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Ann Maria KJ
Vimala College, Thrissur, Kerala, India

Kezia Kuruvilla
Vimala College, Thrissur, Kerala, India

Correspondence
Kezia Kuruvilla
Vimala College, Thrissur, Kerala, India

Relative abundance of *Halcyon smyrnensis fusca* in Palakkal kole, Thrissur and its foraging behaviour

Ann Maria KJ and Kezia Kuruvilla

Abstract
Palakkal kole land provides a suitable habitat for arboreal aquatic foragers like kingfishers. This study showed the presence of six different kingfishers, with relative abundance of *Halcyon smyrnensis fusca.* This was followed by *Ceryle rudis* in their number. Both these birds were present in the study area throughout the year. *Halcyon pileata, Alcedo atthis, Alcedo meninting* and *Pelargopsis capensis* were also reported from the area. The white-throated kingfishers feed on diverse prey items by the sit and wait method and preferred a height of 4-7 m for perching. Water dive was the most common foraging technique used by the bird, but ground dive was found to be more successful. Perching time of up to thirty minutes was observed in 55.40% and between thirty and sixty minutes by 39.19%. 5.41% showed a waiting period of sixty to ninety minutes. Larger prey was immobilized before swallowing by battering it on the branches.

Keywords: Arboreal aquatic foragers, *Halcyon*, foraging, kole land

Introduction
Wetland ecosystems and the hydrological processes that govern them are fundamental to the maintenance of life on Earth. It provides mankind with a wealth of essential services. The kole lands of Thrissur is part of Vembanad kole, which forms one of the largest, highly productive and threatened wetland declared as Ramsar site in 2002. Kole wetlands provide multiple microhabitats which are utilized by birds belonging to different ecological groups. The vegetation directly or indirectly affects the arboreal aerial foragers [1]. Hydrological factors control the vegetation and food resources that influence the bird density, diversity and species richness [2-4].

Kingfishers are small usually bright blue and orange birds seen diving into water bodies and hunting fish, occasionally hovering above the water surface. They are small to medium-sized birds belonging to the order Coraciiformes. There are roughly ninety species of kingfishers, of which twelve are found in India. They have a very wide distribution and the group is treated either as a single family Alcedinidae, containing three subfamilies - Alcedininae, Halcyoninae, and Cerylinae [5] or as a suborder Alcedines containing three families Alcedinidae (river kingfishers), Cerylidae (water kingfishers) and Halcyonidae (tree kingfishers). Family Alcedinidae include the small kingfishers, family Cerylidae comprise the pied kingfishers and family Halcyonidae comprise the large tree kingfishers which occupy a wide range of habitats from rain forests to woodlands and even urban surroundings.

The common kingfisher (*Alcedo atthis*) also known as the river kingfisher has blue upperparts, orange under parts and a long bill. The blue-eared kingfisher (*Alcedo meninting*) is distinguished by the blue ear coverts, darker and more intense cobalt-blue upperparts with richer rufous under parts. The white-throated kingfisher (*Halcyon smyrnensis*) also known as the white-breasted kingfisher is widely distributed throughout the Indian subcontinent [6]. The black-capped kingfisher (*Halcyon pileata*) has a distinctive black cap that contrasts with the whitish throat, purple blue wings and coral red bill. The stork-billed kingfisher (*Pelargopsis capensis* formerly known as *Halcyon capensis*), is a tree kingfisher living in a variety of wooded habitats near lakes or rivers. The pied kingfisher (*Ceryle rudis*) is a water kingfisher with its characteristic black and white plumage.

Reza *et al.* [7] studied the status and density of kingfishers in the Sundarbans mangrove forest of Bangladesh. The feed preferences of the white-breasted kingfisher has been reported by Mukherjee [8] through the analysis of stomach contents. The present study is an attempt to record the occurrence of arboreal aquatic foragers in the wetlands of Palakkal kole area, Thrissur.

Feeding behaviour of *Halcyon smyrnensis* was also observed during the study.

Study area

The study was conducted in the kole wetlands of Palakkal, which is a part of Thrissur kole lands of Thrissur district. Thrissur kole is a unique ecosystem lying interconnected throughout the district. Palakkal is situated at the distance of 6 km from Thrissur, at geographical coordinates of 10^0 28' 15'' N and 76^0 12' 40''E. The study site had many different habitats such as deep and shallow waters, open mudflats, grassland and paddy fields.

Methodology

Bird survey was mainly based on line transect method [9] and direct counting. The time of observation was from 0630 hrs to 1030 hrs. Birds were identified with the help of 8x40 binoculars and classified according to the hand book and checklist of Ali and Ripley [10] and Ali [11].

The study period of October 2014 to September 2015 was divided into four quarters: months of October to December, January to March, April to June and July to September. The relative abundance (%) of bird species was estimated using the following expression: n/N x100 [12], where n is the number of a particular bird species and N is the total observations detected for all species. The feeding behaviour of *Halcyon smyrnensis fusca* was studied by observing the bird using 8X40 binoculars. The perching time and height was also recorded.

Results

Birds occupy a significant position in a wetland community. Their presence and diversity is the result of the extent of habitat and availability of food. Water is a major factor affecting the diversity of arboreal aquatic foragers. Kingfishers, a major representative of this group are generalist predators that feed mainly on fish, aquatic invertebrates, insects and amphibians.

The study showed the presence of six different kingfishers in the area, the most common sightings being of *Halcyon smyrnensis fusca*. The maximum sightings of the bird were in the months January to March. This was followed by *Ceryle rudis* in their number. Both these birds were present in the study area throughout the year (Table 1). *Halcyon pileata* had the minimum sightings followed by *Alcedo meninting.* These two birds showed their presence in the area only during the months January to March. *Alcedo atthis* and *Pelargopsis capensis* were also recorded from the area (Fig.1). Relative abundance of avian species was determined using encounter rates and the data of different kingfishers recorded from Palakkal kole is shown in Fig.2. *Halcyon smyrnensis* showed the highest relative abundance (37.37%), followed by *Ceryle rudis* (21.41%). *Halcyon pileata* showed the lowest value of 4.55%.

Halcyon smyrnensis perched itself on elevated areas from where it followed the prey in the ground or water. The bird used various perches for foraging which included electric wires running across the paddy fields, branches of trees and elevated poles fixed on the ground. The time spent by the bird on the perches for preying varied from 55.40% of the cases being less than thirty minutes, 39.19% between thirty and sixty minutes and 5.41% between sixty and ninety minutes (Fig.3). The height of the perch varied from one to ten meters. Majority of the birds perched at a height between 4 and 7 m (47.12%), while 14.42% used perches of 8-10 m height. Low perches below 3 m in height were also selected by the birds (38.46%). They dived into shallow or deep water or even into grass and vegetation from the perches.

The foraging method of *Halcyon smyrnensis* included 32.5% ground dive, 43.6% water dive, 9.4% aerial feeding and 14.52% ground feeding (Fig.4). Even though water dive is the most common tactic among white-throated kingfishers, they are not deep divers and do not spend significant amount of time under water. The most successful type of feeding was ground dive (78.9%) followed by water dive (74.5%). Hovering over water bodies was not exhibited by *Halcyon smyrnensis.* Birds usually exhibited sudden alert movements such as head turns before diving into a water body. After catching the prey, they flew straight out of the water and the prey is usually returned to a branch before swallowing. Sometimes, they engulfed the prey immediately after catching it. Sometimes they hold the prey in their beak for a while before swallowing. Small prey was swallowed directly by adjusting with the bill. Larger prey was immobilized by battering it on the branches with interspersed attempts of swallowing. Their large bill comes in handy to hammer the prey to death.

Table 1: Arboreal aquatic foragers recorded from Palakkal kole wetland during different quarters of the study period

Arboreal aquatic forager	Months			
	Oct-Dec 2014	Jan-Mar 2015	Apr-Jun 2015	Jul-Sept 2015
Ceryle rudis	1.27±0.53	4.33±0.9	4.33±1.35	2.53±0.86
Halcyon smyrnensis	4.5±0.52	8.2±0.78	6.7±1.02	4.9±1.43
Halcyon pileata	-	0.66±2.76	-	-
Alcedo atthis	0.7±3.14	2.94±1.89	1.35±2.88	-
Alcedo meninting	-	0.7±3.64	-	-
Pelargopsis capensis	-	3.77±2.43	1.4±0.2.69	-

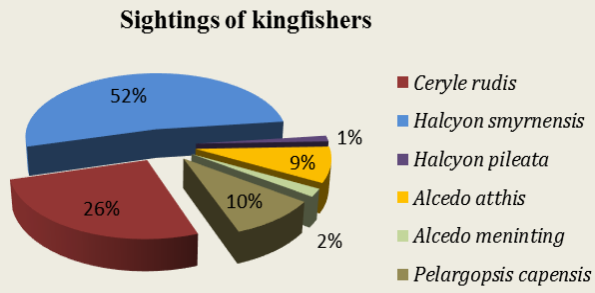

Fig 1: Percentage sightings of arboreal aquatic foragers recorded from Palakkal kole, Thrissur

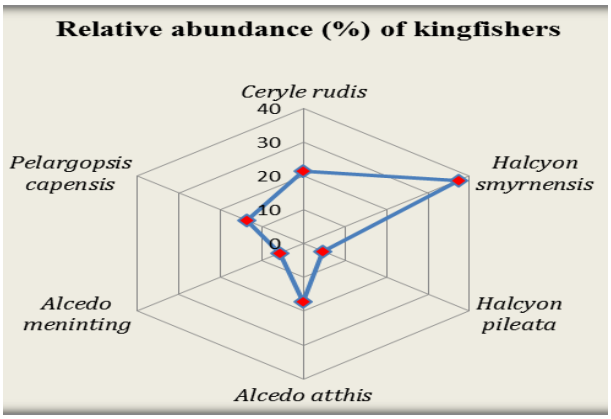

Fig 2: Relative abundance (%) of different kingfishers recorded from Palakkal kole

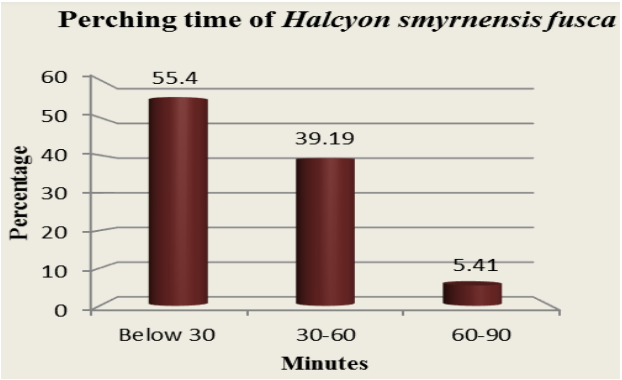

Fig 3: Perching time of *Halcyon smyrnensis fusca* was categorised as below 30 minutes, 30-60 minutes and 60-90 minutes

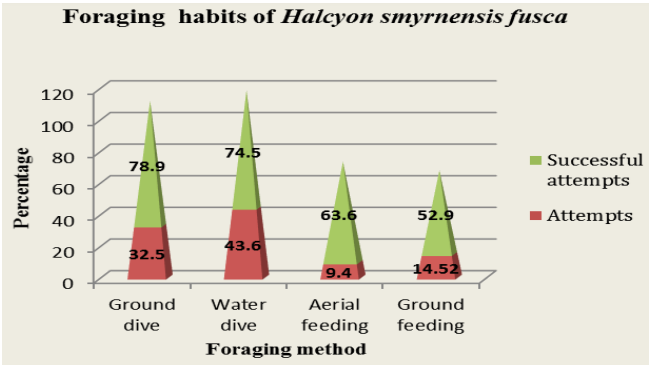

Fig 4: Attempt and success of different foraging techniques exhibited by *Halcyon smyrnensis fusca* expressed as percentage

Discussion

The presence of foraging bird species in an area is dependent on habitat type, climatic conditions and resource stability [13, 14]. Multiple feeding guilds offered by kole wetlands supply surplus food to different types of birds. Six different types of kingfishers were recorded during the study. These birds feed on a variety of animals like crustaceans, insects, earthworms, fishes, frogs etc. and they scan both land and water bodies for their dietary sources.

The white throated kingfisher is a sit-and-wait predator and spent long periods searching for the prey. Ali *et al.*, [15] reported that the scanning activity was the most time consuming activity for white-throated kingfishers. During preying, they perched on the branches of trees or electric lines near a water body or in paddy fields. According to Islam and Kamruzzaman [16] they foraged by scanning the water surface from a perch and plunged head long into water. They also preyed on flying insects. Swarming termites may be caught in flight [17].

According to Avian web [18] perching height was up to 10 m from the ground. The present study showed the maximum cases of perching at a height between 4 and 7 m**.** With perch plunge method, a bird will increase its perch height with an increased depth of water [19]. Kingfishers usually preferred a certain height from where it would be easy for them to prey. Maximum attempts were found to be from a height of 4-7 m. The time taken to engulf a prey after a catch depends on the prey. It was noticed that the prey was immobilized by battering it against the perch several times. Ali and Ripley [20] has reported that the fish was held crosswise in the bill. *H. smyrnensis* hunt alone, but where hunting is good, birds might perch as close as 100 m apart without showing much hostility [17].

Conclusion

Kole lands with its favorable conditions and resources support a wide range of avifauna. The highly productive water bodies and paddy fields cater to the needs of aerial aquatic foragers with their diverse feeding habits. The commonly seen white-throated kingfisher with its euryphagic behaviour is found to occupy a wide range of artificial and natural ecosystems. They adopt diverse feeding strategies to successfully establish themselves in shifting environment.

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