as template for amplification using the primer specific for the null allele of lipoxygenase-2. The oligonucleotide sequence of this null allele-specific marker was obtained from Sigma Aldrich. PCR reactions were performed in a thermocycler (model PTC100) and the reaction mixture (10 µl) contained 2 µl DNA (20 ng/µl), 1 µl PCR (10×) buffer, 1.1 µl $MgCl_2$ (25 mM), 0.1 µl dNTPs (25 mM), 0.4 µl each of forward and reverse SSR primers (30 ng/µl), 0.068 µl *Taq* DNA polymerase (3 U/µl) and 4.932 µl distilled water. Initially, DNA was denatured at 94°C for 1 min followed by 30 cycles, each cycle comprising denaturation at 94°C for 2 min, primer annealing at 68°C for 2 min and primer elongation at 72°C for 3 min. Finally, elongation was carried out at 72°C for 10 min. The PCR products were resolved on 3% metaphore gel. Amplicons of 769 bp size were observed in NRC109 and NRC110, similar to the donor parent PI086023 (Figure 1) and no amplicon was seen in Samrat, the lipoxygenase-2-positive parent. This confirmed the transfer of null allele of lipoxygenase-2 in NRC109 and NRC110. There was minor difference in plant height and flowering time between NRC109 and NRC110 and both the varieties bore purple flowers. NRC109 yielded seeds with yellow seed coat and black hilum, whereas the seeds of NRC110 were greenish-yellow with brown hilum (Figure 2). Furthermore, both the genotypes are bold-seeded and the weight of 100 seeds for NRC109 and NRC110 was 16.5 and 16.3 g respectively. NRC109 and NRC110 are early-maturing, a character desired by the farmers in Central India, with yield potential of 2.6 and 2.8 tonnes/ha respectively. NRC109 and NRC110 attain maturity in 85 and 93 days respectively. In brief, NRC109 and NRC110 are the first two Indian soybean genotypes which are free from lipoxygenase-2 isozyme, and can contribute immensely in boosting the soy food industry for health and nutritional security of the masses of the country.


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# Ground feeding observations on corn (*Zea mays)* by eastern hoolock gibbon (*Hoolock leuconedys*)

Hoolock gibbons (genus *Hoolock)* inhabit primary tropical evergreen and subtropical semi-evergreen rainforests and also semi-deciduous forests of Southeast Asia[1], extending from Brahmaputra River east to the Salween River[2]. Globally, they are widely distributed in different forest types from the foothills to the mountains in Northeast (NE) India, South China, Bangladesh and Myanmar between lat. 20–28°N and long. 98–99°E. Two distinct species of hoolock gibbons are recorded from India, viz. western hoolock gibbon (*Hoolock hoolock*) and eastern hoolock gibbon (*Hoolock leuconedys*). In India, *H. hoolock* is distributed throughout the seven NE states except Sikkim[3], while *H. leuconedys* is only reported in protected and unprotected lowland tropical evergreen and semi-evergreen forest areas of Lohit and Lower Dibang Valley districts in Arunachal Pradesh and the eastern most part of Assam as well as south bank of Brahmaputra–Dibang river system[4,5].

Generally, gibbon species are highly selective feeders that are largely dependent on small, scattered fruit patches[6,7] and mostly feed on sugar-rich, juicy ripe fruits and figs[8]. Gibbons inhabiting tropical forests like the warm lowland forests in Bangladesh have been found to consume more fruit (70%) and less leaves (15%)[9,10]. Feeding ecology of the genus *Hoolock* is mostly documented for western hoolock gibbon. Only a few studies have been conducted on eastern hoolock gibbon in India, with particular emphasis on distribution and population status[4,5]. However, no study with regard to diet and behaviour has been made for *H. leuconedys* in India. Recently, a study in the northern montane forest of China has documented the seasonal variation of diet and time budget of the species[11].

During our long-term study on behavioural observation of *H. leuconedys*, we recorded uncommon ground feeding behaviour on agricultural crops (corn, *Zea mays*) by one of our selected study gibbon groups, which was mainly surviving in the highly fragmented, unclassed forest areas in the southeast boundary of Mehao Wildlife Sanctuary, Lower Dibang Valley district, Arunachal Pradesh. Geographically the area lies between 27°58′30″–28°03′38″N lat. and 95°50′30″–95°58′18″E long., and altitude ranges from 145 to 390 m amsl. The selected group was composed of one adult male

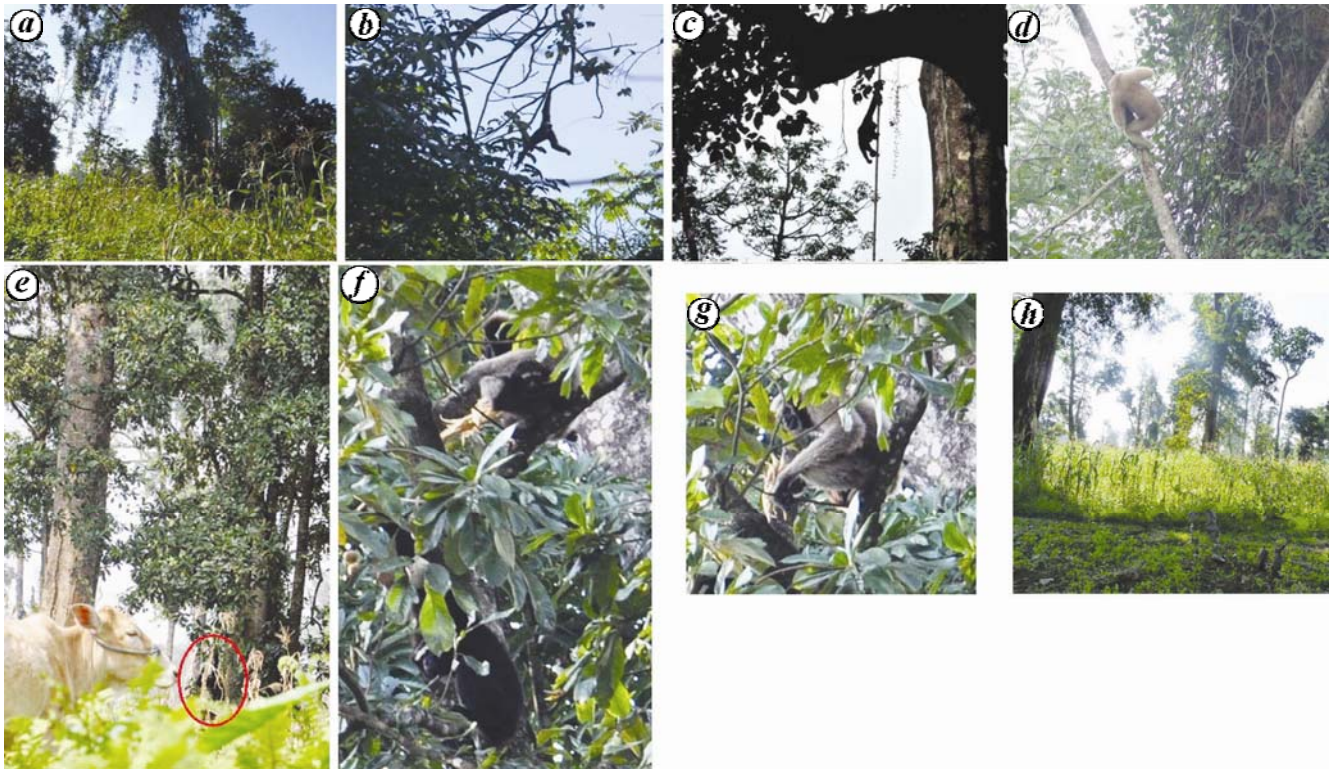


**Figure 1.** ***a***, Corn field around roosting tree of gibbons. ***b***, ***c***, Gibbon coming to the ground with the help of climbers. ***d***, Adult female gibbon looking around for any threat before coming to the ground. ***e***, An adult male gibbon collecting corn (*Zea mays*) from the field. ***f***, ***g***, An adult female gibbon feeding on corn. ***h***, Overview of the study area.

and one adult female with an infant. Before recording monthly behavioural observations the gibbons were habituated for five months to get their original behaviours in presence of human. The group was regularly monitored from September 2011 for a detailed study on feeding ecology, ranging pattern and time-budget activity pattern in fragmented habitats using focal animal sampling at 5-min intervals[12].

Subsequent to the observation of uncommon ground feeding episode by the gibbons, the group was followed continuously in February 2012. The gibbons were observed for seven consecutive days in the month for ground feeding on corn. The study group was spotted collecting and feeding on corn from the agricultural land surrounding their roosting tree in the highly fragmented forest stand. It was observed that the gibbons come down to the ground using the tree trunk and woody climbers and visit the nearby maize field to pluck corn (Figure 1). Immediately after plucking the corn they go back to middle canopy of the tree and feed on the collected corn. The adult male initiated the ground feeding episode followed by the adult female. Vigilance by the adult male was also recorded while the female collecting corn holding the infant. Five episodes of such feeding were recorded during the study period, all in the afternoon between 13 : 00 and 14 : 30 h. The gibbons spent a maximum of 30% (30 min) of diurnal feeding time per day in foraging and feeding on corn. During the days of observation, the adult male was recorded to pick up on an average two corns per day whereas the female picked up three corns per day, thus ranging from 1 to 3 corns for male and 2 to 4 corns for female. In diurnal feeding observation, gibbons spent 65% of their total feeding time eating fruits and figs followed by corn (30%) and leaves (5%). Fruits and figs were recorded as the dominant food category in their seasonal diet. *H. leuconedys* spent maximum (62%) feeding time on forest climber species followed by 30% of the feeding time cultivated crop (corn) and 8% on tree species in fragmented habitat. It was recorded that 68% of the total time of diurnal activities of gibbons was spent in the lowest height class between 0 and 10 m followed by 21 and 30 m (24%) and 11 and 20 m (8%). The time spent on ground foraging and feeding is included under the 0–10 m height class.

The entire vegetation of the study area is classified under low hills and plains semi-evergreen forest, Assam alluvial plains semi-evergreen forest (2B/Cia) and sub-Himalayan light alluvial evergreen forest[13]. The area is mostly dominated by trees like *Ficus* spp., *Duabanga grandiflora*, *Canarium bengalensis*, *Ailanthus grandis*, etc. The study area is occupied by Idu-Mishmi and Adi tribes who have been primarily encroaching and fragmenting the forest lands for agricultural practices and selective logging for their livelihood. They cultivate mainly ginger (*Zingiber officinale*), corn (*Zea mays*), mustard (*Brassica juncea*) and paddy (*Oryza sativa*). Forest fragmentation due to extensive agricultural practices and selective logging in the area increases edge effects and decreases the ability of arboreal animals to migrate widely without coming down to the ground and crossing cultivated lands. We recorded habitat destruction for firewood collection, selective illegal timber logging and forest clearing for settlement, permanent

agricultural practice and shifting cultivation, etc. as indirect threats for *H. leuconedys* in the study area. Eventually, these anthropogenic activities have led to severe fragmentation of the habitat, which greatly affects the survival of gibbons in general and lactating females in particular, due to inadequate diets in terms of both quality and quantity[14]. Maximum feeding time on climber species followed by agricultural crops in the present study area revealed that the remaining habitats where the gibbons live are unable to provide quality foods to the species. Probably, to overcome the scarcity of quality food in the study area, gibbons were compelled to come down to the ground for feeding upon corn. Similarly, rare feeding was recorded by lactating and pregnant females of capped langur (*Trachypithecus pileatus*). It was observed that they came down and enter the water and immerse their bodies up to the neck level for feeding on white water lilies (*Nymphaea alba*)[15] during scarcity of quality food in the tropical semi-deciduous fragmented forest patch. Moreover, corn is a rich source of protein and carbohydrate[16] (dry matter of cob = 12% protein), which is an essential requirement for lactating females. Other studies also confirmed that the primates and other wildlife get attracted towards ripening fields of maize[17]. Thus wild animals use agricultural crops as 'fall-back' food during the scarcity of nutritious wild food.

The expansion of agricultural land and habitat destruction in the study area are posing a serious threat to the gibbon population. Even though the local inhabitants do not hunt on the species due to some cultural taboos and beliefs, this change in the behaviour of gibbons to environmental factors may lead to increasing conflicts between humans and gibbons, and predation by domestic dogs in future. Therefore, there is an urgent need to take proper conservation measures for future survival of this vulnerable and flagship species and protection of agricultural crops as well.


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