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### **COMMUNICATION**

### GOLDEN JACKAL *CANIS AUREUS* LINNAEUS, 1758 (MAMMALIA: CARNIVORA: CANIDAE) DISTRIBUTION PATTERN AND FEEDING AT POINT CALIMERE WILDLIFE SANCTUARY, INDIA

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# Golden Jackal *Canis aureus* Linnaeus, 1758 (Mammalia: Carnivora: Canidae) distribution pattern and feeding at Point Calimere Wildlife Sanctuary, India

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Abstract: Golden Jackal *Canis aureus*, a medium-sized omnivore belonging to the family Canidae, ranges widely from Europe and extends across the middle-east to India. It's adaptable social system according to the distribution of food resources enabling it to range widely from desert to evergreen forests, mangroves, rural, and semi-urban human-agro-ecosystems. Despite its wide distribution, the species has not received adequate scientific attention in much of its southern India range. This study was carried out to assess its distribution pattern, diet composition, and prey preference at Point Calimere Wildlife Sanctuary, a well-known habitat for the jackal and the only predator of the sanctuary. Data on distribution collected through extensive field surveys revealed that the species distribution is uniform in southern and southeastern parts of the sanctuary, in areas where the habitat is more open with grasslands and mudflats and is patch in the tropical dry-evergreen habitat. Analysis of 155 scat samples revealed that the diet comprised 19 species of food items, including mammals, birds, insects, other invertebrates, and plant matter characterizing omnivorous nature. Temporal variation in diet composition—with significantly higher proportion of birds during winter than in summer—coincides with abundance of prey species in relation to season, which indicate the opportunistic foraging and hunting nature of the species. Data on diet preference showed that jackals in the area preferred Black-naped Hare, Spotted Dove and Lapwing followed by Chital, Grey Francolin, Cattle Egret, and Large Egret, while Blackbuck, Bonnet Macaque, and cattle were not preferred, which is discussed under optimal foraging. The jackal being the only large-sized predator of this natural system, more detailed studies and effective measures to conserve the species are vital not only to understand the prey-predator mechanism, but also to conserve the biodiversity of this unique ecosystem.

Keywords: Diet composition and preference, spatio-temporal variation in diet, southern India.

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#### INTRODUCTION

The Golden Jackal Canis aureus is an Old-World medium-sized habitat generalist belonging to the family Canidae, similar to the Coyote Canis latrans in North America (Bekoff & Gese 2003) and ranges widely from Europe and extends across the middle-east to India and southeastern Asia. The species is currently listed as Least Concern (LC) (Hoffmann et al. 2018) and included in Appendix II of CITES and Schedule III of the Indian Wildlife (Protection) Act 1972. Its tolerance to dry conditions and its omnivorous diet, enable the Golden Jackal to live in a wide variety of habitats, exceeding 2,000m in elevation, ranging from semi-arid environments to forested, mangrove, agricultural, rural, and semi-urban habitats in India and Bangladesh (Clutton-Brock et al. 1976; Poche et al. 1987). The species with omnivorous and opportunistic foraging nature feeds on a wide variety of food that varies in space and time. In Bharatpur, India, rodents, birds, and fruit comprise the bulk of its food (Sankar 1988), and similarly, in Kanha, over 80% of its diet comprises rodents, reptiles, and fruits (Schaller 1967); however, studies on Golden Jackal in Bhal region of Gujarat (Aiyadurai & Jhala 2006) and recently in Bharatpur, Rajasthan, India (Singh et al. 2016) showed higher proportions of large mammals and plant matter in their diet. While in Europe, the slaughter remains and other animal waste from livestock, represents approximately 40% of the jackal diet across the continent (Ćirović et al. 2016).

Golden Jackals are social animals with an extremely flexible social organization that varies upon the availability and distribution of food resources (Macdonald 1979). There is little quantitative information on jackal



Image 1. A pair of Golden Jackal *Canis aureus* at Point Calimere Wildlife Sanctury.

densities, habitat use, and ranging patterns in relation to food availability. And data on dispersal, survival, and mortality factors of adults, pups, and dispersing individuals are still a major gap in our understanding (Jhala & Moehlman 2004). Despite its wide distribution, the species hasn't received sufficient scientific attention in much of its southern Indian ranges. Point Calimere Wildlife Sanctuary, situated on the southern boundary of the Coromandel Coast, is a well-known habitat for the Golden Jackal (Ali 2005). This study assessed the distribution of jackal, diet composition, and preference estimating the availability of major prey species, at Point Calimere Wildlife Sanctuary.

#### MATERIAL AND METHODS

#### Study Area

This study was carried out between December 2013 and June 2014 at Point Calimere Wildlife Sanctuary located between the geographical coordinates 10.27°N, 79.83°E and 10.33°N, 79.84°E and lies at the confluence of Bay of Bengal and the Palk Strait, near Nagapattinam, Tamil Nadu. The sanctuary derives its name as 'Point Calimere' for the spot inside the sanctuary, where the coast takes a 90° turn from the Bay of Bengal towards Palk Strait (Figure 1). The reserve was declared in 1967 (Ramasubramaniyan 2012) mainly for the conservation of Blackbuck Antelope cervicapra and it encompasses an area of 30km<sup>2</sup> of sandy coast fringed by saline swamps and thorny scrub around the backwaters. The coastal area consisting of shore, shallow water, intertidal flats, saline lagoons as well as manmade salt pan sites supports >250 species of birds, with about 120 being water birds that include vulnerable species like Spoonbill Sandpiper Euryhoryhynchus pygnaeus, Grey Pelicans Pelecanus philippensis, and Greater Flamingo Phoenicopterus roseus, Lesser Flamingo P. minor and is among the 26 wetlands in India designated as wetlands of international importance (pointcalimere. org/overview.htm). The sanctuary consists of unique vegetation types; tropical dry evergreen, open grassland with patches of open scrub (Ali 2005). Its tropical dry evergreen forest is considered as the richest tract in the entire country. The grasslands located on its southern part are the natural habitat of the Blackbuck. Apart from jackal, which is locally called 'kullanary', the sanctuary is also known for Blackbuck , and other mammals like Chital Axis axis, Wild Boar Sus scrofa, Bonnet Macaque Macaca radiata (Muralidharan 1985; Nedumaran 1987; Ramasubramaniyan 2012). A notable feature of the



Figure 1. Golden Jackal sightings at Point Calimere Wildlife Sanctuary between December 2013 and June 2014.

sanctuary is the presence of feral horses, an introduced species in the ecosystem. Olive Ridley Turtles have been regularly nesting on the sanctuary beach and during winter, dolphin sighting is common along the sanctuary coast. The natural habitats experience pressure from the invasive feral horse (Baskaran et al. 2016, 2020; Arandhara et al. 2020), anthropogenic pressure from cattle (Nedumaran 1987) and also from the proliferation of *Prosopis juliflora* (Ali 2005), an alien invasive shrub species from Central and South America. With an average density of 14 cattle/km<sup>2</sup>, the sanctuary experiences grazing pressure from 300 to 600 cattle/day (Ali 2005).

#### **Distribution pattern**

To identify and map the distribution of *C. aureus*, a systematic field survey was carried out on foot covering various administrative units (beats) and forest types of the sanctuary. During the survey, boundaries of administrative units of forest division were marked on a map in consultation with the concerned forest officials and official documents available to record the presence/absence of *C. aureus*. Later, through intensive field surveys covering all the habitats, the distribution of the jackal was identified following direct sightings and indirect evidence (scat). On every sighting of the

target species or its evidence, geo-coordinate data were collected using the global positioning system (GPS) besides recording their number. In addition, sighting data recorded during the jackal prey-abundance estimate were also considered. The location data (both direct sighting and indirect evidence) along with other variables (division boundaries) marked on the survey of India topographic map were digitized using the geographical information system (GIS) software (Arc View 3.3, ESRI Inc.) to create the distribution map of the jackal.

#### **Diet composition**

The diet composition of jackals was studied following the indirect method, i.e., scat analysis based on frequency occurrence of various undigested food items found in the scat (Schaller 1967). The scat of the jackal can be identified, by size, shape and odour in addition to the nature of feeding and pug marks in the area. Differentiating jackal scat in the field from small carnivore scat requires more experience, however, the absence of most small carnivores excepting mongoose made identification easier in the present study. Similarly, the scat of jackal could be differentiated from domestic/feral dogs based on plant matters like fruits, seeds, pericarp, on which jackal usually feeds unlike

dogs. Scats were collected whenever encountered in the study area along the predetermined road and trail surveys. The collected scats were air-dried and sealed in a separate container and numbered serially, and the date and habitat were noted (Joseph et al. 2007). To determine the diet composition, dried scat samples were broken down and washed under running water through a sieve. The scat contents were broken apart and remains of different food items such as hair, feather, scales of reptiles, invertebrate and vegetable matter (grass and fruit seeds) were separated. In case of hair samples, a sample of 20 hairs was picked up randomly from each scat (Mukherjee et al. 1994) to circumvent the possible biases (Karanth & Sunguist 1995). The prey species were identified from the hair structure using a microscope and compared with standard slides. Prey remains in scats were observed microscopically and identified by comparing with standard reference slides (both medullary or epithelial structure prepared using DPX mountant) available at the Department of Zoology, A.V.C. College (Autonomous), and plant materials especially fruit remains such as seeds and pericarp were compared with specimens from natural habitats or collection maintained at the Bombay Natural History Society Field Station at Point Calimere Sanctuary.

#### Prey abundance

To estimate the prey abundance, line transect (Burnham et al. 1980) direct sighting method was employed. Based on the diet composition data, a list of food items eaten by the jackal was prepared. The abundance of animal species from birds and mammals consumed by the jackal was quantified using the line transect method. To decide about the sampling sites for line transect study, the sanctuary maps were overlaid with 1 × 1 km grid and all the grids were numbered with running serial number resulting in 40 grids. Of these, 37 were selected for sampling. In each grid, a line transect was randomly laid, but aligned to run across drainage patterns and water bodies. From this map, geocoordinate details were extracted for each line transect start and end points and using them, the transect lines were established in natural habitats of the sanctuary with the help GPS and field compass. These lines were marked with red colour paint or tags. All these transects were sampled at weekly intervals between January and March 2013 during morning (06.00-10.00 h) and evening (16.00–18.00 h). At every sighting of prey item like Black-naped Hare, Palm Squirrel, Chital, Blackbuck, Bonnet Macague, Wild Boar, feral horse, cattle, and terrestrial birds, besides their group size, sighting angle,

and sighting distance were recorded respectively using field compass and range finder.

#### Data analysis

Using the transect data, the density was estimated following distance-sampling techniques employing the software DISTANCE (version 6.0, Buckland et al. 2004; Thomas et al. 2010). Group and individual density of Blackbuck and feral horse and their standard error (SE) were estimated, evaluating each model of detection probability, viz., uniform, half-normal, and hazard-rate with three different series adjustment terms such as cosine, simple polynomial and hermite polynomial (i.e., detection probability uniform with cosine series adjustment, uniform with simple polynomial and uniform with hermite polynomial and similar combination for half-normal and hazard rate). The best model was selected for estimating the density of each species from nine different combinations of analyses, using the minimum Akaike Information Criteria (AIC) as the standard model selection procedure.

#### Statistical analyses and prey preference calculation

The diet composition data were quantified in terms of frequency of occurrence, percent of scat containing particular food item out of the total number of scats collected, following traditional scat analysis method (Schaller 1967). The data on the frequency occurrence of various food items recorded in the diet of the jackal between seasons was tested using the Mann–Whitney U test. Prey preference by the jackal was estimated using the % occurrence of various prey items in the diet (as usage rate) and their abundance in the environment (as availability) following Jacob's preference index =  $(u - a)/(u + a) - (2 \times u \times a)$ , where 'u' is the proportion of a particular category in the diet, and 'a', the proportion of that category in the population.

#### RESULTS

#### Distribution pattern of the jackal

In total, the study recorded 41 locations of direct sightings and indirect evidence of jackal between December 2013 and June 2014 and superimposed them on the sanctuary map to produce its distribution map (Figure 1). From the distribution map, though it appears that jackals are distributed throughout the sanctuary, areas in southern and eastern parts, where grassland habitat is dominating, have more uniform distribution Table 1. Frequency occurrence of various food items recorded from jackal scats (n = 155) at Point Calimere Wildlife Sanctuary.

	Prey item scientific name (common name)	Percent frequency (mean ±SE)
	Mammals	82.5 ± 3.05
1	Antilope cervicapra (Blackbuck)	20.0 ± 3.22
2	Axis axis (Chital)	11.6 ± 2.58
3	Lepus nigricollis (Black-naped Hare)	28.4 ± 3.63
4	Rattus rattus (House Rat)	9.7 ± 2.38
5	Sus scrofa (Wild Boar)	8.4 ± 2.23
6	Macaca radiata (Bonnet Macaque)	3.9 ± 1.55
7	Bos taurus (Cattle)	4.5 ± 1.67
	Birds	25.1 ± 3.49
8	Francolinus pondicerianus (Grey Francolin)	3.2 ± 1.42
9	Vanellus indicus (Red-wattled Lapwing)	5.2 ± 1.78
10	Bubulcus ibis (Cattle Egret)	4.5 ± 1.67
11	Ardea alba (Great Egret)	5.2 ± 1.78
12	Egretta garzetta (Little Egret)	3.2 ± 1.42
13	Spilopelia chinensis (Spotted Dove)	3.9 ± 1.55
	Invertebrate	15.4 ± 2.91
14	Beetle (Coleoptera)	11.6 ± 2.58
15	Pleurroncodes planipes (Red Crab)	4.5 ± 1.67
	Plant materials	32.2 ± 3.76
16	Hugonia mystax (Fruits)	5.2 ± 1.78
17	Manilkara hexandra (Fruits)	6.5 ± 1.97
18	Prosophis julifera (Leaves)	12.3 ± 2.64
19	Cloris parpata (Grass)	11.6 ± 2.58
	Unidentified	$1.9 \pm 1.11$

unlike the western and northern parts, where the dryevergreen habitat predominant.

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#### **Overall diet composition**

In total, analyses of 155 scats revealed that the jackals' diet comprised 19 different food items including seven species of mammals, six of birds, one each of insect and invertebrate, and four of plants (Table 1). Of the 19 food items, Black-naped Hare and Blackbuck were the most frequent items in  $\geq$ 20% of the scats collected. The other important items include Chital, and coleopteran insects formed over 10% of the scats indicating the importance of their contribution to jackals' diet. Food items such as leaves of Cloris parpata grass and Prosopis juliflora, are more likely unintentional consumption, as these are likely ingested along with meat in grasslands or under Prosopis cover, as dry leaves stuck to the meat being consumed. Of the five major groups of prey, the contribution of mammalian prey was the highest (53%) followed by plant materials (20%), birds (16%), invertebrates (10%), and unidentified category (1%).

#### **Diet composition between seasons**

The diet composition of jackals also varied between the winter and summer. For example, the jackal preved upon birds significantly more during winter (36%) than during summer (18%) (Man-Whitney-U = 2377.5, p = 0.01) (Figure 2) and all other taxa such as mammals (Man-Whitney-U = 2850.5, p = 0.754), invertebrates (Man-Whitney-U = 2744, p = 0.330), plants (Man-Whitney-U = 2637, p = 0.220), and unidentified (Man-Whitney-U = 2893.5, p = 0.778) appeared in the diet between the two



#### Summer Winter

Figure 2. Percent frequency occurrence of various food items identified from Golden Jackal scats in different season at Point Calimere Wildlife Sanctuary between December 2013 and June 2014.



Figure 3. Food preference of the Golden Jackal at Point Calimere Wildlife Sanctuary recorded between December 2013 and June 2014.

Table 2. Prey availability (abundance estimate) and prey use (% frequency occurrence in diet) data to calculate the food preference by the jackal ('due to inadequate sample size instead of density encounter rate arrived; - indicates that abundance data unavailable).

	Prey species (mean ± SE)			
Prey items (scientific name)	Availability (Density/km²)	Use (% frequency in the scat)		
Mammals				
Antilope cervicapra	50.2 ± 4.79	20.0 ± 3.22		
Axis axis	9.3 ± 2.06	11.6 ± 2.58		
Lepus nigricollis	6.2 ±1.18	28.4 ± 3.63		
Rattus rattus	-	9.7 ± 2.38		
Sus scrofa	14.7±_1.86	8.4 ± 2.23		
Macaca radiata	34.1±6.67	3.9 ± 1.55		
Bos taurus	45.1 ± 6.89	4.5 ± 1.67		
Birds				
Francolinus pondicerianus	-	3.2 ± 1.42		
Vanellus indicus	-	5.2 ± 1.78		
Bubulcus ibis	0.1±0.04*	4.5 ± 1.67		
Egretta garzetta	0.2±0.07*	5.2 ± 1.78		
Ardea alba	0.2±0.06*	3.2 ± 1.42		
Spilopelia chinensis	$0.01 \pm 0.013^{*}$	3.9 ± 1.55		
Invertebrate				
Insect: Beetle (Coleoptera)	-	11.6 ± 2.58		
Red Crab (Pleurroncodes planipes)	-	4.5 ± 1.67		
Plant materials				
Hugonia mystax (Fruits)	-	5.2 ± 1.78		
Manilkara hexandra (Fruits)	-	6.5 ± 1.97		
Prosophis julifera (Leaves)	-	12.3 ± 2.64		
Cloris parpata (Grass)	-	11.6 ± 2.58		
Unidentified	-	1.9 ± 1.11		

seasons with similar frequency.

#### Food preference

Of the 19 food items identified in the jackal's diet, abundance data could be obtained for 12 items only (Table 2). Of these 12 items, Black-naped Hare, Spotted Dove and Red-wattled Lapwing were the most preferred items followed by Cattle Egret, Chital, Grey Francolin, and Large Egret (Figure 3). Although the sanctuary has more biomass of Blackbuck and cattle, jackals did not prefer them.

#### DISCUSSION

#### Distribution pattern of the jackal

The present study showed that the distribution of jackal, though not restricted, was uniform in the eastern and southern parts of the sanctuary, where large areas fall under open grasslands and mudflat. The western and northern parts predominantly have tropical dryevergreen forests, where the jackal sightings and signs were found to be patchy, indicating that this habitat was used relatively lesser than the grassland habitat. This could be an appropriate strategy to optimally use the dry-evergreen habitat, which harbours the food species patchily including fruit bearing trees. Detections of jackals and their signs, however, were likely to be lower in forested habitats, which could also be a reason for the observed higher use of more open habitats. Food availability is one of the most important factors affecting the behaviour, ecology, and evolution of animals. Prey species distribution and their abundance influence the predators' life-history traits like growth, reproduction,

and survival (Bilde & Toft 1998; Karanth et al. 2004). Therefore, the prey availability could influence the ecological traits of the predator including movement, distribution patterns and habitat selection (Pyke et al. 1977; Gittleman & Harvey 1982). The reason for the uniform distribution of jackals along open grassland habitat and patchy distribution in dry-evergreen habitat could be the function of its prey distribution. As shown by the diet composition data, Black-naped Hare and Blackbuck, which occupy open grasslands, were the two major prey species that contributed nearly 50% to the jackals' overall diet. Similarly, the jackal's frequent movement in mud-flat habitats could also be due to their dependence on crab and shore birds. The species being omnivorous with a flexible social system can adapt to wide range habitats from Thar Desert of Rajasthan, India to the evergreen forests of Myanmar and Thailand as well as from mangrove to rural and semi-urban humanagro-ecosystems (Clutton-Brock et al. 1976; Poche et al. 1987). In the present study area, however, with its principal diet of Black-naped Hare and Blackbuck being mostly found in the open habitats, it might use the open habitat more uniformly over the wooded forest that is used patchily.

#### **Diet composition**

Diet composition identified based on 103 scats analyses revealed that jackals' diet comprised 19 different food items ranging widely from mammals, birds to invertebrates, such as insects and plant part like fruits. Jackal being an omnivorous and opportunistic forager in nature feed on a wide variety of foods that vary in space and time. In Bharatpur, northern India, rodents, birds, and fruit comprise the major bulk (Sankar 1988), and similarly in Kanha, over 80% of the diet comprises rodents, reptiles, and fruit (Schaller 1967). The reason for jackals not depending much on rodents could be the variation in prey availability between the areas. It is likely that the rodent density is lesser in the present study area compared to Bharatpur and Kanha or Black-naped Hare that served as the principal diet of the jackal in the present study area are more abundant in the study area as compared to the other places in India. Besides the above reasons, the difference in study duration and season could also contribute to variation in diet composition between areas. Also, the fact that the rodents being smaller in size compared to Black-naped Hare, given a choice of similar density, the jackal might prefer the Black-naped Hare as it is more optimal. On the other hand, Blackbuck, an ungulate, being much larger than the Black-naped Hare and also with a higher

biomass in the study area has not been noticed in the diet as much as the Black-naped Hare, and this may be a trade-off, as the prey is much larger than the predator, and hunting Blackbuck could be more expensive, as it may not able to bring down the prey easily. Nevertheless, the occasional appearance of Blackbuck in the diet of the jackal may be of young ones or calf. Since Blackbucks hide their calves, the jackal hunts them (Jethva & Jhala 2004; Aiyadurai & Jhala 2006).

Of the 19 food items, Black-naped Hare and Blackbuck were the most frequent food items of jackals' diet that appeared in more than 20% of the scats collected during the period. The other important food items include the Red Crab Pleurroncodes planipes and coleopteran insects appeared in over 10% of the scats indicating the importance of their contribution to the jackals' diet. Of the five major groups of prey items that constituted the diet of the jackal, mammalian prey contribution was the highest followed by plant materials, birds, insects and invertebrates. Similar to the present study, mammalian species contribution is the most dominant elsewhere in India: in Bhal region, Gujarat (Aiyadurai & Jhala 2006), Pench Tiger Reserve (Majumder et al. 2011), in Sariska Tiger Reserve, India (Chourasia et al. 2012), and abroad; Isreal (Barkowski & Manor 2011), Peljesac Peninsula (Radovic & Darkokovacic 2010). In Hungary, central Europe, the Golden Jackals feed predominantly on animal matter especially small mammals and to a lesser extent on plant matter (Lanszki et al. 2006).

The contribution of plant matter, especially fruit, to the overall diet was lesser in the present study compared to other studies (Kotwal et al. 1991; Gupta 2006). Unlike the present study, greater quantities of vegetable matter are found in the diet of the jackal; during the fruiting season, jackals feed intensively on the fallen fruits of *Ziziphus* sp., *Syzigium cuminii*, and pods of *Prosopis juliflora* and *Cassia fistula* (Kotwal et al. 1991; Gupta 2006). Contrarily, lower proportion of plant matter especially the fruits recorded in the present study could be attributed to the absence of palatable fruit plants in fruiting condition.

#### Temporal difference in diet composition

The study showed that birds formed the diet of jackal significantly more during winter than in summer. As the present study area is one among the 467 Important Bird Areas of India and one among the 26 RAMSAR sites of India (http://wiienvis.nic.in/Database/IBA\_8463.aspx) and also attracts very diverse range of bird species including the migratory water birds in high density during winter than in summer. Therefore, the higher

proportion of birds in the diet of jackal coincides with migratory season of water birds in the study area and such shift in diet composition could be a function of optimal foraging (Pyke et al. 1977). The results further indicate the opportunistic foraging and hunting nature of the species, which in turn helps the species to use the heterogenous environment of the study area.

#### Prey preference

Among the 10 food items available (compared with usage), Black-naped Hare and Spotted Dove were the most preferred diet items followed by Chital, Cattle Egret and Great Egret. Although, the sanctuary has higher number or biomass of Blackbuck and cattle, the jackal did not prefer these species as its principal diet. As discussed earlier, given its smaller size in comparison to blackbuck, it may not be possible for the jackal to bring down the well-grown Blackbuck and thus, it may not be an optimal choice. It may, however, be comparatively easier for the jackals to hunt on the offspring or calf of Blackbuck, which are left behind by females in dense bushes, while going for grazing. During the peak calving time of Blackbuck in Velavadar National Park, India, jackals were observed searching for hiding calves throughout the day with search intensifying during the early morning and late evening (Jhala & Moehlman 2004; Aiyadurai & Jhala 2006). In addition, therefore, the low proportion of blackbuck and cattle in the diet of jackal could be due to the jackal's smaller size. Apart from Black-naped Hare, the jackal also showed preference to Chital, whose population is relatively small in the area.

#### **Conclusions and recommendations**

The Golden Jackal population found at Point Calimere Wildlife Sanctuary seems to be a healthy one, although the present study was unable to estimate population given the crepuscular nature of the species. The species is distributed uniformly in the grasslands and patchily in the tropical dry-evergreen habitats. Its ability to exploit a wide spectrum of food, ranges from mammals, birds, invertebrates to plants, which changes temporally, enabling the species to use all the habitats available in the study area. Being the only large-sized carnivore of the sanctuary, effective management of the Golden Jackal is essential for the dynamics of the ecosystem as a predator and may also act as seed disperser, as reported elsewhere and thus, we suggest a long-term study to understand the species ecology and their role in maintaining the ecosystem.

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