

Population Density and Diurnal-Activity Patterns of Black Drongo *Dicrurus macrocercus* (Aves: Passeriformes) at Cauvery Delta, Tamil Nadu, India

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Abstract: Population density and diurnal time-activity patterns of Black Drongo *Dicrurus macrocercus* was studied at Cauvery delta of Nagapattinam District, Tamil Nadu, India between 2004 and 2006. Black Drongo density varied from 52/km² to 138/km² and the agricultural lands supported relatively higher population followed by social forests and river-banks. Black Drongo population showed year-wise variations in agricultural lands, social forests and river-banks having high densities during 2005 (120/km²), 2006 (102/km²) and 2006 (88/km²). Significant seasonal variations (P<0.05) in the densities among habitats were also recorded. Black Drongo spent an average of 53.4% of day time on scanning, 22.9% on feeding, 15.5% on flying, 4.3% on preening and 4.1% on resting activities. Feeding and flying activities did not change (P>0.05) among years and seasons, but varied (P<0.05) among time blocks. Scanning and resting activities differed (P<0.05) between years and seasons (in 2006), but did not differ (P>0.05) among time blocks and habitats. Preening activities varied (P<0.05) between years, seasons (in 2006) and time blocks.

Key words: Black Drongo · Population density · Feeding · Flying · Scanning · Resting · Preening

INTRODUCTION

Black Drongo *Dicrurus macrocercus* (Vieillot, 1817) is a small sized passerine bird of temperate and tropical Asia. It breeds in south-east Iran, Afghanistan, India, south-east Tibet and from northern China discontinuously south through south-west Thailand, to Bali and Java. The whole plumage of Black Drongo is deep black with a wide fork tail. Black Drongo is found predominantly in open country, cultivated areas and usually perches on electric power lines and hunts close to the ground [1]. They are aggressive and fearless birds they will attack much larger species that enter their nesting territory, including crows and birds of prey. They feed mainly on insects such as beetles, grasshoppers, wasps, bees, ants, butterflies and dragonflies [2]. Black Drongo plays a significant role in controlling agricultural insect pests in South India [2, 3]. Little has been published about their biology and behavioural study in India [1-6]. Hence, the present study aimed at investigation of the population density and diurnal activity-patterns of Black Drongo in different time blocks,

seasons, years and habitats at Cauvery Delta of Tamil Nadu, India.

MATERIALS AND METHODS

Study Area: The study was conducted in three village's viz., Mannampandal, Manakudi and Thiruvananthapuram of Cauvery delta in Nagapattinam District (18°18' N, 79°50' E), Tamil Nadu, India, between 2004 and 2006. The study area is dominated by wet agricultural lands irrigated by the River Cauvery and its tributaries. Woody vegetation is sparse in the form of groves and roadside trees. The predominant wood plant species found in the study area are *Cocos nucifera*, *Borassus flabellifer*, *Madhuca indica*, *Mangifera indica*, *Enterolobium saman*, *Tamarindus indicus*, *Ficus benghalensis*, *Ficus religiosa*, *Thespesia populnea*, *Acacia arabica*, *Odina woder* and *Azadirachta indica*. Important shrub species are *Prosopis juliflora*, *Jatropha glandulifera*, *Adhathoda vasica*. Plantations of *Casuarina equisetifolia*, *Tectona grandis* and *Bamboosa arundinacea* are also found in the study area. The northeast monsoon usually brings rain to

the study area from October to December (65% of the total rainfall in a year) and the dry seasons occurs between May and July.

Study Habitats: The present study was carried out three different habitats, namely agricultural lands, river-banks and social forests. The agricultural lands are under cultivation of paddy; river-banks are characterized by the predominance of riverside vegetation and the social forestry plantations include a variety of village woodlots planted with Casuarina, bamboo, teak and Eucalyptus.

Population Density: The line transect method described by Gaston [7] was used to estimate the population density of Black Drongo. Though many methods of avian populations estimation are available, the line transect method is suited to our study area, which predominantly open, sparse distributed trees. In each habitat, three one-kilometer long transects were laid and birds were censused within a 50m belt on either side of transects. Censuses were carried out fortnightly in each month during the study period in all the three habitats. All census operations were carried out immediately after sunrise and normally from 06.00 to 08.00 hrs. Transects were walked at a rate of 0.75 to 1.00 km/hr. Double counting was avoided by noting the direction of movements of the birds. Counting of birds was avoided on cloudy, rainy and windy days. To estimate the bird densities as number per sq km following formula was used.

$$D = \frac{\text{Number of birds}}{2 \times L \times W}$$

Whereas,

L = Length of transect

W = ½ width of transect.

Diurnal-Activity Patterns: Data were collected monthly two times from January 2005 to December 2006 in three habitats *viz.*, agricultural lands, river-banks and social forests. Each day was divided into 4 time blocks: early morning (06:00-09:00), late morning (09:00-12:00), midday or afternoon (12:00-15:00) and late evening (15:00-18:00). The study season was divided in the following manner: post-monsoon (January-March), summer (April-June), pre-monsoon (July-September) and monsoon (October-December). Behavioral observations were made with 7 x 50 field binoculars and duration of activity was measured with an electronic stopwatch. The focal animal sampling technique as described by Altmann [8] was used

to study the time-activity patterns of Black Drongo. Behavioural data were collected from individual bird for 15 minutes continuously and followed by 5 minutes break. The month-wise time spent in different activities was calculated and from these values percentage time spent for each activity during different times on the day was estimated. The activities are divided into five major categories:

1 Feeding: Time spent by birds in capturing the prey and manoeuvring them into the mouth prior to swallowing.

2 Flying: Time spent by the birds in flight which was very often in pursuit on prey.

3 Scanning: Birds perched in an upright position, scanning their surroundings actively.

4 Resting: Perched birds that were sleeping or dozing, with the head retracted and eyes closed.

5 Preening: All forms of comfort movements including the feather shaking, wing flapping, bill cleaning, bill scratching, body shaking and tail shaking.

Statistical Analysis: One-way Analysis of Variance (ANOVA) was used to compare mean seasonal and yearly population densities between years and seasons. Kruskal-Wallis test was performed to compare different activities between time blocks, seasons and habitats. All the analysis was performed using MINITAB statistical software. Significance of all tests was assessed at $\alpha = 0.05$. Results of the above analysis were interpreted using standard statistical procedures [9].

RESULTS

Population Density: Population density of Black Drongo varied between 52/km² (monsoon 2004 at the river-banks) and 138/km² (summer 2006 at the agricultural lands). In general the agricultural lands supported relatively higher numbers of Drongos, followed by social forests and river-banks (Table 1). Year-wise mean higher densities (across all seasons) in agricultural lands, social forests and river-banks were recorded during 2005 (120/km²), 2006 (102/km²) and 2006 (88/km²). A significant year-wise difference ($P < 0.05$) was recorded only in river-banks (Table 2). Significant seasonal variations ($P < 0.05$) in densities existed in all the three habitats, in general the density was comparatively lower during monsoon than in other seasons of all the three habitats (Table 3).

Table 1: Variations in the population density (birds/km²) of Black Drongo by habitat and season, from 2004 to 2006. Values are mean ± SD

Year	Season	Habitats		
		Agricultural lands	River-banks	Social forests
2004	Post-monsoon	123±22.6	64±4.4	119±23.2
	Summer	127±35.1	62±15.1	96±14.5
	Pre-monsoon	116±14.3	55±6.3	77±8.1
	Monsoon	98±9.6	52±3.8	82±18.4
2005	Post-monsoon	112±30.3	84±24.6	103±24.8
	Summer	137±19.7	91±15.2	108±21.2
	Pre-monsoon	124±27.2	76±20.4	108±35.6
	Monsoon	107±17.6	69±13.5	85±20.3
2006	Post-monsoon	117±15.7	97±27.3	98±18.4
	Summer	138±19.4	91±23.9	110±29.5
	Pre-monsoon	103±18.2	89±26.3	104±16.3
	Monsoon	105±23.5	77±27.1	97±19.4

Table 2: Yearly variations in the density (birds/km²) of Black Drongo in different habitats from 2004 to 2006. Values are mean±SD

Habitat	Year			ANOVA		
	2004	2005	2006	df	F	P
Agricultural lands	115±23.8	120±14.2	116±16.7	2,32	0.22	0.796
River-banks	58±9.7	80±10.4	88±14.2	2,32	2.79	0.000*
Social forests	91±21.2	101±16.8	102±9.3	2,32	1.78	0.184

*Differences between years (P<0.05).

Table 3: Seasonal variations in the density (birds/km²) of Black Drongo in different habitats from 2004 to 2006. Values are mean±SD

Habitat	Year				ANOVA		
	Post-monsoon	Summer	Pre-monsoon	Monsoon	df	F	P
Agricultural lands	117±13.5	134±20.2	114±12.4	103±9.8	2, 31	7.47	0.000*
River-banks	84±14.2	81±17.7	73±18.4	66±15.2	2, 31	2.07	0.023*
Social forests	105±16.1	96±20.3	96±20.4	88±13.5	2, 31	2.47	0.000*

*Differences between seasons (P<0.05).

Table 4: Mean percentage of diurnal time spent in various activities by Black Drongo in different seasons and years

Activity	2005					2006				
	POM	SUM	PRM	MON	Overall	POM	SUM	PRM	MON	Overall
Feeding	22.8	25.7	23.1	17.5	22.8	23.3	24.4	22.1	18.7	22.4
Flying	13.6	18.3	14.9	14.1	15.2	16.3	15.3	15.8	12.8	14.2
Scanning	55.2	46.1	52.5	58.5	53.7*	53.2**	51.5**	51.6**	57.4**	54.4*
Resting	3.1	3.5	5.7	3.2	3.6*	3.1**	4.3**	5.7**	5.6**	4.5*
Preening	5.3	6.4	3.8	6.7	4.7*	4.1**	4.5**	4.8**	5.5**	4.5*

POM: Post-monsoon; SUM: Summer; PRM: Pre-monsoon; MON: Monsoon

*Differences between years (Kruskal-Wallis test, P<0.05),

**Differences between seasons (Kruskal-Wallis test, P<0.05)

Table 5: Mean percentage of diurnal time spent in various activities by Black Drongo in different time blocks (years, seasons and habitats pooled)

Activity	Time blocks (hours)				Overall
	06:00-09:00	09:00-12:00	12:00-15:00	15:00-18:00	
Feeding	24.3	20.1	17.1	25.4	22.5*
Flying	16.8	18.3	10.6	18.9	16.9*
Scanning	48.1	53.7	56.8	46.7	52.7
Resting	3.5	4.2	12.3	3.2	3.8
Preening	7.3	3.7	3.2	5.8	4.1*

*Differences between time blocks (Kruskal-Wallis test, P<0.05)

Table 6: Mean percentage of diurnal time spent in various activities by Black Drongo between habitats (years, seasons and time blocks pooled)

Activity	Agricultural lands	River-banks	Social forests	Overall
Feeding	25.4	22.5	19.8	23.1*
Flying	16.5	13.9	12.6	14.2*
Scanning	50.1	53.4	55.2	52.6
Resting	3.8	6.1	7.3	5.6
Preening	4.2	4.1	5.1	4.5

*Differences between habitats (Kruskal-Wallis test, P<0.05)

Diurnal-Activity Patterns: Feeding: Black Drongo spent an average of 22.9% of their diurnal time on feeding, which did not vary (P>0.05) between years and between seasons within years (Table 4). Feeding activity varied (P<0.05) among time blocks and was higher in the morning (24.3%) and evening (25.4%) than that midday (17.1%; Table 5). They fed most often (P<0.05) in agricultural lands (25.4%) than river-banks and social forests (Table 6).

Flying: Black Drongo spent an average of 15.5% of their diurnal time on flying, which did not vary (P>0.05) between years and between seasons within years (Table 4). Flying activity varied (P<0.05) among time blocks of a day and is always peaked 09:00-12:00 hours (Table 5). Flying activity differ between habitats and usually was greatest (P<0.05) in agricultural lands (Table 6). In general the peaks in flying were similar to the peaks in feeding in all time blocks, season and habitats.

Scanning: Overall, Black Drongo spent 53.4% of their diurnal time on scanning, which varied (P<0.05) among years (53.7% in 2005 and 54.4% in 2006). In 2005, scanning activity was similar (P>0.05) among seasons, but they spent more time (P<0.05) during monsoon than other seasons in 2006 (Table 4). Scanning was similar (P>0.05) among the time blocks, but in general they allocated more time at midday than other time blocks (Table 5). Time spent on scanning was similar (P>0.05) among habitats (Table 6).

Resting: Black Drongo spent 4.1% of their diurnal time in resting activity. This activity was lower (P<0.05) in 2005 than in 2006. In 2005, time allocated to this activity did not change (P>0.05) among seasons. In 2006, Black Drongo spent less time (P<0.05) resting activity during the post-monsoon than other seasons (Table 4). They were equally rested (P>0.05) at all times of day (Table 5) and among habitats (Table 6).

Preening: Black Drongo averaged 4.3% of diurnal time in preening activities. These activities were higher (P<0.05) in 2005 than in 2006. In 2005, time allocated to these activities did not change (P>0.05) between seasons; in 2006, they spent more time (P<0.05) during monsoon than other seasons (Table 4). Preening activities varied (P<0.05) among time blocks of day and it always peaked at midday (Table 5). Preening activities were occurred similarly (P>0.05) between habitats (Table 6).

DISCUSSION

Black Drongo densities showed habitat-wise variations with the agricultural lands generally supporting highest populations followed by social forests and river-banks. The greater number of Drongos at the agricultural lands might be due to relatively rich supply of insect preys. Asokan *et al.* [10] and Sivakumaran and Thiyagesan [11] reported that food resources were most important density-dependent factor for insectivorous

bird's viz., Small Bee-eater *Merops orientalis* and Indian Roller *Coracias benghalensis*. The social forests and river-banks ranked second and third in the order of population habitat preference that might be due to greater vegetation densities and availability of insect prey. In river-banks and social forestry plantations, Black Drongo usually perched on trees and would rest amongst shady vegetation, suggesting the vegetation is an important factor in relation to Black Drongo density. The river side vegetation provided suitable nesting trees is probably another contributing factor to preference by this species in river-banks. The relationship between availability of nest sites and bird numbers has been documented for a number of predatory birds [10, 12-14].

Seasonal variations in the density of Black Drongo were recorded among habitats with river-banks and social forests showing high densities during post-monsoon and the agricultural lands during summer season. In our study area Black Drongo breeds between March and June, since the river-banks and social forests provided suitable nesting trees, so these habitats had high number of Black Drongo populations during post-monsoon and summer. Relatively high densities of Black Drongo during summer in agricultural lands might be attributed to the movement of newly recruited young ones together with their parents in pursuit of insect prey, which was usually abundant in the agricultural lands. Various factors may be cited for yearly variations in bird densities viz., predation, intra-and interspecific-competition, parasites and diseases, habitat availability, weather, food habits and migration status [10, 15-20].

Black Drongo had a bimodal feeding patterns one during morning (06:00-09:00 hrs) and another during evening (15:00-18:00 hrs). Other birds are known to exhibit feeding maxima early in the morning and late in the evening [11, 21-25]. More feeding activity of Black Drongo in the late evening may reflect their need to obtain energy for overnight energetic requirements. Seasonal feeding activity inferred that they fed more during summer and low during monsoon. In the study area, insect prey resources were generally abundant during summer, so they take variety of insects [2]. Feeding activity was greater in agricultural lands, because it is dynamic habitats that are unpredictable in terms of insect prey abundance and availability. Less time spent in river-banks and social forests may be due to less insect availability, avian predator pressure and human disturbances. However, the amount of time spent in feeding does also reflect the effect of temperature, time of day and microhabitats.

Black Drongo spent more than 50% of the day time for scanning, because it's a 'sit-and-wait' predatory bird, so they spent majority of day time to searching the prey. Earlier, many investigators have been reported that scanning as a major diurnal activity in predatory birds [11, 26, 27]. Among seasons, scanning activity was greater in monsoon and post-monsoon and lower in summer. During monsoon the study area was generally wet condition due to northeast monsoon rainfall and they greatly affected by insect prey distribution. In post-monsoon also, due to colt temperatures, it could be expected that birds devote more time to scanning, while the reverse is true during summer. Differentiation of higher and lower amount of time spent to scanning within time blocks and habitats by Black Drongo was directly correlated with availability of prey in the study area.

Sleeping was the major midday diurnal resting activity for Black Drongo and generally rested on dense shaded trees in the study area. Earlier, many researchers found that resting to be a major midday activity of birds [28-32]. Tamisier [33] suggested that an increase in resting in midday as a mechanism to minimize the heat load on a bird at high environmental temperatures.

The wings, breast and back were body parts most often preened by Black Drongo, followed by the tail, neck, rump and feet. The most frequent comfort activities were bill scratching, feather shaking and wing flapping. Time spent to this kind of body maintenance activities were recorded in several bird species [21, 23, 32, 34-36].

Data of daily time-activity pattern can be of use in environment monitoring, evaluating the habitat suitability and population management [22, 37, 38]. Our study provided the detailed numerical data of diurnal activity of Black Drongo and should be useful in planning the conservation and population management strategy for Black Drongo in India.

ACKNOWLEDGEMENT

We are grateful to the Head of the Department and Staff members of Zoology, the Principal and the Management of A.V.C. College (Autonomous), Mannampandal, South India for having rendered facilities and encouragement. Financial support provided by the Ministry of Environment and Forests, Government of India under the Environmental Research Scheme. We thank Mr. M. Chakravarthi for field assistance.

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