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Nesting biology of Black-shouldered Kite (*Elanus caeruleus*) in oil palm landscape in Carey Island, Peninsular Malaysia

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KEYWORDS

Road-side counts;
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Abstract Black-shouldered Kite (*Elanus caeruleus*) is a well-known raptor that inhabits open areas such as oil palm plantation or paddy field. To determine preferable habitat and nesting site of Black-shouldered Kite in oil palm landscape, we conducted a study on Black-shouldered Kite's nesting biology in Carey Island, Selangor, Malaysia. We divided the island into six types of habitat and conducted road-side count of Black-shouldered Kite from April 2009 to February 2011. Whenever the Black-shouldered Kite was detected, we thoroughly searched the surrounding area for their nest. In total, we have recorded forty nests. The nests were built on 15 species of trees but most of the trees shared common physical characteristics. Some novice breeders also used oil palm tree as their nesting site. Structure and building materials of nests constructed on oil palm trees were different from nests built on other trees. Of all breeding attempts, only four nests which were located in residential area adjacent to young oil palm habitat were successful. Among important characteristics of successful nesting site include taller trees with strong branches and good leaf coverage. These trees not only protect nests from predator detection (except from other predatory birds) and physical environment but also facilitate Black-shouldered Kite's foraging activities by providing good vantage point.

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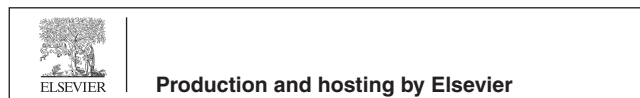
1. Introduction

There are four species of kites (genus *Elanus*) distributed throughout the world. Black-shouldered Kite (*Elanus caeruleus*) can be found in Old World (especially in southern Asia and Africa), Australian Black-shouldered Kite (*Elanus axillaris*) and Letter-winged Kite (*Elanus scriptus*) are restricted to Australia, while White-tailed Kite (*Elanus leucurus*) is resident to New World area. Although raptor diversity generally decreases with changes in land-use patterns

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(Herremans and Herremans-Tonnoeyr, 2000), Black-shouldered Kite population had increased in most countries since they are benefited from the establishment of new land and new agricultural area (Balbontin et al., 2008) which provide their prey populations, mainly rodents (Faanes and Howard, 1987).

Black-shouldered Kite prefers to nest in open habitats with the presence of scattered trees, but it usually nests in any suitable tree of moderate height (Faanes and Howard 1987). For instance, Black-shouldered Kite tends to breed in sawgrass (*Cladium jamaicense*) and cottonwoods (*Populus fremonti*) in America (Gatz et al., 1985; Curnutt and Hoffman, 1992), Scots pines (*Pinus pinaster*) and French oak (*Quercus robur*) in France (Duchateau et al., 2003), and few other tree species in Spain such as Almond tree (*Prunus amygdalus*), Oneseed hawthorn (*Crataegus monogyna*), and Holm oak (*Quercus ilex*) (Manosa et al., 2005; Balbontin et al., 2008).

Generally, Black-shouldered Kite's nest is bowl-shaped, consists of sticks and twigs, and is lined with grasses, straws or mammal fur (Anderson and Batchelder, 1990). Nest size also varies from one place to another. In Washington, Black-shouldered Kite's nest size was 50 cm in diameter and 12 cm in depth (Anderson and Batchelder, 1990) while in Peninsular Malaysia the nest dimension was 30 cm across and 20 cm deep (Renganathan, 1984).

Black-shouldered Kite is a resident bird of Peninsular Malaysia. It is widely spread in agricultural and open habitats such as oil palm (*Elaeis guineensis*) plantation and paddy (*Oryza sativa*) field. Black-shouldered Kite's nests were

observed on Australian Pine tree (*Casuarina equisetifolia*) in oil palm plantation (Mohd Rizuan et al., 2014) while in paddy field, the nests were recorded on Mango (*Mangifera indica*) and Coconut (*Cocos nucifera*) trees (Renganathan, 1984). Although Black-shouldered Kite usually build their nests on trees, there is also a record of nesting on a telephone pole in South Africa (Broekhuysen and Broekhuysen, 1974), an electric line pylon in France (Duchateau, pers. obs.), and metal pylon crossbars in Malaysia (Chye, 2012). Wells (1999) discovered that Black-shouldered Kite prefers taller trees and taller palm (such as coconut tree, *Cocos nucifera*) as its nesting site. This study examines habitat preference and tree selection by Black-shouldered Kite in building its nest.

2. Methods

2.1. Study site

This study was conducted in Carey Island, Selangor (Fig. 1). Geographically, Carey Island is located north to Banting and south to Port Klang in Selangor, Malaysia. Although the island is separated from mainland by Langkat river, it is connected to mainland by a bridge. Most of the island areas (10,521 hectares) are planted with oil palm which is owned by a private company known as Sime Darby Plantation Berhad (Siti et al., 2008). The remaining island areas are state land, concessional land, residential area, small-holders plantation area and forest reserves (mainly mangrove habitat).

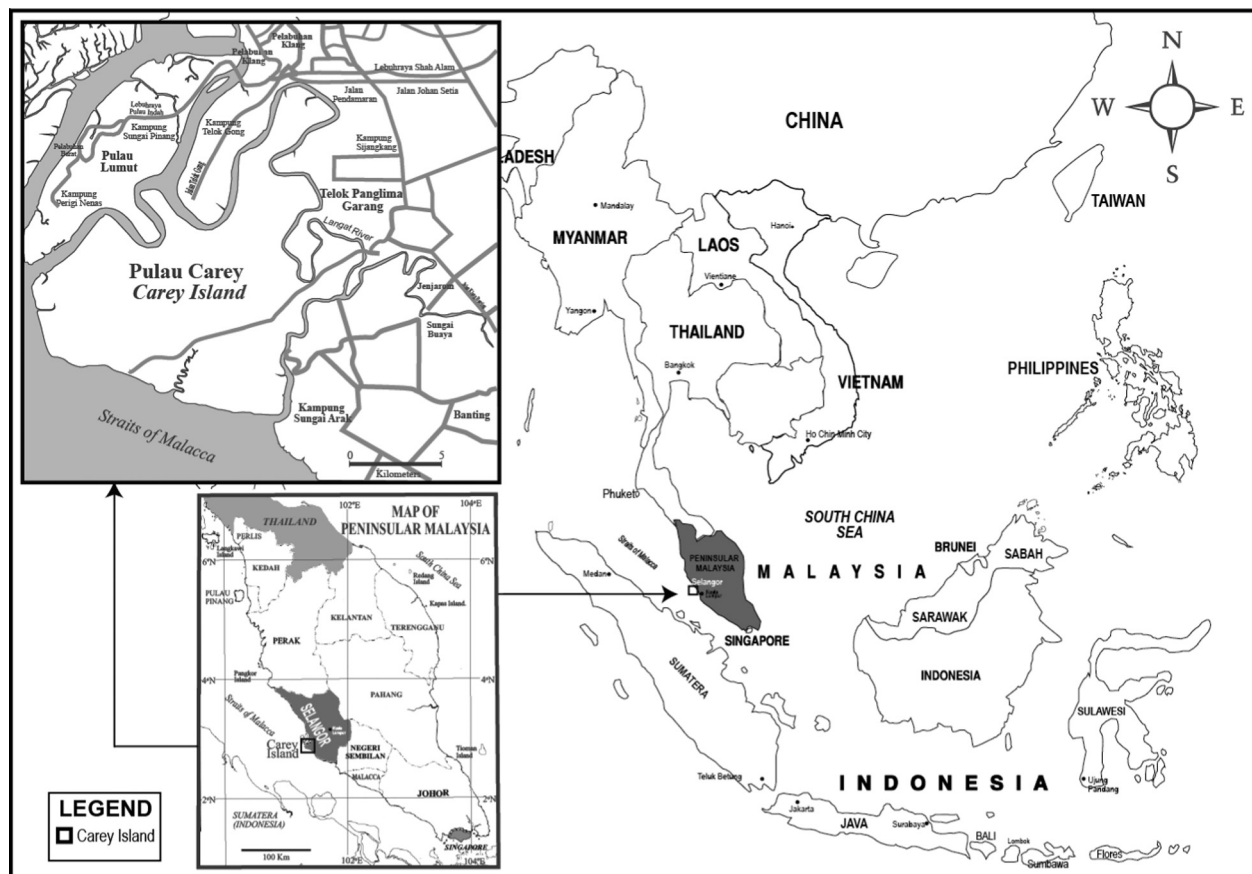


Figure 1 Location of the study site. Carey Island is located on the western part of Peninsular Malaysia.

Carey Island is a coastal area and most of the areas are dominated by oil palm plantation. The island is relatively rich in biodiversity (see Ramli et al., 2006; Haron, 2007; Siti et al., 2008; Nur Syazana et al., 2013).

The island was divided into six different habitats based on its physical characteristics. These are young oil palm plantation, matured oil palm plantation, old oil palm plantations, mangrove forest, residential area, and other habitats. Oil palm is the main agriculture in the Carey Island and it was classified into three age groups. These are young oil palm (< 1–5 years old), mature oil palm (6–20 years old) and old oil palm (> 21 years old). Each group is different in terms of height and frond coverage. Young oil palm habitat is an open habitat since the trees are short and the frond coverage is very small. Thus, there is no overlap in frond coverage resulting in exposed ground area. Mature oil palm differs from young oil palm by the height, ground vegetation and canopy coverage. Mature trees can grow up to 20 m with longer fronds that touch the neighbouring fronds, therefore shading the ground. Old oil palm trees can reach up to 30 m. The ground vegetation below these trees can be clearly seen which mostly consist of herbaceous plants, scrubs, weeds, ferns and taller grass. Mangrove plants occupied the island edge and the island is two metres below sea-level during high-tide. Therefore, a bund was built throughout the island edge to prevent the encroachment of sea-water into plantation area. Mangrove trees such as Mangrove apple (*Sonneratia alba*), Tengar (*Ceriops tagal*) and Bakau minyak (*Rhizophora apiculata*) can be spotted along the bund. The mangrove area was kept as forest reserve to maintain island's biodiversity. Residential areas mostly comprise of estate worker houses, traditional and indigenous (Mah Meri tribe) villages. This habitat was occupied by a complex of houses and buildings used by residents such as mosque, church, office, temple, hospital and factories. Other habitat consists of Biodiversity Park, the main road area, Herbal Garden and other areas that do not belong to any previously classified habitat.

To relate between Black-shouldered Kite's nesting site, nesting trees and nest-stand features, all groups of habitat were divided specifically into groups A, B, C, D, E, F and G. Group A is the combination of residential area surrounded by young oil palm habitat while group B consists of residential area surrounded by mature oil palm habitat. The residential area bordered with old oil palm habitat was divided into group C. The combination between residential area with young oil palm habitat and mature oil palm habitat was defined as Group D while group E comprises of young and matured oil palm habitats. Group F consists of oil palm habitat adjacent to mangrove habitat while group G includes young oil palm habitat neighboured with other habitats.

2.2. Bird's survey

The survey was conducted from April 2009 until February 2011 to record Black-shouldered Kite's nest. Road-side count was carried out throughout the island by travelling in a slow-moving vehicle through all accessible roads. Binoculars and digital camera (equipped with full video-mode) were used to observe the nest. Once a nest was detected, detailed observations to identify nest's characteristics were made for 10–30 min. Presence of Black-shouldered Kite and any

behaviour related to nesting and breeding activities were used to confirm that the nest belongs to the species. Other information related to the nesting site such as description of the tree and surrounding habitats was recorded. The picture of nesting tree was recorded to facilitate the process of species identification either by referring to identification book (Chin and Enoch, 2002) or consulting expert on plant systematic. GPS reading of nesting-tree location was taken and tagged on the map.

Indirect line method using Height Stick (also known as Graduated Pole) had been conducted to estimate trees and nest's height (Rucker, 2012). The pole has scale to facilitate the measurement. This method required three people; one or two persons held the pole while another person took the height's reading and measured the distance between the tree and observation point. Each measurement was recorded in metres. Correlation and simple regression analyses were conducted using SPSS software to determine degree of significance between two variables.

3. Results

3.1. Nest abundance and nest distribution in Carey Island

A total of 40 Black-shouldered Kites' nests were recorded on 15 species of trees throughout the island. Of this, 11 nests were recorded from April to December 2009, 16 nests were detected from March to December 2010 while 13 nests were discovered from January to February 2011. Black-shouldered Kite's nests were randomly distributed throughout Carey Island (Fig. 2). Black-shouldered Kite prefers East estate area than other parts of the island. Within East estate, where the residential complex is surrounded by young and mature oil palm habitats, Black-shouldered Kite were seen building their nest close to each other. It is estimated that four pairs of Black-shouldered Kite have built their nest in the area. Some nests were built on the same trees from year to year but on different branches. These nests were probably built by the same pair of Black-shouldered Kite. There were five species of trees which have been reused for nesting site. These are Australian Pine, Cempedak (*Artocarpus integer*), Fig (*Ficus sp.*), Angsana (*Pterocarpus indicus*) and Sandbox tree (*Hura crepitans*).

Of total recorded nests, 14 were studied in detail. Unfortunately, only four pairs of Black-shouldered Kite successfully completed their breeding attempts. Six nests were abandoned without clear reason. Eggs were produced in two nests but they were destroyed before hatching while one chick was found dead and swarmed by ants in another nest. The successful nesting attempts were recorded on four different tree species, i.e. Mango, Sandbox, Fig and Madras Thorn trees (*Pithecellobium dulce*).

3.2. Nest-site selection and nesting tree characteristics

Selecting a good nesting site had greatly contributed to successful breeding attempt. In this study, nest-site selection by Black-shouldered Kite was determined by the suitability of habitat and tree characteristics. Habitat groups B, D and G recorded the highest number of nests ($n = 8$). Habitat group A recorded seven nests while habitat group F had five nests only. Three nests were recorded in group C habitat and only

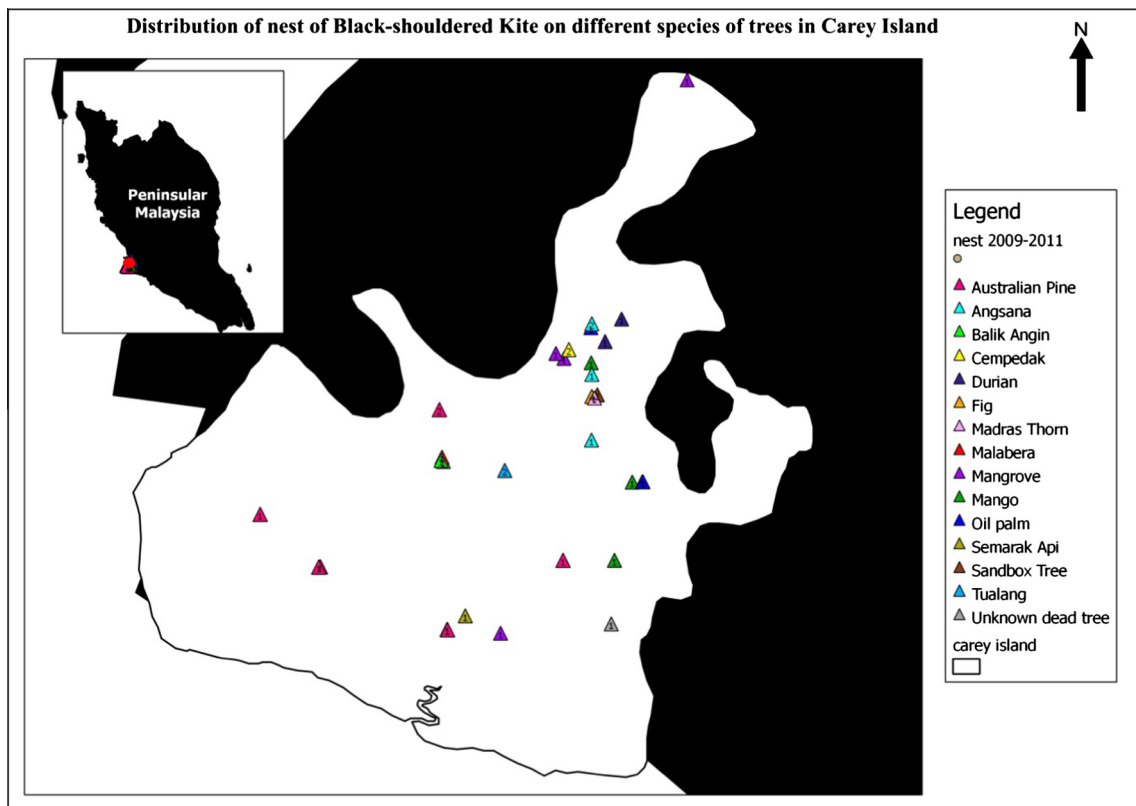


Figure 2 The location of recorded nests were marked throughout the island to examine the pattern of nest-site distribution.

one nest was recorded in habitat group E. From all selected tree species, Australian Pine was the most favourable by Black-shouldered Kite. Eight nests were constructed on this tree species which can be easily found in dry and exposed habitat along main road, residential area and throughout the island. This monopodial tree has strong branches as the main nest stand to support nest built by Black-shouldered Kite. Some nests were also built on shoots at the end of the branches which were covered by alternate tiny leaves. The other preferable tree species include Fig, Angsana and Mangrove Apple, with four nests built on each tree species. Other selected tree species have less than three nests each (Fig. 3).

Ornamental plants (such as Angsana, Fig, Sandbox, Madras Thorn and Semarak Api, *Delonix regia*) and fruit trees (such as Mango, Cempedak and Durian, (*Durio zibethinus*)) are widely planted within the residential complex, along the main and estate roads. The tree's height ranged from 14 to 16 m, with full leaf coverage and wide branches. These trees provide suitable nesting site for Black-shouldered Kite. Breeding attempt by one pair of Black-shouldered Kite at seven metres high on a Mango tree had successfully produced a fledgling. Other tree species, such as Malabera tree (*Fagraea crenulata*) which had wide leaves and Balik Angin (*Mallothus biaceae*) which had brownish leaves that covered the trunk

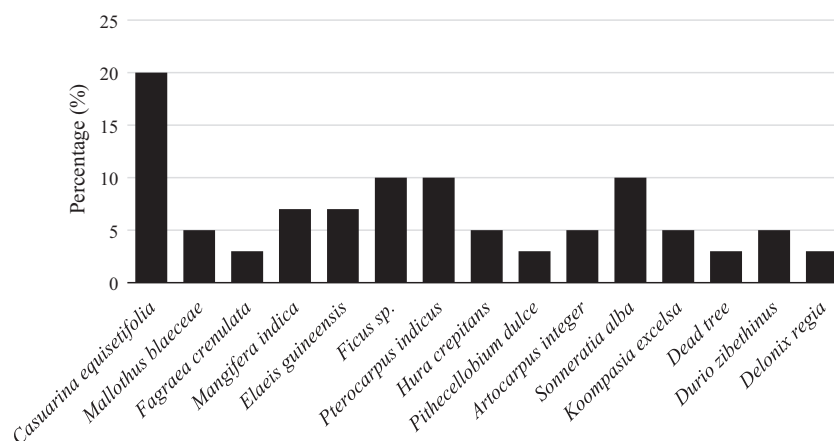


Figure 3 Percentage of tree species that have been selected by Black-shouldered Kite as their nesting site.

and branches provide better camouflage for Black-shouldered Kite's nest. In addition, Mangrove apple can also be found along the island boundary adjacent to Langat river. This species can reach up to 30 m high, therefore would provide great vantage point for Black-shouldered Kite's foraging activity.

Surprisingly, three nests were found in young oil palm habitat. The nesting tree's height was approximately 3–4 m; quite low for raptor's nest. Moreover, oil palm tree is unsuitable for raptor's nest in terms of support and stability since it did not have strong branches. Two nests were found on four year old oil palm tree while another nest was found on three year old oil palm tree. As expected, all breeding attempts on these oil palm trees failed due to strong wind and predator's disturbance. All nests on oil palm tree were built between the fronds and the main trunk, quite close to the ground as it was built on young oil palm.

Overall, most nests (except on oil palm) were constructed above five metres to ensure safety. Nests on trees' crown were hidden in leaves and built on strong and wide branches. All recorded nesting trees have common characteristics such as tall, strong branches and good leaf coverage. These features provide good support and protection for Black-shouldered Kite's nest. For shorter trees, good coverage leaves might be the main characteristic to ensure the nest's safety.

In selecting their nesting site, Black-shouldered Kite seems not to be intimidated by other raptors. Four Black-shouldered Kite's nests were built close to other raptor's nest. On one occasion, Black-shouldered Kite built their nest on Fig tree which was located adjacent to raptors' nest on Australian Pine tree. Besra (*Accipiter virgatus*) and Brahminy Kite (*Haliastur indus*) also built their nest on different trees of Australian Pine. In other areas, a pair of Black-shouldered Kite was observed bringing twigs to build their nest on Durian tree which was also occupied by Japanese Sparrowhawk (*Accipiter gularis*).

3.3. Comparison between nests in oil palm habitat and other habitats

Black-shouldered Kite's nest was made from different sizes of twigs, lined with straws and dry leaves. Dry leaves, grass, and straws were used to cover the inner part of the nest while the outer part was built with stronger materials like twigs. Fresh green leaves were also taken by Black-shouldered Kite to cover the inner part of the nest. It is difficult to measure the size of each nest due to tree heights and location. Only the nests that were built on young oil palm were measured. The characteristics of nests on oil palm tree are slightly different from those of the nests on other trees especially in terms of structure and materials used. Generally, Black-shouldered Kite's nest looks like a bowl with an approximate diameter of 20–30 cm while its depth is ranged from 5 to 20 cm. However, the depth of Black-shouldered Kite's nests on oil palm tree is very deep (Fig. 4). On oil palm trees, the nest is 33 cm in diameter, 8 cm long and 44 cm depth. The nest on oil palm trees is a cone-shaped structure and was tied to two to four palm fronds since oil palm trees do not have branches. The materials used in constructing this nest are similar to nests on other trees but sizes of twigs are slightly different. For nest that was built on oil palm tree, tiny and medium sized twigs were used and supported by dry grasses. On the contrary, Black-shouldered Kite's nests built on other types of trees are made of medium



Figure 4 Nest of Black-shouldered Kite built on three year old oil palm tree in the East Estate, Carey Island. The nest was built between fronds and supported by the lining of fine twigs.



Figure 5 Nest of Black-shouldered Kite built on Sandalwood tree (*Hura crepitans*) in the residential area of East Estate. The nest was built on a strong branch and was supported by large twigs.

and large-sized twigs, lining with dry grasses and leaves to form a shallow cup (Fig. 5).

4. Discussion

More nests were recorded in habitat groups A, B, D and G which consist of residential, mature oil palm, young oil palm and other habitats. There were various types of tree and vegetation such as ornamental, herb, scrubs and fruit trees that can be found in residential and other habitats. These trees served as Black-shouldered Kite's nesting site. Martin (1993) stated that habitat with dense vegetation will be chosen by kites to reduce predation. Young and mature oil palms differ in terms of height and ground vegetation. Mature oil palm habitat had taller ground vegetation such as grasses, ferns and weeds while young oil palm habitat usually has less ground coverage and low vegetation. Open and exposed landscape of young oil palm facilitates Black-shouldered Kite's hunting process but preys

are also abundant in a habitat with taller vegetation that served as rodents breeding site (Mendelsohn and Jaksic, 1989). Most studies on rodents were conducted in matured oil palm habitat (e.g. Wood, 1984; Wood and Liau, 1984; Buckle et al., 1997) since rodents normally eat oil palm fruit which need to be controlled to reduce crop losses. In addition, Black-shouldered Kite was observed spending more time hunting over taller vegetation (Renganathan, 1984; Faanes and Howard, 1987). This is also true for group F habitat where mangrove trees provide perching, copulation and breeding sites. Oil palm habitats may have limited number of rodents but they also provide other prey species for Black-shouldered Kite such as lizards, frogs, insects, snakes or small bird (Tarboton, 1978; Wells, 1999; Parejo et al., 2001; Manosa et al., 2005; Abdessalam et al., 2013). This explains why nests were built in group C habitat which consists of residential and old oil palm habitats. Only one nest was found in group E habitat and was probably built by a novice breeder, as the selected nest-tree was not suitable. Black-shouldered Kite has a tendency to breed in a place where nesting and foraging sites are available. In South Africa, breeding success is known to be higher when food supply is abundant (Mendelsohn, 1984). Most nests were built in residential areas, indicating that Black-shouldered Kite prefer to select a nest-site in the corridors of natural vegetation that comprise of agricultural and human settlement areas (Erichsen et al., 1996).

Previous study also recorded that Black-shouldered Kite prefers to nest on Australian pine tree in oil palm landscape (Mohd Rizuan et al., 2014). This tree species is similar to coniferous tree based on its structure which was greatly preferred by raptors due to better protective cover and stable nest stands (Lohmus, 2006). Twelve selected species of trees (except oil palm, Tualang (*Koompassia excelsa*) and unknown dead tree) were tall to avoid predator, had strong and wide branches for good support and strong trunk to stand against strong wind during bad weather. Leaf coverage assists in hiding Black-shouldered Kite's nest to ensure it would not be easily detected by predator which explained why few short trees were chosen as nesting site. Five species of trees were reused as nesting site because of good location and Black-shouldered Kite is well adapted to the surrounding area. In California, kites frequently used the same nesting tree or nest grove when successful breeding was promised (Niemela, 2007). It is possible that nests on oil palm and dead trees were built by novice breeder that lack breeding experiences. The height of nests is directly affected by the height of trees where most of the nests were built on the top branches or 2–7 m from the upper crown of the trees.

Result of this study indicated that predator disturbance by other species such as House Crow (*Corvus splendens*) and Asian Koel (*Eudynamis scolopaceus*) and unexpected weather condition play important roles in affecting breeding success of Black-shouldered kite. Choosing nesting trees that are safe from these predators will reduce predation rate and increase breeding success. Similar adaptation is also shown by other raptors in ensuring breeding success. Little Owl (*Athene noctua*) for instance can avoid from being killed by not nesting in the trees used by other predators (Tome et al., 2004). Unfortunately, presence of Black-shouldered Kite's nest in any area always attracts predators to the area. In this study, there was an occasion where a group of House Crows were observed coming to the Black-shouldered Kite's nesting area and build

their nest in the surrounding habitat. Therefore, Black-shouldered Kite usually build their nest on taller trees and tolerate nearby observers unless it was disturbed. However, Black-shouldered Kite is wary of people when their nest was built on shorter trees (Martin and Geupel, 1993). They will react abnormally or avoid visiting their nest in the presence of humans as they were sensitive to the observers. Severe weather conditions such as heavy rain, strong wind, lightning and storm always affected Black-shouldered Kite's breeding success. These situations usually damage Black-shouldered Kite's nests which will lead to broken eggs or it moves to other places, as observed in Arizona (Gatz et al., 1985).

Generally, Black-shouldered Kite's nest was built on tree branches at higher level which provide better support than oil palm fronds. However, few nests were built on oil palm trees which are at lower level. These nests also have different features as they were constructed using finer and lighter twigs compared to bigger twigs for the nest built on taller trees. This gives more support in holding Black-shouldered Kite's nest and ensures it will not fall down. However, since oil palm fronds are more flexible than tree branch, it is easy for Black-shouldered Kite's nest to be destroyed during strong wind resulting in reduction in breeding success.

Black-shouldered Kite breed throughout the year without true breeding season and most individuals have capability of breeding more than once (Mendelsohn, 1983; Renganathan, 1984; Garcia, 2008). This multi-brooding capability, as commonly seen in France (Duchateau et al., 2003), sometimes occurs immediately after first breeding attempt was completed or failed (Ferrero et al., 2003). To ensure higher success rate in each Black-shouldered Kite's breeding attempt in Carey Island, the favoured nesting tree species should be preserved and cared.

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