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FORAGING BEHAVIOUR OF FIVE EGRET SPECIES IN POME POND AREA AT CAREY ISLAND, PENINSULAR MALAYSIA

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ABSTRACT

The foraging behaviour of five egret species in four POME ponds at Carey Island, Peninsular Malaysia was observed using 10 x 42 binoculars and digital video camera. The highest probing activity was recorded during 0900 to 1000hrs in Little Egret (*Egretta garzetta*; i.e. 52 probes/minute) followed by Cattle Egret (*Bubulcus cormorandus*; i.e. 42 probes/minute), Intermediate Egret (*Mesophoyx intermedia*; i.e. 20 probes/minute), Chinese Egret (*Egretta eulophotes*; i.e. 19 probes/minute) and Great Egret (*Casmerodius albus*; i.e. 5 probes/minute). In contrast, the lowest mean probing activity was recorded in Great Egret (0.4 probe/minute) as compared to Chinese Egret (1 probe/minute), Cattle Egret (2 probes/minute), Intermediate Egret (3 probes/minute), and Little Egret (4 probes/minute) during 1700 to 1800hrs. One-way ANOVA and Tukey's (HSD) test indicated that the mean probing per minute of Little Egret, Intermediate Egret and Great Egret was significantly different ($F_{4,\ 35} = 8.22$, $P < 0.05$). The most frequent feeding behaviour sighted was walking slowly for Great Egrets (52.6%), walking quickly for Little Egrets (38.2%), moved slowly for Intermediate Egrets (38.2%), and walking slowly for both Cattle and Chinese Egrets (48.0% and 46.6% respectively). Cattle Egret was the only species showed gleaning behaviour in preying hidden invertebrates under soft mud while Little Egret was the only species that employ foot shuffling technique. The study revealed that feeding strategies employed by five egret species vary in term of sites selection and prey capturing technique.

Key words: Foraging behaviour, Egret, POME, Carey Island, Probing.

INTRODUCTION

The foraging behaviour is broadly defined as allocation, acquisition and assimilation of food by organisms (Breed, 2001). It is an essential aspect of avian species in which food resources were obtained and consumed using variety of tactics. Therefore, foraging behaviour is one of the most important activity for avian species in term of survival and reproduction (Yu-Seong *et al.,* 2008). Most birds spend majority of their time in foraging related activity either to feed themselves or care for a brooding mate or young hatchlings (Mayntz, 2012). Approximately 41 foraging behaviours based on movement, body and head posture and used of wing or feet have been reported in family Ardeidae that include egrets, herons and bitterns (Mckilligan, 2005; Kushlan and Hancock, 2005).

The foraging ecology is often characterized by food selection, habitat preferences and prey capturing tactic or behaviour employed by avian species in particular habitat (Dunchin *et al.*, 2008). The foraging ecology of egrets such as food intake, prey capture rate, and percentage of successful pecks had been investigated in various habitats such as rice fields, freshwater marshes, salt marshes, river and estuaries (Custer *et al.*, 2004; Trocki and Paton, 2006; Taylor and Schultz, 2008).

Egrets are good subject for foraging study because they are large, abundant and consumed easily identified prey. They are most gregarious birds and often foraged on variety of food items that occur in shallow wetland habitat (Frederick, 2002). Unfortunately, research on foraging behaviour of egrets in various habitats particularly POME (Palm Oil Mill Effluent) ponds, lakes, wetlands and aquacultural ponds in Malaysia is lacking. Information on egrets foraging strategy in POME pond area is not sufficient, even though these species commonly occurs in a variety of aquatic habitats.

To date no detail studies have been done to examine the foraging strategies of egrets in POME area in Malaysia. Due to variation in foraging behaviour of egrets, more research is needed to assess the diverse foraging strategies employed by egrets in POME ponds. This information can be used to properly manage biodiversity and propose effective conservation programme. The main objective of this study was to determine foraging strategy employed by egrets. Various foraging strategies employ by five species of egrets in POME ponds area at Carey Island, Peninsular Malaysia were recorded.

MATERIALS AND METHODS

Study Site: Carey Island is located in Kuala Langat District, south to Port Klang and north to Klang River near Banting within the quadrant of 101 22′ E and 2 52′

N, in the state of Selangor, Peninsular Malaysia (Figure 1). It is separated from mainland by Langat River and connected by a bridge at Chondoi or Teluk Panglima Garang near Banting. This island encompasses of 15,000ha of land area, out of which 80.0% of the area belongs to Sime Darby Plantation Berhad while the remaining 20.0% is state land. The island is located at 2 meter below sea level (during high tide) and encompass of diverse habitats such as narrow sea-shore, mudflats, sandy beach and swampy area.

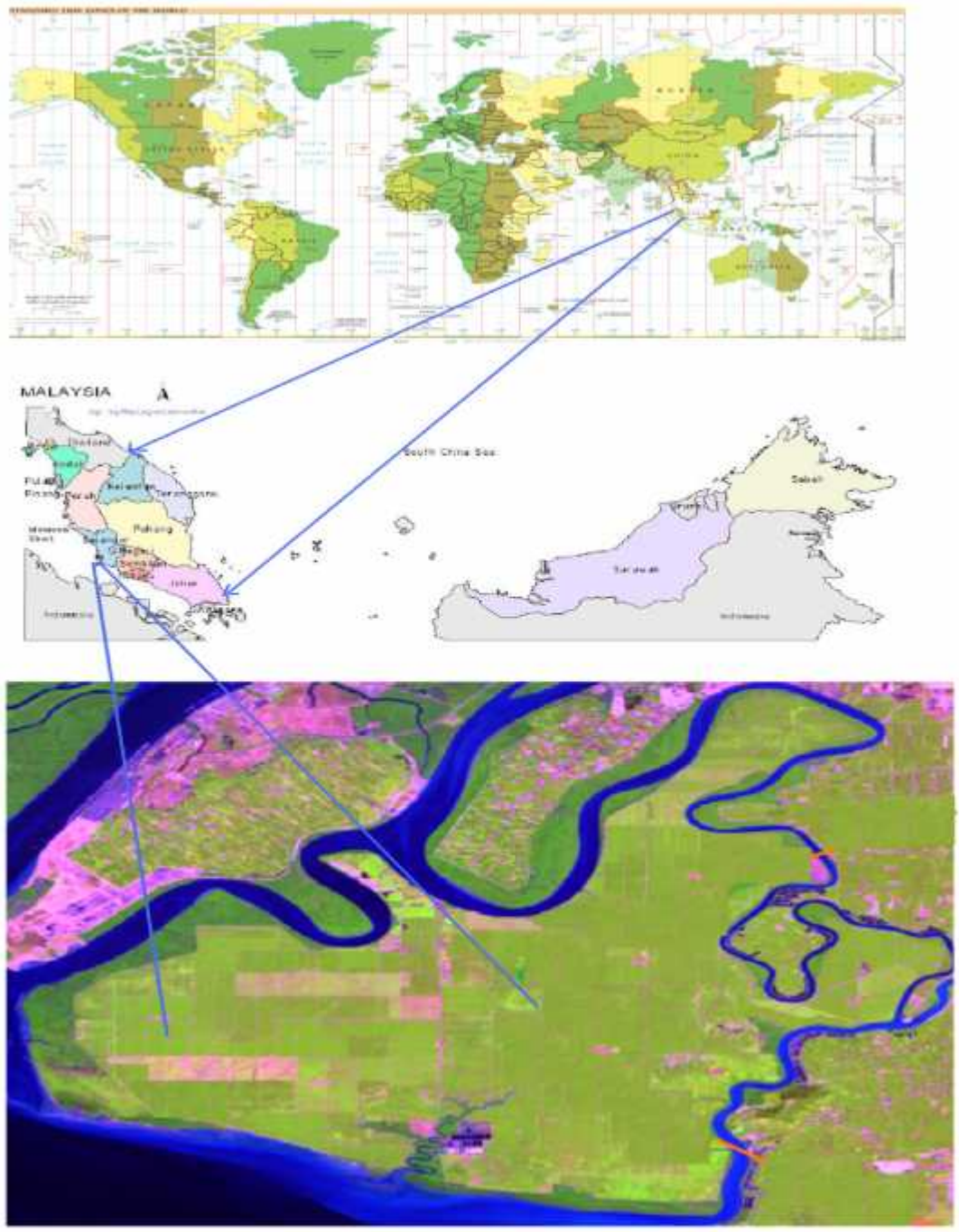
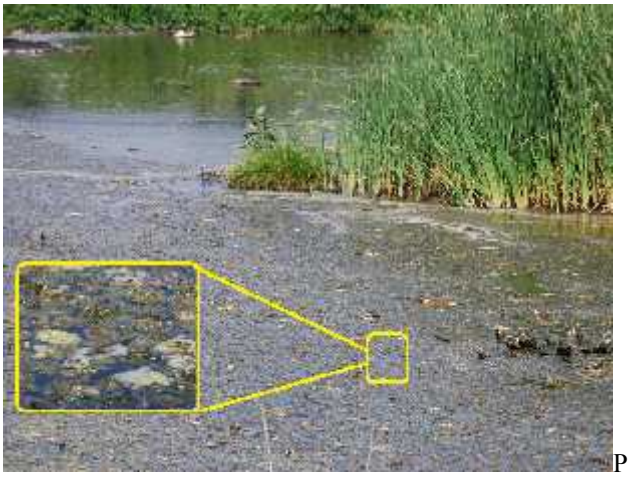


Figure 1. Location of study site in Carey Island, Selangor, Peninsular Malaysia

There are four POME ponds in the study site. Each pond varies in term of size, water level, floating material, percentage of vegetation cover and physical structure. For example; POME pond number one dominated by compacted waste material along the sides as well as in center, the edges were covered with Cattail

(*Typha* sp.) and in some places with trees, i.e. Blush Macaranga (*Macaranga tanarius*), Oil Palm (*Elaeis guineensis*), Timar (*Avicennia marina*), and *Rhizophora apiculata.* POME pond number two possess small size floating compacted waste material and around 40% of its surface is covered with Cattail (*Typha* sp.) while Blush Macaranga (*Macaranga tanarius*) and Oil Palm (*Elaeis guineensis*) are observed at pond side. Pond number three was quite different as compared to pond number one and two. This pond contains dead fallen trees and some mud mounds covered with Climbing Fern (*Stenochlaena palustris*) and Three Square Bulrush (*Scirpus olneyi*). Pond number four was densely covered with algae giving lush green look. Along its edge few species such as Climbing Fern (*S. palustris*), Blush Macaranga (*M. tanarius*), and Oil Palm (*E. guineensis*) trees were observed (Figure 2).

POME Pond Number One



POME Pond Number Two

POME Pond Number Three

POME Pond Number Four

Figure 2. Morphological Features of Four POME ponds of Carey Island

Observation on Foraging Behaviour: The foraging behaviour of five egret species patronising four POME ponds was recorded for a total of 192 days (i.e. once a week or four days a month), from January to December, 2008. Binoculars (10X42 magnification) and Digital video camera were used to observe and record various strategies employed by egrets in exploiting food resources. The observation was done from 0900 to 1800 hours. A tent was setup in dense vegetation along the bank and was used as a hide to minimize the effect of human presence on egret behaviour. The methodology was described in details by Kushlan (2007), Sharah *et al.* (2008), Yu-Seong *et al.* (2008) and Choi *et al*. (2010).

Data Analysis: The sighted probing activities of five egret species were summed and categorized according to hours and hourly frequency was determined as n/N x 100 (where n is numbers of particular sighted probing activity of each species per minute and N is total recorded probing activity per minute). The significant difference of mean probing activity per minute among five egret species was compared by one-way analysis of variance (ANOVA) and Tukey's (HSD) test. ANOVA is a

powerful statistical technique that involves partitioning the observed variance into different components to conduct various significance tests while Tukey's (HSD) test keeps the EER (Experiment wise Error Rate) at the specified significance level (Montgomery, 2001).

RESULTS AND DISCUSSION

Probing Behaviour of Five Egret Species per Minute: The results indicate that Little Egret had higher mean probing activity during morning, i.e. from 0900 to 1000hrs (52 times per minute) followed by 1000 to 1100hrs (46 times per minute) and 1100 to 1200hrs (42 times per minute) while the lowest probing activity was recorded during afternoon session, i.e. from 1700 to 1800hrs (only four times per minute) (Table 1). A total of 1186 sightings of Cattle Egret were recorded, indicated that the highest mean probing activity occurs during morning session, i.e. 42 times per minute (0900 to 1000hrs), 37 times per minute (1000 to 1100hrs) and 33 times per minute (1100 to 1200hrs). On contrary, the lowest probing activity occurs during afternoon session, i.e. from 1700 to 1800hrs (Table 1). A total of 956 sightings of Intermediate Egret were recorded. This bird active during morning session, i.e. from 0900 to 1000hrs to probe invertebrates (i.e. 20 mean probes per minute) and their probing activity was reduced during evening session, i.e. from 1700 to 1800hrs (only three probes per minute; Table 1). A total of 1023 sightings of Great Egret were recorded and these revealed that Great Egret had higher probing activity during 0900 to 1000hrs i.e. five probes/minute and lowest probing activity i.e. 0.4 probes/minute during 1700 to 1800hrs (Table 1). A total of 262 sightings of probing activity of Chinese Egret were recorded. This bird was actively forages during 0900 to 1000hrs (i.e. 19 probes/minute) but reduced its probing activity (one probe/minute) during evening, from 1700 to 1800hrs (Table 1).

Table 1: Probing activity of five egret species during different hours at POME ponds

Time (Hours)	Mean Probing/minute				
	Little Egret	Cattle Egret	Intermediate Egret	Great Egret	Chinese Egret
0900-1000	52 (*n* = 270)	42 (*n* = 232)	20 (*n* = 178)	5 (*n* = 185)	19 (*n* = 65)
1000-1100	46 (*n* = 220)	37 (*n* = 184)	15 (*n* = 165)	4 (*n* = 168)	15 (*n* = 44)
1100-1200	42 (*n* = 190)	33 (*n* = 156)	13 (*n* = 140)	3 (*n* = 144)	13 (*n* = 35
1200-1300	24 (*n* = 160)	21 (*n* = 142)	12 (*n* = 125)	3 (*n* = 125)	10 (*n* = 32)
1300- 1400	36 (*n* = 108)	18 (*n* = 100)	9 (*n* = 86)	2 (*n* = 98)	7 (*n* = 26)
1500-1600	21 (*n* = 120)	14 (*n* = 112)	7 (*n* = 74)	1 (*n* = 85)	5 (*n* = 20)
1600-1700	11 (*n* = 135)	8 (*n* = 124)	4 (*n* = 80)	0.6 (*n* = 100)	4 (*n* = 18)
1700-1800	4 (*n* = 145)	2 (*n* = 136)	3 (*n* = 108)	0.4 (*n* = 118)	1 (*n* = 22)
Total	236 (n = 1348)	175 (*n* = 1186)	83 (*n* = 956)	19 (*n* = 1023)	74 (*n* = 262)

(n= total number of observations)

The results showed that the mean probing per minute of Little Egret, Intermediate Egret and Great Egret was significantly different ($F_{4, 35} = 8.22$, $P < 0.05$) (Table 2 and 3).

Table 2: Comparison of probing activity per minute between five egret species at POME ponds in Carey Island, Selangor

Species Name	Mean Probing Per Minute
Little Egret	29.50 a
Cattle Egret	21.88 a
Intermediate Egret	10.78 b
Chinese Egret	9.25 b
Great Egret	2.38 c

(The mean values bearing similar letter are not significant at P = 0.05, Tukey's HSD test; Critical Value, 15.39)

Table 3: Analysis of Variance (ANOVA) of probing per minute of five egret species at POME ponds of Carey Island, Peninsular Malaysia

DF	SS	MS	F	P
4	3766.65	941.66	8.22	0.0001
35	4007.64	114.5		
39	7774.3			

Other Activities Employed by Five Egrets during Foraging: Other foraging activities shown by egrets include walking slowly or quickly, lean and wait, stand and wait, stand and feed, wing flick, foot shuffle, gleaning and aggressive behaviour. The most frequent feeding behaviour sighted for Great Egrets was walking slowly (52.6%) and stand and wait (25.3%). This species wing flick, foot shuffle, and gleaning techniques during foraging. Little Egrets prefer to capture their prey using walking quickly (38.2%) and stand and wait (23.3%)

strategies. This is the only egret species that was recorded employing foot shuffling technique in capturing their prey. Intermediate Egrets frequently moved slowly (38.2%) while foraging and employed lean and wait (31.0%) method to capture their prey. On the other hand, Cattle Egrets (i.e. 48.0%) and Chinese Egrets (i.e. 46.6%) preferred walking slowly in searching for their prey. Cattle Egret was the only egret species that use gleaning behaviour to prey on hidden invertebrates under soft mud (Table 4).

Table 4: Frequency (%) of main feeding methods employed by five egret species in POME ponds of Carey Island, Peninsular Malaysia (n = total number of sightings).

Feeding Methods	Egrets Species				
	Great Egret (n = 860)	Little Egret (n = 1080)	Intermediate Egret (n = 620)	Cattle Egret (n = 740)	Chinese Egret (n = 180)
Walk Slowly (WS)	52.60%	5.40%	38.20%	48.00%	46.60%
Walk Quickly (WQ)	1.40%	38.20%	3.40%	3.30%	2.00%
Lean and Wait (LW)	15.00%	5.20%	31.00%	16.00%	6.40%
Stand and Wait (SW)	25.30%	7.60%	17.60%	12.50%	19.80%
Stand and Feed (SF)	4.70%	23.30%	7.30%	15.00%	21.20%
Wing Flick (WF)	-	2.30%	1.30%	2.00%	3.00%
Foot Shuffling (FS)	-	16.00%	-	-	-
Gleaning (G)	-	-	-	2.20%	-
Aggressive (A)	1.00%	2.00%	1.20%	1.00%	1.00%

This study revealed that different egret species have employed various feeding strategies depending on sites selection and types of available prey. Since egrets are active forager, they need to employ various foraging methods and prey capturing techniques in particular habitats or under specific conditions. This allow egrets to walks slowly, walks quickly, lean and wait, stand and wait, stand and feed, wing flick, foot shuffle, gleaning, stand and wait to detect their prey items occurring at various water depth.

It was observed that morphological characteristics such as bill lengths and shapes, neck lengths and leg lengths are affecting egrets foraging behavior. These physical characteristics influence egrets in obtaining their prey at various water levels below the length of tarsus. Most egrets prefer to forage along the ponds' edges, at shallow water area where depth was below their tarsus and on floating objects such as compacted waste material and dead fallen trees. Previous study by Kushlan and Hancock (2005) also reported that morphological characteristics such as tarsus, beak and neck length allowed egrets to hunt on variety of prey items at certain water depths.

It was observed that Little Egret (*Egretta garzetta*) was more active than other egret species utilizing POME area. The former species employed nine foraging strategies in acquiring its food resources. These include walk slowly, walk quickly, lean and wait, stand and wait, stand and feed, wing flick, foot shuffling, gleaning and aggressive behavior during foraging. Little Egret was the only species that used foot shuffling technique to disperse the insects hidden in the mud or submerged vegetation. Once the insects were dispersing, they pick them quickly and gulp them. They walk slowly and sometime quickly in shallow water with raise wing to chase the insects. In stand and wait technique Little Egret wait for prey to come within the range of their beak. Most of the time Little Egret used compacted waste material that was floating in the center of the POME pond or somewhere deposited along the banks of the POME ponds for loafing. Such type of foraging strategies employed by Little Egr*et al*so has been recorded in previous study (Kushlan, 2007).

Intermediate Egrets (*Mesophoyx intermedia*) prefer to forage in open shallow water areas along the edges and soil depositions inside the pond number one and three. These ponds do not have vegetation allowing easy catch of prey in open shallow waters. The vegetation structure reduced the visibility of prey and inhibits forager's ability to locate and catch the prey. The edges of POME ponds may have a higher richness of prey and water depth is not too deep to catch the invertebrates prey items easily. During feeding, Intermediate egret use stand and wait behaviour for their prey to come within the range of their pointed beak and long neck, but sometimes they walk slowly and caught insect quickly when foraging with other species. Similar types of foraging strategy employed by Intermediate Egrets also have been recorded in previous studies (Bancroft *et al.,* 2002; Stolen, 2006; Yu-Seong *et al*., 2008; Choi *et al*., 2010).

Great Egrets (*Casmerodius albus*) foraged mostly in stand and waits behaviour and sometimes walks slowly to catch larger insects such as beetles, waterbugs and flies larvae in open shallow water of POME ponds. They caught the prey in shallow water along the edges in fully erect position by extending their neck and hold their beak perpendicular to the ground. They also hunted insect on crouch position, withdrawn their beak and hold back

against the body. Sometimes, they also hold their head to the water surface to reduce glare effect in bright sun. The results of foraging behaviour of Great Egrets are consistent with previous study carried out in agricultural landscape in Korea (Yu-Seong *et al*., 2008). Great Egret is known to attract other egret species in feeding areas (Gawlik, 2002). Great Egret that forages in flocks has a higher average strike rate than solitary foraging. Sherry (2006) had reported that Great Egret mostly foraged in the area with 16-30 cm water depths.

The Cattle Egrets (*Bubulcus cormorandus*) prefers to utilize the wet soil along the edges. They walk slowly or quickly and glean insects from low vegetation by rapid pecks. They prefer to use water body edges to hunt mostly on the insects and other animals such as tadpole and worms. The edge foraging preference may be due to diversity and richness of insects that disperse from water bodies due to movement of aquatic animals or the insects such as water beetles and flies larvae that are at final stage of their life cycles. They frequently peer nearby vegetated areas in upright posture and scanned larger area for preying on insects and other invertebrates. They chase insects, sighted from distance, moved quickly to hunt them. The larger preys caught were killed with sharp bill by smashing them on the ground and tore them into pieces before swallowing.

In POME pond number one and pond number three, Chinese Egret (*Egretta eulophotes*) preferred to forage extensively along pond edges surrounded by mangrove vegetation and mudflats, walk slowly in shallow waters and preyed on insects and other invertebrates such as flies' larvae. It was frequently sighted that they foraged solitary and silently in POME areas, but sometimes, they also mixed with other egret for foraging. During foraging, they lean their neck and bent their legs backwards at the knee, half-extended their wings and touch their beak towards the water surface to catch invertebrate prey. Sometimes, they also showed flush and stab behaviour such as running rapidly through shallow water along the mangrove and POME pond edges with forward neck and tilted head searching for food.

It was also observed that Great Egrets often defended their territory while Little Egrets and Cattle Egrets shared their feeding territories. Foraging sites was the major factor that influenced the distribution and foraging behaviour of egrets in the study area. Egrets used various sites such as POME edges, compacted waste material, surrounding landscape i.e. mangroves, oil palm plantation and mudflats for foraging, loafing and resting in the study area. Little Egrets and Cattle Egrets forage in a flock while Great Egrets foraged solitary. Little Egrets prefer to forage in flocks during morning and then in solitary when approaching mid-day. Feeding in aggregation is important behaviour of Little Egrets and Cattle Egrets. They can get more benefits from this behaviour such as decreased in searching time and reduce risk of obtaining no food and also increased capturing rate and energy consumption in flock foraging. Egrets often concentrated where their prey are more abundant.

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