

Diet of White-throated Kingfisher (*Halcyon smyrnensis* [Linnaeus, 1758]: Alcedinidae: Coraciiformes) inferred from pictorial postings in social media



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Abstract. White-throated kingfisher *Halcyon smyrnensis* (family Alcedinidae, order Coraciiformes) is known to distribute widely in Asia, including Sinai Peninsula, South Asia, China, until Southeast Asia. As each population has become resident to their respective range, it has adapted to its environment which effect on diet they eat. Recall that the wide distribution of this kingfisher, it is difficult to do field survey to observe the range of its dietary. This study aims to do an inventory on the diet of white-throated kingfisher by using social media as survey platform. Instagram and Facebook were surveyed by making inquiries using keywords such as 'white-throated kingfisher,' '*Halcyon smyrnensis*,' and other terms related to this kingfisher species. The query specifically sought pictorial postings instead of non-pictorial ones, in order to analyze preys' classification. More than 1,200 posts were retrieved from the two social media, yet only 89 posts counted as they showed predation activities by this species. Identification on the preys signifies that they consist of arthropods (27.0%), fishes (19.1%), amphibians (13.5%), reptiles (20.2%), other birds (6.7%), mammal (1.1%) and unknown prey items (12.4%). Including into these preys were monitor lizard, munia, locusts, crickets, beetles, cockroaches, and snails which may become pests in agricultural area. The wide array of diet consumed by white-throated kingfisher not only proves its opportunistic nature in preying food items, nevertheless it also provides opportunity to use this bird as natural biological control in agricultural system.

Keywords: Facebook, Instagram, natural biological control, opportunistic, pest

INTRODUCTION

White-throated kingfisher *Halcyon smyrnensis* (Alcedinidae: Coraciiformes) is a bird species commonly inhabits various habitats, from forest-edge up to anthropogenic area. It distributes across Turkey, Egypt, Iraq, Iran, Afghanistan, South Asia, and many parts of Southeast Asia [1-3]. Currently, there are three subspecies recognized; *H. s. saturator* that is limited to Andaman Island, *H. s. fusca* that distributes in Southeast Asia and *H. s. smyrnensis* inhabits other parts of the distribution range; *Halcyon gularis* from Philippines was previously included as its subspecies [3,4]. Its global population size, despite not yet quantified, is assumed to be increasing due to its high adaptability to anthropogenic-impacted habitats such as garden or oil-palm plantation [5]. A 2015 census in Europe estimated a record of 170-260 breeding pairs (equal to 340-520 mature individuals) which presumably contributed to <5% of the global population [6].

White-throated kingfisher has been recorded to consume a wide variety of prey, including insects, crustaceans, earthworms, fishes, frogs, and other vertebrates [3,7]. It is an ambush predator, by waiting potential prey at aboveground perch before diving head first and captures the prey with its robust beak. Prey will be foremostly battered by ramming it to hard surface before swallowed. Despite being well documented for its prey items, the vast distribution range of white-throated kingfisher may impose that more unknown food items it has adapted to consume. The knowledge on this matter will be important in assessing the resilience of this species against impending anthropogenic and natural threats which may decrease its population.

Surveying species with global distribution range presents some difficulties especially that sizeable area should be physically visited. It will cost a tremendous amount of time, effort, and funding. This troublesome hindrance has found its solution through the implementation of citizen science where biodiversity monitoring can be conducted through the advance of communication and



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Table 1. Predation by white-throated kingfisher per prey taxa

Taxa	Arthropods	Fishes	Amphibians	Reptiles	Aves	Mammal	Unknown
ΣPic	24	17	12	18	6	1	11
%	27.0%	19.1%	13.5%	20.2%	6.7%	1.1%	12.4%
Total Pictures =							89

information technology combine with community participation in survey scheme [8,9]. Biodiversity data can be compiled from the information voluntarily submitted by masses of people into certain database such as Global Biodiversity Information Facility (GBIF), iNaturalist or eBird where the overall data is synthesized to describe the possible condition of such biodiversity [10]. Therefore, this study intends to do an exhaustive inventory and analysis on the diet items of white-throated kingfisher by using citizen science scheme through online query on the pictures of targeted bird species posted in social media from across its distributional range.

METHODOLOGY

Observation Technique and Study Period

This study specifically observed pictorial postings from Instagram and Facebook, conducted from 1 March to 30 April 2022. The survey process followed six steps procedure for online monitoring to observe the intended bird species, i.e., 1) defining scope and target of monitoring, 2) finding the candidates websites, which in this study required ones with pictorial posting capacity and equipped with search engine to facilitate inquiry with certain keywords (i.e., Instagram and Facebook), 3) selecting the targets through more thorough observation, 4) mining the pictures and metadata, 5) cleaning and sorting data, and 6) analyze the data [11]. The use of Instagram and Facebook was based on their nature as free photo and video sharing social networking aside from their massiveness in storing pictorial contents potentially related to this study. Both also have more relaxed nuance in accommodating the picture posting, hence it was more suitable to look for pictures that specifically recorded the predating occasions made by white-throated kingfisher upon its preys. The photos showing the bird preying on other organisms considered valuable to attract the like or attention from audiences (i.e., other users of social media platforms). The searching for such pictures using two main keywords '*Halcyon smyrnensis*' and 'white-throated kingfisher' while the pictures were selected based on the recorded situation of 'predation' commenced by this kingfisher species. Whenever possible, the inquiry was also conducted using keywords in local language (i.e., Indonesian Bahasa) to extend the result.

Ethical Consideration

The monitoring on social media postings followed the research protocol in data collection for online market observations, that social media posts were perceived as 'free to use' for anyone, hence can be used by user with access [12]. Posts marked as 'private' or 'disallowed' by

the owner would be excluded from the data record. In order to warrant the safety of account holders, none of them mentioned in this study [13,14]. Authors also recognize the ownerships of pictures used as data in this study to belong to each account where it is posted.

Data Analysis

Descriptive analysis was used to outline the data gained from online observation. The prey that predated by the white-throated kingfisher was identified into general taxa such as arthropods, fishes, amphibians, reptiles, birds, and mammals. The taxonomy of prey organism was determined whenever possible and if the clarity of object allowed for such purpose. When the prey organism could not be identified at all, it was group into 'unknown' category. The percentage of certain prey category was calculated and whenever unusual prey item observed from the picture, its significance was outlined based on current knowledge regarding the diet inventory of white-throated kingfisher.

RESULTS AND DISCUSSION

The Result of Online Inquiry on Predation by White-throated Kingfisher

In total, there were more than 1,200 pictures tagged as '*Halcyon smyrnensis*,' 'white-throated kingfisher' or other written variations of these two names used for bird species of interest retrieved from Instagram and Facebook. After scrutinized, however, only 89 pictures that depicting predation occasions performed by this kingfisher. Sorted according to the prey taxa, it was shown that arthropods constituted the major diet (27.0%), followed by reptiles (20.2%), fishes (19.1%), amphibians (13.5%), other bird species (6.7%) and one occasion of predation on small mammal (Table 1). There were 11 predation occasions which could not be determined to happen on which prey taxa and included as 'unknown' category. Usually, this happened to the poor quality of pictures, miniscule size of prey compared to the kingfisher posture and other causes.

The diet composition of white-throated kingfisher is usually dominated by various arthropod species [15]. Breeding white-throat kingfisher is known to preferably feed their chicks with beetles, grasshoppers, crickets, ants, and crustacean [16]. Arthropods, especially insects, are known to be main food items for birds despite birds' diet typecasting, due to nutritional contents and the ubiquitous of arthropods [17,18]. The proportion of prey taxa could also be varied depends on habitat where the bird lives or influenced by season, as white-throated kingfisher which nesting nearby water body or during wet season tend to consume fishes more than other

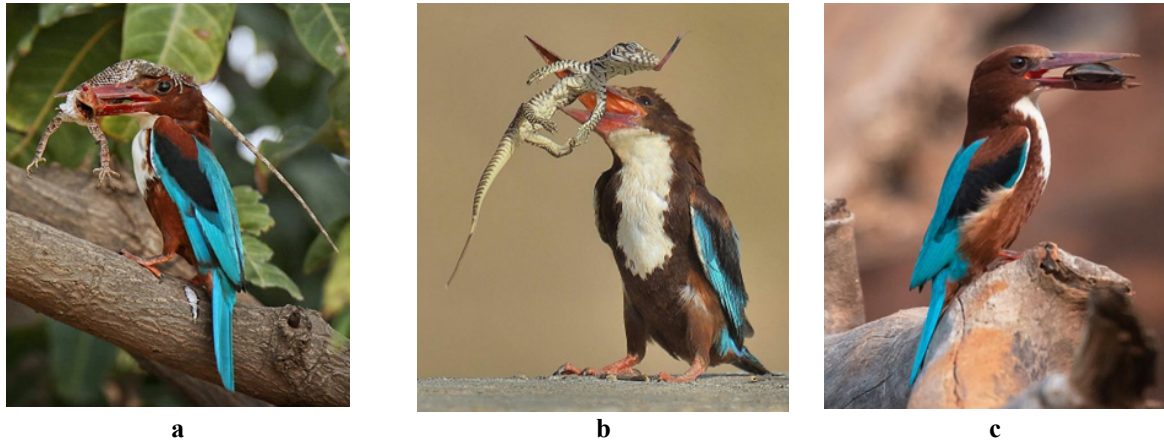


Figure 1. Some unusual prey for white-throated kingfisher: large agamid lizard (a), young monitor lizard (b) and turtle hatchling (right) (Source: various Instagram accounts)



Figure 2. Two subadult white-throated kingfishers perch on tree where the heron colony nesting (a). The individual on the right holds a heron chick before trying to swallow it down (video of this occasion can also be accessed through https://www.instagram.com/p/CQan_tIAm-n/)

organisms [3,19,20]. White-throated kingfisher also shows ability to prey upon organisms living in anthropogenic area such as house lizard *Hemidactylus aquilonius* [21].

Unusual Preys of White-throated Kingfisher

Some pictures showed unusual prey items which possibly not or rarely recorded in previous publications. Despite known to prey on small reptiles such as skinks, lizards, or snakes, two pictures show white-throated kingfisher can overcome sizeable agamid lizard (Agamidae), a young monitor lizard (Varanidae) and even a turtle hatchling (Figure 1). The agamid and monitor lizards probably have not yet listed as food items for this kingfisher [2-4,15-20]. Meanwhile predation on testudines by white-throated kingfisher was previously reported happened on hatchlings of Indian flapshell turtle *Lissemys punctata* and western Caspian turtle *Mauremys rivulata* [22]. The fresh condition of preys may suggest that white-throated hunt down and subdue them before devouring them, instead of just taking advantage on mere dead organisms. In addition, a Facebook posting with a sequence of pictures also signified the capability of white-throated kingfisher to hunt down a small mammal like adult rat, possibly from *Rattus* genus (pictures are not shown due to possible copyright infringement, yet

the information regarding the hunt was allowed to record in this study).

Previous publications noted that white-throated kingfisher preys on many adults and chicks of passerines such as those from genera *Lonchura*, *Passer*, *Zosterops*, *Copsychus*, *Phyloscopus* or *Vanellus* [3]. Predations of some of these passerine taxa were also observed from pictures collected in this study. Furthermore, a series of pictures and video in an Instagram post made by an Israeli wildlife observer showed two subadult white-throated kingfishers hunting prey in a tree colonized by unidentified heron species (family Ardeidae, order Pelecaniformes). One of these kingfishers held a heron chick in its beak before devoured it despite the noisy commotion made by the surrounding adult herons (Figure 2). These pictures provide proof that white-throated kingfisher can actively hunt its prey even from among breeding colony of herons that are noticeably and comparably bigger in body size and highly alert for any upcoming threat to their nests or chicks. Moreover, this predation occasion possibly added new avian species into white-throated kingfisher's food items which previously listed species only from Passerine group.

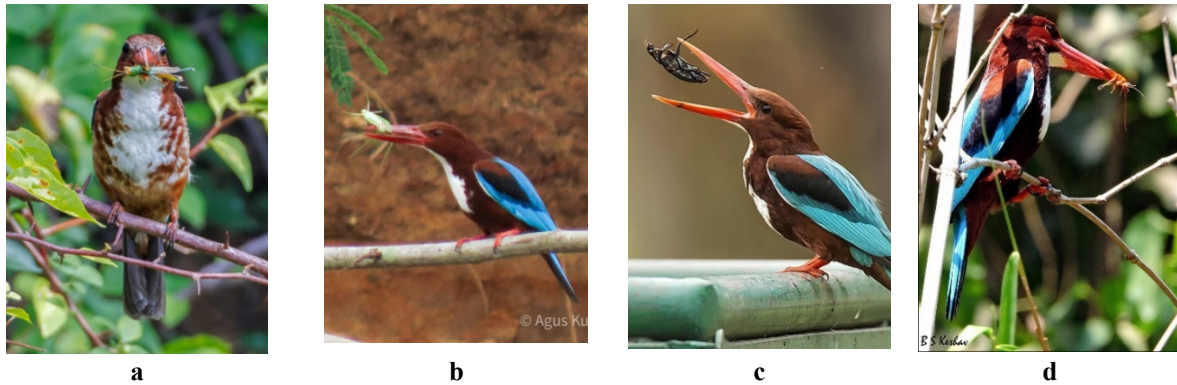


Figure 3. Agricultural pests which preyed by white-throated kingfisher: locust (a), grasshopper (b), beetle (c) and cockroach (d) (Source: various Instagram accounts)

Further Implication of Predation by White-throated Kingfisher

White-throated kingfisher, through the collection of sampled pictures in this study, was shown to prey upon young monitor lizard, munia (*Lonchura* birds of Estrildidae), locusts, crickets, beetles, cockroaches, and snails as well as rodent. These recognized preys are also considered to be pests in agricultural area which impact can be negatively significant (34-100% crop damage) if their population grow outbreaks [23,24]. Pest management which involves chemical substances most often result in the ineffectiveness due to ability of pest organisms develop resistance. Hence, biological pest management using natural food chains in nature can be considered much safer and more efficient in the long run of agricultural activities. Insectivore and carnivore birds are essential parts in agricultural pest management as they help suppressing pest population [25]. Species with broad diet array such as white-throated kingfisher (Figure 3) can be invaluable component in agricultural pest management as many of pest organisms it preys upon, in addition to its wide range distribution and adaptability to various types of habitats which make it possible to be used for this purpose across the globe [26]. It is also safe to assume that other kingfishers with similar morphology, ecology and behavior like white-throated kingfisher would possess similar potential. Therefore, the existence of this kingfisher, along with other kingfisher and bird species in agricultural area provide ecological benefits as biocontrol agents. Hence, their existence should be accommodated or just left undisturbed for the least.

CONCLUSION

According to the data from online survey, the white-throated kingfisher more prefers arthropods, reptiles, and fishes as its food, despite amphibians, other bird species and even mammal would be consumed whenever possible. The predation and consumption of agamid lizard, monitor lizard, turtle hatchling and heron chick by white-throated kingfisher that were observed through the pictures collected from social media postings presented proof of feeding and preying extensivity of this kingfisher. In addition to it, the white-throated kingfisher can be an opportunistic bird that feeds upon most

organisms they can subdue. At the same time, its broad array of feeding items also demonstrates the potentiality of integrating this kingfisher species into the agricultural pest management.

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