



# Population density, nesting ecology and conservation of the Indian giant squirrel (*Ratufa indica*) Erxleben, 1777 in protected areas of Odisha

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## ABSTRACT

The population distribution, activity, feeding, ranging and nesting behaviour and conservation aspects of Indian giant squirrel (*Ratufa indica*) across six major habitats in the tropical forests in Eastern Ghats of Odisha are discussed. The species is listed as Least Concern in Red List Data of IUCN and in Schedule I (Part -I) of the Indian Wildlife (Protection) Act, 1972. More than 162 hours were spent in the field survey at different habitats mostly for observing the feeding and activity pattern of Indian giant squirrel including different other wild animal species. Observations were recorded in Budhagiri hills, Karlapat Wildlife Sanctuary (WLS), Sunabeda WLS, Similipal Tiger Reserve (STR), Kuldiha, Kapilash and Lakhari Valley WLS, and proposed Mahendragiri Biosphere Reserve. In total, 38 sightings were recorded from 79 km line transect walk. As per the findings, the Kapilash WLS recorded the high density population i.e. 4.6 squirrels per sq km, whereas Mahendragiri shown the lowest population i.e. 1.2 individuals per sq km. It was inferred that the lowest population density of Indian giant squirrel in Mahendragiri was because of poor canopy cover with low girth evergreen shola forest tree species.

**Key words:** Eastern Ghats, ecology, feeding, Indian giant squirrel, shola forest

## INTRODUCTION

The ecology of squirrels in Asia has been little studied, hindering conservation and management efforts. The Indian giant squirrel or Malabar giant squirrel (*Ratufa indica*) an endemic species to India, is widely distributed from the evergreen to moist and dry deciduous forests of Western and Eastern Ghats and the central Indian hills. It is one of the four species of giant squirrels presently seen in the world. Its populations are severely fragmented due to developmental activities and urbanisation in around forest patched habitats. It is a diurnal large arboreal squirrel completing all life activities over

the trees from feeding to breeding. The species is widely distributed in peninsular India (Daniel, 1952; Abdulali and Daniel, 2011; Corbet and Hill 1992) from the evergreen to moist and dry deciduous forests of Western Ghats (Ramachandran 1988; Rout and Swain, 2005), and Eastern Ghats (Kumara and Singh, 2006) and central Indian Hills (Agarwal and Chakraborty, 1979; Datta and Goyal, 1996). The species, like many other squirrels of its genus, is a top canopy dweller, which occasionally comes to the ground (Ramachandran, 1988; Baskaran et al., 2011), mostly to overcome breaks in canopy continuity. The species mostly feeds on seeds, leaves, flowers and bark from trees. It is a solitary living species, constructs

globular nests with leaves and twigs (Baskaran et al., 2011). This animal exhibits 2-3 types of colour pattern with shades of black, brown and dusky white. The body of the rodent varies from deep red to brown with white patches on belly as well as dirty white or cream coloured under parts and forelimbs. The animal has pink lips and nose. Long hairs appear behind the mouth and nose as line moustache. The eyes are coloured in bright dark or light brown. In some individuals the tail length exceeds the length of body from nose to tail. At older age, the tail fur becomes thin and in some individuals it is discontinuous brush with fallen hairs. The powerful and long tail is light brown with creamy white tip. Individuals of both sexes look alike, although females have three set of mammae. It weighs 1.5-2kg and reaches 25-45 cm long and the average life span is round 20 years. These rodents are generally solitary animals, occasionally living in pairs during the mating season (Nameer, 2009). But they stay in social contact with audible calls in patched habitat. These cautious and shy creatures are usually active early in the morning and in the evening. During the midday, they rest in tree holes or large globe-shaped nests in the trees, constructed with twigs and leaves. Each squirrel has 2-5 nests, found within a small territory. One of these nests is made exclusively for reproducing and nursing the young, while others are used as sleeping sites. The Indian giant squirrels are also very agile animals, able to leaps up to 6 meters when travelling among trees. There are 4 sub species of Indian giant squirrels (IGS) in India namely *R. i. indica*, *R. i. maxima*, *R. i. centralis*, *R. i. dealbata* (possibly extinct) and distributed in peninsular India-Eastern Ghats, Western Ghats, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Karnataka, Odisha, Maharashtra (Daniel, 1952).

## MATERIALS AND METHODS

### Study area

The study was undertaken in selected protected areas of Odisha state during different field visits from 1998-2019. Odisha is located between the parallels of 17.49°N and 22.34°N latitudes and meridians of 81.27°E and 87.29°E longitude and its north western part falls in Chotanagpur Plateau, south western part in Deccan Peninsular and eastern parts fall in east coast of India (Fig. 1).



Fig. 1. Map showing the sites where Indian giant squirrel was studied and observation was done

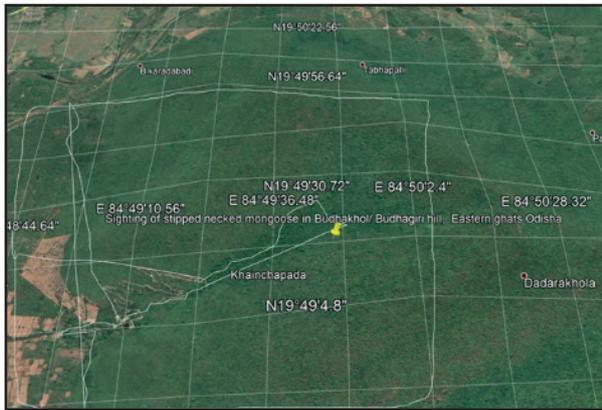
The Eastern Ghat in Odisha extends from part of Ganjam district in eastcoast to Malkangiri in southwest and Nuapada in the west spreading over a vast stretch of ten districts. The study area covers proposed Mahendragiri Biosphere Reserve, Similipal Biosphere Reserve including Karlapat and Lakhari WLS, Budhagiri Hill (Kriamba Reserve Forests) and Pandakhhol RF of Ghumusur South forest division, Kotagarh WLS, Kapilas WLS, Kuldiha WLS, some part of Ghumusur North and Karanjia forest division. The study area covers plain forest (70 m) in Ghumusur north division to high mountain peak terrain in Kapilas (535 m), Similipal (1165 m) and in Mahendragiri (1505 m) elevation. Six sites were selected for detailed behavioural data collection on giant squirrels in different habitats, which include moist deciduous forest, dry deciduous forest, river based forest habitats and shola forests (Fig. 2). The vegetation follows a gradient similar to the rainfall, with dry deciduous forests dominating the state followed by semi evergreen patches along hill streams and moist deciduous forests in Similipal and shola forests in Mahendragiri mountain. The state can be divided broadly into four natural divisions: the northern plateau, the Eastern Ghats, the central tract, and the coastal plains. The northern plateau is an extension of the forest-covered Chhotanagpur plateau centred in Jharkhand. The Meghasini peak having altitude of 1165 m is the highest in this region. The Eastern Ghats, extending roughly



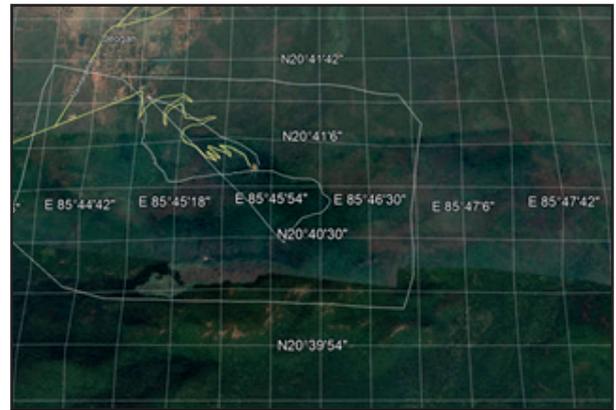
Map 1. Survey area in the Mahendargiri hill keeping the Judhistira temple as centre



Map 2. Survey area in the Lakhari WLS keeping the Baliganda village as centre



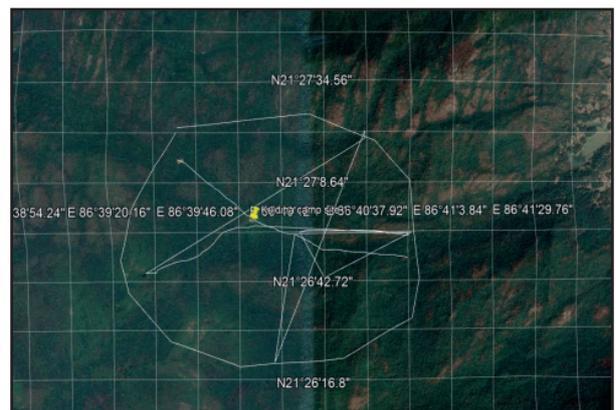
Map 3. Survey area in the Budhagiri hill keeping the Budhakhhol shrine area as centre



Map 4. Survey area in the Kapilas hill keeping the Lord Shiva shrine area as centre



Map 5. Survey area in the Debasthali beat house as centre in Similipal Tiger Reserve/ Biosphere Reserve



Map 6. Survey area in the Kuldiha Wildlife Sanctuary centred at FRH/ Ecotourism camps

**Fig. 2.** Maps(1-6) showing the sites where Indian giant squirrels activities were studied and observation: Google maps of survey areas were shown keeping as core of distribution sites in different PAs

parallel to the coast and rising to an elevation of about 3,600 feet (1,100 metres), are remnants of a very ancient line of hills in eastern peninsular India. The central tract is a series of plateaus and basins occupying the inland area to the west and north of the Eastern Ghats. In addition to the Mahanadi, the main rivers are the Subarnarekha, Budhabalanga, Baitarani, Brahmani, Rushikulya and Bahuda. The annual average temperature of the study area ranges from 4°C at hilly areas to 45°C at Kapilash forest area with annual average rainfall ranges from 800 mm to 1500 mm (Das and Kar, 2011). The maximum and minimum relative humidity are 88% and 62% respectively. Details of topography and environmental parameters of the study sites have been presented in Table 1.

### Survey on distribution of Indian giant squirrel in Odisha

The distribution of giant squirrel were mapped based on the presence and absence, direct sightings, calls and their nests through transect survey of 25 transects covering 79 km laid across different habitat types (Fig. 2). In all the major habitats, an effort was made to sample the river based (along river and stream) microhabitats as they are distinct from surrounding areas in terms of tree species composition and canopy contiguity, especially in the dry deciduous and dry thorn forest. For population density estimation, the line transect method (Burnham et al., 1980) was adopted to estimate population density. In total, 16 transects were sampled with length varying from 2-4 km and were laid systematically covering all the habitats and microhabitats across the sanctuary. The survey was conducted from February 2014 to May 2018. The transects were walked during morning (06:30-10:45 hr) or evening (16:00-18:00 hr) and at every sighting of squirrel we recorded the perpendicular distance, using range finders and group size of the squirrel. Observations on ecological aspects of Indian giant squirrels have been recorded and analyzed (Table 2).

### Tools and Techniques

During trail walk, it is contiguous without stop at sighting spot and new individuals are sampled ahead and putting the location, time recorded both in

GPS (Garmin 76 Map) and note book. The spotted site was marked and loaded in GPS. The angle and distance of the tree where the animal sighted were calculated from ocular estimation. During later part of the survey i.e. after 2016, the smart phone, Gionee and Motorola were used for google mapping and using digital compass as tools. Canon DSLR 1100D with 200 mm zoom lens was used for photography in field. The free version of Google earth pro is used for identifying the location using map and demarcating the sites.

### RESULTS AND DISCUSSION

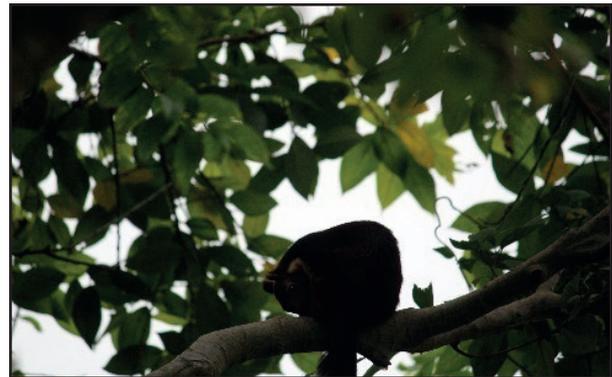
Extensive survey of the major habitats like tropical moist, dry deciduous and montane sola forest in the sanctuary shows that its distribution is discontinuous and patched in Odisha. The moist and dry deciduous forests with good canopy contiguity with climbers are most preferred place for nesting sites. All the sites are categorised under the forest types of dry deciduous, semi-evergreen and moist deciduous forest patches in Odisha (Champion and Seth, 1968). The presence of animal in high canopy is also detected by collection of call data like frequency, angle of call direction, location in the forest patch, distinguishing different calls by loudness, duration and intensity. In total, 38 sightings were recorded from 79 km line transect walk. Mean group (G) size as 3 with standard error (SE) 0.2 were found based on data where complete counts of individuals were obtained on transects. Population density was estimated using distance-sampling techniques following the software DISTANCE version 6.0 (Buckland et al. 2004). Grouping the data into 20 m perpendicular intervals to the transect laid were calculated. The feeding sites are also located in some isolated mango trees near Jagannathprashad range of Ghumusur north forest division. A lone Indian giant squirrel was found in a moi (*Lannea coromandelica*) tree at Kapilas WLS (Fig. 3). Another IGS was seen near the nest in upper portion of a fig (*Ficus glomerata*) tree in Kapilas WLS (Fig. 4). At Similipal inside the protected area, one pair noticed to come to ground twice which were seen on sal tree at 65ft height. Hence, the population was believed to be in increasing trend. At Kapilas hill range, in another instance, a couple of IGSs, one buck (male) and the other one a doe (female) were

sighted during the courtship at Mahendragiri Reserve forest (Fig. 6). It supports the study that IGS seen in pairs with Nameer, (2009). A male IGS buck was found relaxing over an Indian fig tree at Kapilas hill range (Fig. 5). It was noticed that one squirrel was consuming the flowering pods of jackfruit (*Artocarpus heterophyllus*) in its early flowering stage in Budhagiri hills near the Budhakhhol shrine at Budhakhhol (Kriamba RF, Ghumusur South division). Here in, the animal was observed to move swiftly on fine fig branches and later took complete grip of the branch with support of hind limbs and lower abdomen in a circular manner and holding the pod with the forelimbs in a very fascinating and relaxed manner (Fig. 7, 12). In one case, at Kapilas, one IGS seen jumped from branches of mango tree to collect food. It corroborates with the study undertaken by Mishra et. al, 1996. In another instance, feeding was noticed

in hanging free posture by IGS in Kuldiha WLS (Fig. 11). Indian giant squirrel uses creepers atundi (*Combretum decandrum*) for jumping movement amidst bushy thickets of fig trees, as seen in Kapilas WLS. It was recorded that creepers like siali, atundi acted like a communicating ropeway from tree to tree for swift movement for purposes of mating and escape from predation and disturbances (Fig. 8). Indian giant squirrels are active and agile animals, move from tree to tree taking amazing leaps with limbs spread. The animals are not easy to discover and usually lives alone or in pairs (Mishra et. al.,1996). IGS builds nests in high tree branches with support from many different creepers. A linear nest of IGS was seen in a tree branch amidst complex of creepers in Kapilas WLS (Fig. 9). A globular nest of IGS was noticed in a tall single tree branches centrally with the support of branches only at Kuldiha WLS (Fig. 10).



**Fig. 3.** Indian giant squirrel in a Moi (*Lannea coromandelica*) tree at Kapilas WLS



**Fig. 4.** Indian giant squirrel near the nest in upper portion of a fig (*Ficus glomerata*) tree in Kapilas WLS



**Fig. 5.** A male Indian giant squirrel buck over an Indian fig tree at Kapilas.



**Fig. 6.** Indian giant squirrel buck (male) and doe (female) during courtship at Mahendragiri RF



**Fig. 7.** Indian giant squirrel taking flower pods of jackfruit at Budhakhol shrine area close to temple.



**Fig. 8.** Indian giant squirrel uses bushy thicket of creepers atundi (*Combretum decandrum*) in Kapilas WLS



**Fig. 9.** Linear nest of Indian giant squirrel in both tree branch and complex of creepers in Kapilas WLS



**Fig. 10.** Globular nest of Indian giant squirrel in tall and single tree at Kuldiha WLS



**Fig. 11.** Feeding in hanging free posture by keeping forearms free to use as arms in Kuldiha WLS



**Fig. 12.** Movement of IGS on a jackfruit tree at Budhakhol (Kriamba RF, Ghumusur South division)

For population density estimation, different trails and forest roads were used. Results shown that Kapilas was having highlight density population of 4.6 squirrels per sq km and 1.2 individuals per sq km in Mahendragiri. The less number in Mahendragiri was studied to be due to poor canopy cover with low girth evergreen trees. Here, the squirrels come to ground for uncertain reasons like searching of rhizome food in Mahendragiri habitat and chasing movement to female and intruder male by the breeding buck. Daytime activity and feeding patterns were observed consuming more than 62 hours in the field survey altogether in Odisha. The most active part of feeding time is 7.30 hours to 10.45 hours of the spring days. Interim rests were observed during mid-day hour. Sampling revealed that animals take equal time for feeding and resting. The team observed that giant squirrels used seeds, bark, petioles, leaves and fruits from more than 54 plants out of which 3 are large creepers. The identified fodder plants of Indian giant squirrel (*Ratufa indica*) in Kapilash Wildlife Sanctuary was previously studied by Palei et. al. (2017) covering around 65 plant species. The flowers, fruits and soft pulvinus parts of siali creeper were most preferred in Ganjam habitat. In Lakhari habitat, the squirrels prefer karada tree (*Schleichera oleosa*) flower and mango (*Mangifera indica*) twigs in Kapilas area. The squirrel is a top canopy dweller, rarely comes to the ground (Baskaran et al., 2011). It was observed that giant squirrel comes to ground and serves the rhizomes and roots of herbs mostly the roots of lemon grass and takes the orchids over mango tree as food in Mahendragiri habitat. Its home range size varied from 0.6 ha in high density area of south to deer parks in Kapilas to 2.2 ha in low density Lakhari habitat with mean of 1.4 ha in Odisha state. Nesting characteristics assessed through 24 nests surveyed along 79 km transects per trail walks that the squirrel uses around 20 large tree species found, with higher preference to karada and mango. Nests on dhoura and sal trees are significantly far in height, and canopy contiguity may need from nearest non-nest trees, which are attributed to better protection

and escape from predators. In Kriamba reserve forest compartment no 4, the density of used and unused nest counting 6 in 100 square meter area. The height of these nests ranges from 6 to 21m. The nesting tree species are teak, piasal, sal, karada and banyan trees in this reserve forest. There were more fall of fresh broken mango twigs fallen free under the mango trees in Budhagiri area. It was also observed that giant squirrels are active and started feeding during the early sun shine area where as the squirrels remain asleep till 6.39 hrs in cleft areas during winters. In the western part of hill are in a mid-day observation at Lakhari that one giant squirrel climbed high up in to a single non nesting dhaura tree to escape from avian predators like serpent eagle for half an hour. It was noticed that the squirrel sat still without movement under the camouflaged in leafy branches for more than half an hour. After the serpent eagle flew it descended from the high tree and moved further for feeding in other trees. The nests were studied to be composed of 70 leafy twigs. The leafy thick nests are important to hiding the young ones from predation. It was interesting in Kapilas WLS to observe that the squirrels had false dummy nests constructed in around the actual nests in order to camouflage and escape from predators like serpent eagles. The reshus monkeys often disturbed the lower high nests as they climb to the smaller branch due to their less weight and swift movement than the langurs in Kapilas habitat. However, during an observation a long rectangular nest is located in low canopy of branched small fig (*Ficus glomerata*) tree in Kapilash during march 2019. Maintenance of old nests were also observed as the squirrels used the same nest in Lakhari habitats. Status of giant squirrel (*Ratufa indica*) in Similipal Tiger Reserve was previously studied by Rout et al. (2005) and in Kuldiha the feeding, nesting ecology and conservation of IGS was studied by Nayak and Patra (2015). Previous works were undertaken in Karlapat Wildlife Sanctuary over observation on nesting pattern by IGS in Odisha (Pradhan et al., 2012). The call is a social communication recorded mostly during feeding, breeding and movement

individuals. It was also observed that the call was equally responded for the other ones when the researchers remain in hide out. In Lakhari, the call is recorded from same forest block, from same nesting trees and the call is random at any time during day. Most of the squirrels are concentrated at Medicinal plant conservation site near Chandragiri. They also use a giant banyan tree (*Ficus bengalensis*) for nest and rest at night and seen around the year at same area ranging from 0.10 to 0.25 sq km. Also they use for chasing the mate in all study areas. It was a rare observation that the animal came to ground and spent very limited time in ground for different

activities like communication to different patches of vegetation, chasing movement for mating, in search of rhizome of grasses and herbs as food, and even for drinking water from streams during summer. In Similipal, one pair was photo captured when one on the ground and the other in the climbing posture to a 4ft girth inclined tree trunk during 08.35 hours. It was observed that the giant squirrels crossed the forest road near pillar post (7 km) in compartment 4 of Kriamba RF. It was also observed that they covered about 1 km to the northern stream site for drinking water once a day and come to ground due to break in canopy cover along the forest road.

**Table 1.** Details of topography and environmental parameters of study sites in Odisha

Sl. No.	Name of the site PAs (WLS/TRs/BR)	Elevation of obs. place MSL (m)	Average annual rainfall (mm)	Min. winter temp (°C)	Max. summer temp. (°C)	Obs. time for IGS (Hrs.)	Days in PAs	Major bio-geographic regions	Survey transects and IGS seen (km)
1	Similipal TR/BR	600-1200	Above 1600	5-10	32-37	12	25	Chotnagpur Plateau, EGs	3 nos 10 km
2	Kuldiha WLS	250-450	1400	10-12	37-40	6	4	Eastern Ghats (EGs)	2 nos 6 km
3	Kapilas WLS	120-535	1300	9 - 12	37-42	21	35	Eastern Ghats	3 nos 12 km
4	Budhagiri Kriamba RF	300-600	1500	7 -12	35 -40	28	52	Eastern Ghats	2 nos 8 km
5	Jagannath prashad RF	56-120	1400	10-15	35-44	8	12	Eastern Ghats	1 nos 3 km
6	Kotagarh WLS	300-900	1200	5 -12	32- 38	6	8	Eastern Ghats	3 nos 6 km
7	Karlapata WLS	250-600	1300	8-12	37- 42	8	10	Central tract / EGs	2 nos 4 km
8	Sunabeda WLS	250-450	1200	10-12	37-42	8	24	Decan plateau, EGs	4 nos 8 km
9	Lakhari WLS	250-600	1500	6 -10	37 -40	20	40	Eastern Ghats	2 nos 8 km
10	Mahendragiri RF Pr BR	1200-1505	Above 1700	4 -8	30 -32	7	8	Eastern Ghats	3 no 14 km
Total 10 sites						118 spent	218 days stay		79 km survey

\*WLS- Wildlife Sanctuary, RF/ RFs- Reserve Forests, BR- Biosphere Reserves, TR- Tiger Reserve, EGs- Eastern Ghats.

**Table 2.** Observations over ecological aspects of Indian giant squirrel in Odisha

SL No	Name of the site PAs (WLS/TRs / BR)	Ground utilisation observed	Observed height of trees where IGS movement seen	Elevation in MSL (m)	Conservation status and population trend
1	Similipal TR/BR	One pair two times comes to ground	Above 65 feet in Sal trees	650 m	Population believed to be in increasing trend
2	Kuldiha WLS	Not observed	overhead 12 feet feeding in jamun tree	245 m	Population believed to be in increasing trend
3	Kapilas WLS	Single individual one times	overhead in Mago tree above 14 feet	110 m	Population believed to be in increasing trend
4	Budhagiri/ Kriamba RF	3 individual crossing the forest road one by one	Seen overhead 10 feet in jack fruit tree	210 m	Population believed to be in decreasing trend
5	Jagannathprashad RF	Not Observed	Moving in mango tree 40 feet above	85 m	Habitat lost and population is pocketed and in decreasing trend
6	Kotagarh WLS	Not Observed	Around 55 feet Sal tree	250 m	Population believed to be in decreasing trend
7	Karlapata WLS	Not Observed	Above 45 feet Dhaura tree	230 m	Population believed to be in increasing trend
8	Sunabeda WLS	Not Observed	Seen overhead above 15 feet	280 m	Population believed to be in decreasing trend
9	Lakhari WLS	Not Observed	Seat silence in Dhaura tree above 75 feet	320 m	Population believed to be in decreasing trend
10	Mahendragiri RF/ Pr BR	One for using lemon grass shoot as food	Feeding on Orchids in Mango tree above 12 feet	1335 m	Population was displaced by present road construction and in decreasing trend
11	Badagada range Forests	Not utilising foot hill and plain area.	Only occurs in hill side Tree vegetation	120 m	Habitat synchronized Population believed to be in decreasing trend
12	Pondakhhol RF of Soruda Range	Well undergrowths. Ground is not utilized	Distributed in interior patches of vegetation.	450 m	Habitat is best suitable Population; believed to be in increasing trend
13	Ramaguda RF of Berhampur Range	Never come to plains and village side vegetation	Past distributed and use Mango trees for Nests	150 m	Population became isolated, thin and then locally unavailable due to habitat change. Recently vanishing population after 2010

## CONCLUSION

Following new findings are recorded during the process of the extensive survey.

- i. The Kapilas WLS recorded the high density population i.e. 4.6 squirrels per sq km, whereas Mahendragiri shown the lowest population i.e. 1.2 individuals per sq km.
- ii. The Indian giant squirrel live and sustain in high altitude like Mahendragiri. It is recorded that they come to ground for food, chasing of male to male noticed for safeguarding the territory. and also consume the rhizomes of orchids and roots of wild lemon grasses.

- iii. Use creepers as support to jump from branches also communicating trees.
- iv. Linear, lengthy nests are seen during the course of the study.
- v. In one tree, apart from main resting nest, more than one nests are observed. Different cluster of nests are seen in neighbouring trees.
- vi. Rearing of neonates made in leafy and thick secretive nests which hunter birds do not recognize and reach.
- vii. Monkeys usually disturb IGS and hamper their peaceful leaving just to retain the fruits mostly in mango trees.
- viii. They stay in groups during feeding within audible range and communicate with loud vocal calls. The other members respond to alarming calls from lone IGS in danger. Alarming calls are also passed from individual to individual along disturbed areas.
- ix. It is seen that they remain calm and quiet and camouflage over tree branches by spreading legs gripping the branches.
- x. In hill ranges, in morning sun shine, they get up and become active and in shed areas they were seen sleeping in the same area at the same time.
- xi. In night, they normally do not move
- xii. Indian giant squirrel facilitate seed disposals through habit on feeding of fruits and help rejuvenation of the forests and contribute to the ecosystem.
- xiii. IGS mostly break branches to collect tender twigs and in the process dropping fallen branches to the ground, those are used by other herbivores like spotted and barking deer as fodder.
- xiv. They use different water bodies to drink water once or twice at noon hours or afternoon during hot summer days when human activities are lessened. Sometimes they move a long distance of 500 metres from their nests to fulfil their thirst.
- xv. It was studied that mating was exclusively made in the upper branches of tall trees.

## CONSERVATION ETHOS

Forest fire, plastic, garbage, tree felling for fuel and branch looping for fodder are major constraints for the habitat restoration and conservation of giant squirrel in non-protected areas. However, there are little threats to giant squirrel populations in major pilgrimage sites like, Kapilas, Budhagiri, Mahendragiri, though poaching is rare as the habitat belongs to sacred and holistic area. Other sites like Kuldiha, Kapilas, Similipal, Lakhari, Karlapat, Kotagarh and Sunabeda are protected areas in Odisha which are under government protection measures. Still there are reports of poaching. Rest of the other distribution areas in Odisha are lack of proper awareness paving the path for more poachings for meat and fur. All these studies give inputs for better food and living towards conserving these scheduled animals. It is a bad practice in southern Odisha that the goat and sheep grazers cut and fell the low girth trees covered with creepers for feed of small animals during grazing in forest land. Rather cutting the entire trees, looping can be a better option to save the fodder tree and continuous supply of fodder branches in different seasons. In Ganjam habitat, the squirrel was practised in fruit collection and hence, people keep them as pet and trained them for their own benefits of procuring mangos, harida (*Terminalia chebula*), bahada (*Terminalia belarica*) and other medicinal fruits and seeds. In central Odisha including the Satkosia Tiger Reserve, siali leaves are major non-timber forest produce (NTFP) items which are regularly collected by locals for their livelihood. The crude siali leaf collectors cut the climbers and drag down the creepers that links different trees suited for giant squirrel movement which should be checked through awareness programs. In few parts IGS habitats in Odisha, tribal people poach the cute animal for easy bush meat and ignorance of the importance of these arboreal animals. In south Odisha, there is still practice of catching the young ones to keep as pets and sometimes sell it for paltry money. In Mayurbhanj, there was an instance of cutting and felling a single tree to poach a giant squirrel that occasionally used it as escape shelter. The killing of these innocent and cute animals should be prohibited. Earlier, due to involvement and awareness by VSS (Vana Surakhya Samiti),

there were significant reduction in anthropogenic pressure like cutting of trees and collection of both siali creeper (*Bauhinia vahlii*) leaves and creepers for binding materials in Budhagiri hill which rejuvenated the vegetation and canopy cover since 2016 sustaining the population of IGS. The need of the hour is to create proper awareness for conservation of this rare and highly endangered animal in non-protected areas of Odisha.

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