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Seasonal Incidence of Asian Bee-Eater, *Merops orientalis* Lan. on *Apis mellifera* Linn. under *Terai* Agro-ecological Region of West Bengal

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***Abstract*:** The present study was conducted to evaluate the seasonal incidence of Asian green bee-eater, *Merops orientalis* on Western honey bee, *Apis mellifera* under *Terai* agro-ecological region of West Bengal, India. Different trees, crops, shrubs, electric power lines, instructional boards, fencing, bamboo pegs, rice stubbles, as well as ground were the perching sites used by the birds. Their incidence on honey bees was maximum during December to February and completely absent near the apiary from last week of March to the first week of July. They were quite successful as a predator with a success ratio of 76.27%. Highest activity of the birds was recorded at 13:00-14:00 when the foraging activity of the honey bees was also high enough. The results obtained from the present study could be helpful to adopt appropriate vertebrate pest management strategies against *M. orientalis* that will allow the beekeepers to look after that particular time period when these birds are more abundant.

***Keywords*:** *Apis mellifera*, *Merops orientalis*, Seasonal incidence

Beekeeping is always considered as a lucrative venture, specifically for the rural people, who heavily rely on agriculture and forest resources. The *Terai* agro-ecological region of West Bengal is home of many of such rural communities who are fully depend on agricultural and horticultural as well as forest resources to earn a livelihood. Moreover, this region is also blessed with a rich floral diversity that can be utilized by honey bees as a potential source of pollen and nectar (Saha et al 2023a). So, beekeeping could play an important role in the socio-economic upliftment of these rural communities. However, in the present framework of technological advancement, worldwide commercial beekeeping is facing a downward trend (Potts et al 2010a, Kohsaka et al 2017, Gajardo-Rojas et al 2022) due to various biotic and abiotic stressors (Potts et al 2010b, Hristov et al 2020, Saha et al 2023b). Among them, different pests and natural enemies of honey bees have a significant impact on beekeeping. In our previous works, we have already evaluated the incidence of some important pests and natural enemies on Western honey bee, *Apis mellifera* Linn. colonies under *Terai* agro-ecological region of West Bengal (Singha et al 2022, 2023a, 2023b, 2023c). However, a few pests and/or natural enemies still remain.

Bee-eater is a group of insectivorous bird (Coraciiformes: Meropidae), predominantly feeding on any flying insects. However, as their name suggests, they mostly prefer hymenopterans in their diet. There are a total of 26 bee-eater species distributed throughout the Palaeotropics and southern Eurasia (Glaiim 2014) of which six species are found in India (Vaidyanathan and Venkatraman 2022). Among the bee-eaters found in India, *Merops orientalis* is the most variable one in terms of their plumage colour. This birds frequently forage over agricultural fields and search for insects, as 95% of their prey consist of various group of insect (Asokan et al 2010). However, their role as pest is not well defined. As insects are their basic food, so some people, mostly farmers consider this bird beneficial due to their feeding on crop pests. Whereas, some people, like beekeepers consider them as pest, as they prey on honey bees and reduce the colony strength. This present work has been designed to evaluate the seasonal incidence of another important natural enemy of honey bees, i.e., Asian green bee-eater bird, *Merops orientalis* Lan. (Meropidae: Coraciiformes) in the agro-climatic region under consideration.

MATERIAL AND METHODS

Study area: The present investigation was carried out at the apiary of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal, India located at latitude of 26^{0}19' N and longitude of 89^{0}23' E, at an elevation of 43 meter above mean sea level (msl) during 2019 and 2020. In the apiary unit, a total of ten strong (similar in strength) *A. mellifera* colonies have been

placed without adopting any vertebrate pest management strategies. During dearth period, the colonies were fed with only sugar-syrup solution to maintain their strength. This region is characterized by typical per humid climate with an annual average rainfall of >3000mm and relative humidity of 65–90%. Here, the southwest monsoon is responsible for 80% of the total rainfall during June–September. This region has an average maximum and minimum temperature of 24°C and 33.2°C, respectively, with the presence of warm weather except December-February months having a short spell of winter.

Seasonal incidence of *Merops orientalis*: To evaluate the seasonal incidence of *Merops orientalis* on *Apis mellifera*, their foraging activity near the apiary was carefully monitored using a 360°viewing CCTV Camera, installed in the apiary. Recorded movie was analysed/viewed to record data at a time gap of one hour, viz. 09:00-10:00, 11:00-12:00, 13:00-14:00, and 15:00-16:00. Direct observation was also recorded. Data was recorded based on continuous stay by birds near the apiary during study time, number of total, successful and unsuccessful attempts to catch the bees, number of raids by a bird, and number of individual birds participated in raid.

RESULTS AND DISCUSSION

Merops orientalis used to perch on different trees, crops, shrubs, electric power lines, instructional boards, fencing, bamboo pegs, rice stubbles, as well as on ground. Electric cables were the most utilized perching site by the birds, where they wait and capture the flying bees whenever noticed. Such high elevations allow them to capture the bees more efficiently (Fig. 1). Along with the visual observation, the sound of chewing bees by the birds also served as an indication of successful attempt. Usually, the activity of honey bee predators depends on the activity of foraging bees. Maximum incidence of *Merops orientalis* on *Apis mellifera* colonies was from December to February with the population reaching its peak in January (i.e., 68 individual birds attempting a total of 344 number of raids) (Table 1). Usually in

Fig. 1. Act of predation of *Merops orientalis* on honey bee

Table 1. Seasonal incidence of Asian green bee-eater bird, *Merops orientalis* during 2019-20 (Mean±SEm)

Months	Number of individual birds encountered in attack	Number of attacks observed	Raid/ individual bird	Raids by the birds in a day during study time	Number of successful attacks observed	Number of successful raids/day	% of successful raids	Number of unsuccessful attacks observed	Number of unsuccessful raids/day	% of unsuccessful raids
September	50	190	3.80	47.50±3.23	134	33.50±2.10	70.63±0.95	56	14.00±1.22	29.37±0.95
October	51	216	4.24	54.00±2.12	158	39.50±1.66	73.16±1.53	58	14.50±1.04	26.84±1.53
November	60	273	4.55	68.25±2.75	216	54.00±2.38	79.10±1.08	57	14.25±0.85	20.90±1.08
December	62	316	5.10	79.00±1.78	257	64.25±2.53	81.25±1.69	59	14.75±1.11	18.75±1.69
January	68	344	5.06	86.00±2.86	275	68.75±2.69	79.90±0.92	69	17.25±0.75	20.10±0.92
February	62	317	5.11	79.25±3.50	249	62.25±2.87	78.53±0.78	68	17.00±0.91	21.47±0.78
March	25	95	3.80	23.75±8.14	71	17.75±6.18	72.87±2.09	24	6.00±1.96	27.13±2.09
April-June	0	NA	NA	NA	0	NA	NA	0	NA	NA
July	19	65	3.42	16.25±4.46	49	12.25±3.42	73.76±3.72	16	4.00±1.22	26.24±3.72
August	36	140	3.89	35.00±2.12	108	27.00±1.47	77.25±1.41	32	8.00±0.82	22.75±1.41
Total	433	1956	—	—	1517	—	—	439	—	—
Mean±SEm	—	—	4.33±0.22	—	—	—	76.27±1.24	—	—	23.73±1.24

northern districts of West Bengal, this time period was considered as honey flow period with presence of ample amount of pollen and nectar providing plants (Saha et al 2023a), which might be responsible for higher foraging activity of honey bees in fields that ultimately increased the incidence of birds preying on them. Thereafter, from March onwards there was a steady decline in the incidence of *M. orientalis*. There was no presence of these birds from last week of March to the first week of July. This time period is characterized by high temperature and high rainfall which

Table 2. Time variation in the incidence of Asian green bee-eater bird, *Merops orientalis* during 2019-20 (Mean±SEm)

Months	Time duration	Duration of staying in apiary at an hour interval	No. of birds involved in attack	No. of raids carried out by the birds	No. of raids/min (during staying in the apiary)
September	09:00-10:00	8.75±3.15	1.00±0.41	3.00±1.08	0.34±0.03
	11:00-12:00	30.50±2.10	3.75±0.48	12.00±1.08	0.42±0.09
	13:00-14:00	60.00±0.00	4.50±0.29	21.75±1.49	0.37±0.03
	15:00-16:00	38.00±2.97	3.25±0.25	10.75±1.11	0.33±0.04
October	09:00-10:00	21.00±1.08	1.75±0.25	5.50±0.65	0.27±0.04
	11:00-12:00	38.00±2.86	3.75±0.48	16.75±1.38	0.45±0.06
	13:00-14:00	60.00±0.00	4.75±0.48	21.75±2.59	0.36±0.04
	15:00-16:00	34.5.±2.02	2.50±0.29	10.00±0.71	0.29±0.03
November	09:00-10:00	35.5.±1.66	2.50±0.29	8.00±0.82	0.23±0.03
	11:00-12:00	40.5.±2.10	4.75±0.25	22.50±1.85	0.55±0.02
	13:00-14:00	60.00±0.00	5.25±0.25	27.00±1.29	0.45±0.02
	15:00-16:00	37.75±2.21	2.50±0.29	10.75±0.85	0.29±0.04
December	09:00-10:00	25.50.±1.85	2.00±0.00	7.25±0.48	0.29±0.02
	11:00-12:00	56.00±1.68	5.75±0.48	29.00±1.80	0.52±0.05
	13:00-14:00	60.00±0.00	5.25±0.25	33.00±1.08	0.55±0.02
	15:00-16:00	46.75±2.84	2.50±0.29	9.75±0.85	0.21±0.02
January	09:00-10:00	16.25±1.75	2.00±0.41	7.00±0.82	0.43±0.02
	11:00-12:00	55.50±1.66	5.75±0.25	30.75±1.75	0.56±0.04
	13:00-14:00	60.00±0.00	7.00±0.41	39.75±1.80	0.66±0.03
	15:00-16:00	38.75±1.49	2.25±0.25	8.50±0.65	0.22±0.02
February	09:00-10:00	23.50±2.18	2.25±0.25	7.50±0.65	0.33±0.03
	11:00-12:00	48.75±2.29	4.75±0.25	27.00±1.78	0.56±0.03
	13:00-14:00	58.75±1.25	6.25±0.48	35.25±2.25	0.60±0.03
	15:00-16:00	33.25±1.38	2.25±0.25	9.50±0.65	0.29±0.02
March	09:00-10:00	3.00±3.00	0.25±0.25	0.75±0.75	0.25±00
	11:00-12:00	16.75±6.75	1.75±0.63	7.50±3.23	0.44±0.03
	13:00-14:00	23.75±9.44	2.25±0.75	9.25±3.25	0.41±0.05
	15:00-16:00	14.00±3.19	2.00±0.41	6.25±1.38	0.44±0.09
April–June	No incidence observed	NA	NA	NA	NA
July	09:00-10:00	12.50±5.20	0.75±0.25	1.75±0.63	0.16±0.04
	11:00-12:00	19.75±6.71	1.25±0.48	3.50±1.19	0.18±0.01
	13:00-14:00	30.00±7.36	2.00±0.41	8.50±1.94	0.30±0.04
	15:00-16:00	20.00±7.36	0.75±0.25	2.50±0.87	0.14±0.03
August	09:00-10:00	16.00±5.89	0.75±0.25	2.50±0.87	0.16±0.03
	11:00-12:00	26.75±1.93	2.25±0.25	8.25±0.48	0.32±0.04
	13:00-14:00	43.75±4.27	4.00±0.41	17.75±2.06	0.41±0.03
	15:00-16:00	34.75±3.54	2.00±0.41	6.50±0.87	0.20±0.04

may be attributed to the absence of *M. orientalis* in the apiaries. Moreover, these months also indicate the onset of dearth period (Saha et al 2023a) when the foraging activity of honey bees might be minimum due to the unavailability of proper foraging sources. In contrast, Ali (2012) reported that *M. orientalis* appeared from last week of March to first week of May during spring season with no presence during summer season and again appeared in last week of September to first week of November during autumn season with no presence during winter season in Saudi Arabia. The slight difference in finding may be due to the variation in prevailing weather condition and topography of the study location.

During the study period, 433 individual birds were encountered, attempting 1956 raids with a success ratio of 76.27%. This success ratio was much higher compared to that of black drongo, *Dicrurus macrocercus* (Vieillot) (56.27%), which was another important bird predator in this region (Singha et al 2023a). The average number of raids per bird during the study period was recorded 4.33 raids/bird. These birds caught the foraging bees from the field instead of visiting the front of beehives. The activity of *Merops orientalis* was minimum at early morning hours, *viz.* 09:00-10:00 and increased thereafter (Table 2). Highest incidence was noted at mid hours, *viz.*13:00-14:00 and birds also spent maximum time near the apiary during this time interval. Usually, *A. mellifera* was highly active during mid hours of the day in this region (Nath et al 2023a, 2023b), that may responsible for higher incidence of *M. orientalis* during this time period. Moreover, presence of low temperature at morning hours and ample temperature at midday hours may also responsible for variation in incidence of *M. orientalis*.

CONCLUSIONS

Merops orientalis is an important predator of honey bees in the region under consideration. Their presence near the apiary significantly reduce the honey bee colony strength as well as the honey production. The management of this bird, specifically near the apiary is necessary to safeguard the beekeepers from facing an economic loss. For that, monitoring is a prerequisite action to address the incidence of *M. orientalis* as soon as possible to protect the colonies from severe loss specifically in December-February. In this respect different vertebrate pest management strategies, such as use of mechanical sounding devices, fire crackers, hanging of plastic strips or red coloured cloths can be utilized to manage this bird from causing severe loss.

AUTHORS' CONTRIBUTION

Designed the work: Sibananda Singha, Nripendra Laskar. Performed the field observation: Sibananda Singha, Samrat Saha, Riju Nath. Wrote the paper: Samrat Saha, Pushpa Kalla, Nripendra Laskar. Photography: Adrish Dey.

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