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DISTRIBUTION PATTERN AND HABITAT UTILIZATION OF VULTURES IN SATHYAMANGALAM TIGER RESERVE, TAMIL NADU, SOUTHERN INDIA

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ABSTRACT

Vultures are nature's most successful scavengers, and they provide an array of ecological, economic, and cultural services. The present study was aimed to attempt on the status, distribution, and habitat utilization of various vulture species in the Sathyamangalam Tiger Reserve from November 2018 to March 2019. In STR, vultures were counted on-road transects; tarred roads and metal roads are maintained by the Tamil Nadu Forest Department to provide easy access to the villages in the protected areas of STR. Throughout the survey, a total of 612 (6.43 ± 0.59) individuals of vulture species were recorded in a 1500km Transect in STR. Of which in 80 sightings a total of 497 (6.21 ± 0.56) White-rumped vultures were recorded with an Encounter Rate of 0.331 individuals/Km. Maximum 36 vultures and minimum one vulture was recorded in the survey. Range wise distribution of vulture in STR shows that in six ranges vultures were observed of which Bhavanisagar range has more number of sightings (n=50) as well as individuals (n=365 7.83 ± 0.92). As considers the presence of vultures within different vegetation structures in STR, most vulture sightings were recorded in Scrub and Thorn Forest (n=291 8 ± 1.18).

Keywords: Eastern Ghats, India, Sathyamangalam Tiger Reserve, Vultures

INTRODUCTION

Vultures are nature's most successful scavengers, and they provide an array of ecological, economic, and cultural services (Moleonet al.2014). It is noteworthy to mention that the scavengers occupy an imperative and last level of the ecosystem without which the recycling or proper disposal, especially that of dead and decaying materials will be either stopped or delayed. There are nine species of vulture found in the Indian sub-continent. (Ali and Ripley,1983). Populations of White-rumped vulture, Long-billed Vulture, and Slender-billed Vultures have declined more than 97% in India, Pakistan, and Nepal (Prakash et al. 2003; Pain et al. 2004; Baral et al. 2005). The sharp decline of White-backed Vulture, Indian Vulture, and Slender-billed Vultures are classified by IUCN as Critically Endangered (Bird Life International, 2008).

The cause of this decline has been found due to the veterinary drug called Diclofenac (Oaks et al. 2004), which is widely used to treat diseased livestock in Asia. Vultures are exposed to diclofenac by feeding on livestock carcasses which contain residues of this drug. The post-mortem examinations of dead or dying birds from India and Nepal showed that the high incidence of diclofenac residues in visceral gout (Shultz et al. 2004). Other than the diclofenac effect, some of the factors are also the reason for the decline of vultures in India. They are kite flying is one of the major threats for all avian birds species particularly 47% of the death rate of vultures in Gujarat was due to kite flying (Roy and Shastry, 2013). Malaria was also reported in declining of the vulture population in the Indian subcontinent (Poharkar et al. 2009). However, habitat destruction, road kills illegal poisoning, food shortage, and other ecological factors are playing an important role in the decline of vultures in the Asian subcontinent and worldwide (Chhangani and Mohnot, 2004; Chhangani, 2002,2005; Margalida, 2012, Margalida and Colomer, 2012).

In southern India there are seven species of vultures recorded namely, White-rumped (*G. bengalensis*), Long-billed (*G. indicus*), Red-headed (*Sarcogyps calvus*), Egyptian (*Neophron percnopterus*), Himalayan Griffon (*G.himalayensis*), Eurasian Griffon (*Gyps fulvus*) and Cinereous vultures (Aegypius monachus) were recorded. The Tamil Nadu part of the Nilgiri Biosphere Reserve (5540 sq. km) reported 6 species of vultures. (Ramakrishnan et al.2010, 2014; Samson et al. 2016; Venkitachalam and Senthilnathan, 2016; Samson et al. 2019). They are mainly dependent on wild carcasses (90%) as their diet (Ramakrishnan et al. 2010). Sathiyamangalam Tiger Reserve located in Eastern Ghats

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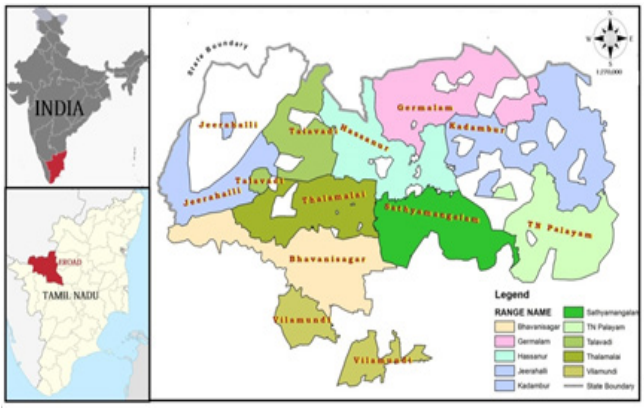
Landscape which is considered to have the single largest Asian elephant population in the world. It also probably holds the largest tiger population in the country and their wild prey ensures continuous food availability to vultures. Among the lesser carnivores, wild dog packs quickly consume their prey leaving behind skeleton remains. Leopards always prefer small or medium-sized prey and usually hide the remains on the tree branches inaccessible to vultures. The tiger generally prefers large size prey and tends to consume its prey over several days which is accessible to vultures. The previous study by Davidar and Davidar (2002) reported that the given study area had a good number of vultures but had been lost mainly due to the retaliatory killing of carnivores through poisoning of carcasses. This area is now harboring sizeable numbers of vulture populations and is considered to be India's southernmost wild viable breeding population. With their scavenging adaptation vultures play a significant role in destroying the pathogens growing on animal carcasses. They also help in controlling livestock diseases (Swan et al. 2006). This indirectly helps in preventing the contamination of the water bodies. Scarce studies are found regarding the ecological aspects of these birds (Navneethan et al. 2015). The sudden decline in the population of the vultures causes no cleaning mechanism in the forest and also human-inhabited areas. In many parts of the country, no vulture zones are facing the problems with the unattended carcasses like spreading of diseases from the decaying dead animal bodies, increase in the populations of the feral/street dogs, and the chance of water body contamination. As there is no better alternative to the ecosystem service provided by the vultures and also to keep the nutrient cycle rolling it's now very important to conserve these large Aves. Since captive breeding programs have been undertaken in the northern Indian States, the conservation of this wild breeding vulture population is need of the hour.Therefore this present study was aimed to attempt on status, distribution pattern, and habitat utilization of various vulture species in the Sathyamangalam Tiger Reserve from November 2018 to March 2019.

STUDY AREA

Sathyamangalam Tiger Reserve (Figure 1) is situated in the south-west corner of the Eastern Ghats and falls between the latitudes 11 29' N to 11 43' N and longitudes is 76 50' E to 2 77 27' E, covering 1,411 km. It is an important wildlife corridor connecting the Western Ghats and the Eastern Ghats. A wide variety of habitats can be seen from eastern to the western part of the sanctuary. There is a rainfall gradient from east to west and the change in vegetation is believed to be a result of the spatial-temporal pattern. The Eastern part of this sanctuary falls in the rain shadow region of Western Ghats. The average minimum and maximum temperature of the study area are 21.54ºC and 32.84ºC. The average annual rainfall is 824mm.The Tiger Reserve is represented by several forest types such as tropical dry deciduous, tropical scrub, tropical moist deciduous, tropical semi-evergreen forests, etc (Champion and Seth, 1968). The study area is very rich in wildlife harboring a good population of Asian elephants, Tiger, and numerous other wild fauna and flora. In the recent bird census, 125 birds are identified in the STR (Surendar and Asokan, 2014).



Figures 1. Showing the study area Sathyamangalam Tiger Reserve, Tamil Nadu, India.

METHODOLOGY

Line transect method

In STR, vultures were counted on-road transects; tarred roads and metal roads are maintained by the Tamil Nadu Forest Department to provide easy access to the villages in the protected areas of STR. Road transects were selected according to these habitat types. A total of 150 km of road transect were sampled on 10 occasions (n=1500km). The transects were driven between 08:00 and 17:00 local time at 20-30 km/h on 10 occasions from January to June in 2015. We also walked on elephant footpaths and alongside streams and rivers to search for vulture nests. When spotting vultures, the number of individuals, the activity of the birds, and the major vegetation type in the surrounding area were noted. The geo-coordinates were recorded using a GPS handset for all vulture sightings during the survey period. These geo-coordinates were subsequently used for the preparation of maps using Quantum GIS Madeira.

RESULTS

Throughout the survey, a total of 612 (6.43 ± 0.59) individuals of vulture species were recorded in a 1500km Transect in STR. Of which in 80 sightings a total of 497 (6.21 ± 0.56) White-rumped vultures were recorded with an Encounter Rate of 0.331 individuals/Km followed by Long-billed vulture (S=37; n=76 (2.05 ± 0.12); ER=0.051 individuals/km), Red-headed vulture (S=20; n=35 (1.75 ± 0.20); ER=0.23 individuals/km), Egyptian vulture (S=2; n=2 (1 ± 0); ER=0.001 individuals/km) and only one Himalayan vulture was also recorded. The flock size result shows that Maximum 36 vulture and minimum one vulture was recorded in the survey. The species wise maximum flock size was observed on White-rumped vulture (n=30) followed by Long-billed and Red-headed vulture (n=4) and Egyptian vulture (n=1). Long-billed vulture nesting site and Old and abandoned nesting areas of White-rumped vulture were also identified (Figures 1 and 2).

Figures 2. *Different vulture species recorded in the Sathyamangalam Tiger Reserve, Tamil Nadu, India.*
A: Red-headed vulture, B: White-rumped vulture, C: Long-billed vulture, D: Himalayan vulture, E: Egyptian vulture.

Range wise distribution of vulture in STR shows that in six ranges vultures were observed of which Bhavanisagar range have more number of sightings (n=50) as well as individuals (n=365 7.83 ± 0.92) followed by Thalavadi (S=9; n=71 7.88 ± 2.62) Sathyamangalam range (S=16; n=76 7.83 ± 0.92) and Hassanur (S=10; n=61 6.77 ± 1.75) less number of vultures were recorded in Thalamalai range (S=6; n=16 2.66 ± 0.66).

As considers to the presences of vultures within different vegetation structures in STR, most vulture sightings were recorded in Scrub and Thorn Forest (n=291 8 ± 1.18), followed by Deciduous Forest (n=117 5.85 ± 1.28), Scrub and Mixed Deciduous Forest (n=102 5.66 ± 0.92) and Dry Mixed Deciduous Forest (n=89 5.56 ± 1.08) (Table 1). The maximum and minimum group sizes of vultures recorded in the different vegetation types were as follows: Scrub and Thorn Forest (max. 37, min. 1), Deciduous Forest (max. 27, min. 1), Dry Mixed Deciduous Forest (max. 18, min. 1), and Scrub and Mixed Deciduous Forest (max. 16, min. 1).

recorded during the study period. White-rumped vultures were observed high densities in STR compare to other two resident species Long-billed vulture and Red Headed vulture. Huston (1985) reported that White-rumped vultures are the very commonest birds of prey in the Indian subcontinent. Long-billed vulture also found fairly well in this region because of STR are generally hilly terrain region Long-billed vultures have preferred mostly hilly terrain regions for their home territory in nature (Naroji, 2006). A total of 35 Red-headed vultures were recorded on 20 sightings and a maximum of four individuals were recorded in one sighting.Red Headed vultures are solitary in nature as well as timid it has a very strong bill so it will act as an opener in huge carcasses(Naroji, 2006). Ramakrishnan et al. (2012) and Samson et al (2016) reported that Red-headed vultures are fresh carcasses feeders in nature and it will track the predator's presence for their food. It is evident that a total of four individuals were recorded in single sighting shows the vultures havea strong relationship with predators in STR. A similar finding was also reported in the adjoining area of MTR a total of six individuals in one sighting (Ramakrishanan et al. 2012 and Samson et al. 2016).

Two nesting habitats were identified in STR presently using one Long-billed vulture nesting site as well as White-rumped vulture old nesting habitats (Map). Long-billed vulture nesting habitats were recorded in Moyar valley its falls under the STR and Mudumalai Tiger Reserve (Venkitachalam and Senthilnathan, 2015 and Samson and Ramakrishnan, 2018). STR is mostly hilly terrain habitat with huge Rocky Mountains Long-billed vultures are generally cliff nesters in nature (Naroji, 2006) so STR will support Long-billed vulture nesting further studies is needed for understanding the nesting habitats of Long-billed vulture in STR. White-rumped vulture nesting habitats were well documented in STR adjoining areas of MTR (Ramakrishnan et al. 2014; Samson et al. 2014; Samson et al. 2016).

Table 1. Shows that population details of vultures species in STR.

S.No	Vulture Species	Total number of sightings	Min	Max	Total number of individuals sighted	Overall Sightings	ERKm
1	White-rumped vulture	80	1	30	497	6.21 ± 0.56	0.331
2	Long-billed vulture	37	1	4	76	2.05 ± 0.12	0.051
3	Red headed vulture	20	1	4	35	1.75 ± 0.20	0.023
4	Egyptian vulture	2	1	1	2	1 ± 0	0.001
5	Himalayan vulture	1	1	1	1	1 ± 0	0.000
	Total	**92**	**1**	**36**	**611**	**6.43 ± 0.59**	0.407

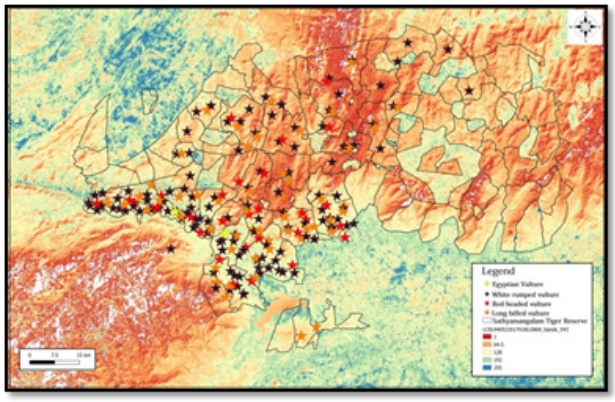
DISCUSSION

STR is a classical example for people and wildlife living harmony. The reserve was entirely covered by Human Habitations and Agricultural fields. The vulture occurrences as well as distribution were speckled distributed in the STR as well as they efficiently used this reserve as a foraging site. A total of five vulture species namely three "Critically Endangered" resident White-rumped, Long-billed and Red Headed vultures, and two migratory species "Endangered" Egyptian and "Near Threatened" Himalayan vulture were

Vultures are also observed in five types of vegetation in STR namely Scrub and Thorn Forest, Deciduous Forest, Scrub and Mixed Deciduous Forest, Dry Mixed Deciduous Forest, and Moist Deciduous Forest. These results are indicated that Thorn and Deciduous type of vegetation areas are attracting more number of vultures in STR. Samson et al. (2016) recorded that the Thorn forest attract more numbers of vultures in the Mudumalai Tiger Reserve.Vegetation structure plays a crucial role inthe selection habitat by wild animals. Vultures are areal scavengers and it will spot the carcasses with acute eyesight and the vegetation structure are

plays an important role in finding carcasses. Brown (1985) established two hypotheses namely Search efficiency and Runway Hypothesis against vegetation structure and carcass finding of vulture species. Increased vegetation density caused by bush encroachment decreases the likelihood of vultures locating a carcass, as they rely almost entirely on eyesight when foraging was explain by the search efficiency hypothesis. This hypothesis was confessed by Schultz (2007) showed that Cape Vultures *Gypsco protheres* in the Waterberg region of Namibia were unable to locate carcasses when the vegetation density was greater than 2600 trees ha–1. In the runway hypothesis vultures, which are heavy birds adapted for soaring and unsuited for flapping flight in confined spaces, will not land at carcasses they have located if they do not have sufficient space in which to take off again. This hypothesis was endorsed by Bamford et al. (2009) and Samson and Ramakrishnan (2017)reported that carcass utilization by vultures may be constrained by the surrounding vegetation, as high vegetation densities may leave insufficient space for the vultures to take-off. These hypothesis pieces of evidence are evident that presences as well as the survival of vultures are based on the vegetation structure in the forest ecosystem.

This study showed that vultures were predominantly observed in Human dominated areas. Donazar et al. (1993) reported that the breeding density of vultures was directly correlated to the ruggedness of the topography, altitude, and distance to the nearest village. The open area gives the impression to have positive effects, most likely by increasing the accessibility of food, although its effects were not separable from that of the relief, as the two factors covaries. Vultures are evidence for lower breeding success by plummeting accessibility to human, and possibly by increasing food availability (Donazar et al. 1993). Land-use patterns influence raptor diversity and density (Herremans and Herremans- Tonnoeyr, 2000). In Africa, Brandl et al. (1985) reported a negative correlation between human impact on the landscape and raptor diversity and density. However, vultures have the highest density at the interface between protected and non-protected areas (Herremans and Herremans-Tonnoeyr, 2000). In the present study also, the vultures were seen mostly on the periphery of the reserve near the human Settlements (Figure 3).



Figures 3. *Distribution pattern of different vulture species in Sathyamangalam Tiger Reserve, Tamil Nadu, India.*

CONCLUSION

Based on this short time study STR will act as an efficient foraging grounds for residents and well as migratory vultures and partially supported for Long-billed vulture nesting also. Past shreds of evidence clearly showed that STR was home for White-rumped vulture also due to some obstacles like STF camp (Special Task Force) exactly located the past nesting habitat of White-rumped vulture it may a reason for abandoning of the nesting site. Prakash et al. (2007) reported that thousands of vultures may remain; they are now spread very thinly across a huge area. This is the dangerous situation for such social birds, which they built a nest and roost communally and rely on information gained from one another when searching for widely dispersed food sources. The number of individuals of vultures has decreased considerably during the last five years. The population declining was reported in this region at the early as the late 70s and early 80s (DavidarandDavidar, 2002). This was due to the practice of deliberate poisoning of the carcasses, as a perceived revenge-seeking method on carnivores by the local people. With the launch and successful implementation of a compensation scheme for loss of cattle by a wildlife enthusiast, people have been weaned away from this rather disastrous practice.

MANAGEMENT RECOMMENDATION

- The present study shows that vegetation type of the Sathyamangalam Tiger Reserve support as a good foraging area of vultures. Removal of invasive alien species such as Lantana camara, Prosopisjuliflora, andEupotorium spp. is urgently warranted to ensure carcass findings in the forest areas especially in Thorn and dry deciduous forests.

- It is recommended that regular monitoring of vulture in the study area to assess habitat utilization is crucial for prepare the management plane for conserving the vulture species in the reserve.

- Since we observed more numbers of vultures recorded near the human settlements of the reserve is highly threatened for Diclofenac incidences on this concern use of Diclofenac in the villages around the reserve should be monitored as it has caused large-scale mortality in vultures in different regions of the country.

- Awareness creation to the local people living in the surrounding areas of the vulture habitat is also urgently needed.

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