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Perching Behaviour and Seasonal Incidence of Black Drongo, *Dicrurus macrocercus* (Vieillot) on *Apis mellifera* Linnaeus Apiaries under *Terai* Agro-Ecological Region of West Bengal

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***Abstract*:** Black drongo, *Dicrurus macrocercus* is an important insectivorous bird that also feeds on honey bees and is considered as an important natural enemy of Western honey bees (*Apis mellifera* Linn.) causing a significant reduction in the colony strength and honey yield. The present investigation evaluated the perching behaviour and seasonal incidence of *D. macrocercus* in apiary of *A. mellifera* under terai agro-ecological region of West Bengal, India. Black drongo used different trees, shrubs, crops, electric wires, and different other structures for perching with more preference to trees (43.50%) at an average height of 6.93 m. This bird was more active to *A. mellifera* colonies from September–November and was quite successful as a predator (56.27%). Higher activity was during the evening hours i.e. 03:00–04:00 pm (7.04 number of raids) when a greater number of honey bees returned from foraging. The results obtained from the study can be helpful to determine the perching ecology of black drongo and to design appropriate vertebrate predator management protocols against the black drongo that will allow the beekeepers to focus on that particular time period when this pest is more abundant.

***Keywords*:** *Dicrurus macrocercus*, *Apis mellifera*, Perching behaviour, Seasonal incidence

In the present framework of creating entrepreneurship opportunities, beekeeping is one of solitary alternatives. Beekeeping with Western honey bees, *Apis mellifera* Linnaeus is highly promising as they are not ferocious and lead to the production of good quality and quantity of honey. In terai agro-climatic region of West Bengal, *A. mellifera* is found as an important pollinator of different agricultural and horticultural crops (Nath et al 2023) and beekeeping with *A. mellifera* colonies is gaining popularity day by day in this region (Singha et al 2022). However, recent evidences indicate a steady decline in the regional population of both hive and wild honey bees throughout the world (Biesmeijer et al 2006, Potts et al 2010, Saha et al 2023). A number of interconnecting factors including both biotic (insect and non-insect pest, diseases) and abiotic (topographic, environmental conditions etc.) stresses are responsible for the massive decline in honey bee population. Among several biotic stresses passerine insectivorous bird black drongo, *Dicrurus macrocercus* (Vieillot) (Dicruridae: Passeriformes) is found to be a major threat to the bee colonies in different corners of the world (Oldroyd and Nanork 2009, Sharma et al 2018, Parveen et al 2022).

Black drongo is widely distributed throughout the Indian subcontinent (Kaur and Kler 2018). Being a terrestrial bird it perches close to the ground (Okosodo et al 2016) and the height of its perching sites varies greatly (Narayana et al 2014). It perches on electric cables very frequently (Asokan et al 2008). Usually the foraging height of this insectivorous bird depends on various factors such as temperature, season, vegetation structure, abundance and distribution of prey, pray-predator interaction, composition of plant species etc. and collects most of their feed from agriculture land by feeding on bees, wasps, ants, cicadas, grasshoppers, moths, beetles etc. Even they feed on exposed caterpillars in the ploughed field (Asokan et al 2009, Mariappan et al 2013, Narayana et al 2013, Arjun and Paul, 2022). Farmers find it beneficial as it controls some agriculturally important insect pests to some extent. But it is a nuisance to beekeepers as they prey upon the honey bees and affect their colony strength (Fig. 4). Keeping in view the importance of foraging ecology of black drongo in determination of its habitat utilization and role on beekeeping under terai region of West Bengal, the present study has been designed to determine the perching behaviour and seasonal incidence of black drongo on *Apis mellifera* colonies in the region under consideration.

MATERIAL AND METHODS

Study area: The study was conducted at the apiary unit of Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari,

Cooch Behar, West Bengal, India during 2019. The apiary unit is located at 26°19' N latitude and 89°23' E longitude and at an altitude of 43 meter above the mean sea level (MSL). To carry out the investigation a total of ten *A. mellifera* colonies having similar strength has been placed in the apiary unit. No vertebrate pest management strategies were undertaken in the apiary unit and the colonies were only fed with sugar-syrup solution during the dearth period to maintain the colony strength. For monitoring of birds a 360^0 viewing CCTV Camera was installed in the apiary unit and the recorded movie was considered for analysing the activity of birds.

Climatic condition of study area: The terai agro-ecological region of West Bengal is characterized by typical per humid climatic conditions. This region has an annual average rainfall of more than 3000mm and the relative humidity is about 65-90%. About 80% of the total rainfall of this region is caused by the South-West monsoon during the rainy season i.e. June-September. However, the rainfall pattern is erratic and not distributed uniformly throughout the year. Average maximum and minimum temperatures are 24°C and 33.2°C. The whole area is characterized by humid and warm weather except having a short spell of cold during December-February months.

Assessment of perching behaviour of black drongo: As black drongo utilized various plant species for perching, so different trees, shrubs and crops present in and near the apiary unit have been identified. The recorded movie has been analyzed and direct observation also taken to determine the utilization of various perching sites by black drongo. For determination of perching height data was recorded 15 times per month for an observation period of 30 minutes during 3:30 to 4:30 pm when their activity was high (Kaur and Kler 2018). The perching height was measured as per stick method recommended by Hairiah et al (2001) without disturbing the birds. Monthly 50 birds have been observed to evaluate the percentage utilization of various perching sites. Photographs on the activity of black drongo has been captured using Nikon D5600 and Nikon D5300 cameras.

Assessment of seasonal incidence of black drongo: For estimation of seasonal incidence of black drongo, their foraging activity on *A. mellifera* has been carefully monitored near the apiary unit. Data was recorded during the active foraging period 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 by analysing/viewing the recorded movie and also by direct observation. Data was recorded with regard to continuous stay by the birds in the apiary site during the study time, number of successful attempts to catch the bees, number of unsuccessful attempts to catch the bees, total number of attempts, number of individual birds in raid, and number of raids by a bird.

RESULTS AND DISCUSSION

Perching behaviour of black drongo: Black drongo was found to utilize different trees, shrubs, crops and electric power lines for perching (Fig. 1). Some other structures like instructional boards, bamboo pegs, rice stubbles, fencing were also utilized by them for perching. Different plant species were found to be utilized by black drongo surrounding the apiary (Table 1). Among different tree species *Acacia auriculiformis* and *Neolamarckia cadamba* were most preferred perching sites. Among different crops *Zea mays* and *Sesbania bispinosa* were utilized for perching. *Bougainvillea glabra* was an important shrub plant used for perching by black drongo. The highest perching height was noted in electric cables (7.32m) followed by trees (6.93 m) (Table 2). The black drongo preferred to perch on comparatively low height during March-April on trees which also coincided with their breeding period. In rest of the period the perching height was little higher on trees. But no such height preference was noted on electric cables, shrubs and other structures and remains more or less similar round the year. Black drongo preferred to perch on trees compared to other perching sites with a percentage utilization rate of 43.50% (Fig. 2). This may be due to the presence of more trees near the apiary and such high elevation also allowed them a good searching view. The perching site utilization

Table 1. Utilization status of different plant species by black drongo surrounding the apiary unit during 2019-20

Tree	Utilization for perching (+/–)*	Tree	Utilization for perching (+/–)*	Shrub	Utilization for perching (+/–)*	Crop	Utilization for perching (+/–)*
Acacia auriculiformis	+	*Delonix regia*	+	*Murraya paniculata*	+	*Zea mays*	+
Neolamarckia cadamba	+	*Psidium guajava*	–	*Bougainvillea glabra*	+	*Oryza sativa*	–
Azadirachta indica	+	*Murraya koenigii*	–	*Hibiscus rosa-sinensis*	–	*Triticum aestivum*	–
Caesalpinia pulcherrima	+	*Litchi chinensis*	–	*Lagerstroemia indica*	+	*Brassica* sp.	–
Callistemon sp.	+	*Bauhinia acuminata*	–	*Jasminum multiflorum*	–	*Sesbania bispinosa*	+

*'+' indicates utilized for perching and '–' indicates not utilized for perching

pattern was trees>other structures>electric cable>ground> crops.

Kaur and Kler (2018) also observed that trees were most utilized perching sites by the black drongo with average perching height of 12.9 3 m to 13.28 m on electric cables and 13.43 m to 15.93 m on trees. Arjun and Paul (2022) also recorded the maximum perching height of 12m and minimum of 10m. But in the current investigation the recorded perching height was less, that may be due to the variation in topography, environment and vegetation structure. Another reason may be the trees that were utilized by the black drongo in the study area were of relatively low height. Near the apiary main food was the foraging bees and as the bees forage on a low elevation from the ground that also may be responsible for the low perching height of black drongo.

Seasonal incidence of black drongo: The maximum activity of the *D. macrocercus* on the *A. mellifera* colonies was during September-November with peak incidence in October (31 individual birds making a total of 97attempts on honey bees) (Table 3, Fig. 3). After that there was a steady

Table 2. Average perching height in different perching sites of black drongonear the apiary unit during 2019-20

Months	Perching height in different perching sites (Mean±S.E.) (m)			
	Electric cables	Trees	Shrubs	Other structures
September	7.33±0.12	7.03±0.19	1.43±0.07	0.95±0.18
October	7.34±0.09	6.95±0.18	1.35±0.04	1.07±0.16
November	7.41±0.11	7.03±0.26	1.33±0.06	0.92±0.12
December	7.36±0.10	6.99±0.14	1.37±0.09	1.09±0.15
January	7.45±0.10	7.09±0.14	1.34±0.07	0.91±0.13
February	7.37±0.10	7.11±0.13	1.30±0.07	1.01±0.13
March	7.33±0.09	6.90±0.11	1.19±0.06	0.97±0.12
April	7.45±0.09	6.92±0.12	1.28±0.05	1.05±0.14
May	7.11±0.10	6.78±0.14	1.20±0.05	0.91±0.10
June	7.30±0.10	6.83±0.10	1.22±0.05	0.99±0.12
July	7.18±0.08	6.53±0.16	1.28±0.07	0.95±0.12
August	7.17±0.07	6.99±0.07	1.33±0.06	0.92±0.13
Mean±S.E.	7.32±0.03	6.93±0.05	1.30±0.03	0.98±0.02

Table 3. Seasonal incidence of black drongo, *Dicrurus macrocercus* during 2019-20 (Mean±S.E.)

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	25	73	2.92	18.25±1.70	42	10.50±0.96	57.56±0.42	31	7.75±0.75	42.44±0.42
October	31	97	3.14	24.25±2.63	51	12.75±1.75	52.21±1.72	46	11.5±0.96	47.79±1.72
November	29	81	2.79	20.25±0.75	44	11.00±0.58	54.24±1.07	37	9.25±0.25	45.76±1.07
December	18	50	2.78	12.50±3.38	27	6.75±1.89	53.22±1.13	23	5.75±1.49	46.78±1.13
January	16	30	1.88	7.50±1.85	18	4.50±1.04	60.97±6.57	12	3.00±0.91	39.03±6.57
February	23	59	2.57	14.75±1.31	34	8.50±0.96	58.00±5.01	25	6.25±1.03	42.00±5.01
March	26	60	2.31	15.00±2.38	34	8.50±1.50	56.39±2.37	26	6.50±0.96	43.61±2.37
April	22	56	2.55	14.00±1.47	31	7.75±0.85	55.28±0.72	25	6.25±0.63	44.73±0.72
May	25	64	2.56	16.00±2.45	35	8.75±1.55	54.36±2.52	29	7.25±1.03	45.64±2.52
June	20	46	2.30	11.50±1.04	27	6.75±0.48	59.17±2.62	19	4.75±0.63	40.83±2.62
July	22	61	2.77	15.25±2.10	33	8.25±1.25	54.17±2.92	28	7.00±1.08	45.83±2.92
August	22	65	2.95	16.25±1.11	39	9.75±1.03	59.66±3.60	26	6.50±0.50	40.34±3.60
Total	279	742	---	---	415	---	---	327	---	---
Mean±S.E.	---	---	2.63±0.10	---	---	---	56.27±0.81	---	---	43.73±0.81

decline in their incidence up to January. Lowest incidence was in January when the ambient temperature was low enough. Though their incidence never came down to zero at any point of the year. From February with increasing temperature their incidence also started increasing with a more or less similar population during the hotter months of the year. During the entire study period 279 birds were encountered making 742 attempts against the Western

Fig. 1. Different perching sites utilized by black drongo near the apiary unit during 2019-20

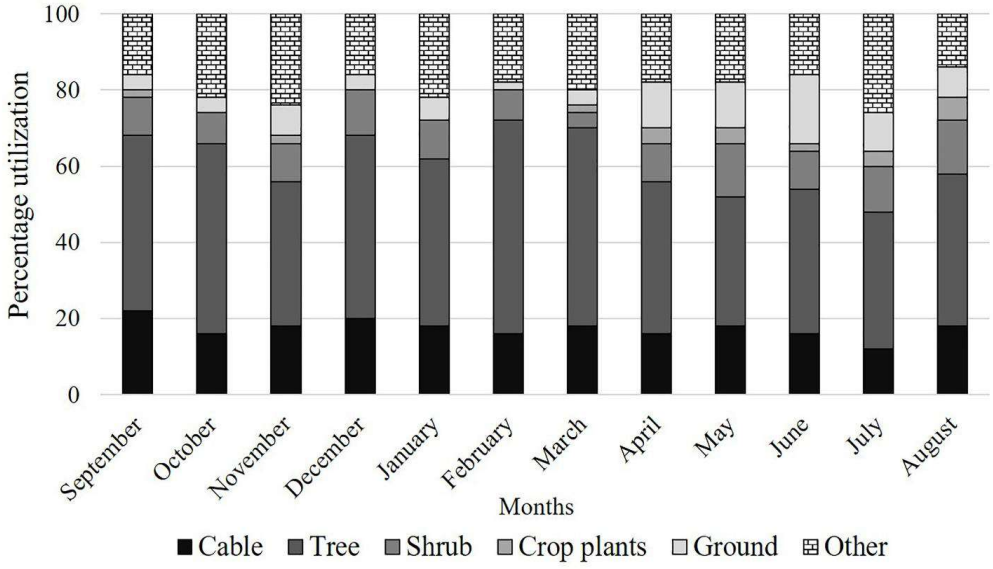

Fig. 2. Percentage utilization of various perching sites by black drongo in the apiary during 2019-20

Table 4. Time variation in the incidence of black drongo, *Dicrurus macrocercus* during 2019-20 (Mean± S.E.)

Months	Time duration	Duration of staying in the apiary during one 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	9.25±3.25	1.00±0.41	2.00±1.22	0.22±0.05
	11:00-12:00	17.25±1.11	1.00±0.00	2.25±0.85	0.14±0.08
	01:00-02:00	23.00±3.14	1.25±0.25	4.00±1.08	0.21±0.04
	03:00-04:00	45.75±2.78	3.00±0.41	10.00±1.41	0.21±0.03
October	09:00-10:00	11.25±1.49	1.50±0.29	3.50±1.26	0.35±0.12
	11:00-12:00	15.75±5.72	0.75±0.25	2.00±0.71	0.13±0.01
	01:00-02:00	33.25±3.12	2.25±0.25	8.00±2.04	0.24±0.05
	03:00-04:00	56.25±3.75	3.25±0.25	10.75±0.85	0.19±0.02
November	09:00-10:00	9.50±2.10	0.50±0.25	1.25±0.75	0.10±0.06
	11:00-12:00	14.00±1.96	0.75±0.25	3.00±1.08	0.21±0.07
	01:00-02:00	24.75±2.06	1.25±0.29	4.75±0.63	0.20±0.04
	03:00-04:00	41.75±6.30	2.00±0.25	11.25±0.63	0.29±0.04
December	09:00-10:00	7.75±5.01	0.50±0.29	1.25±0.75	0.17±0.02
	11:00-12:00	7.75±3.30	0.75±0.25	1.50±0.65	0.19±0.01
	01:00-02:00	17.50±3.23	1.25±0.25	2.75±0.85	0.15±0.02
	03:00-04:00	26.25±4.27	1.50±0.41	7.00±1.35	0.26±0.03
January	09:00-10:00	6.75±4.31	0.75±0.29	0.50±0.50	0.06±0.06
	11:00-12:00	8.75±3.15	1.00±0.25	0.75±0.48	0.08±0.04
	01:00-02:00	16.25±1.75	1.50±0.25	2.75±0.75	0.16±0.03
	03:00-04:00	23.75±2.53	2.50±0.29	3.50±0.65	0.15±0.03
February	09:00-10:00	8.75±3.15	1.00±0.25	1.00±0.58	0.11±0.06
	11:00-12:00	18.25±3.07	1.50±0.00	2.00±0.71	0.13±0.05
	01:00-02:00	24.75±2.06	1.75±0.29	4.25±0.75	0.17±0.03
	03:00-04:00	30.50±0.96	2.25±0.29	7.50±1.19	0.25±0.04
March	09:00-10:00	10.75±0.75	1.00±0.00	1.75±0.63	0.17±0.06
	11:00-12:00	18.00±2.86	1.00±0.29	3.25±1.38	0.26±0.07
	01:00-02:00	23.00±2.38	1.50±0.48	4.25±1.44	0.22±0.08
	03:00-04:00	32.00±2.86	2.00±0.25	5.75±0.48	0.20±0.02
April	09:00-10:00	9.50±1.26	1.00±1.26	2.00±0.41	0.25±0.09
	11:00-12:00	11.75±1.18	1.00±0.00	2.25±0.85	0.21±0.09
	01:00-02:00	24.50±1.32	1.50±0.29	3.75±0.75	0.16±0.03
	03:00-04:00	32.50±3.23	2.00±0.41	6.00±1.08	0.19±0.04
May	09:00-10:00	7.50±3.23	0.75±3.23	1.67±0.76	0.13±0.07
	11:00-12:00	13.50±0.87	1.25±0.48	2.00±1.22	0.13±0.08
	01:00-02:00	27.75±3.47	2.00±0.41	5.25±1.03	0.20±0.04
	03:00-04:00	30.25±4.66	2.25±0.25	7.50±1.55	0.29±0.11
June	09:00-10:00	6.25±2.53	0.75±2.53	0.67±0.58	0.06±0.06
	11:00-12:00	14.00±2.94	1.00±0.00	2.50±0.29	0.21±0.06
	01:00-02:00	21.75±2.39	1.75±0.48	4.25±1.11	0.21±0.07
	03:00-04:00	34.75±2.43	1.50±0.29	4.25±0.75	0.13±0.03
July	09:00-10:00	9.25±1.49	1.00±1.49	2.00±0.41	0.32±0.12
	11:00-12:00	15.75±1.65	1.25±0.25	3.50±0.65	0.28±0.07
	01:00-02:00	17.50±3.23	1.75±0.25	5.25±0.85	0.31±0.02
	03:00-04:00	38.00±3.39	1.50±0.29	4.50±0.65	0.15±0.07
August	09:00-10:00	10.50±2.10	0.75±2.10	2.00±0.71	0.25±0.15
	11:00-12:00	12.50±1.04	1.25±0.25	3.75±1.11	0.33±0.13
	01:00-02:00	20.75±2.17	1.50±0.29	4.00±0.71	0.19±0.02
	03:00-04:00	33.50±2.36	2.00±0.41	6.50±0.87	0.20±0.04

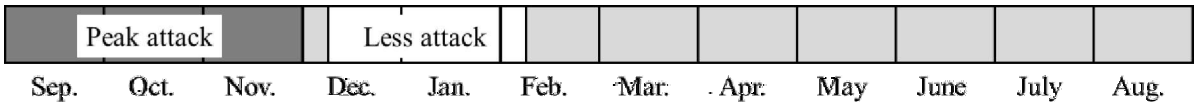

Fig. 3. Seasonal occurrence of black drongo at different months during 2019-20

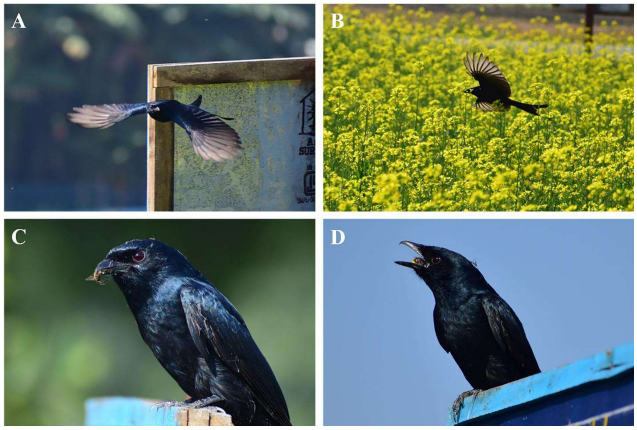

Fig. 4. Act of predation of black drongo on *Apis mellifera* near the apiary. (A) Looking for the prey, (B) Locating and capturing the prey, (C) Returning to the perching site with the prey and (D) Devouring the prey

honey bees. They were found quite successful as an aerial predator of honey bees with a success ratio of 56.27%. The average number of raids per bird during the study period was recorded 2.63 raids/bird. They were least active at early morning hours, viz. 09:00-10:00 am (1.63 number of raids) and thereafter activity increased gradually. Even black drongo birds were found to catch the returning bees from close to the hives and were most active during evening hours, viz. 03:00-04:00 pm (7.04 number of raids). They also spent maximum time in the apiary during this time gap (Table 4). Higher activity during this time interval may be due to a greater number of forager bees returned to the hive at this point of time. Their activity was very less during the initial hours of the day that might be due to the presence of cool weather and less activity of honey bees during the early morning and activity kept increasing as time passed. Sharma et al (2018) also recorded that *Dicrurus* sp. attacking honey bees during April to October months in Kullu valley. The slight difference in the result obtained in the current investigation with the above mentioned work is due to the variation in prevailing environmental condition, topography and position of colony with the food sources.

CONCLUSIONS

Black drongo utilized different sites like trees, shrubs, electric cables, crops, bamboo pegs, stubbles, instructional boards, sheds etc. for perching with more preference to the trees. However their perching height differs significantly that may be based on several biotic and abiotic factors. Farmers consider this bird as an important natural enemy to different economically important insect pests. But beekeepers of this region consider it as a threat to their bee colonies as it has a negative impact on the colony strength. Incidence of black drongo is high during September to November. Though this bird is present throughout the year. This the optimum time when different integrated management strategies need to be implemented to protect the colonies from severe loss. This includes active monitoring of bee colonies so that higher loss caused by this bird can be addressed as soon as possible and based on that proper vertebrate management strategies can be incorporated. Though beekeeping is not that much popularized in the terai region as compared to the other parts of West Bengal, but as the rural peoples get aware about the importance of beekeeping in the socio economic development, its popularity also starts increasing day by day. But proper care of the colonies need to be taken to protect them from different biotic stresses otherwise it will cause a great loss to the beekeepers creating a threat to the country's economy.

AUTHORS' CONTRIBUTION

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

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