutkan oleh pusaran air yang timbul pada permukaan laut, dan ini membantu WBSE untuk memburu dan mendapatkan makanan. Ini adalah penting untuk mengekalkan dan meningkatkan kawasan yang sesuai untuk habitat membiak WBSE. Langkah pengurusan hendaklah termasuk (1) pantauan tahunan tempat bersarang di semua kawasan Taman Negara Pulau Pinang semasa musim membiak untuk menentukan kejayaan pembiakan per masa, (2) mengenalpasti habitat kritikal atau pemilihan tempat bersarang oleh WBSE, (3) penubuhan zon penampakan sekitar tempat bersarang dan habitat yang berpotensi daripada gangguan manusia, dan (4) menggalakkan kajian berterusan untuk kefahaman lebih lanjut mengenai spesies ini.

Kata kunci: Helang Siput, Taman Negara Pulau Pinang, Sarang, Pemuliharaan, Pengurusan

Abstract: Taman Negara Pulau Pinang (Penang National Park) is the only site on Pulau Pinang that supports a large population of the White-bellied Sea-eagle (WBSE) *Haliaeetus leucogaster*; however, the nesting sites of WBSEs have not been widely studied. As information on the location of WBSE nesting sites is very important for conservation works by local authorities, the objective of this study was to determine the distribution of nesting

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WBSEs in the coastal dipterocarp forest of Penang National Park. Surveys were conducted from December 2007 to July 2008 and October 2008 to April 2009, covering the breeding season of the species (September–July). The nesting sites were observed by boat along the coastline of Penang National Park and by performing ground surveys along the seashore at accessible areas; the nest survey was conducted three days/month from 0900 to 1500. A total of 34 WBSE nesting sites was located. Most of the occupied nests (seven nests) were found at Muka Head and Pantai Kerachut areas, which exhibit the densest concentration of occupied WBSE habitat in Penang National Park. WBSEs preferred to build their nests around Muka Head, which could be due to the frequent occurrence of whirlpools in the water body around that area. Aquatic animals, such as sea snakes and fish, stunned by the whirlpools would emerge to the sea surface, facilitating the foraging and feeding of WBSEs. Our results indicate that it is important to maintain and improve areas of suitable nesting habitat for WBSEs. Management actions should include (1) the yearly monitoring of known breeding sites throughout Penang National Park during the breeding season to determine breeding success over time, (2) recognising the critical habitat or nest-site selection of WBSEs, (3) establishment of a buffer zone surrounding nesting sites and potential habitat from human disturbance, and (4) encouraging on-going research to further understand this species.

Keywords: White-bellied Sea-eagle, Penang National Park, Nest, Conservation, Management

INTRODUCTION

The sea eagles (genus *Haliaeetus*) belong to the family Accipitridae; they are diurnal birds of prey and possibly one of the oldest genera in living birds (Rasmussen *et al.* 1987). The endemic White-bellied Sea-eagle [WBSE (*Haliaeetus leucogaster*)] is the largest avian species in Penang National Park and is also the largest resident raptor species in Malaysia (Jeyarajasingam & Pearson 1999). Although the WBSE is one of the most common soaring raptors in the country, the distribution and abundance of nesting areas for this species at the regional or local scale remain poorly studied and described. Therefore, information about this species for awareness and conservation purposes has been gathered from published articles in other countries and from expert opinions. Accordingly, an improved understanding regarding the ecology and behaviour of this species is essential for the proper design of management and conservation strategies.

WBSEs are native to New Guinea and China, all of the coastal countries of mainland Southeast Asia (Thailand, Malaysia, Singapore, Indonesia and the Philippines), Australia and India. This species is also found in other island groups, from Bangladesh, Sri Lanka, Burma, Andaman, Laos, Ceylon, Wallacea, Bismarck Archipelago, Nicobars, and Greater Sundas in the west to Hainan, Taiwan, New Ireland, New Britain, and Louisiades in the east, and south around Australia to Tasmania (Ferguson-Lees *et al.* 2001; Strange 2000) (Fig. 1).

WBSEs can be found mainly on sea coasts, large rivers, inland freshwater swamps, settled mining pools, reservoirs and open country (Ferguson-Lees *et al.* 2001). These magnificent eagles are a common sight in coastal and near coastal areas, soaring slowly on thermals and holding their

wings in a V-shape (other raptors hold their wings horizontally) or perched high on trees. The species is primarily recorded in coastal lowlands but can occupy habitats up to 1400 m above sea level on the Northern Tablelands and up to 800 m above sea level in Tasmania and South Australia (Marchant & Higgins 1995). Breeding has been recorded on the coast, at inland sites and on offshore islands (Marchant & Higgins 1995). Breeding territories are located close to water and mainly in tall open forest or woodland (Marchant & Higgins 1995; Emison & Bilney 1982), though nests are also occasionally found in other habitats, such as dense forest (including rainforest), closed scrub and in remnant trees on cleared land (Emison & Bilney 1982).

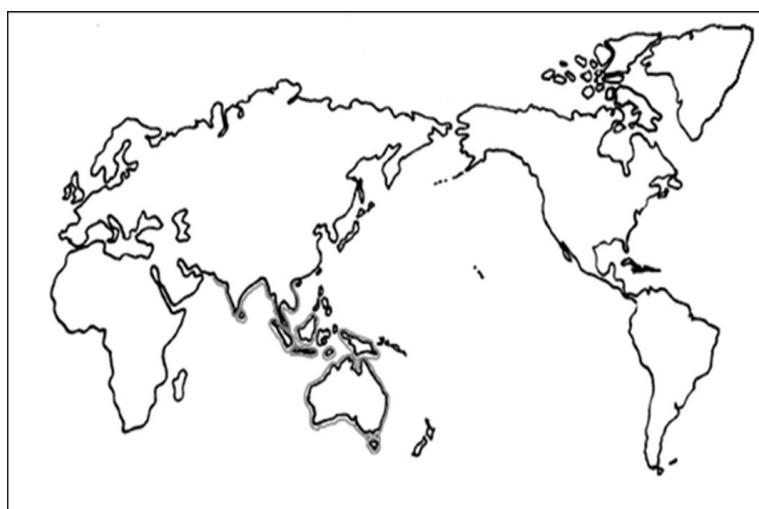


Figure 1: Global distribution of WBSE as designated by the grey line (adapted from Ferguson-Lees *et al.* 2001).

For WBSE, the main attribute of a nest site is height, choosing the tallest objects near the coasts or other large body of water (e.g., reservoir) (Strange 2000; Jeyarajasingam & Pearson 1999). The sites include tall emergent trees in mangroves or along the shore or a tall telecommunication mast (pylon); indeed, when a taller pylon is built nearby, the birds often shift to the taller structure. The birds may also nest on islands, occasionally on a small tree growing on a cliff face, on a rocky cliff or on rocky ledges where there are less ground predators (Marchant & Higgins 1995).

WBSE adults are commonly found living in pairs, and the nests serve as breeding, feeding and sleeping platforms, also acting as territorial flags (Marchant & Higgins 1995). The nests are large (1.5 m across and 2.0 m tall), composed of sticks and lined with green vegetation, and often located on a tree up to 30 m above the ground (Strange 2000). The same nests are reused in succession during every breeding season and are built up until they become a large pile of sticks; if the original pair does not return, another pair soon takes over the abandoned nest (Herklots 1954). Two bluish-white eggs are laid in a

nest that has been lined with green leaves, mainly for hygiene. The female incubates while the male feeds her and defends the nest from other birds and intruders. The eggs require up to 40–44 days to hatch; typically, the first nestling to emerge will destroy the other egg. The nestling will live in the nest up to 95 days (approximately 3 months), and the fledgling is dependent on its parents for food for another few months. Once independent, mortality is high; yet, if the young eagle survives to breeding age, which may not occur until the eagle is 6 years old (Marchant & Higgins 1995), it might live for 30 years (Parks and Wildlife Service Tasmania 2003).

Most of the research to date on the WBSE has been conducted in mainland Australia and the Tasmanian region. The species is considered to have a declining world population, and concern has been expressed in recent years over the conservation status of the WBSE in Australia (Shephard *et al.* 2005; Marchant & Higgins 1995; Emison & Bilney 1982). Studies have been reported on the foraging behaviour (Wiersma & Richardson 2009), distribution and breeding status (Dennis & Baxter 2006), conservation genetics and trends in continental distribution and abundance (Shephard *et al.* 2005; Shephard 2003), biology and diet (Debus 2008), and habitat use and nest site characteristics (Emison & Bilney 1982) of Australian WBSEs.

In Malaysia, WBSEs are commonly observed in the coastal and near coastal areas of Taman Negara Pulau Pinang (Penang National Park), soaring on thermals or perched high on the tree. According to Kumar (2004), Penang National Park is the only site in the state that supports a large population of WBSE, with at least 6 breeding pairs and a population of approximately 20 to 30 birds, which is possibly the largest population in northern Peninsular Malaysia. Although the species distribution is island-wide, there is a high concentration in Penang National Park in terms of nesting sites and population density (Kumar 2004); the park area is also used as a roosting site by non-breeding birds.

In this study, surveys were conducted to provide preliminary estimates about the distribution and population of WBSE in Penang National Park and species distribution maps. These estimates will be useful as baseline data for future population assessments and monitoring of the species.

MATERIAL AND METHODS

Study Area

WBSEs are known to nest in the coastal hill forest in the northwestern part of Pulau Pinang (D. Kanda Kumar, Malaysia Nature Society, *pers. comm.*). This preliminary study focused on the Penang National Park area, which is situated at the northwest corner of Pulau Pinang; also known as Pantai Acheh Forest Reserve, the park is located at latitude 5° 28' N and longitude 100° 10' E (Fig. 2). The area covers approximately 2562.963 ha, comprising 1181.949 ha of land, primarily coastal hill dipterocarp forest, coastal mangrove forest, sandy beaches and rocky shores, and 1381.014 ha of sea areas (Yusop 2004). Most of the land areas are composed of granite rock that consists of hill land (Chan *et al.* 2003). The lowlands are narrow and small in size, occupying only the immediate coastal

areas north and west of Penang National Park. The establishment of Penang National Park as a protected area could result in a positive impact on the conservation and management of WBSEs in addition to the other flora and fauna species inhabiting the park.

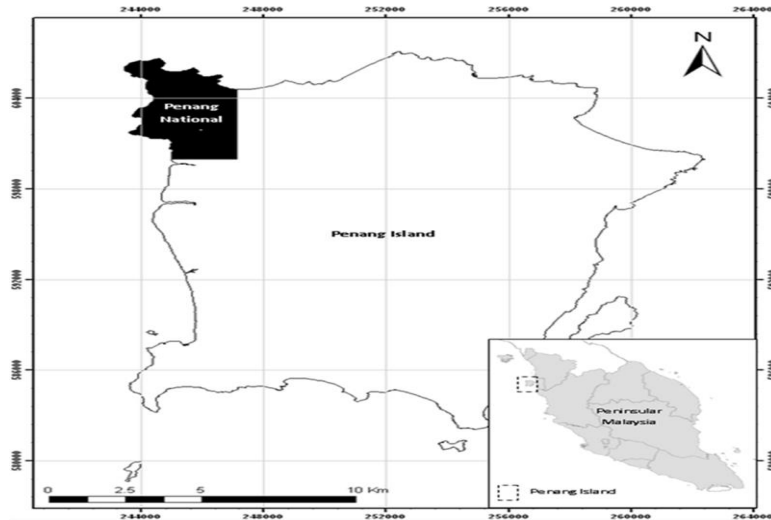


Figure 2: Location of Penang National Park on Pulau Pinang and Peninsular Malaysia.

Portions of the area were logged prior to 1955, but logging activities have since ceased (Mansor 2003). In 1966, approximately 800 ha of the Pantai Acheh Forest Reserve was recultivated and received silvicultural treatment, i.e., some supplementary tree planting (Malaysian Nature Society 1999). Although a small portion had been logged, the area is still substantially intact, including a pristine virgin jungle (approximately 80 ha) that is undisturbed and designated as the Virgin Jungle Reserve; this jungle contains a variety of shore habitats, ranging from rocky outcrops and sandy beaches to estuarine flats at the mouths of the streams. The sandy beach zone covers seven beaches, namely, Teluk Bahang, Teluk Aling, Teluk Duyung (Monkey Beach), Teluk Ketapang, Pantai Kerachut, Teluk Kampi and Pantai Mas. Mansor (2003) states that most parts of this area are high in commercial timber plant species, which can be categorised as a *Shorea* community.

The vegetation coverage throughout the Penang National Park area consists primarily of higher elevation, large and tall emergent dipterocarp tree species, such as *Shorea* sp., *Hopea* sp., and *Dipterocarpus* sp., which are believed to be preferred by *H. leucogaster* (D. Kanda Kumar, Malaysia Nature Society, *pers. comm.*) in addition to the medium-sized trees, such as *Gluta* sp. and *Eugenia* sp. riparian plants (*kelat*, *Syzygium gratum*; *terap*, *Artocarpus scortechinii*) and monocotyledons (*pandan*, *Pandanus odoratissimus*; *salak*, *Salacca conferta*; *bertam*, *Eugeissona tristis*; *nibung*, *Oncosperma tigillarum*), which dominate the areas of lower elevation. There are occurrences of small patches of mangrove forest along the shores of Pantai Mas and at the river

mouth of Sungai Tukun consisting primarily of *Avicennia* sp., *Sonneratia* sp. and *Bruguiera* sp., which provide additional suitable habitat for eagle species. The vegetation that covers the beach ridges includes *Ipomea* sp., *Cocos nucifera* and *Casuarina* sp. Most areas of native forest and scrub have been replaced by fern (*Dicranopteris linearis*), particularly in disturbed and open areas.

The topography of Penang National Park can be broadly divided into two main geomorphic units: narrow coastal plains and hills. The areas are primarily composed of granite hill land with steep slopes. Indeed, almost 80% of the Penang National Park area consists of hill land with heights ranging from approximately 100 to approximately 460 m above sea level (asl). The terrain in the area is typically rugged and steep, with slopes of more than 30%. Many of the hills approach near the coast, ending as a steep cliff (Chan *et al.* 2003).

Nest Site Survey

The survey of nesting sites was focused in Penang National Park; all nesting sites were counted, including both occupied and unoccupied nests. The survey was conducted from December 2007 to July 2008, covering a complete breeding season of the species, and revisited surveys were also conducted from October 2008 to April 2009 to accurately locate and census the distribution of the nesting sites. All surveys were conducted during the breeding and non-breeding seasons.

A nesting site is defined as the immediate location at which a pair of sea eagles attempts to rear offspring (Mathiu *et al.* 2006), with a clearly recognisable nest cavity. However, as the purposes of this study were only to determine the distribution of nesting sites of the eagle species and to provide conservation and management information about WBSE, successful breeding was not taken into account.

The status of each nest was defined as "occupied" if adults were present within a 1 km radius from a known nest or if there were signs of recent activity, such as adults bringing food to the nest, and other territorial behaviour. Only nests occupied at some times during the breeding season were considered to belong to a potential breeding pair, data that can be used to estimate the breeding population.

To facilitate nest location, additional information on WBSE sightings was regularly collected from the local people and park rangers. Due to an exhaustive search at the inland area, the search and survey efforts were concentrated on likely habitats in the coastal zone of the park and, in particular, on revisiting the sites where breeding had been recorded previously.

Most of the nesting sites were observed from boat and during ground surveys along the sea shore in accessible areas. The precise locations of nesting sites were determined by compass bearing and the estimate of distance from a fixed viewing point, as determined using a hand-held Garmin 60CSx (Garmin International Inc., Kansas, USA) GPS receiver unit (<4 horizontal accuracy with differential correction) (Fig. 3). The nest survey was conducted three days/month from 0900 to 1500, and a survey of the entire coastline of Penang National Park was conducted by boat.

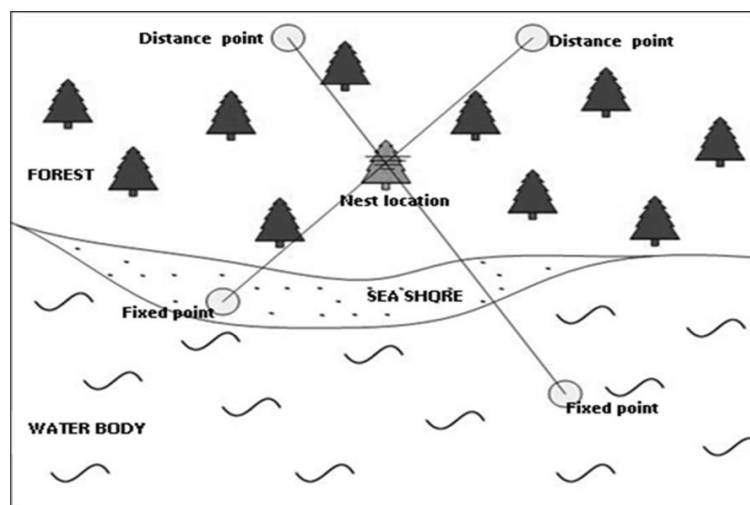


Figure 3: Determination of nest location using GPS compass bearing.

RESULTS

Very few data on the distribution and abundance of WBSE in the study area are available from previous surveys. Indeed, there is only one regional survey that attempts to map WBSE nests and to provide local estimates of breeding populations at localities throughout the Penang National Park area (Kumar 2004). A total of 34 nesting sites of WBSEs were located during the survey period (2007–2009) (Fig. 4) (see Table 1 for locations of occupied nests). Three nests were located at Teluk Aling (two occupied), two at Teluk Duyung (Monkey Beach) (one occupied), five at Muka Head (three occupied), four at Teluk Ketapang (two occupied), eight at Pantai Kerachut (four occupied), five at Teluk Kampi (one occupied), and seven at Pantai Mas (two occupied). These data exceeded those reported in previous surveys by Kumar (2004), which were conducted from 2000 to 2004, with a total of 16 nesting sites located. All of the nests were found in the coastal or near the coastal region of the Penang National Park area, consistent with the earlier study by Kumar (2004).

The boat surveys were particularly successful as a platform to observe the target species and locate nest structures. The boat-based surveys were appropriate because they provided minimal disturbance, without discernible changes in the natural behaviour of the birds (Dennis & Baxter 2006). The search and location of nests by ground surveys were rather difficult due to the highly dense forest canopy and obstruction of middle-storey plants and trees by foliage. Based on observations during the boat-based surveys, the authors are confident that there no nests existed in inland locations.

Table 1: Nest site locations.

Nest	Coordinate	Occupied	Level of threat
Alin1	5.467350° N, 100.202033° E	–	High
Alin2	5.465183° N, 100.199600° E	√	High
Alin3	5.466517° N, 100.194783° E	√	High
Monk1	5.468217° N, 100.191650° E	–	High
Monk2	5.473595° N, 100.185808° E	√	High
MH1	5.475876° N, 100.183239° E	√	Moderate
MH2	5.474233° N, 100.179081° E	√	Moderate
MH3	5.472815° N, 100.178454° E	–	Moderate
MH4	5.471017° N, 100.178158° E	√	Moderate
Keta1	5.467932° N, 100.179122° E	–	Low
Keta2	5.468656° N, 100.182585° E	√	Low
Keta3	5.462777° N, 100.183809° E	√	Low
Keta4	5.462145° N, 100.184082° E	–	Low
Keta5	5.460645° N, 100.183228° E	–	Low
PK1	5.458088° N, 100.182564° E	–	Moderate
PK2	5.458461° N, 100.184981° E	√	Moderate
PK3	5.458628° N, 100.187542° E	–	Low
PK4	5.458393° N, 100.188469° E	√	Low
PK5	5.458815° N, 100.188327° E	√	Low
PK6	5.448450° N, 100.183590° E	√	Moderate
PK7	5.448319° N, 100.183142° E	–	Moderate
PK8	5.448531° N, 100.180590° E	–	Moderate
Kamp1	5.442753° N, 100.182512° E	√	Low
Kamp2	5.437421° N, 100.182065° E	–	Low
Kamp3	5.434133° N, 100.178983° E	–	Low
Kamp4	5.433707° N, 100.180044° E	–	Low
Kamp5	5.433021° N, 100.180845° E	–	Low
Kamp6	5.433000° N, 100.182582° E	√	Low
Mas1	5.431510° N, 100.183024° E	–	Low
Mas2	5.431083° N, 100.183593° E	–	Low
Mas3	5.431303° N, 100.184251° E	–	Low
Mas4	5.430685° N, 100.185880° E	–	Low
Mas5	5.434218° N, 100.191553° E	√	Low
Mas6	5.424389° N, 100.190512° E	√	Moderate

Notes: Alin – Teluk Aling, Monk – Monkey Beach, MH – Muka Head, Keta – Teluk Ketapang, PK – Pantai Kerachut, Kamp – Teluk Kampi, Mas – Pantai Mas

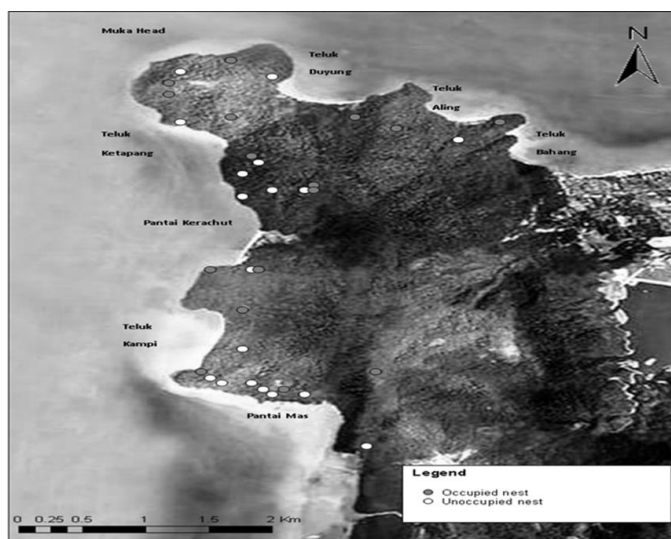


Figure 4: Location and distribution of the WBSE nesting sites on map (image from Google Earth).

DISCUSSION

The survey of 34 WBSE nests revealed a rate of territory occupied of 16 of 34 (47%) (Table 1). However, the rate of territory may be different in other areas, as there were apparent differences in the surrounding activity, e.g., food abundance and human disturbance (Thurstans 2009). Most of the WBSEs built their nest on cliffs in open coastal landscapes, with little visual screening over a long distance (Dennis & Baxter 2006). Most of the occupied nests (seven nests) were found at Muka Head and Pantai Kerachut; four of these nests were considered active during the course of the survey, comprising the densest concentration of occupied WBSEs' habitat in Penang National Park. The WBSEs preferred to build their nests around the Muka Head area, which could be due to the frequent occurrence of whirlpools in the water body around that area: aquatic animals such as sea snakes and fish stunned by the whirlpools would emerge to the sea surface, facilitating the foraging and feeding of the birds.

The WBSEs were more concentrated at the southern and western parts than the eastern part of the park. This finding was because these parts were less disturbed than the eastern part of the park, even though fishing activity by local fisherman was common around the coastal area. Most of the intact forested areas were also located in these less disturbed parts, and the western and southern parts, including Teluk Ketapang, Pantai Kerachut and Teluk Kampi, are also rarely visited compared to Teluk Duyung (Monkey Beach) and Teluk Aling, which are located at the eastern part of the park. Furthermore, the main entry to the park, which is located at Teluk Bahang, was busy with tourist-based activities: commercial boat tours bring visitors from Teluk Bahang to Teluk Duyung

(Monkey Beach) and Pantai Kerachut daily. Accordingly, all nest sites located at Teluk Duyung (Monkey Beach) were considered to have a high potential of human disturbance (Table 1: level of threat). Previous work has proven that most raptors are very sensitive to human activities, particularly during their breeding season (Thiollay 2007; Camp *et al.* 1997, Richardson & Miller 1997).

No nests were found in the long stretch of Sungai Pinang mangrove area at the southern part of the park, possibly due to the absence of suitable trees for nest placement. Another finding from the survey was that most of the mangrove areas had been occupied by another species of raptor, Brahminy Kite (*Haliastur indus*), as their nesting habitat. WBSE juveniles were also observed using these areas to forage. It was estimated that over 30 individual birds were recorded during the survey, including juveniles and wandering or solitary birds, with at least 8 breeding pairs. This population number is considered quite high for a such small area of the study site. However, any calculation based on area would be pointless, particularly considering such a small island as Pulau Pinang where the species is generally regarded as common. Furthermore, a nest count may not accurately indicate the population number of a species because several nests of the same pair may exist within a given territory [Department of Sustainability and Environment (DSEV) 2003].

Conservation Status

The WBSEs has been listed as a totally protected wild bird on Schedule III of the Wildlife Conservation Act 2010 (Government of Malaysia 2010). Malaysia acknowledges that the protection of wildlife and sustainable environment management are important and desirable objectives, and the country ratified the Convention on Biological Diversity (CBD) in 1994, the 65th country to do so [Ministry of Natural Resources & Environment (NRE) 2006]. In addition to its obligation under the CBD, Malaysia has been promoting biodiversity conservation as an integral component of sustainable development, a policy theme from the 7th to 9th Malaysia Plans spanning 1996–2010, a period during which a National Policy on Biodiversity Conservation was also adopted in 1998 [Ministry of Science, Technology and Innovation (MOSTI) 1998]. Although the WBSE is not considered to be a threatened species, this species could soon be labelled as “nationally endangered” species if no immediate actions are taken to conserve its population. This will be even more critical if the lack of data on the WBSE persists.

Currently, the conservation status of WBSE in Malaysia is still in the early stage. Nonetheless, it is important to maintain and improve suitable areas for nesting habitats for these birds to halt the possibility of population decline and to increase the population size. Raptors such as the WBSE play an important role in the balance of ecosystems and as bio-indicators for environmental changes i.e., habitat quality and pollution, because of their position at the top of many food chains (Ferguson-Lees *et al.* 2001): a high number of individuals and a variety of prey birds indicate that an ecosystem is balanced. However, human disregard for the habitat and surroundings is reducing the population.

Little is known regarding the size of WBSE territories, though it appears that the active nest sites of the sea-eagles in Penang National Park are quite

narrowly spaced (<1 km per pair) compared to the recorded distances between active nest sites in Australia, which include one pair/8–10 km, one pair/40 km and one pair/65 km (Ferguson-Lees *et al.* 2001). This finding is possibly due to the abundance of food in the park area and the increase in human settlement on Pulau Pinang, which constrains the WBSE habitat in the only intact forest remaining in the park.

Although the population of WBSE in Malaysia and on Pulau Pinang has not been well studied, the population in Penang National Park is known to be high and can be considered as a common species at that site. The study area occupied by the WBSE is a protected area, which would strongly reduce or prevent human disturbance in the area and largely contribute to the establishment of potential nesting sites. A comparison study of raptors among protected, buffer and cultivated areas in West Africa shows that most large vultures and eagles are frequently found only in protected areas, with fewer individuals in the surrounding buffer zones and nearly none elsewhere (Thiollay 2007). Indeed, high human population growth and habitat changes, overhunting, disturbances and poisoning have been identified as the critical factors that influence the population of raptors in a habitat (Thiollay 2007).

Habitat destruction represents the most crucial threat to such species, as it results in the direct loss of potential nesting sites and reduced breeding success (Bilney & Emison 1983). Increased human presence is detrimental to nesting WBSE because these birds are sensitive to disturbance and may leave the nests and their young (DSEV 2003), with the nest productivity of WBSE being greatly affected by the level of disturbance by humans or predators (Dennis *et al.* 2011). In this study, it was found that most of the nest sites in Penang National Park were also subject to disturbance by human activity. Other possible threats that may affect the species in the park included the depletion of fish stock along the coastal region of Pulau Pinang, or more specifically in the waters of the park's shoreline, due to over fishing and illegal trawling (Mohd Hifni *et al.* 2006). Water contamination by oil spills around the park area from fishing and tourist boats could also contribute to food chain contamination.

Management Issues

WBSEs are very sensitive birds, particularly during the breeding season, which occurs annually from September to July. Thus, proactive management plans should be implemented to minimise human activities from potentially disturbing these birds. Human disturbances can be placed into three categories: (1) visual disturbances (human development/recreation), (2) audible disturbances and (3) direct disturbances (Richardson & Miller 1997). The avoidance of nest sites by humans during the breeding season is particularly important and can be implemented by determining adequate protection for WBSEs through the establishment of spatial and temporal buffer zones. Spatial buffer zones vary in scale depending on the species concerned. As an example, the distance recommended for the Peregrine Falcon (*Falco peregrinus*) is 800 m from a nesting site (Holthuijzen *et al.* 1990; Hustler 1983), whereas the distance for WBSE is 1000 m (Dennis *et al.* 2011). A temporal buffer refers to time restrictions for human activities when raptors are using a critical resource, such as a nest site

or foraging area (Knight & Skagen 1988). Local authorities should not allow visitors to be in the spatial and temporal buffer zones of the nest sites because outdoor activities, such as rock climbing, shouting, and other noise, are liable to cause the sea-eagles to abandon their nests. According to Mohd Hifni *et al.* (2006), the illegal poaching of chicks from nests may have occurred outside the park area and could also occur along the park border areas. There are no known natural predators of adult WBSE at Penang National Park. Other raptors, namely, Lesser Fish Eagle (*Ichthyophaga humilis*) and Grey-headed Fish Eagle (*Ichthyophaga ichthyaetus*), which have a similar fish diet, have not been recorded at Penang National Park (Kumar 2004); Osprey (*Pandion haliaetus*), which also feeds on fish, has been recorded only once at the Penang National Park. Free flying, non-paired WBSE have been observed to break from soaring to harass Brahminy Kite, a scavenger, over water and over the forest of Teluk Aling area when the offending bird was in an area beyond the eagle's territory.

It is recommended that education bird conservation programmes, particularly with regard to WBSE, be held by Penang National Park to create awareness among the public about the existence of protected WBSE in the park. National Parks Act 1980 also provides for the reservation, protection, and management of flora and fauna within national park boundaries. The protection and enhancement of native vegetation that is suitable for WBSE i.e., timber trees are likely to benefit other indigenous flora and fauna species, is also highly relevant. Management actions should include (1) yearly monitoring of known breeding sites throughout Penang National Park during the breeding season to determine breeding success over time, recognising the critical habitat or nest-site selection of WBSE, (2) the establishment of a buffer zone surrounding nesting sites and potential habitat from human disturbance, and (3) on-going research to further understand the species.

CONCLUSION

This study provides a preliminary estimate of the population size of WBSE in the Penang National Park area and additional data on the local distribution of their nests as a basis for future and more detailed research. When integrated with other local studies, this preliminary survey should serve as a starting point for the collection of reliable baseline information that will contribute to the better conservation and management of this sea-eagle species, thereby enhancing our ability to monitor future changes.

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