Status and Distribution of Grizzled Giant Squirrel in Chinnar Wildlife Sanctuary, Kerala, India

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A. Veeramani, M. Balasubramanian, Sanjayankumar, and John Mathew

Abstract

Grizzled giant squirrel is placed in Schedule I of Indian Wild Life (Protection) Act, 1972, and categorized as "Near Threatened" in 2008 IUCN Red List of Threatened Species. In India, the grizzled giant squirrels are distributed in the Western and Eastern Ghats. The status of their Indian population is vulnerable due to drastic habitat loss, clear-felling, logging, construction of dams, hunting for local consumption, and expansion of agro-industry construction. A survey was conducted in Chinnar Wildlife Sanctuary (CWS) to estimate the population of grizzled giant squirrels, and 34 individuals were recorded within – 106.8 km. The length of the transects varied from 1.3 to 3.7 km. The present study analysis shows an overall density of 7.75 individuals per square kilometer, with standard error of 2.49. The total number of population in the study area was calculated by multiplying density to the total area (34.46 km^2) and obtained 267 individuals/km^2. The analysis based on the low AIC value 47.747 and chi-square P-value 0.51246. The density of the grizzled giant squirrel's nests shows 68.99/km^2 with the standard error of 19.55. A total of 12 tree species were used for nesting by grizzled squirrel, with a height variation of 2.5–35 m. Suitable conservation management suggestions were recommended.

Keywords

Chinnar · Density · Grizzled giant squirrel · *Ratufa* · Status

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11.1 Introduction

Giant squirrels belong to the genus *Ratufa* and are confined only to the Asiatic region. This genus is characterized by three species *Ratufa bicolor* (black or Malayan giant squirrel), *Ratufa macroura* (grizzled giant squirrel), and *R. indica* (Indian or Malabar giant squirrel) (Ellerman 1961; Srinivasulu et al. 2004). There are only two species of giant squirrels found in India which are Malabar giant squirrel (*Ratufa indica*) and grizzled giant squirrel (*Ratufa macroura*). The distributional ranges of giant squirrels vary from evergreen forest to riverine forests. However, its distribution was confined only to forests with tall trees (Ramachandran 1989; Kumara and Singh 2006). There are three subspecies of grizzled giant squirrels, which are found in Sri Lanka, namely, *Ratufa macroura macroura*, *Ratufa macroura dandolena*, and *Ratufa macroura melanochra*. The grizzled giant squirrel (*R. macroura*) is the smallest giant tree squirrel, generally endemic in South Asia, and it is restricted to the forests of Srivilliputhur, Tamil Nadu; Cauvery Valley Karnataka; Chinnar Wildlife Sanctuary, Kerala; and Sri Lanka (Ramachandran 1993; Nowak 1991; Senthilkumar et al. 2007; Vijayakumaran Nair et al. (1997)). This animal has been listed in Schedule I of Indian Wild Life (Protection) Act, 1972, and categorized as "Near Threatened" in 2008 IUCN Red List of Threatened Species.

This species mostly inhabits on high trees in dry deciduous and moist evergreen forests and is rarely coming to the ground. It is diurnal in habit. Its diet consists of fruits, nuts, and insects (Tikader 1983). Studies have shown that habitat loss and hunting lead to decrease its numbers drastically (Joshua and Johnsingh 1992, 1994; Molur et al. 2005). Few studies on the estimation of population of this species in Periyar and Agasthyamalai which included Srivilliputhur Grizzled Squirrel Sanctuary also reported the reduction in number (Joshua 1992; Paulraj et al. 1992; Paulraj and Kasinathan 1993).

Population status and their distribution range in Anamalai and Chinnar Wildlife Sanctuary have been reported by Ramachandran (1993), Senthilkumar et al. (2007), and Joshua et al. (2008). Few individuals have also been reported from Palani Hills of the Western Ghats (Davidar 1989; Sharma 1992). In Eastern Ghats, a small population is reported (Karthikeyan et al. 1992; Kumara and Singh 2006; Baskaran et al. 2011). Few sightings from Cauvery Wildlife Sanctuary and forests in Karnataka and Hosur, Krishnagiri, Tamil Nadu were also reported. There were only few studies about the tree and grizzled giant squirrel interactions and conservational information for maintenance of the squirrel in Srivilliputhur Grizzled Squirrel Sanctuary, Tamil Nadu (Vanitharani et al. 2011). The status of their Indian population is vulnerable because of drastic habitat loss, clear-felling, logging, construction of dam, hunting for local consumption, and expansion of agro-industry construction (Molur et al. 2005). Ramachandran (1989, 1993) carried out an extensive study in Chinnar Wildlife Sanctuary to assess the status, distribution, and population estimation. Jayson and Ramachandran (1996) had studied the habitat utilization of lager mammals in the same area and reported 119 sightings of grizzled giant squirrel. This research study was conducted with the following objectives: (1) estimate the density

of grizzled giant squirrel, (2) density of nest and occupancy, (3) preference of tree species for nesting, and (4) relation between nest and height of trees.

11.2 Study Area

CWS is located in the eastern part of the high ranges of southern Western Ghats of Kerala. The sanctuary, which is situated between 10° 15′ to 10° 21′ N latitude and 77° 05′ to 77° 16′ E longitude, has a total area of 90.44 km^2 (Fig. 11.1). The area falls in Marayoor and Kanthalloor Panchayath of Devikulam Taluk in Idukki District and is regarded as one of the important protected areas in Western Ghats. The habitat types range from shola-grassland to dry thorny scrub, across a diverse cultural landscape as well, making the PA unique in comparison with others (Fig. 11.2).

11.2.1 Boundaries

The erstwhile Chinnar Reserve was notified as a sanctuary in 1984. The original notification of the Chinnar Reserved Forest dates back to 1942, and the boundaries follow a jumble of cairn numbers and survey numbers. The boundaries are fully demarcated except in certain areas like Njavala-Ollavayal; thus the status is vague and may not correspond to the situation on the field. The northern and eastern

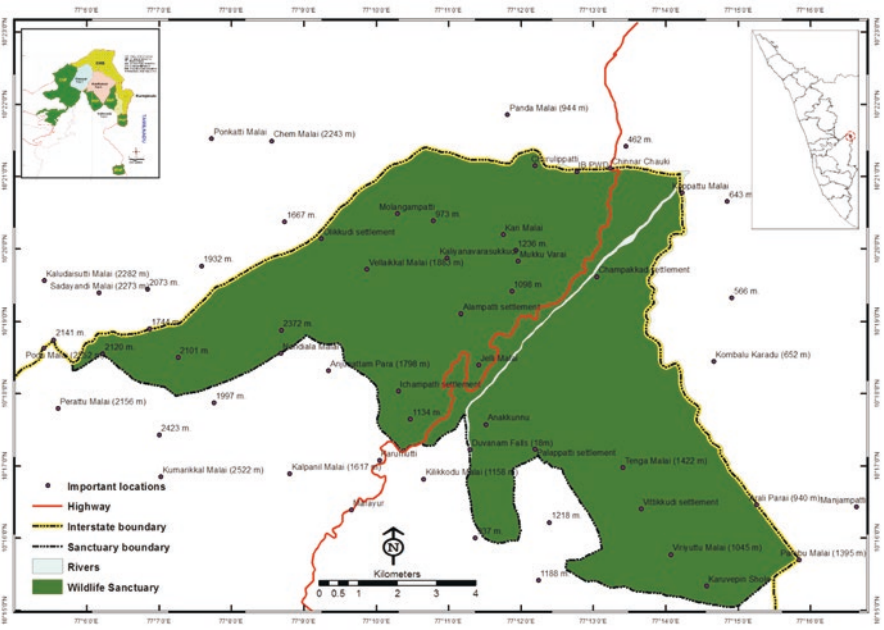

Fig. 11.1 Location map of Chinnar Wildlife Sanctuary

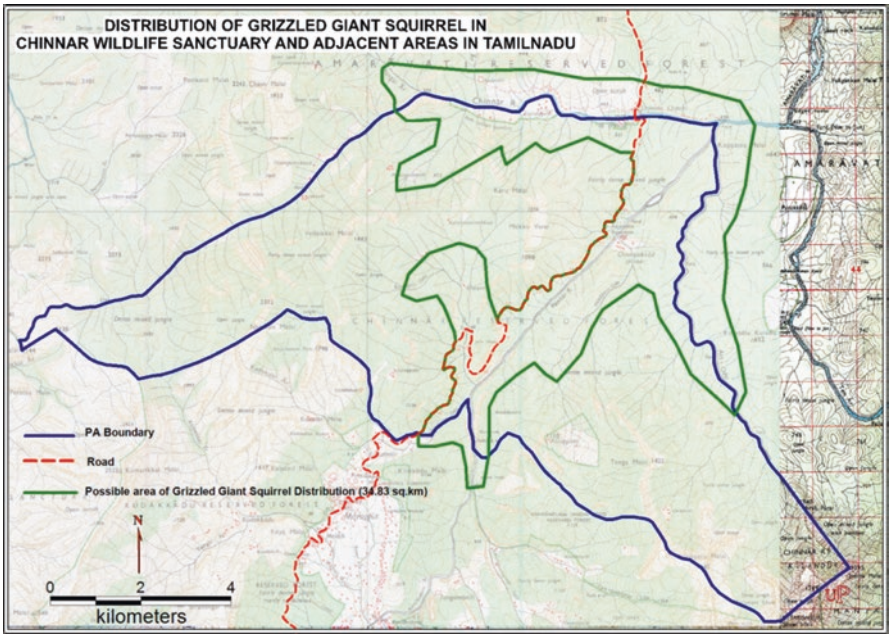

Fig. 11.2 Map showing the possible areas of distribution of grizzled giant squirrel in CWS

boundaries of Chinnar Reserve share 30 km with the Anamalai Tiger Reserve of Tamil Nadu. Toward the west, it is bordered by Eravikulam National Park, and on the southern side, it is bordered by the reserve forests of Marayoor Sandal Division. The park provides an ecological connectivity between the Anamalai Tiger Reserve and Eravikulam National Park.

11.2.2 Water Sources

Chinnar and Pambar rivers are the major perennial water resources in the sanctuary. Chinnar originates from near the Kumarikal Malai and flows through the interstate boundary toward the northwest edge of the sanctuary for 18 km and then to Tamil Nadu as Amaravati River. The Pambar River originates in the Anamudi Hills and is joined by seasonal rivulets and a few perennial streams originating from sholas in the upper reaches. It traverses the Turner's Valley in Eravikulam National Park and flows down into the sanctuary through the Taliar Valley between Kanthalloor and Marayoor villages and eastwards through the sanctuary. These two rivers merge at Koottar and drain into the Amaravati Reservoir in Tamil Nadu. Most of the rivulets and streams inside the sanctuary come alive immediately after the northeast monsoons and dry up soon. The water in the check dams remains for a longer period, but they also dry up during summer months. But a few streams originating from the upper reaches are

perennial. The spectacular Thoovanam waterfalls lie deep within the sanctuary on the Pambar River. This breathtaking cascade is a major tourist attraction.

11.2.3 Vegetation

The vegetation shows an entire spectrum ranging from sub-temperate shola to dry scrub of the arid plains. In many areas, vegetation of the sanctuary is highly disturbed mainly due to a combination of factors like earlier fellings and planting, anthropogenic pressures of the settlements inside and on the fringes, and cattle grazing. Therefore in many cases, secondary forest types replace primary types, and an obvious classification of forest types is impracticable. Notwithstanding these, the vegetation of the sanctuary can be broadly classified into the following types according to Champion and Seth (1968) and Chandrasekaran (1962):

1. Southern tropical thorn forest (scrub jungle)
2. Southern dry mixed deciduous forest (dry deciduous forest)
3. Southern moist mixed deciduous forest (moist deciduous forest)
4. Tropical riparian fringing forest (riparian forest)
5. Southern montane wet temperate forest (Hill hoal forest)
6. Southern montane wet grassland (grasslands)

The dominant vegetation is dry deciduous forest followed by scrub forest. Together they constitute about 50% of the total forest area and are located in the low-altitude areas. The riparian fringing forests are linearly distributed along the hill folds and occupy a small but considerable area. Shola forests occupy a tiny fraction of the total area.

11.3 Methods

The population of grizzled giant squirrel and its nest in the study area has been estimated using line transect method (Burnham et al. 1980; Buckland et al. 1993). This method has been effectively used to determine animal densities (Karanth and Sunquist 1992, 1995; Varman and Sukumar 1995; Khan et al. 1996; Biswas and Sankar 2002; Jathanna et al. 2003). A total of ten transects were selected to carry out for the fieldwork. All transects were chosen along the way of riverine stretch with the length between 1.8 and 3.5 km. Three observers walked along each of the transect early morning and late evening. All transects were replicated to the subsequent day again. While walking along the transect, the following parameters were recorded: (1) sighting angle (with a compass), (2) sighting distance (visually estimated), (3) group size, (4) nesting tree species, (5) number of nests and its status, (6) tree height (ocular estimated). The density was estimated using the Distance 6.0 statistical software.

11.4 Results

A total of 40 encounters, which comprise of 34 individuals, were recorded with the effort of 106.8 km. The results from the transect data intended the overall density of grizzled giant squirrel. The name and length of transects used for the survey are shown in Table 11.1, and the length of transect varies from 1.3 to 3.7 km. The output from the line transect survey provided the overall density of 7.75 individuals per square kilometer with the standard error of 2.49 (Table 11.2). The total number of population in the study area was calculated by multiplying density to the total area (34.46 km^2) and obtained 267 individuals. The analysis was based on the low AIC value 47.747 and chi- square P value 0.51246. Figure 11.3 shows the best fit model of half-normal cosine and the component percentage such as cluster size found to be 1.2% with the encounter rate of 87.5% and detection probability of variation of 11.3% (D). The group density and sex ratio were not found because of fewer sightings. The number of nests was also recorded along with the tree species and its height.

The density of the grizzled giant squirrel's nests shows 68.99 km^2 with standard error of 19.55. The number of old nest was lesser than the new nests (Table 11.3). Figure 11.4 shows the best fit model half-normal simple polynomial with the component percentage such as cluster size 0.9% with encounter rate 89.2% and the detection probability of variation 9.9%. The percentage of coefficient variation was 28.34% and 95%. CV is between 39 and 123. A total of 12 tree species were selected

Table 11.1 Name and length of the transects in CWS, Kerala

Sl. No.	Name of the transect	Length
1	Koottar-Athioda	2.4
2	Koottar-Chinnar	2.8
3	Palapatti-Koshuvoda	3.7
4	Thoovanam-Chambakkad	3.5
5	Madhani-Alempetty	1.3
6	Thayannankudi-Churulipatty (Kuttyamma oda)	2.3
7	Madhani-Mangayoda	1.5
8	Surulipatty-Chinnar Bridge	1.8
9	Koottar to Champakkadu	2.8
10	Vashyappara trek path	3.1

Table 11.2 Population densities of grizzled giant squirrel in CWS

Parameter	Point estimate	Standard error	Percent co ef. of variation	95% percent confidence interval	
DS	6.9002	2.1966	31.83	3.4972	13.614
E(S)	1.1232	0.50612	4.51	1.0243	1.2315
D	7.7500	2.4917	32.15	3.9146	15.343
N	8.0000	2.5721	32.15	4.0000	15.000

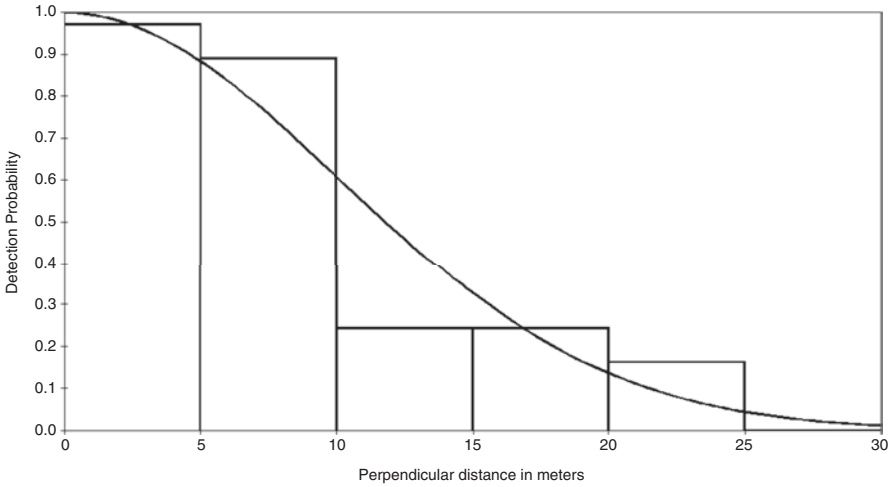

Fig. 11.3 Results of best model fitted in distance to estimate the detection probability and effective strip width for moist deciduous and riparian forests of CWS

Table 11.3 Density of grizzled giant squirrel's nest in CWS, Kerala

Parameter	Point estimate	Standard error	Percent coef. of variation	95% percent confidence interval	
DS	61.571	17.369	28.21	34.554	109.71
E(S)	1.1206	0.30126	2.69	1.0622	1.1823
D	68.998	19.552	28.34	38.651	123.17
N	69.000	19.553	28.34	39.000	123.00

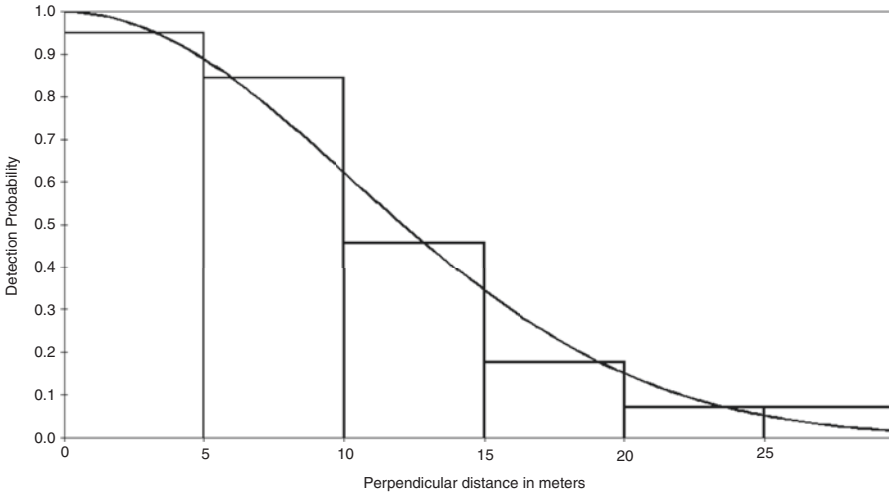

Fig. 11.4 The best model fitted in distance estimating and the detection probability of grizzled giant squirrels' nest in CWS

Table 11.4 Details of tree species, average height of the nest, and the range of the height of grizzled giant squirrel in CWS

Sl. No.	Name of species	Average height (m)	Range (m)
1	*Terminalia cuneata*	10.90	4–20
2	*Mangifera indica*	16.56	10–35
3	*Pongamia glabra*	18.15	8–30
4	*Tamarindus indica*	11.09	6–15
5	*Diospyros oocarpa*	18.08	10–15
6	*Syzygium cumini*	11.25	8–15
7	*Ficus benghalensis*	8.50	2.5–15
8	*Albizia chinensis*	24.50	18–30
9	*Cassine paniculata*	24.50	18–30
10	*Gyrocarpus asiaticus*	26.25	22–30
11	*Azadirachta indica*	22.67	15–35
12	*Cinnamomum verum*	19.25	15–30

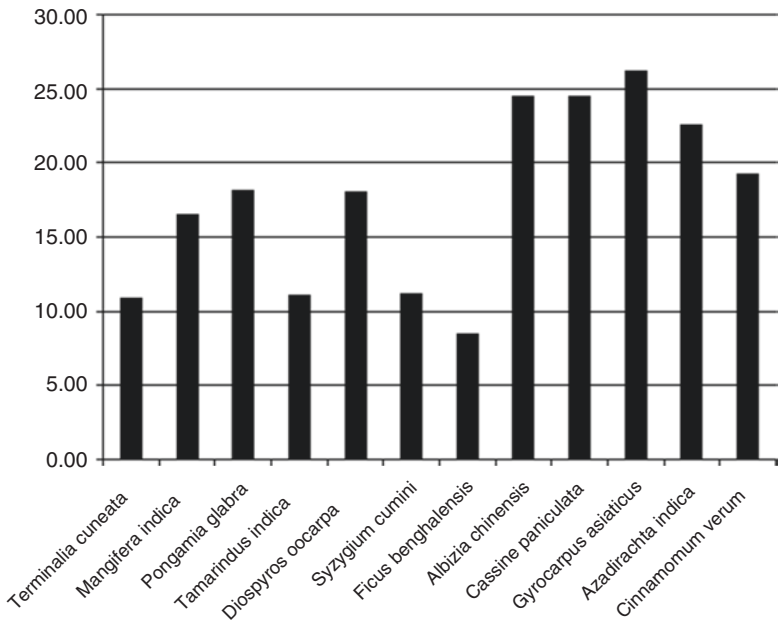

Fig. 11.5 The average height of nest of the grizzled giant squirrel in accordance with the tree species in CWS

for nesting by the grizzled squirrel in different heights ranging between 2.5 and 35 m (Table 11.4, Fig. 11.5). The details of tree species preferred by the grizzled squirrels for nesting are shown in Table 11.5. A total of 32 tree species were recorded for nesting of grizzled squirrel, of which 13 species of trees had only one nest. According to the nest occurrence, the tree species were divided into three categories such as highly preferred, moderately preferred, and less preferred. Compared to the

Table 11.5 Details of the number of nests and tree species used for nest by grizzled giant squirrels in CWS

Sl. No.	Name of species	No. of nest
1	*Terminalia cuneata*	59
2	*Mangifera indica*	37
3	*Pongamia glabra*	14
4	*Tamarindus indica*	13
5	*Diospyros oocarpa*	12
6	*Syzygium cumini*	7
7	*Ficus benghalensis*	6
8	*Albizia chinensis*	5
9	*Cassine paniculata*	5
10	*Gyrocarpus asiaticus*	5
11	*Azadirachta indica*	4
12	*Cinnamomum verum*	4
13	*Ficus racemosa*	4
14	*Alstonia scholaris*	3
15	*Dalbergia sissoides*	3
16	*Acacia planifrons*	2
17	*Drypetes sepiaria*	2
18	*Elaeocarpus serratus*	2
19	*Terminalia paniculata*	2
20	*Bischofia javanica*	1
21	*Butea monosperma*	1
22	*Carallia brachiata*	1
23	*Cassia fistula*	1
24	*Ficus mollis*	1
25	*Ficus tinctoria*	1
26	*Garcinia gummi-gutta*	1
27	*Lannea coromandelica*	1
28	*Lepisanthes tetraphylla*	1
29	*Melia dubia*	1
30	*Phyllanthus emblica*	1
31	*Schleichera oleosa*	1
32	*Sterculia foetida*	1

overall tree species, five species were highly preferred, 14 species were moderately preferred, and the rest was less preferred. Table 11.5 shows the average height of the tree where the nests were built.

11.5 Discussion

This study reveals that the total population of grizzled giant squirrel in CWS is about 260 individuals within the 35 km^2 of riparian vegetation, which indicates the increase in population. The previous studies (Ramachandran 1993, 1995; Senthilkumar et al. 2007) stated that the population was below 150 individuals in the entire potential habitat. The study by Ramachandran (1993) proved that the

density of grizzled giant squirrel was 18–23 individuals/ km^2, but the present study states the density is 7.7 individuals/ km^2. The studies of Ramachandran (1989) and Joshua (1992) reported that a total of 50–75 individuals only were estimated. A recent study (Senthilkumar et al. 2007) reported 107 individuals in Chinnar. Moreover the entire study area has been extended a bit more. CWS has been considered as the home for the second viable population of grizzled giant squirrel in South India after the Srivilliputhur Grizzled Giant Squirrel Sanctuary (Ramachandran 1993; Senthilkumar et al. 2007).

During the present survey, Malabar giant squirrel was also sighted which shows that the habitat is being shared by these two giant squirrel species sympatrically. The ecological dynamic state of grizzled giant squirrel with other prey species and predators clearly affirms that the population is abundant. The habitat of grizzled giant squirrels is generally narrow (Ramachandran 1993), and the distribution of this species also occurred along with the stream and riverside. The canopy cover is also continuous along the streamside except some parts. The discontinuity of the tree canopy of the potential areas limits the movement of grizzled giant squirrels.

The feeding habits of the grizzled giant squirrel and the tree density of CWS have been studied by Senthilkumar et al. (2007) in detail. The result of the nest density of the study area shows that the number of old nest was less than the fresh nests. The density of the nest was about 68/km^2. The nests were categorized into two types like fresh and old. The height of the nest in the tree species also shows the range which indicates the grizzled giant squirrels prefer a certain height for each tree species. Sex ratio of grizzled giant squirrel was also not attained because of insufficient data. A broad-range study is required to estimate the statistics of sex ratio of grizzled giant squirrel.

11.5.1 Management Suggestion

Forest fire is one of the major threats to the sanctuary, and every year the fire disturbs and damages not only the forest but also the wild animals. The grizzled squirrel's habitats in the deciduous forests are also getting damaged due to forest fire. The authorities should take necessary action to control the regular forest fires not only for protecting the grizzled squirrel habitats but also the entire forest as such. The grizzled squirrels are seen apart from the riverine habitat and intruded in the deciduous patches. Necessary steps are to be taken to protect the species, and annual enumeration is to be conducted to monitor the population and its distribution. Many ecotourism activities are being carried out by the PA management. Some of the ecotourism activities are carried out along the riverine forests, which negatively affects the squirrel habitat. The preventive measures are to be taken to minimize the disturbance due to visitors and thus reduce the mitigation between visitors and wild animals.

The sanctuary is delimited with the Anamalai Tiger Reserve in Tamil Nadu; therefore, an interstate coordination is relevant to manage the wildlife population. It is being suggested that periodic meetings be conducted at various levels of officers

and joint patrolling may be initiated to control illegal activities. The weekly ritual offering at Kodanthur temple situated in Tamil Nadu attracts a number of pilgrims, and they pollute the Chinnar River in various levels, and this affects the survival of wild animals and grizzled squirrels. The authorities should initiate necessary action to control this pollution and rusticate the flow of pilgrims to these areas. A periodic monitoring of the grizzled squirrel in the PA by the forest department staffs of the sanctuary will help the seasonality, status, and movement of wild animals. This can be implemented by giving training to the staffs and forest watchers for monitoring these species in the sanctuary. Long-term studies should be carried out to conduct the detailed investigation of the species in the area.

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