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Cover: *Saproamanita praeclara*: Sporocarp in habitat © Kantharaja. R.



## Group size pattern and distribution of threatened Sambar *Rusa unicolor* (Artiodactyla: Cervidae) in Moyar River Valley, India

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The Sambar *Rusa unicolor* (Kerr, 1792) is the largest deer in southern Asia and has a wide geographical distribution (Schaller 1967; Leslie 2011; Jhala et al. 2020). The subspecies *R. u. niger* is found throughout India except in the high Himalaya (>3,800 m), desert of Kutch, and the coast. It occurs in a wide range of habitat types that include mixed deciduous forest, thorn forest, arid-dry forest, shola grassland, coniferous forest, and evergreen forest (Varman & Sukumar 1993; Menon 2014). It is adapted to a wider variety of environmental conditions than any other ungulate in India (Schaller 1967). Sambar's readiness to graze/browse is the primary reason for the broad distribution of this species. They mainly graze when fresh green grass is available (Schaller 1967; Eisenburg & Lockhart 1972). Although Sambar is distributed in widespread locations and habitat types, its population has declined in the past

few decades. Hence it is classified as 'Vulnerable' on the IUCN Red List (Timmins et al. 2015). In India, Sambar is protected under the Schedule III category of the Wildlife Protection Act 1972 (Jhala et al. 2020).

Sambar is essentially a non-social species (Sankar & Acharya 2004) and is usually seen as solitary or in small groups with fewer than six individuals (Schaller 1967). The characteristic social unit is one hind and one fawn, or one hind, one yearling and one fawn (Schaller 1967). Sambar prefer dense vegetation cover and avoid resting in open areas (Johnsingh 1983). Though it is a widely distributed deer species in India, information on its group size and composition is scanty. We recorded the Sambar distribution and group composition based on opportunistic sightings during the python telemetry project survey between January 2018 and January 2020 in the Moyar River valley that encompasses

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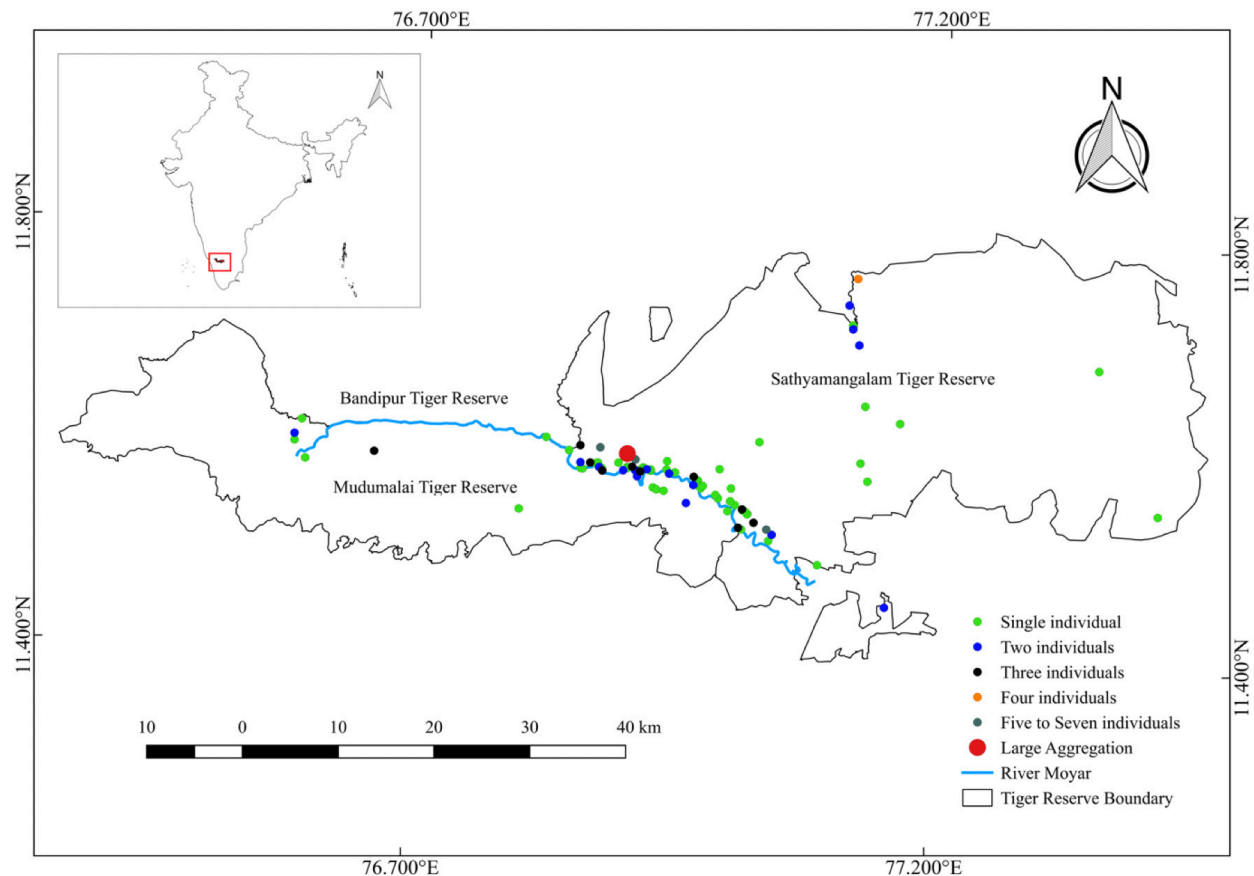


Figure 1. Distribution of Sambar sighting locations in Moyar River valley, Tamil Nadu.

Sathyamangalam and Mudumalai tiger reserves.

Moyar River valley (Figure 1) is a unique landscape situated at the tri-junction of Tamil Nadu, Kerala, and Karnataka states. This landscape is also a juncture of the Western and the Eastern Ghats, and has high diversity of flora and fauna (Thirumurugan et al. 2021). In addition, this landscape supports a large wild population of Asiatic Elephants and high density of carnivores & herbivores, including Sambar (Jhala et al. 2020). During our two years of field work, we recorded a total of 182 Sambar individuals (101 females, 38 males, 11 fawns, and 32 individuals whose sex could not be determined) at 86 different occasions (Figure 1). Among our observations, 65% were solitary individuals, and 17% and 12% were two and three individuals, respectively. Only in 6% of our observations we saw four or more individuals. Solitary Sambar ( $n = 56$ ) were common in the study area; occasionally, females with a fawn ( $n = 6$ ) and male/female pairs ( $n = 5$ ) were recorded (Figure 2). The group size usually varied between one and seven with a mean of  $1.62 \pm 1.13$  (SD). In one instance, we recorded a large aggregation of 44 individuals resting in the grassland on 29 June 2019 at 1510 h, ( $11.593^\circ\text{N}$  &  $76.902^\circ\text{E}$ ; 837 m),

in Thekkathimalai, Bavanisagar range, Sathyamangalam Tiger Reserve (Image 1). The aggregation site was about 1.5 km away from the perennial river Moyar. This aggregation consisted of four hard-antler adult stags, four velvet stags, 32 females, and four fawns. In addition, small groups of 3–7 individuals were also recorded adjacent to the large group in the adjacent areas on the same day. In all, about 63 individuals were recorded that day in the surrounding locations. The following tree species were observed around the large aggregation site, viz.: *Dicrostacys cinerium*, *Anogeissus latifolia*, *Givotia rotteniformis*, *Bauhinia racemosa*, *Bridelia feruginea*, *Semicarpus anacardium*, *Hardwickia binata*, *Dalbergia latifolia*, *Diospyros* sp., *Grewia tilifolia*, *Flacourtia indica*, *Diospyros montana*, *Pterocarpus marsupium*, *Phyllanthus emblica*, and grasses such as *Cymbopogon flexuosus*, *Apluda mutica*, *Eragrostiella bifaria*, *Digitaria* sp., *Eragrostis tenuifolia*, *Themeda cymbaria*, and two unidentified species.

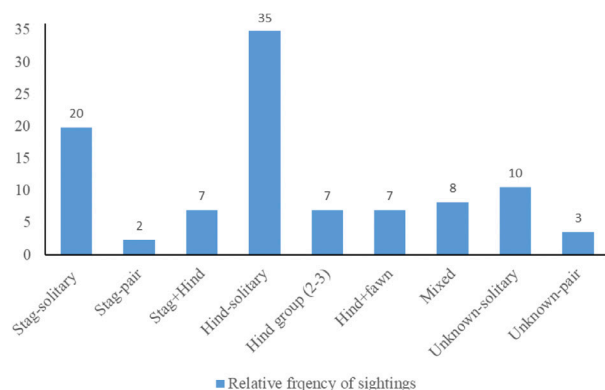
Earlier studies suggest that Sambar is usually found in small groups or as solitary individuals and prefers dense vegetation (Schaller 1967; Eisenburg & Lockhart 1972; Johnsingh 1983; Karanth & Sunquist 1992; Leslie



**Table 1. Maximum number in Sambar groups reported by other authors in India.**

	Group Size (N)	Location	Authors
1	9	Kanha Tiger Reserve, Madhya Pradesh	Schaller 1967
2	10	Periyar Tiger Reserve, Kerala	Ramachandran et al. 1986
3	15	Mudumalai Tiger Reserve, Tamil Nadu	Krishnan 1972
4	28	Sariska Tiger Reserve, Rajasthan	Sankar 1994
5	39	Bandipur Tiger Reserve, Karnataka	Johnsingh 1983
6	44	Sathyamangalam Tiger Reserve, Tamil Nadu	Present observation
7	45	Mudumalai Tiger Reserve, Tamil Nadu	Prasanna 1990
8	36–45	Mudumalai Tiger Reserve, Tamil Nadu	Ramesh et al. 2012
9	50	Mudumalai Tiger Reserve, Tamil Nadu	Varman & Sukumar 1993
10	150–200*	Simlipal Tiger Reserve, Odisha	Jammal & Johnsingh 2015

\*Aggregate every night in and around salt lick near the Bakmuda Range office, and this is the largest aggregation reported in the native range of Sambar.

**Figure 2. Group composition of Sambar sightings in Moyar River Valley, Tamil Nadu.**

2011). Occasionally, Sambar form large groups near water holes, swampy grasslands, open areas, salt licks, and burnt areas (Johnsingh 1983; Eisenburg & Lockhart 1972; Ramesh et al. 2012). In the adjacent landscape at Mudumalai TR, the group size varied between one and 50 (Varman & Sukumar 1993) and group sizes >15 individuals were in 3.7% of 377 sightings from April to October in swampy grasslands by Ramesh et al. (2012). Interestingly, in Mudumalai, the maximum dry-season (March–mid May) group size is recorded as 19 individuals in the deciduous forest, and the maximum wet-season (July–September) group size was between 44 and 50 individuals in the swampy grasslands (Varman & Sukumar 1993; Ramesh et al. 2012). However, though



**Image 1. a—Part of the large aggregation of Sambar sighted in the Sathyamangalam tiger reserve, Tamil Nadu | b—Panoramic view of the woodland savannah habitat along with the large aggregation of Sambar. © Thirumurugan V.**



**Image 2. The undisturbed woodland savannah habitat in the hills and hill slopes © Thirumurugan V.**

our observation is very close to the wet season, it was made on hilly grassland where the substratum is usually dry, unlike the wet swampy grasslands.

The earlier studies suggest that the increased food availability immediately after rain in Mudumalai may account for such large aggregations (Varman & Sukumar 1993; Ramesh et al. 2012). In Bandipur, an aggregation of 39 individuals was observed near a pond in response to a Dhole pack, indicating antipredator strategy which also contributes to large aggregations (Johnsingh 1983).

Although several speculations are advanced to explain the large aggregations among Sambar individuals, there is no concrete evidence to describe why such infrequent aggregations occur. Based on the previous records it is inferred that resource availability, water holes, feeding sites including swampy grasslands, salt lick areas, predator pressure, reproduction, parental care, rainfall, vegetation cover characteristics, and climate are some of the factors known to influence large aggregations of Sambar. How these factors individually or in combination act upon the large aggregations of Sambar merits further detailed study.

The present observation is the first large gathering of sambar reported from Sathyamangalam TR. The large aggregation of Sambar in the Moyar landscape denotes that the grassland savannah (Image 2) is a preferred habitat on a seasonal basis. Similar reports of large gatherings of Sambar are available primarily from the adjacent contiguous landscapes, viz., Mudumalai and Bandipur TRs (Table 1). Interestingly, all previous large group size reports are from famous tiger reserves of India (Table 1), which denotes the importance of this species as prey to large predators. Sambar is a preferred prey species for carnivores such as Tigers, Leopards, Dholes (Varman & Sukumar 1993; Sankar & Acharya 2004), and pythons (Bhupathy et al. 2014). Recently Jhala et al. (2020) reported that the Sambar density in Sathyamangalam TR was higher (8.97/ km<sup>2</sup>) than Mudumalai TR (3.21/ km<sup>2</sup>). Considering the Sambar's preference for cover and avoidance of disturbance, its high abundance would be a reliable indication of the health of the forest ecosystem in the study area. The availability of suitable habitat and better habitat management practices implemented by the local forest department could be a reason for such a high Sambar density that can potentially assist in holding high densities of large predators in the Moyar River valley landscape. The grassland (Image 1a,b) where the congregation was observed could be an important habitat for the Sambar. Further, the depleting grassland habitats in the plains due to the rapid spread of invasive species like *Prosopis juliflora* and *Lantana camara* is a cause for concern. Hence, providing special attention to this habitat in the management aspects can be critical for the long-term conservation of this globally threatened species within the study area.

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