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Comparison of waterbird species composition and habitat characteristics of two different wetlands of Malaysia

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Waterbird species composition and habitat characteristics at two ecologically different wetlands (Paya Indah and Putrajaya) were compared in order to determine the habitat suitability of each particular habitat for waterbird species. A total of 30 waterbird species representing 10 families were recorded through direct observation in both wetland habitats (26 waterbird species in Paya Indah and 22 species in Putrajaya wetland habitats). Out of 30 waterbird species, 17 species were commonly recorded from both habitats, 4 species were absent in Paya Indah and 8 species in Putrajaya. Ardeidae was the dominant family based on the number species (11 waterbird species) while Charadriidae, Ciconiidae, Jacanidae, Pelicanidae and Podicipedidae were the rarest families (only one species was recorded) in both wetland habitats. This indicated that both wetland habitats may vary in waterbird species composition habitat characteristics, that is, a total of 34 aquatic plant species (21 species in Paya Indah and 18 species in Putrajaya wetland) belonging to 14 families were sampled during study period. Five plant species, namely, Water Chestnut– *Eleocharis dulcis,* Twig Rush– *Lepironia articulate,* Blue Lotus– *Nymphaea nouchali,* Common Reed– *Phragmites karaka* and Cattail– *Typha angustifolia* were commonly recorded from both habitats. However, 13 aquatic plant species were absent in Paya Indah and 16 species in Putrajaya wetland. The findings of this study, revealed that Paya Indah wetland is rich in waterbird species composition and habitat characteristics as compared to Putrajaya wetland habitat. This might be due to the richness and diversity of aquatic vegetation composition, occurrence of suitable foraging and breeding sites that had attracted the highest number of waterbird species to utilize the Paya Indah wetland habitat.

Key words: Waterbirds, aquatic vegetation, Paya Indah, wetland.

INTRODUCTION

Wetlands are shallow waterlogged areas where soil is saturated with water and covered by a variety of aquatic vegetation such as submerged and emergent vegetation. Wetlands may vary in habitat characteristics and productivity due to difference in topography, soil, hydrology, water quality, vegetation species composition

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and the surrounding landscape. Wetland always offers diverse habitats for a variety of fauna species, especially waterbirds, fishes, reptiles, mammals and aquatic invertebrates. They had attracted a wide array of waterbird species, that is, especially endangered and threatened waterbirds namely: *Ciconia stromi*, *Tringa guttifer*, *Egretta eulophotes*, *Mycteria cinerea*, *Lepotilos javanicus, Euryorhynchus pygmeus, Pluvialis apricaria*, *Gallinago gallinago, Calidris alpine, Limosa limosa, Thinornis rubricollis* and *Vanellus vanellus,* (Ishikawa et al., 2003; Stroud et al., 2004) as compared to other aquatic habitats and they need special attention for conservation.

Waterbirds are ubiquitous components of wetland ecosystems, that is, top predators and may have effect on the distribution and richness of fishes and other fauna (Steinmetz et al., 2003; Garcia and Yorio, 2007). Waterbirds utilized different wetland habitats for nesting, breeding, foraging, stopover and wintering grounds during migration (Romano et al., 2005; Guadagnin et al., 2005; Junk et al., 2006; O'Neal et al., 2008; Saygill et al., 2011). The waterbird species richness and abundance are influenced by environmental factors such as water level fluctuation, water depth, habitat richness and ecological interactions, that is, predators, richness of food and competition (Guadagnin et al., 2005; Cintra et al., 2007; Cintra, 2012). They are consumers and bio-indicators, that is, their presence or absence may indicate the current status of a particular dwelling wetlands habitat.

It has been stated that >50.0% world's wetland areas had been lost (Fraser and Keddy, 2005; Battisti et al., 2008) due to human induced activities such as discharge of urban sewage, pesticide runoff off from surrounding agricultural fields (Melink and Riojas-Lopez, 2009), draining for conversation into agricultural fields and development of housing societies (Gautam and Kafle, 2007; Kafle et al., 2008). The habitat loss and degradation had adversely affected the population of many waterbird species such as rails, storks, grebes, jacanas and waders, etc, across the world (Ma et al., 2010). Fruther more, some are critically endangered, threatened and extinct due to habitat loss and degradation (O'Connell, 2000; Deluca et al., 2008; Delany et al., 2010; Suazo et al., 2012; Lafferty et al., 2013).

A detailed research on waterbird species composition and habitat characteristics across Malaysia is still lacking. Few studies have been conducted in various wetland habitats on waterbird species and habitat characteristics. For example, effects of water quality in oil palm production landscapes on tropical waterbirds in Peninsular Malaysia (Sulai et al., 2015), the relationships between morphological characteristics and foraging behavior in four selected species of shorebirds and water birds utilizing tropical mudflats (Norazlimi and Ramli, 2015), effects of habitat characteristics on waterbird distribution and richness in wetland ecosystem of Malaysia (Rajpar and Zakaria, 2014), assessing the habitat suitability of two different artificial wetland habitats using avian community structures (Rajpar and Zakaria, 2014) and assessing an artificial wetland in Putrajaya, Malaysia, as an alternate habitat for waterbirds (Rajpar and Zakaria, 2013). There is an urgent need to determine and compare the waterbird species inhabiting different wetland habitats in order to understand the habitat suitability and productivity for waterbird species for future conservation and management plans. The main objectives of this study were to determine and compare the waterbird species and habitat characteristics of Paya Indah and Putrajaya wetland for future conservation and better management activities.

METHODOLOGY

Study site 1

Paya Indah Wetland (a wildlife sanctuary) encompasses of 3050 ha, out of which 450 ha are under the administration of the Department of Wildlife and National Parks, Peninsular Malaysia. The study area (Figure 1) is located within the quadrant of 101°10′ to 101°50′ longitude and 2°50′ and 3°00′ latitude.

Study site 2

Putrajaya wetland is situated around 26 km away from Kuala Lumpur within the quadrant of 2° 57' 43" latitude and 101° 41' 47" longitude (Figure 1). This wetland straddles the water from the catchment areas of Chua and Bisa Rivers and covers an area of 200 ha (77.70ha planted area, 76.80 ha open water bodies, 9.60 ha islands, 23.70 ha inundation area and 9.40 ha tracks).

Waterbird surveys

Monthly waterbird surveys were carried out from January to December, 2011 employing direct visual observation. The presence of waterbirds was determined by using the point count method employing direct observation and employing 10 × 50 binocular. A total of 100 point stations (50 points in each wetland) were established to detect the different waterbird species inhabiting both wetlands. The location of each point count station was established at intervals of 300 m apart to avoid the double counting of the same waterbird species at more than one station (Figures 2 and 3). The survey of waterbird species was carried out early in the morning, that is, between 0730 and 1000 h, and mostly waterbird species were active during the morning hours and easy to observe. The methodology described by Aynalem and Bekele (2008), Zakaria et al. (2009) and Rajpar and Zakaria (2014) was followed.

Vegetation survey

The aquatic vegetation composition of Paya Indah and Putrajya wetland habitats was determined by employing 10 x 10 m quadrant method. This method had been widely used to study the vegetation of heterogeneous habitats (Fernandez-Alaez et al., 2002). Sixty quadrant plots) 30 sample plots in each habitats) were sampled along the edges and in shallow water to examine the aquatic vegetation composition of both study sites. In each sample plot,

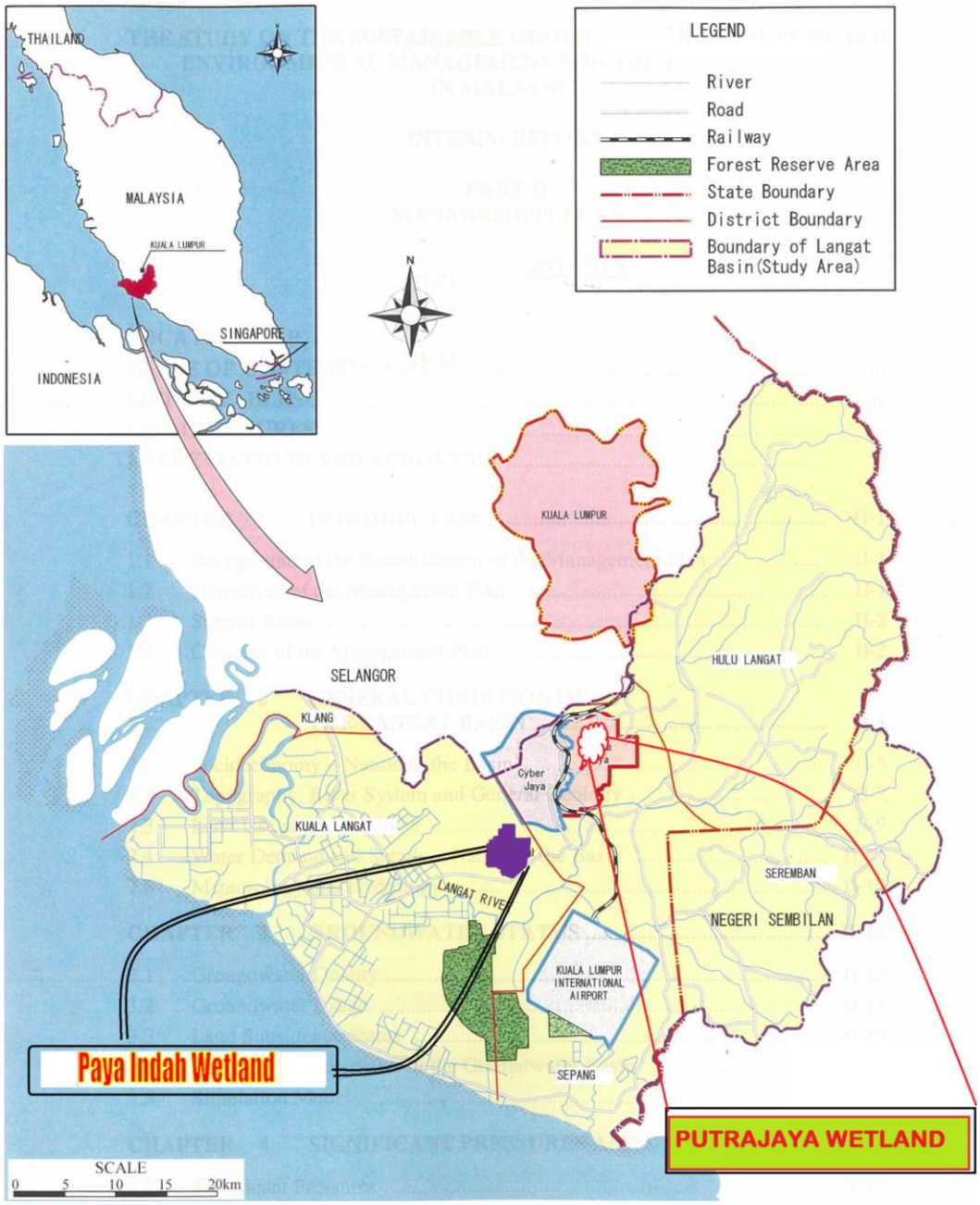

Figure 1. Location map of the study areas.

vegetation cover % (the proportion of the water surface covered with aquatic vegetation), vegetation type (emerged and submerged vegetation, sedges, reeds, ferns and grasses) were recorded. The methodology was followed as described by Isacch et al. (2005).

RESULTS

Waterbird species composition of Paya Indah and Putrajaya wetland

A total of 30 waterbird species representing 10 families were recorded through direct visual observation in both wetland areas, that is, Paya Indah and Putrajaya wetland habitats. Out of 30 waterbird species, 26 were recorded in Paya Indah wetland and 22 waterbird species from Putrajaya wetland habitats. Out of 30 waterbird species, 17 species were commonly recorded in both wetland habitats. However, 4 waterbird species were absent in Paya Indah wetland and 8 were absent in Putrajaya wetland, respectively. Ardeidae (11 waterbird species) and Rallidae (6 species) were the most dominant families of waterbirds in both wetland habitats. In contrast, five

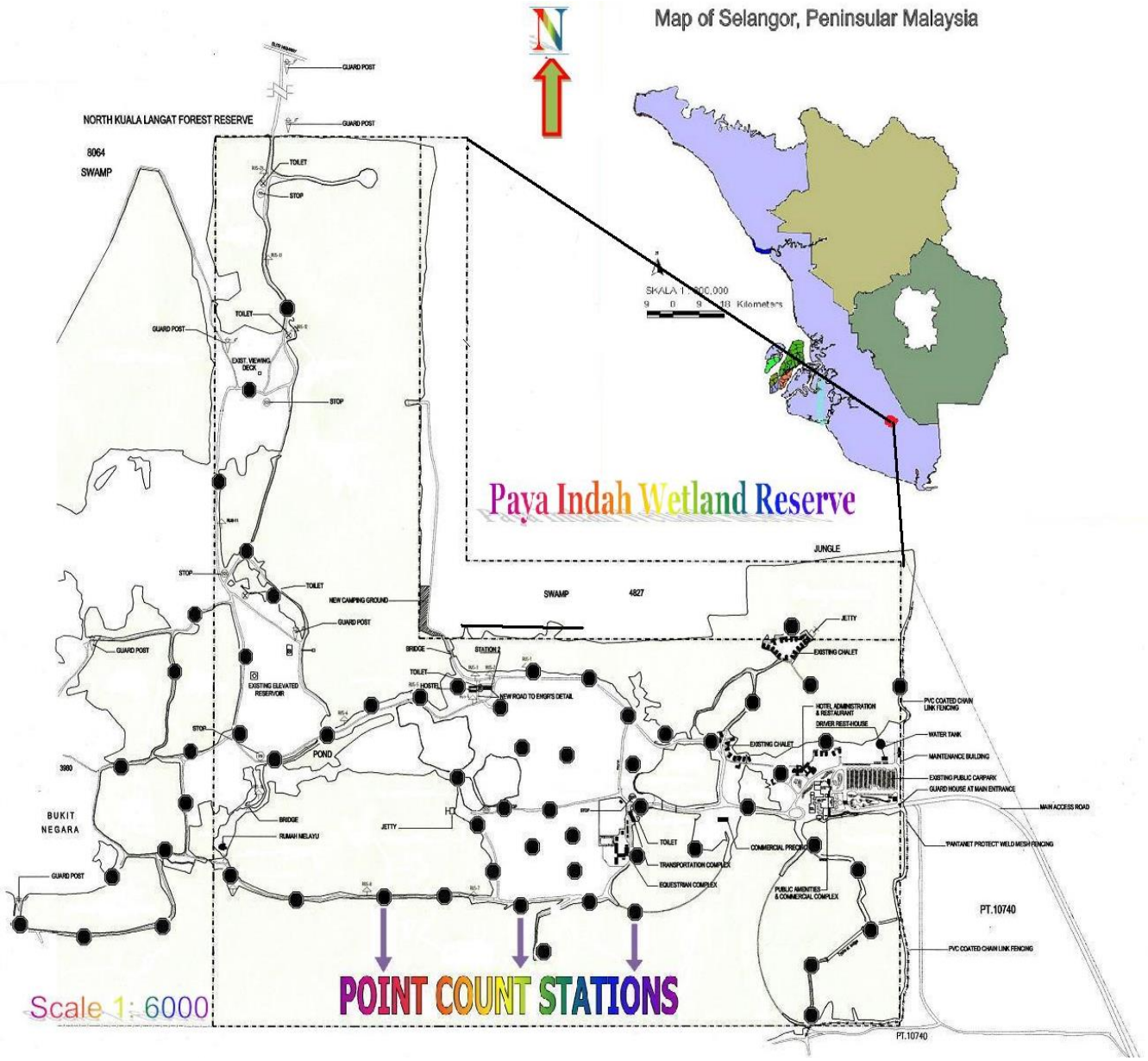

Figure 2. Location map of point count stations at Paya Indah wetland.

families, that is, Charadriidae, Ciconiidae, Jacanidae, Pelicanidae and Podicipedidae were the rarest families (only one species was recorded from each family) of Paya Indah and Putrajaya wetland habitats. This indicated that both wetland habitats may vary in waterbird species composition and habitat characteristics (Table 1).

Wetland vegetation composition of Paya Indah and Putrajaya habitat

The results indicated that vegetation of Paya Indah and Putrajaya wetland habitat vary in species composition. A total of 34 aquatic plant species (21 species in Paya Indah and 18 species from Putrajaya wetland) representing 14 families were sampled from both wetland habitats. Five plant species, namely Water Chestnut– *Eleocharis dulcis,* Twig Rush– *Lepironia articulate,* Blue Lotus– *Nymphaea nouchali,* Common Reed– *Phragmites karaka* and Cattail– *Typha angustifolia* were commonly detected from both habitats. However, 13 aquatic plant species were absent in Paya Indah and 16 species in the Putrajaya wetland habitat. The results revealed that Cyperaceae (13 plant species) was the most dominant family while 10 families were rarest in both wetland habitats (Table 2).

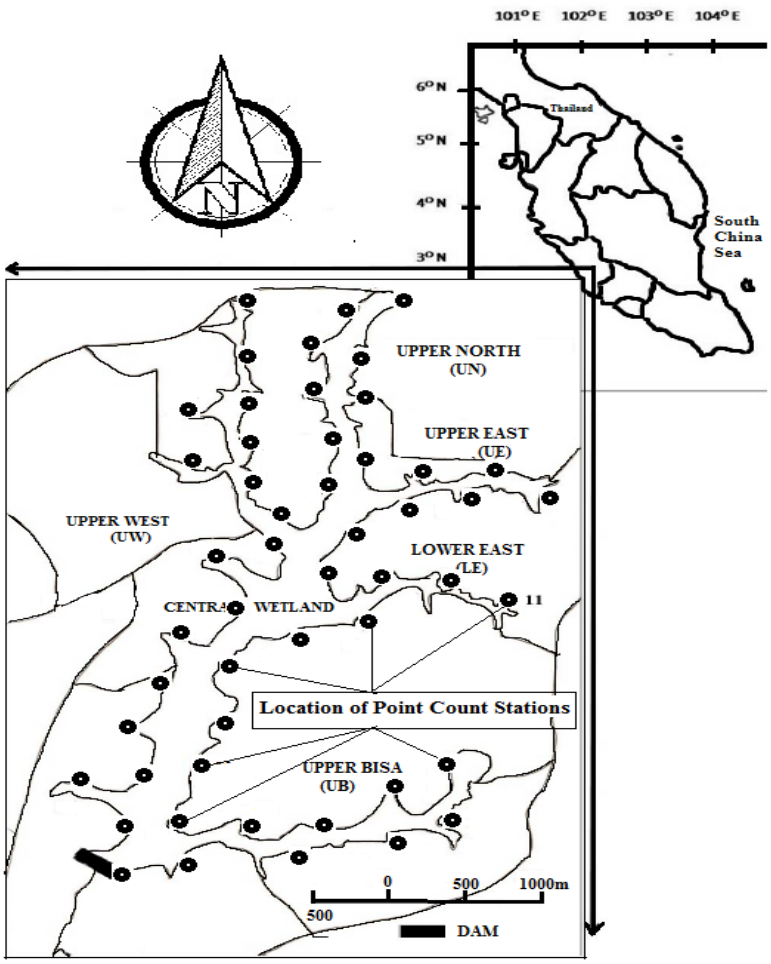

Figure 3. Location map of point count stations at Putrajaya wetland.

Table 1. List of waterbird species recorded in Paya Indah and Putrajaya wetlands.

Family Name	Species Common Name	Species Scientific Name	PIW	PW
Alcidinidae	Common Kingfisher	*Alcedo atthis*	X	X
	White-throated Kingfisher	*Halcyon smyrensis*	X	X
	Black-capped Kingfisher	*Alcedo atthis*	X	–
	Stork-billed Kingfisher	*Pelargopsis capensis*	X	–
Anatidae	Lesser Whistling Duck	*Dendrocygna javanica*	X	–
	Cotton Pygmy Goose	*Nettapus coromandelianus*	X	–
Ardeidae	Black-crowned Nightheron	*Nycticorax nycticorax*	X	X
	Cattle Egret	*Bubulcus ibis*	–	X
	Great Egret	*Chasmerodius albus*	X	X
	Grey Heron	*Ardea cinerea*	X	X
	Javan Pond Heron	*Ardeola speciosa*	–	X
	Little Egret	*Egretta garzetta*	X	X
	Little Heron	*Butorides striatus*	X	X
	Purple Heron	*Ardea purpurea*	X	X
	Yellow Bittern	*Ixobrychus sinensis*	X	X

Table 1. Contd.

	Cinnamon Bittern	*Ixobrychus cinnamoneus*	X	X
	Schrenck's Bittern	*Ixobrychus eurhythmus*	X	–
Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	X	X
Ciconiidae	Painted Stork	*Mycteria leucocephala*	–	X
Pelicanidae	Great White Pelican	*Pelecanus onocrotalus*	–	X
Jacanidae	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	X	–
Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	X	–
Rallidae	Ballion's Crake	*Porzana pusilla*	X	–
	White-browed Crake	*Porzana cinerea*	X	–
	Common Moorhen	*Gallinula chloropus*	X	X
	Purple Swamphen	*Porphyrio porphyrio*	X	X
	White-breasted Waterhen	*Amaurornis phoenicurus*	X	X
	Water Cock	*Gallicrex cinerea*	X	X
Scolopacidae	Common Sandpiper	*Tringa hypoleucos*	X	X
	Pintail Snipe	*Gallinago stenura*	X	X

Table 2. List of wetland vegetation recorded at Paya Indah and Putrajaya wetlands.

Family Name	Scientific Name	Common English Name	Paya Indah	Putrajaya
Alismataceae	*Sagittaria latifolia*	Duck-Potato	X	–
Amaryllidaceae	*Crinum defixum*	Wild Garlic	–	X
Blechnaceae	*Stenochlaena palustris*	Climbing Fern	X	–
Cyperaceae	*Carex* spp.	Swamp Grass	X	–
	Cyperus halpan	Dwarf Papyrus Sedge	–	X
	Eleocharis dulcis	Water Chest-Nut	X	X
	Eleocharis variegata	Chinese Water Chestnut	–	X
	Fimbristylis globulosa	Globe Fimbry	–	X
	Fuirena umbellata	Yefen	–	X
	Lepironia articulata	Twig Rush	X	X
	Rhynchospora corymbosa	Golden Beak-Sedge	–	X
	Scirpus grossus	Giant Bulrush	–	X
	Scirpus mucronatus	Bog Bulrush	–	X
	Scirpus olneyi	Three Square Bulrush	X	–
	Scleria purpurascens	Marsh Sedge/Nut Rush	X	–
	Scleria sumatrensis	Nut Rush	–	X
Graminae	*Distichlis spicata*	Spike Grass	X	–
	Imperata cylindrica	Cogon Grass	X	–
Lycopodiatae	*Lycopodium cernuum*	Creeping Club Moss	X	–
Mackinlayaceae	*Centella asiatica*	Gotu Kola	–	X
Nymphaeaceae	*Nelumbo nucifera*	Indian/Sacred Lotus	X	–
	Nelumbo pubescens	Water Lily	X	–
	Nymphaea nouchali	Blue Lotus	X	X

Table 2. Contd.

	Nymphaea rubra	Rubra Water Lily	X	–
Onagraceae	*Ludwigia palustris*	Water Purslane	–	X
Philydraceae	*Philydrum lanuginosum*	Wooly Water Lily	X	–
	Phragmites karaka	Common Reed	X	X
Poaceae	*Echinochloa crus-galli*	Barnyard Grass	–	X
	Panicum maximum	Buffalo Grass	X	–
	Panicum repens	Torpedo Grass	X	–
	Spartina alterniflora	Rush	X	–
Polygonaceae	*Polygonum barbatum*	Knot Grass	–	X
Salviniaceae	*Salvinia molesta*	Giant or Kariba Weed	X	–
Typhaceae	*Typha angustifolia*	Cattail	X	X

DISCUSSION

The recording of 30 waterbird species in both habitats indicated that they are suitable habitat of the wide array of waterbird species. The recording of 26 waterbird species at Paya Indah and 22 species in Putrajaya wetland showed that Paya Indah had attracted more waterbird species as compared to Putrajaya wetland. The difference in waterbird species composition could be due to variation in vegetation structure, habitat heterogeneity, food resources and foraging behaviour of waterbird species. For example, egrets and herons were more abundant in the Putrajaya wetland as compared to Paya Indah wetland. This might be due to availability of islands dominated by trees and shallow depth of water, which offer ideal foraging and nesting sites for egrets and herons (Elbin and Tsipoura, 2010). On the other hand, a higher number of waterbird individuals such as swamphen, moorhen, watercock, sandpipers, lapwings and kingfishers were observed at Paya Indah wetland habitat than Putrajaya wetland. The occurrence of higher number of these waterbird species could be due to availability of dense aquatic vegetation which forms thick mats in the center of wetland and offer suitable foraging and breeding sites for them. The other reason could be that swamphen moorhen, watercock and sandpipers are a shy species with secretive behaviour and avoid using the open areas and urban habitats (George and Zack, 2001; Voshell and Wright, 2002; Ross et al., 2011).

Fruther more, the sampling of 21 aquatic plant species at Paya Indah and 18 aquatic plant species at Putrajaya habitats indicated that both habitat may vary in vegetation structure and composition. For example, Paya Indah wetland is dominated by *Nelumbo nucifera, Nelumbo pubescens, Nymphaea nouchali, Nymphaea rubra, Scirpus olneyi, Scleria purpurascens, Distichlis spicata, Lycopodium cernuum, Philydrum lanuginosum, Panicum* sp., *Spartina alterniflora* and *Salvinia molesta.* On the contrarily, Putrajaya wetland is dominated by *Cyperus halpan, Eleocharis variegate, Fimbristylis globulosa, Fuirena umbellate, Rhynchospora corymbosa, Scirpus* sp., *Scleria sumatrensis, Centella asiatica, Nymphaea nouchali, Echinochloa crus-galli* and *Polygonum barbatum.* The difference in wetland vegetation and structure could be due to variation in water level and quality, surrounded landscape, and the inflow of water from the catchment area. Putrajaya wetland is surrounded by the catchment of river Chua and Baisa and is shallow in water depth (Rajpar and Zakaria, 2013) while Paya Indah wetland is surrounded by housing societies and agriculture fields, oil-palm plantation and peat swamp forest. The variation in aquatic vegetation structure and composition might have created a variety of microhabitats which had attracted a wide array of waterbird species to utilize the different areas of wetlands in order to satisfy their needs to perform various activities. It has been illustrated that habitat structure of wetland may vary depending upon water supply and surrounding landscapes (Winter et al., 2005). Waterbirds often select available wetland habitats which provide plenty of food resources, protection from predators and harsh weather and also offer suitable breeding sites for them (Marshall and Cooper, 2004; Cunningham et al., 2008; Rajpar and Zakaria, 2011).

Conclusion

Overall, the findings of this study revealed that Paya Indah wetland is rich in waterbird species composition

and habitat characteristics as compared to Putrajaya wetland habitat. This might be due to the richness and diversity of aquatic vegetation, occurrence of suitable foraging and breeding sites for different waterbird species, especially ducks, goose, swamphen, moorhen, crakes, jacanas and sandpipers. These waterbird species are secretive in behaviour, that is, shy species and often prefer large waterbodies dominated by thick aquatic vegetation. The other reason could be that Paya Indah wetland is deep, wide and interconnected with a chain of wetlands, while Putrajaya wetland is shallow and running in between the buildings.

Conflict of interests

The authors did not declare any conflict of interest.

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