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Research Paper

AN UNUSUAL FOOD PLANT SPECIES CONSUMED (*Cyathea gigantea*, A TREE FERN) BY GLOBALLY ENDANGERED AND ENDEMIC PRIMATE SPECIES OF ASSAM- *Trachypithecus gee* KHAJURIA, 1956: A PROSPECTIVE NEW ADAPTIVE RAY OF FOOD COMPENSATION TOWARDS ANTHROPOGENIC FOREST DISTURBANCES AND HABITAT FRAGMENTATIONS IN KAKOIJANA RESERVE FOREST, ASSAM, INDIA

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Abstract

Golden Langur *Trachypithecus geei* was listed as one of the IUCN's world's 25 most endangered Primate Species of India with a very restricted range of distribution. The present study area Kakoijana Reserve forest is one such important fragmented habitat of Golden Langur populations in Bongaigaon District of Western Assam. The forest was completely isolated from the mainland habitat of the Golden Langur. In the present study from January, 2014 through February 2015, an unusual and special feeding/behavioral pattern of Golden Langur was uncovered in three field days. A troop of 14 individuals of Golden Langur (n = 14) was found to feed actively on *Cyathea gigantea* (Wall. Ex. Hook), Holttom. (Tree fern) species along with *Diplazium esculentum* (Dhekia/ i.e. the well-known edible fern of Assam). In the foraging location, both the fern species were grown in the moist spaces nearby stream. During observation, the Langur troop was found to jump from tree branches to fern bushes of *Diplazium esculantum.* Langur consumed mostly on mature leaves and at the same time, they also dragged the long branches of *Cyathea gigantea* using their hands for consuming tender leaves. The Feeding bouts of *Cyathea gigantea* were lasted for 5 minutes. However, it was 7-10 minutes for *Diplazium esculentum*. Again, it was also found that, the adult and sub-adult males and females were only found to feed on both the fern species.
Key words: Golden Langur, Kakoijana, feeding, Cyathea, Diplazium, Habitat fragmentation, Adaptive ray, food compensation.

INTRODUCTION

Golden langur *Trachypithecus geei* is presently listed as one of the IUCN's world's 25 most endangered Primate Species of India with a very restricted range of distribution. The species is restricted to certain semi evergreen and mixed- deciduous foot-hill forests and plains of India and Bhutan (Saikia *et al.* 1987; *Das*, 2008; Chetry, 2016) The distribution is restricted within the range of river Sankosh in the west and, river Manas in the east (*Gee*, 1961). Drastic population decline and habitat fragmentation leads to the species into Schedule-I species of Indian Wild life Protection (Act), 1972 and appendix I of CITES. Golden Langur populations in Assam is more isolated and restricted to certain habitat pockets such as Chakrasila Wild life Sanctuary of Kokrajhar and Dhubri District, Kachugoan and Holtugoan Reserve forest, Chirang Reserve Forest, of Kokrajhar District and Kakaijana Reserve forest, Bhumeswar hill of Bongaigoan District of Assam. These forests have faced severe anthropogenic pressure especially for illegal logging, hunting of wild animals, and large scale invasion for commercial interests in the form of **fire wood collection** for private use and local selling in the market. Monoculture practice of commercial plants by forest department namely *Shorea robusta* and *Tectona grandis* under Joint forest management (JFM) practices and *Hevea brasiliensis* (Rubber plants) particularly in Kakoijana Reserve Forest and also attracted the wood cutters and loggers to the forest frequently. As Golden langur is an arboreal species and depends mainly on mature and tender leaves, ripe and unripe fruits, seeds of different trees, shrubs and lianas for their regular food items, thus the Langurs are at high risk of extinction due to deforestation. Although arboreal, the species frequently go down to the ground for searching food and wandering in an around the ground, understory and sometimes even directly exists on open ground habitat zones due to loss of canopy, food scarcity and non-existence of roosting trees within their habitats. These types of behavioural changes threatened the Golden langurs for potential predators (Biswas *et al*, 2006).

Study Site

Study area Kakoijana Reserve forest has covered an area of 17.24 km^2 (1724 hectares) in Bongaigoan district, Assam. It is one of the most important fragmented habitat of Golden Langur in Bongaigaon District of Western Assam (**Coordinates**: 26°22' - 26°21' N and 90°33' to 90°34' E; height ranges from 4 to 321m) under Aie Valley Division. The forest has completely isolated from the mainland habitat of the Golden Langur by National Highway NH-31, human habitation and agricultural land. The forest supports secondary growth of moist mixed open deciduous forest since last 20 years along with few patches of dense deciduous primary forest. Certain degraded areas of the forest had been used for conservation purpose under **JFM** scheme of the forest Department. Thus, *Shorea robusta* and *Tectona grandis* and *Hevea brasiliensis* have been done under JFM. These JFM areas were handover to the villagers for protection by their own. However, a major part of the forests are still remains as a scrubland and degraded forest (46% of the total area). As the water is one of the major food component of the wildlife species, the major sources of water for the Langurs in the forest areas are numerous natural streams and reservoirs in the forest. Few of such water sources are perennial, whereas, others are seasonal in nature (Fig.1).

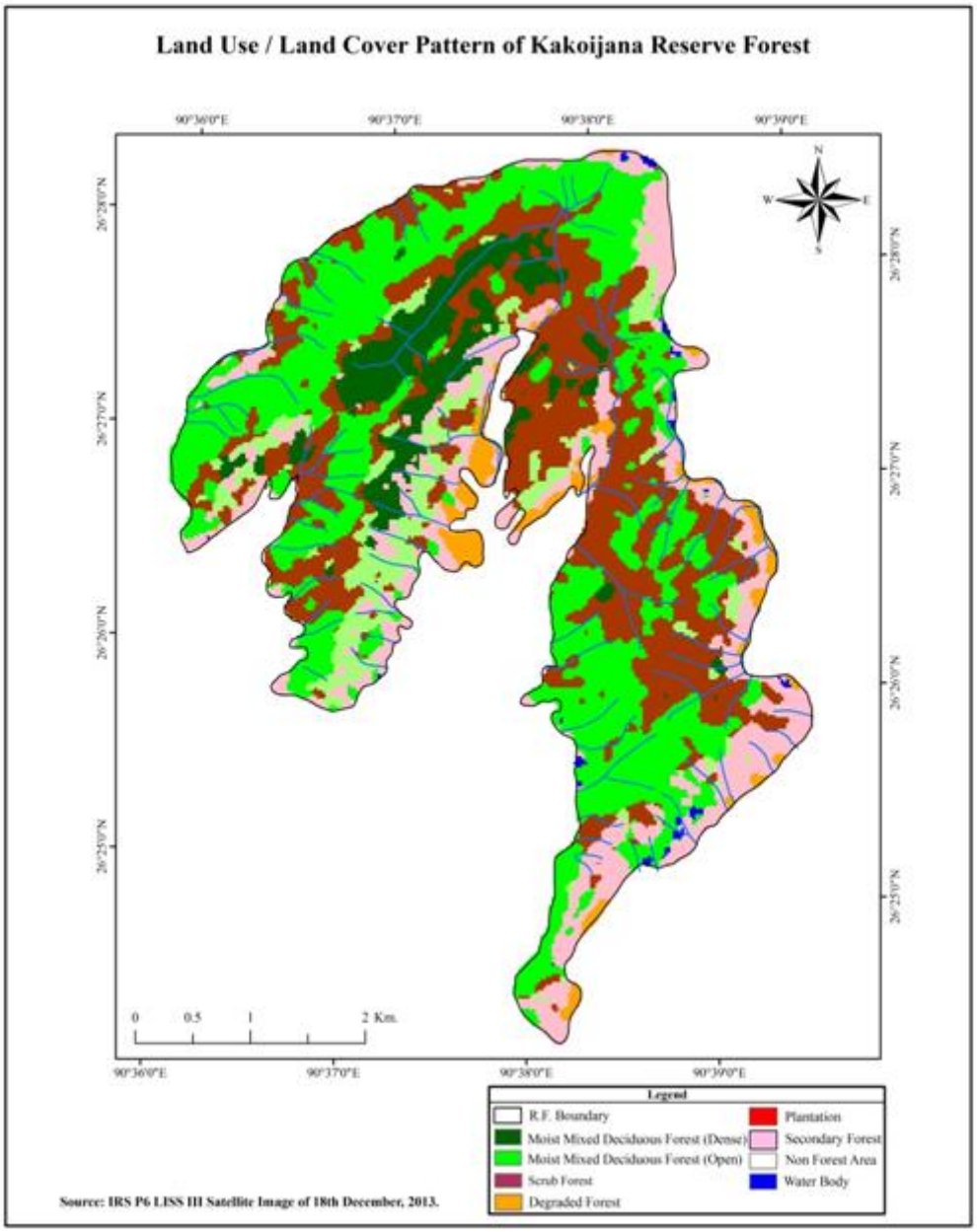

Fig-1: Map of Kakoijana Reserve Forest study sites showing land use types and natural water sources.

Climate

The climate of the study area is sub-tropical with pronounced monsoon. It rains from mid-March to October with most rain occurring during the monsoon from June-August. The annual rainfall ranges from 2713 mm to 4264 mm and the temperature ranges from 5ºC in winter (Dec.- Feb.) to 39ºC during hot Summer, (NIC, Bongaigaon 2014-15).

Methods

The Langurs' foraging data were collected randomly in monthly basis from all the habitat types **viz**. moist mixed deciduous forest, dense deciduous forest, open forests, secondary growth areas and as well as monoculture plantation (Teak-*Tectona grandis*, Sal-*Shorea robusta* plantation and Rubber-*Hevea brasiliensis* Muell-Arg.

plantations) areas of the forest. Field, surveys were carried out from 06.00h. to 07.00h in the morning and continued to till 17.45h for feeding data collections. Depending on the seasons and climates of the study sites, food habit data were collected randomly covering all the habitats. Data were collected using troop monitoring methods (Gupta and Chivers, 2000) from November, 2014 to October, 2015. Both focal and scan animal sampling methods were used for data collection that aimed to record the maximum number of food plants (as used by Altman, 1974). A '**scan'** refers to single records of the behavior of an individual within 15 minutes interval which provides data on feeding. The term feeding includes the processing, chewing and ingestion of food by the langurs. Details such as name of the plant species eaten, plant parts consumed, feeding bouts, numbers of instance eaten etc. are recorded. For food plant identification and classification, help has taken from www.efloraindi.com as well as Kanjilal (2005), Bora (2003), and Barooah & Ahmed (2014). Unidentified plant species were taken to Eastern Regional Botanical Survey of India (BSI), Shillong.

RESULTS AND DISCUSSION

Vegetation and food plants

Study found that the forest was primarily a *Dipterocarp* forest with *Shorea robusta* and *bamboo* as the main vegetation. *Shorea robusta* is a common plant in Monoculture, secondary as well as deciduous open and dense forest patches of Kakoijana RF. *Tectona grandis* (Segun tree) trees and *Hevea brasiliensis* are the main plants in Monoculture area having a total area of 4.41 hectare under these practices. As the forest is comparatively a newly growth secondary vegetation (degradation took place 20 years back) so, canopy is not continuous except in dense forest area. In open and secondary forest areas, the Golden Langur has to be cross a reasonable distances through moving on land, which is a new adaptation for the species of an arboreal primate. Study revealed that, the major vegetation in the dense and open areas are composed of plant species like *Lagerstroemia parviflora (*Cida*,), Bursera serrata (*Neuri*), Malotus philippinensis (*Jarath*), Careya arboreal Roxb. (*Kumbhe*), Albizia odoratissima (*Blackkoroi*), Albizia procera (*White- Koroi*), A. lucidior (*Sil Koroi*), d*ifferent *Ficus ssp.* like *Ficus recemosa (*Mou dimaru*), F. auriculata (*Atha dimaru*), F. fistulosa (*Katia Dimaru*), F, benjamina (*Jari gos*), F. rumphi (*Pakari*) etc, Syzygium cumini (*Kala Jamun*), Syzygium formosum, (*Bhukuracepa*), Bauhinia blakaena* Dunn*. (*Kanchan*)., Kydia calycina (*Pisola*), Holarrhena antidysenterica (*Duthkkhari*) , Lannea coromandelica (*Jia*), Castanopsis indica(*Singari*) , Oreocnidae integrifolia (*Bon rhea*), Terminalia bellirica (*Bhomora*), Heteropanax fragrans (*Karangia*), Salix tetrasperma (*Bher*), Shorea robusta(*Sal*) , Dalbergia sisoo (*Sishu*), Spondius pinnata (*Amara*), Sapium baccatum (*Cheleng*), Callicarpa arborea (*Bonmola*), Actinodaphne angustifolia (*Baghnal*), , Chukrasia tabularis(*Boga poma*), Garuga pinnata (Kachkechi), Litsea monopetala (*Soalu*), Duabanga grandiflora (*Bandar genda*), Sterculia villosa (*Odal*),Alstonia scholaris (*Chatiana*)* etc.are common. Climbers and lianas included*, Ampelocissus latifolia (*Goalia lata*), Desmos chinensis, Merremia vitifolia(*Dighi lewa*), Tinospora cordifolia (*Saguni lata*), Pegia nitida (*Dhindao bagari lata*), Cayratia trifolia (*Cepeta lata*), Millettia pachycarpa (*Bakal bih*), Aristologus saccata(Nilkantha),Cardiospermum halicacabum (*Kapal phuta bon*), Cissus repanda(Medmedia lata), Hodgsonia macrocarpa (*Thebou *lata), Smilax macrophylla (Bagh* anchora lata*) Mikania micrantha (*Mikania*), Butea parviflora (*Sal lata*) , Thunbergia grandiflora (*Kukua lata*), Dioscorea ssp.* etc. Shrubs include mainly *Bridelia retusa (Kuhir), Lepisanthes fruticosa (*Haser ledi*), Sarcochlamys pulcherrima(*Meso*), Morinda angustifolia(*Daru haridra*), Tabernaemontana divericata*

*(*Kathanda*), Holmskioldia sanguinea (*Chatra pushpa*), Grewia multiflora (*Kukur cita*), Glucosmis pentaphylla(* Hengena paka*), Clerodendrum viscosum (*Bhetomali*), Melostoma malabathricum (*Phutuka*) etc.* Herbs mainly consist of *Bambusa* species, *Musa* species*, Impatiens glandulifera(* Dam deuuka*), Ageratum conyzodes (*Gendheli bon*), Chromoleana odorata (*Jarmani bon*), Curcuma aromatic (*Keturi*), Costus speciosus (* Jom lakhuti*), Asparagus recemosus (*Satamul*), Calamus ssp.(*Bet*), Cyathea gigantea, Diplazium esculentum* etc*.*

Feeding behaviour

During the months of January and February, 2015, an unusual and special feeding behavior of Golden Langurs were observed and recorded consecutively in three days. One troop (n = 14; AM=3, AF= 4; SM=1; SF=2; Juv. = 4) was actively feed on *Cyathea gigantea* (Wall. Ex.Hook) Holttom., a Tree fern) species (Family: Cyatheaceae) (**Plate-1a)** along with *Diplazium esculentum* (Dhekia or edible fern; Family: Athyriaceae; (**Plate-1b**). Both the species were grown in wet places nearby streams (**Plate1c**). Langur troop was found to jump from the tree branches to the fern bushes of *Diplazium esculantum* and consumed mostly on mature leaves and at the same time they also lifted the long branches of *Cyathea gigantea* by their hands to consume tender leaves. It was also observed that, the feeding bouts for *Cyathea gigantea* was lasted for 2 to 5 minutes and that of *Diplazium esculentum* was 7 to 10 minutes time periods. Adult and sub adult male and females were found to feed on both the ferns species, but the juvenile individuals were not observed to consume the ferns.

Another unusual feeding behavior of Golden Langur, was recorded only once on December, 2014 (**Plate-1d**). Sub adult male and sub adult female of a troop (n=11; AM=1; AF= 4; SM=1; SF= 2; Juv=3) consumed mature leaves of climbing fern, *Lygodium microphyllum* (Family: Lygodiaceae) in the secondary growth area of the forest. (**Plate-1e**). It was observed that feeding bout lasted from 2 to 5 minutes. It was recorded that, adult and juvenile members of the troop were not consumed the species.

Struhsaker(2010), reported that the additional food intake from several plants may have satisfied colobines total energy and nutritional needs. However, Freeland and Janzen (1974) have suggested that infrequent feeding on a large number of species helps folivores to maintain metabolic pathways for detoxifying secondary compounds found in plant material. Keeping these pathways open may have been necessary for langurs to exploit alternative food plants without suffering any ill-effects, when food from its most frequently exploited species are in short supply. So, selection of unusual food may be one of the strategies for self detoxification (Rasanayagam *et al.,* 2013). Preliminary observation of phytochemical constituents in *C. gigantea* by Talukdar *et al.,* (2010) and Janakiraman *et el.* (2015) revealed that the Steroids, and Saponins are present in the Caudex and leaves of the fern species consumed by the langur. Hepato protective activity of *C. gigantea* was also confirmed by Kiran *et. al. (* 2012). It is also reported that both the species have anti microbial, anti helminthic and anti diarrheal properties. Phytochemical constituents' analysis in fresh leaves of *D. esculentum* by Karmakar *et al.* (2013), revealed *to have* very high water content (91.82 ± 0.43% Moisture). Ethno botanically also *C. gigantea* have importance. In Southern India, traditionally the fresh rhizome of *C. gigantea* mixed with black pepper seeds powdered and taken orally with milk twice a day for one week in stomach against white discharges (Kiran *et al*, 2012). Due to anti microbial, anti helminthic and hepato pancreatic activity recorded in both the species, Golden Langur might fed on the fresh leaves the species.. As the feeding recorded during dry season and the streams were apparently in dried up condition, probably to maintain the bodily moisture content *Lygodium microphyllum*

also has medicinal properties. Decoction of the leaves is used in the treatment of dysentery. The leaves are applied externally as a poultice in the treatment of skin diseases and swelling (Duke, 2011). Fern is not included in the list of the normal food plant of Golden Langur and fed on very actively, so they might fed the plants purposefully (**Plate-2**).

A total 121 plant species comprising trees, shrubs, herbs and climbers used by Golden Langur as food items had been recorded during one year observation (November, 2014 to October, 2015) in Kakoijana Reserve Forest. The forest is a moist mixed deciduous forest with a 45% open and secondary forest which is almost equal with scrub and degraded forest(44%) and 10% dense forest area (**Plate-3**). Golden Langur shows a wide variety of food selection to cope up with the habitat. Villagers of the Surrounding villages are protective and feel proud to have Golden Langur with them, but depend to some extent on the forest for their daily need of timber, fuel as well as grazing their domestic animals (**Plate 3-e**). Hence, in such a critical habitat of Kakoijana Reserve Forest, this type of special feeding behavior may have some indication about the habitat health as well as the future of Golden Langur, the most endangered species and the pride of the locality.

c. Habitat of *Cyathea gigantea* and *D. esculentum*.

d. Feeds on *Lygodium microphyllum*

e. Habitat of *Lygodium microphyllum*

Plate-1: Photographs shows the Golden Langur and consuming different Fern species in forest Habitat of Kakoijana RF during study period.

a. Mature leaves of *Cynthea gigantea*,

b. Mature leaves of *Diplazium esculentum*

c. Mature leaves of *L.microphyllum microphyllum*

Plate-2: Mature Leaves of various fern Species and Troops of Golden Langur in Kakoijana RF.

Plate3: Different Ferns types in Kakoijana Reserve Forest that consumed by Golden langur.

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