A STUDY OF THE POPULATION STRUCTURE OF TWO SPECIES OF NON-HUMAN PRIMATES IN THE SIMILIPAL TIGER RESERVE, MAYURBHANJ, ORISSA, INDIA

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Introduction

The State of Orissa, covering an area of 1,55,707 km^2 on the eastern sea board of India, forms part of two biographical zones, namely, the Deccan Peninsula and the coastal plains. Three species of non-human primates occur in the State : the Hanuman langur, *Semnopithecus entellus entellus* (Dufresne, 1797), the Rhesus macaque, *Macaca mulatta* (Zimmermann, 1780), and the Bonnet macaque, *Macaca radiata* (E. Geoffroy, 1812) (Cercopithecidae) (Mishra *et al.,* 1996). Of these, *M. radiata* is confined to the Malkangiri District in South Orissa. The other two species of non-human primates occur in the forests of Similipal hills of the Mayurbhanj District.

Sixteen sub-species of *Semnopithecus entellus* are distinguished based on minor morphological variations, habits and the area inhabited, of which fourteen occur in India. *Semnopithecus entellus entellus* (Dufresne, 1797) inhabits Southern West Bengal, Southern Bihar, Southern Chhatisgarh, Jharkhand, North-eastern Maharashtra and Orissa in Eastern India, with a probably introduced population in Western Bangladesh (Brandon-Jones, 2004). *Semnopithecus entellus* and *Macaca mulatta* occur in quite large numbers in the Similipal Tiger Reserve of Mayurbhanj District, Orissa. The census of different species of wild mammals occurring in the Tiger Reserve was taken up by the first author during May, 2004. The population structures of the above two species form the basis of study in this paper.

Study Area

The Similipal massif is located between 20° 28' and 22° 08' North latitudes, and 86° 04' and 86° 37' East longitudes in Mayurbhanj District, Orissa (Fig. 1). The hills covering an extensive area of 2,750 km^2 have a large number of crests and radiating perennial streams. The elevation of the tableland varies between 500m and 600m with outer areas 1,000-1,100 m above mean sea level. It is covered with a rich canopy of sub-tropical forest, and harbours a rich floral and faunal composition of 1,124 plant species including 64 species of cultivated plants and 93 species of orchids; and, 42 species of mammals, 264 species of birds, 37 species of reptiles and 13 species of amphibians (Swain, 2006). In this region, the year can be distinguished into three principal seasons :

(1) Warm, wet season (July-October from 1994 to 2004), maximum temperature 17°C-42°C (mean 28.68°C, SD 3.271, SE 0.036), rainfall 821.648 mm -

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Fig. 1

Similipal Tiger Reserve

1727.17 mm (mean 1398.726 mm, SD 275.486, SE 83.06);

(2) Cool season (November-February from 1994 to 2004), minimum temperature 1°C - 32°C (mean 12.507°C, SD 4.135, SE 0.05), rain fall 11.85 mm – 225.507 mm (mean 77.376 mm, SD 67.62, SE 20.39);

(3) Hot, dry season (March-June from 1994 to 2004), maximum temperature 14°C – 49°C (mean 32.69°C, SD 4.49, SE 0.051), rainfall 500.609 mm – 989.97 mm (mean 715.804 mm, SD 161.197, SE 48.60).

During the wet season, food is abundant for animals, but rains affect their activity. During the cool season, the morning temperature records 1°C, frost and heavy dew are common. Foraging activity of diurnal animals begins late. During the hot season, the day length increases and morning temperature is higher and foraging activities start early and continues intermittently throughout the day. Many trees are in flower, including the dominant species Sal (*Shorea robusta).*

The Similipal Tiger Reserve has a well demarcated core area of 845 km^2 and a buffer zone of 1,950 km^2 (Fig. 1). The core area is composed of seven forest ranges namely, Upper Barakamuda (UBK), Chahala, Jenabil, Nawana (South), Nawana (North), Pithabata and National Park, while the buffer zone consist of twelve forest ranges under three forest divisions namely, Baripada, Karanjia and Rairangpur (Fig. 1).

Methods

The census of the two species of primates, viz. the Hanuman langur and the Rhesus macaque was undertaken from 4th to 7th May, 2004, by direct census method recommended by Brower *et al*. (1990) based on actual sighting. The study area was divided into 61 units. Each transect was of two kilometres in length. A census party consist of three persons actually walked through a transect of two kilometer with a pair of 10x35 Leitz binoculars. The party started at 05:00 AM in the morning to 08:00 AM and again started from 03:45 PM to 06:45 PM, depending upon the topography of the ground traversed. The census was carried out for four consecutive days in the above manner, covering a total distance of 122 km. On each of the four consecutive days, the leader of each census party noted observations in a proforma provided. In the data sheet, the information like the troop size, and the composition of the male, female and juveniles, etc. was recorded.

The collected data was analysed using the formula suggested by Hayne (1949) given below :

$$D = \frac{10^4 \, \Sigma(1/di)}{2L}$$

where :

D = the population density, in number/ hectare,

L = Length of transect (m)

di = distance from the observer to the i^{th} animal sighted, measured in (m) to the point where the animal was, at the time it was sighted

10^4 = factor converting m^2 to ha.

Results and Analysis

The summaries of data recorded in the data sheets of 61 census units are presented in Table 1, in respect of the

Table 1

Population density of Hanuman langur and Rhesus macaque in Similipal Tiger Reserve, Mayurbhanj, Orissa

Sl. No.	Range	Census unit	Hanuman langur density/ ha	Confidence level {+t(SE)}	Rhesus macaque density/ ha	Confidence level {±t(SE)}*	% Dense forest	% Open forest	% Grass-land	% Shrub forest
1	2	3	4	5	6	7	8	9	10	11
1	Gurguria	Kuanribil	1.625	2.538	0.000	-	87.65	3.02	0.00	9.33
2	Chahala	Barehipani	1.432	1.520	0.000	-	64.31	9.45	0.00	26.24
3	Jenabil	Hatisal	1.020	1.943	0.983	2.248	75.18	23.42	0.00	1.40
4	National Park	Mahavirsal	0.976	0.888	0.000	-	79.28	20.72	0.00	0.00
5	Nawana (South)	Bakua	0.917	0.427	0.000	-	85.46	5.25	0.00	9.29
6	Nawana (South)	Badmakabadi	0.841	1.863	0.000	-	94.70	5.13	0.00	0.17
7	Kendumundi	Silda	0.787	0.610	0.000	-	87.27	11.31	0.00	1.42
8	Upper Barakamuda	Bahaghar	0.733	0.870	0.000	-	84.06	7.98	0.08	7.88
9	Chahala	Karkachia	0.717	0.845	0.000	-	47.65	1.08	0.00	51.27
10	Upper Barakamuda	Meghasini	0.555	0.662	0.000	-	74.62	24.15	1.23	0.00
11	Upper Barakamuda	Patbil	0.542	0.650	0.000	-	65.69	22.29	0.00	12.02
12	Pithabata	Badmakabadi	0.527	0.450	0.000	-	98.88	1.12	0.00	0.00
13	Upper Barakamuda	Bhanjabasa-II	0.495	0.602	0.000	-	64.38	34.06	0.00	1.56
14	Chahala	Bhatunia	0.491	0.516	0.000	-	49.78	9.15	0.00	41.07

Contd...

1	2	3	4	5	6	7	8	9	10	11
15	Jenabil	Gurandia	0.490	0.608	0.000	-	86.97	8.23	0.00	4.80
16	Chahala	Brundaban	0.475	1.079	0.000	-	51.80	13.70	0.00	34.50
17	Pithabata	Bhajam	0.465	0.355	0.269	0.522	94.84	4.98	0.00	0.18
18	Nawana (South)	Dhudru-champa-II	0.461	0.528	0.000	-	78.99	9.81	0.00	11.20
19	Upper Barakamuda	Bhanjabasa-I	0.456	1.163	0.000	-	87.09	12.56	0.00	0.35
20	Manada	Bandriabasa	0.428	1.189	0.000	-	79.29	7.36	0.00	13.35
21	Chahala	Chahala-I	0.425	0.774	0.000	-	36.09	1.30	0.00	62.61
22	Chahala	Haladia	0.417	1.158	0.000	-	62.61	13.60	0.00	23.79
23	Nawana (North)	Joranda	0.392	0.695	0.000	-	95.00	1.88	0.00	3.12
24	Chahala	Chahala-II/ Kairakacha	0.381	0.455	0.000	-	34.45	1.08	0.00	64.47
25	Jenabil	Jamuna	0.360	0.667	0.125	0.347	87.97	11.53	0.00	0.50
26	Nawana (South)	Jodapal	0.350	0.973	0.000	-	92.81	1.25	0.00	5.94
27	Gurguria	Gurguria	0.340	0.598	0.000	-	84.01	7.89	0.00	8.10
28	Nawana (South)	Balikhal	0.336	0.160	0.000	-	90.89	7.60	0.00	1.51
29	National Park	Nuagaon	0.300	0.834	0.000	-	86.25	8.08	0.41	5.26
30	Nawana (North)	Khadkei	0.283	0.678	0.000	-	60.64	27.98	0.00	11.38
31	Jenabil	Jenabil	0.252	0.419	0.000	-	89.46	5.48	0.00	5.06
32	Nawana (North)	Kusumbani	0.232	0.368	0.000	-	55.64	3.39	0.00	40.97

Contd...

1	2	3	4	5	6	7	8	9	10	11
33	Upper Barakamuda	Nekedanacha	0.200	0.351	0.000	-	75.19	23.41	0.00	1.40
34	Pithabata	Kachudahan	0.186	0.318	0.057	0.158	82.54	16.48	0.00	0.98
35	Jenabil	Tiktali	0.183	0.330	0.000	-	75.52	22.78	0.00	1.70
36	Kaptipada	Dangadiha	0.150	0.417	0.000	-	35.58	59.32	0.00	5.10
37	Jenabil	Hatighar	0.144	0.299	0.000	-	85.48	4.88	0.00	9.64
38	Nawana (South)	Dhudru-champa	0.143	0.250	0.000	-	88.09	10.30	0.00	1.61
39	Kaptipada	Ghagra	0.138	0.235	0.000	-	63.07	25.13	0.00	11.80
40	National Park	Ganapati	0.135	0.178	0.078	0.216	91.38	6.58	0.00	2.04
41	Upper Barakamuda	Upper Barakamuda	0.133	0.371	0.000	-	85.92	12.16	1.82	0.10
42	Kaptipada	Kenduchua	0.100	0.278	0.000	-	39.64	59.92	0.00	0.44
43	Nawana (North)	Nigirdha	0.090	0.250	0.000	-	80.82	3.30	0.00	15.88
44	Bisoi	Talabandha	0.083	0.231	0.000	-	63.73	13.23	0.00	23.04
45	National Park	Kabatghai	0.075	0.208	0.000	-	95.15	4.03	0.00	0.82
46	Pithabata	Bhundadar	0.060	0.167	0.000	-	84.58	15.08	0.00	0.34
47	Upper Barakamuda	Tarinibila	0.050	0.139	0.000	-	71.53	24.42	1.89	2.16
48	National Park	Kalkam	0.017	0.045	0.000	-	82.00	5.03	0.00	12.97
49	Upper Barakamuda	Tinadiha	0.000	-	0.000	-	76.86	17.79	1.09	4.26
50	Upper Barakamuda	Kandadhenu	0.000	-	0.000	-	74.53	25.47	0.00	0.00

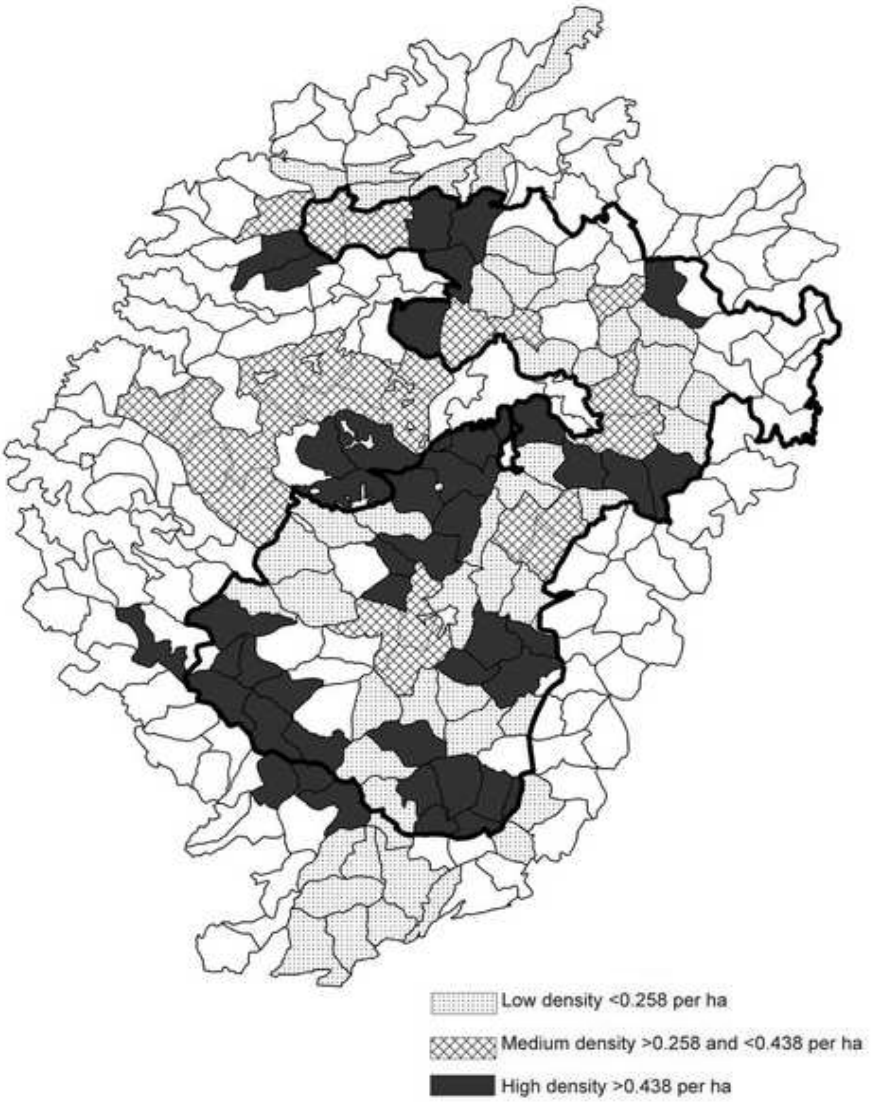
Contd...

1	2	3	4	5	6	7	8	9	10	11
51	Upper Barakamuda	Devasthali	0.000	-	0.00	-	74.43	22.03	0.15	3.39
52	Upper Barakamuda	Gunduria	0.000	-	0.00	-	81.07	14.67	0.00	4.26
53	Jenabil	Sarua	0.000	-	0.00	-	86.84	9.98	0.00	3.18
54	Nawana (North)	Pandabandha	0.000	-	0.00	-	71.96	0.38	0.00	27.66
55	Pithabata	Baunskhal-I	0.000	-	0.00	-	62.38	25.63	0.00	11.99
56	National Park	Ransa	0.000	-	0.00	-	98.89	0.85	0.00	0.26
57	Udala	Deokund	0.000	-	0.00	-	73.71	22.04	0.00	4.25
58	Kaptipada	Champachua	0.000	0.000	0.00	-	56.10	34.81	0.00	9.09
59	Dudhiani	Dudhiani	0.000	-	0.10	0.278	83.21	8.22	0.00	8.57
60	Dudhiani	Kiajhari	0.000	-	0.00	-	83.44	8.76	0.00	7.80
61	Manada	Rajupal	0.000	-	0.00	-	50.90	3.55	0.00	45.55

* t = Students' T; SE= Standard Error

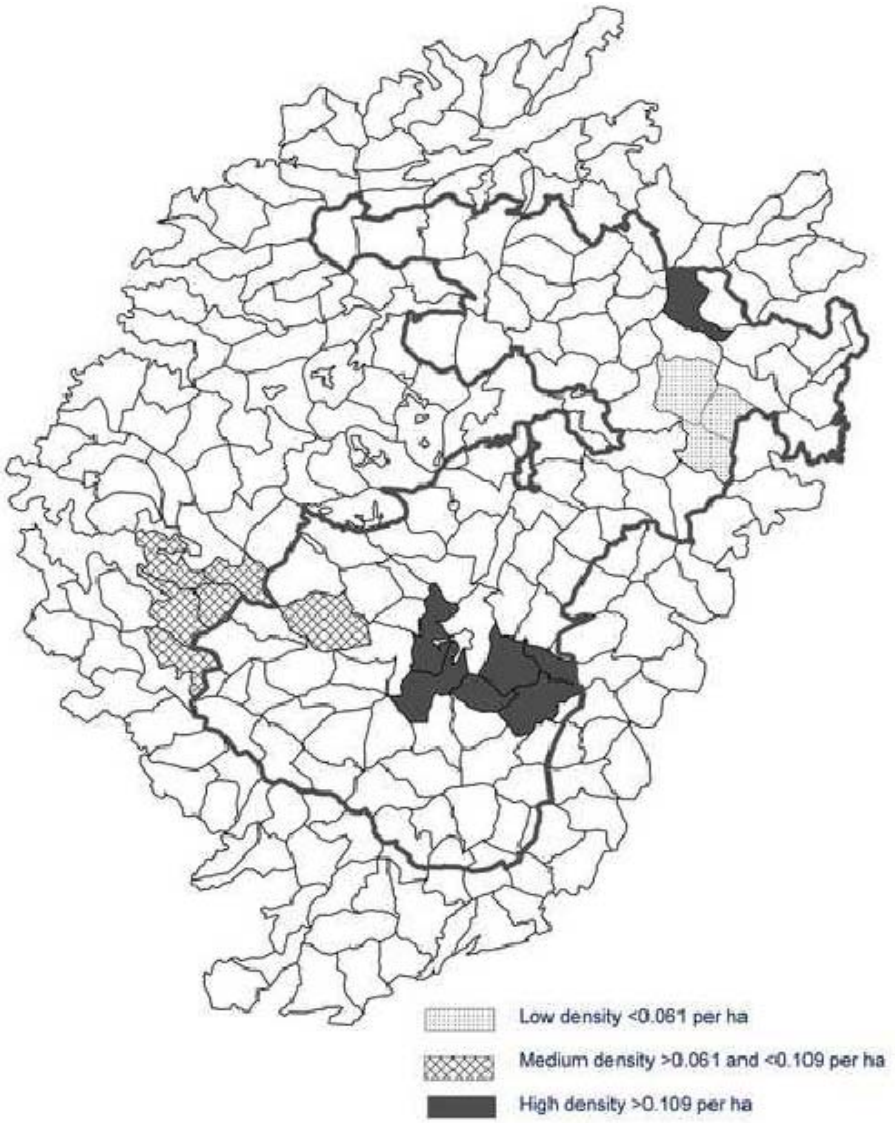
Hanuman langur and the Rhesus macaque, together with the percentage of the dense forest, open forest, shrub forest and grass land as estimated with the help of the Orissa Remote Sensing Application Centre, Bhubaneswar in February, 2003 (Fig. 1). Figs. 2 and 3 depict the distribution of the Common langur and the Rhesus macaque respectively. Table 2 presents the troop size of the Common langur and Table 3

Fig. 2



Hanuman Langur density in Similipal Tiger Reserve, Mayurbhanj, Orissa

Fig. 3



Rhesus macaque density in Similipal Tiger Reserve, Mayurbhanj, Orissa

Table 2

Troop size of Hanuman langur in Similipal Tiger Reserve, Mayurbhanj, Orissa

No. of males	No. of troops	Troop size
1	13	1, 3, 3, 3, 3, 3, 5, 5, 6, 6, 8, 12, 13
2	8	2, 3, 5, 10, 10, 12, 13, 20
3	6	7, 8, 11, 14, 25, 34
4	2	6, 12
5	2	7, 20
6	4	8, 8, 15, 15

Mean = 9.6; SD = 7.04; SE = 1.19; Range 1 – 6

Table 3

Troop size of the Rhesus macaque in Similipal Tiger Reserve, Mayurbhanj, Orissa

No. of sightings	No. of Rhesus macaques in a troop	No. of males in a troop
1	8	?
2	4	?
3	18	?
4	7	?
5	7	?
6	25	?
7	13	?
8	7	?
9	10	?
10	20	?
11	9	?
12	10	?

? = No of male in troop is unknown
Mean = 11.5, SD= 6.32, SE=1.82 and range 4-25

Table 4

Adult males in Hanuman langur troops in Similipal Tiger Reserve, Mayurbhanj, Orissa during census operation from 4th to 7th May, 2004.

Males	Troops
0	1
1	10
2	10
3	5
4	2
5	2
6	2
7	3
Total	35 troops

Mean =4.38, SD= 3.66, SE=1.29 and range 0-7

presents that of the Rhesus macaque. Table 4 shows the number of adult males per langur group.

(a) ***Hanuman Langur***

An analysis of data in Tables 1-4, shows that, in a total number of 144 sightings of Hanuman langur troops, the size ranged between one and 50, but the number of males in a troop could not be ascertained in 106 groups. This was because, the observers had to walk through the forest as silently as possible, otherwise, any disturbance of a group of primates would have disturbed other primate groups in the vicinity, and the census operation would have been vitiated.

Of the 61 census units, all have a forest density of more than 40%, except in three, where the density was 36.09% (Chahala-I), 35.58% (Dangadiha) and 34.45% (Chahala-II). As many as 43 census units areas have more than 70% dense forest, while nine census units (Badamakabadi, Bhajam, Joranda, Jodapal, Balikhal, Ganapati, Kabatghai, Ranasa and Nawana (South) have more than 90% forest density. However, no Hanuman langur was sighted in 13 units in which the forest density varied between 50.90% and 98.89% (Table 1).

Of the 144 Hanuman langur troops sighted, four troops consisted of single individuals. Of them, only in one, the sex could be noted to the male, whereas, in the remaining three of single individual troops, the sex could not be identified.

In a single troop of the two individuals, both were found to be males. We noticed a single male in twelve bisexual groups composed of three to 13 individuals. In seven bisexual groups of three to 20, there were two males; in six troops of seven to 34, males numbered three; in two troops of six and 12 individuals, males numbered four; in two troops of seven and 20, there were five males; whereas in two troops of eight and two troops of 15 individuals, males numbered six in each of the four troops.

Hanuman langurs live in fairly stable groups consisting of juveniles of all ages and males and females. Behura (1987) reported that in a social bisexual Hanuman langur group, the number of individuals varies between 13 and 35, and in all male groups the number varies between four and 15. Prater (1998) states that in North India, a Hanuman langur group consisted of 18 to 25 individuals and in the South around 15. Roonwal and Mohnot (1977) report that in Northern and Central India, most bisexual groups had two to six adult males; one bisexual group had only one adult male; there were a number of all male groups and a few solitary females. In 39 groups of almost 1000 Hanuman langurs, the group size varied from 2 to 120; most groups in forested areas had 18-25 members. In Central India, Sujiyama (1964) found the bisexual group size varying between 15 and 61, with an average of 27.8. In Gujarat, bisexual groups were of 16-48, with occasional all male groups of two or three. In peninsular India, Sujiyama and his co-workers found a significant difference in group size between relatively open and forested areas. The mean group size (both bisexual and all male groups) in forested areas was 14.4 individuals and in the open area 17.1. The average group size for both areas was 15.1 (Roonwal and Mohnot, 1977). In the Similipal Tiger Reserve, in 144 groups of 1505 Hanuman langurs, the mean troop size works out to 9.6 ± 1.19. It thus appears that observations here tally fairly well with the findings of workers in other areas of India. The observations further corroborate that the Hanuman langurs live in social groups of various sizes and compositions in well forested hilly areas.

In the census operation in the Similipal Tiger Reserve, only a single all female group of six was sighted. This appears some what extraordinary.

The highest and lowest density of Hanuman langur in the Similipal Tiger Reserve was 1.625 (Kuanribil) and 0.017 (Kalkam) per hectare respectively. Thus, the concentration works out to 162.5 and 1.7 per km^2, which appear to be quite high

compared to 100 langurs per km² at Dharwar as reported by Sujiyama (1964). This may be due to the higher concentration of preferred food plants in the concentrated area.

(b) ***Rhesus Macaque***

Compared to the sightings of the Hanuman langur in 48 out of 61 census units in the Similipal Tiger Reserve, we met with the number of Rhesus macaques far less in the number of troops and in the number of individuals. The present authors noticed macaques in six census units only (Hatisal, Bhajam, Jamuna, Kachudahan, Ganapati and Dudhiani). Of these, in the first five units, we sighted both langur and macaque troops, while in one unit (Dudhiani), we met with only macaques and no Hanuman langur (Table 1). A total of 12 macaque troops with a total population of 138 individuals were observed (Table 3). The troops were made up of 4 to 25 individuals, with a mean of 11.5±1.82. Unfortunately, in none of the troops, the male could be distinguished. The density varied between 0.100 and 0.983 per ha with a mean of 0.2686. Thus, the population density was 10-98.3/km², with a mean of 26.86.

Neville (1968) found the population density of about 5-15 per km² in the elevated Chir pine forests of Uttar Pradesh and about 57 per km² in the moist deciduous areas at lower elevations, as against 753 per km² in the town (Roonwal and Mohnot, 1977).

It appears that the high population density of 10-98.3 per km² in true dense forest dwelling Rhesus macaques in the Similipal Tiger Reserve, is probably due to preferred host-plant concentration in the census units surveyed.

Acknowledgements

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SUMMARY

Generally three species of non-human primates occur in the State of Orissa (India). Among these only two species of non-human primates occur in the forests of Similipal hills of Mayurbhanj District. A census for different species of wild mammals occurring in the Similipal Tiger Reserve was undertaken during May, 2004. The results of population structure of two species of non-human primates, viz. *Semnopithecus entellus entellus* and *Macaca mulatta* were furnished. The census was carried out for four consecutive days in the line transect method covering a total distance of 122 km. Of the 144 troops sighted consisting of 1,505 Hanuman langurs, the mean troop size worked out to 9.6 ± 1.19. The highest and lowest density of Hanuman langur was 162.5 and 1.7 per km² respectively. Similarly, out of 12 macaque troops sighted consisting of 138 individuals, the troops were made up of 4 to 25 individuals, with a mean of 11.5 ± 1.82. The population density was 10-98.3 per km², with a mean of 26.86.

Key words : Population structure, Non-human primates, Similipal, Orissa, India.

सिमलीपाल बाघ संरक्षित वन, मयूरभंज, उड़ीसा, भारत में नरवानरगण की दो मानवेतर प्राणीजातियों की संख्या–संरचना का अध्ययन करने के विषय में

डी० स्वैन, एस०डी० राउत व बी०के० बेहुरा

सारांश

सामान्यतः भारत संघ के उड़ीसा राज्य में नरवानरगण की तीन मानवेतर प्राणीजातियां पाई जाती है। इन तीन मानवेतर नरवानर जातियों में से केवल दो जातियां भयूरमंज जिले की सिमलीपाल पहाड़ियों के वनों में मिलती हैं। सिमलीपाल बाघ संरक्षित क्षेत्र में मिलने वाले जंगली स्तनियों की विभिन्न जातियों की गणना मई 2004 में कराई गई। नरवानरगण की दो मानवेतर प्राणीजातियों अर्थात *सेम्नोपिथेकस एण्टेल्लस एण्टेल्लस* और *मैकाका मुलाट्टा* की संख्या संरचना के परिणाम यहाँ प्रस्तुत किए गए हैं। यह गणना निरन्तर चार दिनों तक रेखीय संक्षेत्र विधि अपनाकर की गई जिसमें कुल 122 किलोमीटर दूरी ली गई। गणना के दौरान 144 टोलियां दिखाई पड़ी जिनमें 1505 हनुमान लंगूर थे। टोली का औसत आकार 9.6 $\pm$ 1.19 निकला। हनुमान बंदरों की अधिकतम और न्यूनतम सघनता क्रमशः 162.5 और 1.7 प्रति किमी^{2} रही। इसी तरह, मैकाका बंदरों की 12 टोलियां या झुण्ड दिखाई पड़े जिनमें 138 प्राणी थे। टोली या झुण्ड 4 से 25 तक प्राणियों के थे जिनका औसत 11.5 $\pm$ 1.82 आता है। इनका संख्या घनत्व 10–98.3 प्रति किमी^{2}, तथा औसत 26.86 निकलता है।

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