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A preliminary study on the activity budget of post released Eastern Hoolock Gibbon *Hoolock leuconedys* (Mammalia: Primates: Hylobatidae) in Mehao Wildlife Sanctuary, Arunachal Pradesh, India

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Abstract: The Wildlife Trust of India has taken a long term responsibility to identify a suitable habitat for the threatened families of Eastern Hoolock Gibbon from a village called Dello in Arunachal Pradesh to a nearby forested area which was the earlier home of this species. There is an ongoing successful rescue and translocation programme since November, 2011 in which four Eastern Hoolock Gibbon families comprising 11 individuals were translocated in three different habitat types in and around the forested area of the Mehao Wildlife Sanctuary. Post-release monitoring is an obvious and required technique to study the rescued families of Eastern Hoolock Gibbons after translocation to confirm their post-release survival and better livelihood. The regular monitoring of the activity patterns has helped to understand the habitat utilization and resource use in the newly released sites. Along with the rescue operation, there is an additional task to find out the potential habitats to define as ideal release sites for gibbons. The post release monitoring was studied through the instantaneous scan sampling method to collect the information mostly about their activity patterns. The present study describes the overall activity patterns and resource use in the released gibbons on the basis of utilization of different habitat types. It was observed that the ranging pattern was mostly influenced by the resource availability and forest type. The gibbon family released in the denser forest habitat developed a general food habit whereas the family from the thinner forest area became the specialist consumer. However, further detailed study with sufficient data is required to comment on their general ecology.

Keywords: Eastern Hoolock Gibbon, habitat, Mehao Wildlife Sanctuary, post-release monitoring, translocation.

Hoolock leuconedys
Eastern Hoolock Gibbon

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Conflict of Interest: The authors declare no competing interests.

For **Author Contribution** and **Author Details** see end of this article.

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INTRODUCTION

Translocation between two habitats of source populations is sometimes justified to maintain the viable population of any species (Kleiman & Rynalds 2002; Strum 2005). But the movements of wild animals or troops or populations from one part of their range to another need a detailed survey before capture and after release (IUCN 1998; Seddon 1999). As per the previous studies, in the case of re-introduction, intensive monitoring and scientific research was focused and acknowledged (Armstory et al. 1994; Sarrazin & Barbault 1996; Seddon 1999; Seddon et al. 2007). However, long term monitoring is not often implied, even if it is required to signify conservation success (Kapos 2009).

The conservation issue was raised in northeastern India, where hunting is a common practice still (Srivastava 2006; Naro et al. 2015). Other than hunting, expansion of the farm land, serial cultivation, human settlement and many other social factors gradually fragment many forested areas and healthy wildlife habitats. Dello in Arunachal Pradesh is such a type of village which harbors a newly discovered population of Eastern Hoolock Gibbon in Arunachal Pradesh. But there are also some recognized issues like continuous degradation of habitats, destruction of canopy continuation, absence of resources and reckless predation by common village dogs. This has made Dello a highly threatened habitat.

The present study was framed on the basis of activity differences as the gibbon families were released in two different habitats in Mehao Wildlife Sanctuary. The basic question was whether there was any significant difference between different vegetation types for gibbon release on the basis of their resource utilization and activity pattern. It should be addressed because potential habitat utilization in the release sites defines the success of conservation. Primates have their seasonal change of home range and niche shift phenomena as per the habitat quality and resource availability (Remis 1994). Although, it was a very preliminary study, the significant results will help in determining the further release sites for the next capture and translocation.

Subjects

The Wildlife Trust of India took the responsibility for the rescue operation with a collaboration of the Arunachal Forest Department in 2009. The plan was to capture the gibbon families with less mortality and to release them in nearby Mehao Wildlife Sanctuary. The presence of more than 150 families of Eastern Hoolock Gibbon within an altitudinal variation of 142m to 1,865m of sea level in Mehao Wildlife Sanctuary (Das et al. 2006; Chetry et al. 2010) signifies the potential habitat for rescued gibbon release.

Four families of Eastern Hoolock Gibbon comprising 11 individuals were successfully captured and released in Mehao Wildlife Sanctuary, by February 2012. After the translocation in the new forested area the post-release monitoring on a regular basis was important for three to four months as per IUCN guidelines to observe their post release survival and adaptability to the new location.

METHODS

Study Site

Mehao Wildlife Sanctuary (release site) lies between 93^{0}30'–95^{0}45'E & 28^{0}05'–28^{0}15'N (Image 1). The total area of the sanctuary is 281.5km^2 and altitude ranges from 400–3,568 m. Mehao experiences a subtropical climate, with temperatures ranging from below freezing in winter in the higher elevations to a maximum of 30^{0}C in the summer. The sanctuary receives in excess of 2,500mm of rainfall annually. One of the release sites, Sally Lake area (for Group-1 28^{0}10'10.0"N & 95^{0}50'07.6"E and for the Group-2 28^{0}10'05.2"N & 95^{0}50'24.2"E) is situated four kilometers away from Roing Town at an elevation of 426m in the Mehao Wildlife Sanctuary. Two Eastern Hoolock Gibbon families consisting of two adult males, two females, one sub adult female and one infant were released there and monitored afterwards for a duration of two months (Images 2–4). Twenty kilo, (for Group-3 28^{0}09'21.9"N & 95^{0}51'10.7"E) another release site is located almost 20km away from Roing Town at an elevation of 976m in Mehao Wildlife Sanctuary. One family of Eastern Hoolock Gibbon consisting of one adult male, one adult female and one infant was released there and monitored afterwards for two months for seven hours a day (0700 h to 1400 h).

Data Collection

Overall data were collected from the three study groups of released Eastern Hoolock Gibbon families from February 2012 to May 2012. The overall data of two groups of Sally Lake sites were analyzed collectively considering a single habitat use. All three groups were categorized as Group-1 (one adult male, one adult female and one infant), Group-2 (one adult male, one adult female and one sub-adult female) and Group-3 (one adult male, one adult female and one infant). The post release monitoring of all rescued gibbon families

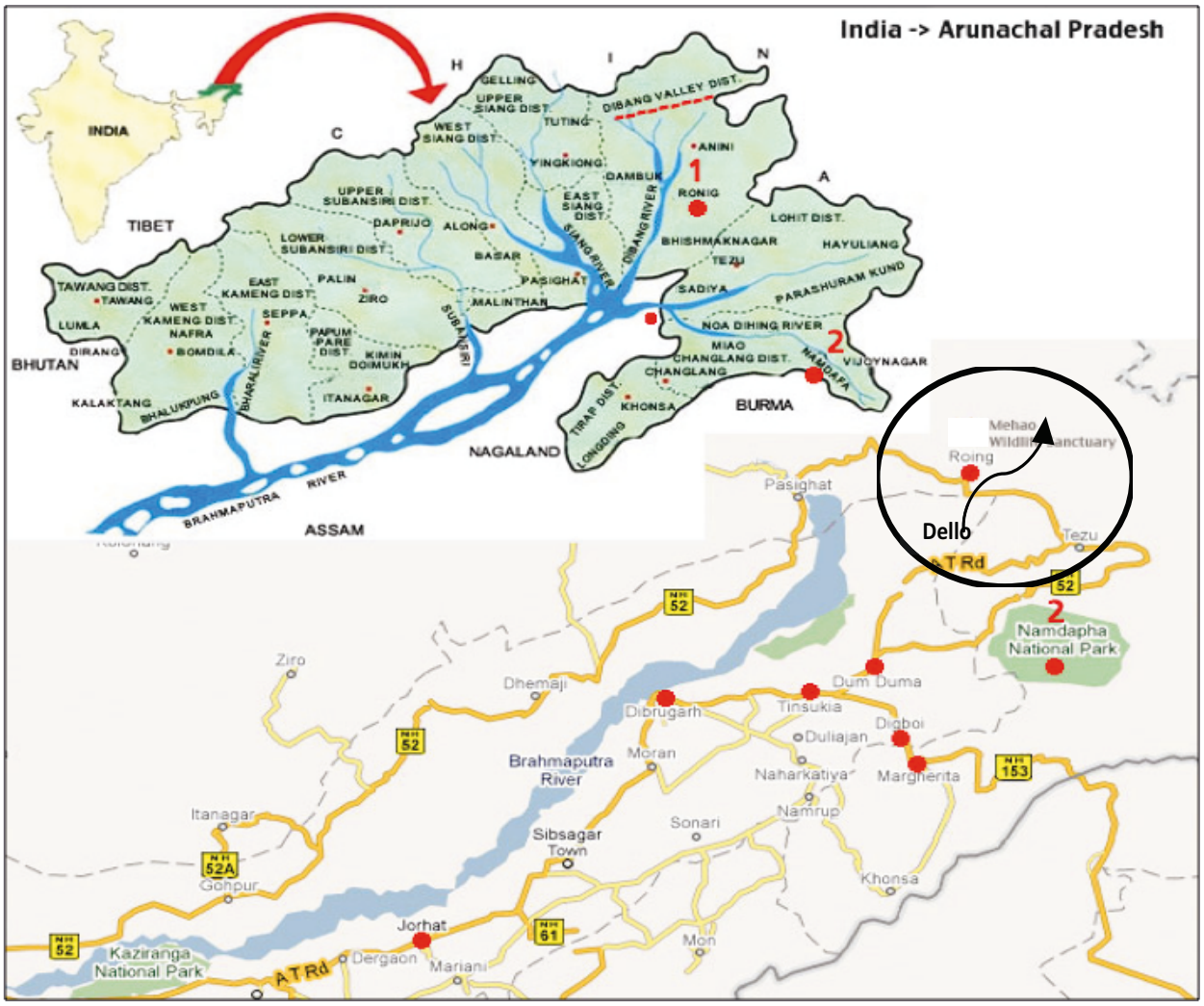

Image 1. The study area - highlighting capture site (Dello) and release site (Mehao Wildlife Sanctuary)

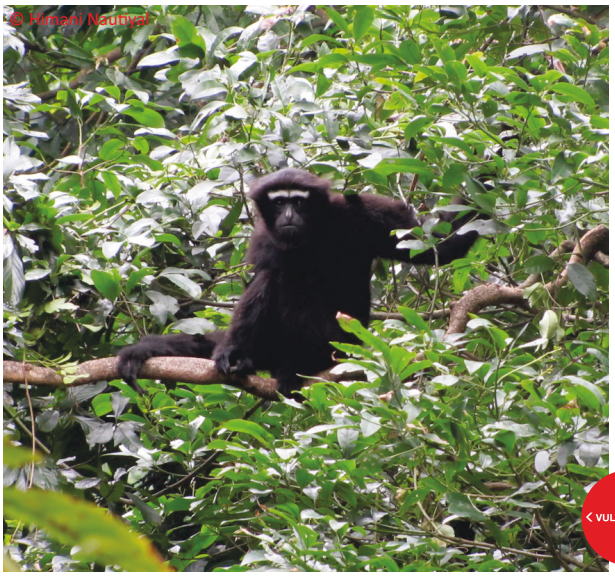

Image 2. Male Eastern Hoolock Gibbon

Image 3. Female Eastern Hoolock Gibbon

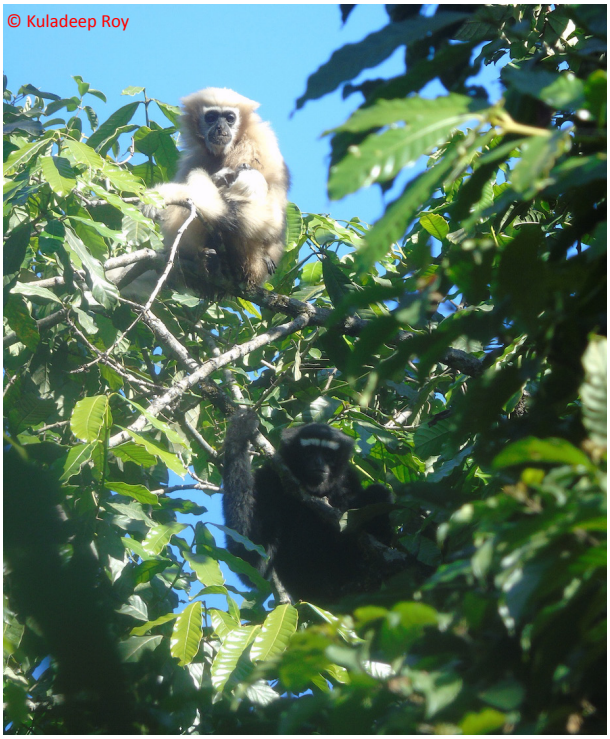

Image 4. Male and female Eastern Hoolock Gibbons

was mostly recorded on the basis of behaviour sampling method. We used Instantaneous/Scan sampling method (Altmann 1974; Lehner 1996) for all individuals of all families including infant. Such a scanning was made for a period of five minutes with 10 minutes of interval (for collecting other related information) during which each individual was observed and the information was collected through a pre-formatted data sheet recording month, date, time, age-sex, activity, food part used and food plant species. The same procedure was repeated after a gap of 10 minutes. Although, there was a detailed activity record of all individuals including, moving, sitting, passivity, foraging leaves, feeding fruits, playing, sitting on lap, grooming, grooming male, foraging fruit, hiding, feeding leaves, travel, feeding flower, foraging flower, hanging etc, for analysis all related activities were categorized in to six major activities including, locomotion, feeding, passivity, social activities, other activities and suckling milk by infant. Feeding and foraging were collectively categorized for further discussion of resource types like feeding fruits, feeding insect, feeding leaves and feeding flowers. Suckling milk for infant was not considered in this category.

The frequency of different activities was compared using chi-square test for proportions. The data of the feeding behavior was sorted out separately according to the resource types and compared across the age-sex of different habitats. The appropriate statistical tests were applied to test the differences.

The detailed vegetation sampling and phenology estimation were not carried out due to the limited study period. The specimens of the fodder plant species were collected for identification.

RESULTS

Group 1

A total of 396 scans were made on Group-1 of which 132, 131 and 133 scans were made on adult male, adult female and suckling infant respectively. Out of the total feeding scans (39 of 132 scans), the adult male was observed mostly to consume different types of fruits (32 of 39 scans, 82.05%) followed by leaves (7 of 39 scans, 17.95%), (χ^2 =16.026; df =1; p<0.01). Similarly, of their total recorded scans on feeding (34 of 131 scans), adult females were also observed to consume fruits mostly (29 of 34 scans, 85.29%) followed by leaves (5 of 34 scans, 14.71%), (χ^2 =16.941; df =1; p<0.01), (Fig. 1). The infant was observed to consume only fruits (17 scans on feeding of total 133 scans).

Group 2

Out of a total of 465 scans of the Group-2 family of Eastern Hoolock Gibbon, 154, 156 and 155 scans were made for adult male, adult female and sub-adult female (black in colour) respectively. The adult male was observed to consume only two types of resource items, flowers and leaves, recorded from their overall feeding scans (20 of 154 scans). Out of two resource items, the adult male was observed in more number of scans to consume flowers (17 of 20 scans, 85.00%) than that of leaves (3 of 20 scans, 15.00%), (χ^2 =9.8; df =1; p<0.01). Similarly, of these two resource items the adult female was also observed to consume more flowers (30 of 39 scans, 76.92%) than leaves (9 of 30 scans, 23.08%), (χ^2 =11.308; df =1; p<0.01) out of their total observed feeding scans (39 of 154 scans). Out of 155 scans, the sub-adult female was observed to perform 12 different types of activities which were classified in to four major activities. The sub-adult female was observed to spend time on feeding (34 of 155 scans) to consume only similar two resource items. However, out of these two resource types flowers (21 of 34 scans, 61.76%) and leaves (13 of 34 scans, 38.24%), there was no significant difference of consumption by the sub adult female (χ^2 =1.882; df =1; NS), (Fig. 2).

Group 3

A total of 843 scans were recorded on the 20 kilo group of which 281, 281 and 281 scans were observed for the adult male, adult female and infant respectively. Of the 281 scans the adult male was observed feeding (56 of 281 scans) it was observed to consume four different types of resources. Out of those resources, the adult male was observed mostly to consume leaves (25 of 56 scans, 44.64%), followed by fruit (14 of 56 scans, 25.00%), faunal components (11 of 56 scans, 19.64%) and flowers (6 of 56 scans, 10.71%), (χ^2 =13.857; df =3; p<0.01). The adult female was observed to perform feeding (59 of 281 scans) to consume similar types of resource items. The adult female was observed in the maximum number of scans to feed on leaves (28 of 59 scans, 47.46%), followed by fruits (16 of 59 scans, 27.12%), faunal components (13 of 59 scans, 22.03%) and flowers (2 of 59 scans, 3.39%), (χ^2 =23.237; df =3; p<0.01), (Fig. 3). The infant was observed to be carried by the adult female and to consume only milk.

Comparison of major activities

The gibbon families from Sally Lake site overall (44.25%, 381 of 861 scans) spent more time on passivity than the family of 20 kilo (30.72%, 259 of 843 scans), (χ^2 =33.232; df = 1; p<0.01). Similarly, the gibbon families from the Sally Lake site overall (21.25%, 183 of 861 scans) used more time feeding than that of 20 kilo (13.64%, 15 of 843 scans), (χ^2 =17.107; df =1; p<0.01). There is also a significant difference in locomotion (χ^2 =19.763; df =1; p<0.01) because it was observed that the gibbon families of Sally Lake site overall (241 of 861 scans, 27.99%) ranged more than that of the family of 20 kilo (159 of 843 scans, 18.86%). It was also recorded that the gibbon family of 20 kilo (17.91%, 151 of 843 scans) had more of different types of other activities, like chasing, body and nipple contact by infant etc, than that of the gibbon families of Sally Lake site (3.02%, 26 of 861 scans), (χ^2 =101.490; df =1; p<0.01). However, there was no significant difference in social activity (χ^2 =.367; df =1; NS) between the two families of gibbon Sally Lake, habitat1 (27.99%, 241 of 861 scans) and 20 kilo (18.86%, 159 of 843 scans) (Fig. 4).

Comparison of feeding ecology

There is a significant difference on consumption of fruits (χ^2 =8.357; df =1; p<0.01) between the gibbon families of the two different habitats, because the gibbon families of Sally Lake site were observed overall (42.62%, 78 of 183 scans) to consume more fruits than that of the gibbon family of 20 kilo (26.09%, 30 of 115 scans).

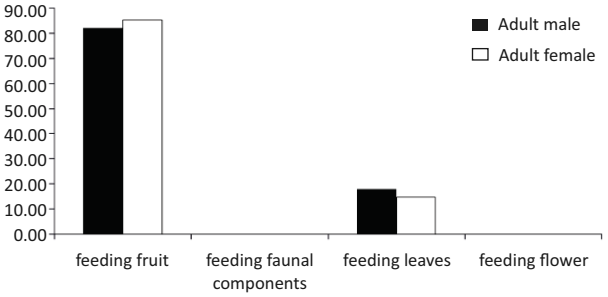

Figure 1. Resource types and their occurrence of consumption in percent scan in adult male and adult female of Group-1

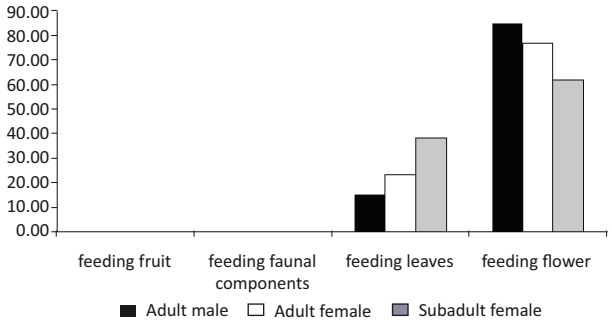

Figure 2. Resource types and their occurrence of consumption in percent scan in adult male, adult female and sub-adult female of Group-2

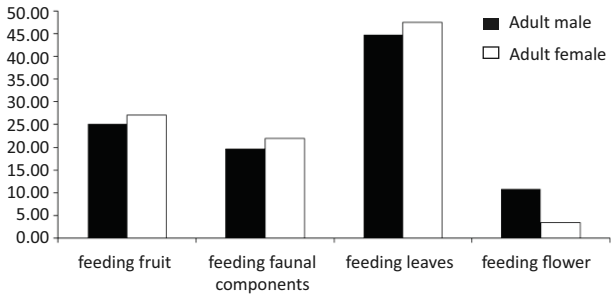

Figure 3. Resource types and their occurrence of consumption in percent scan in adult male and adult female of Group-3

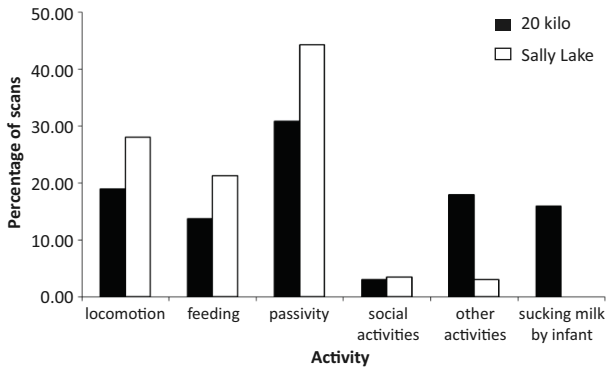

Figure 4. Comparison of major activity of gibbon families in two different habitats

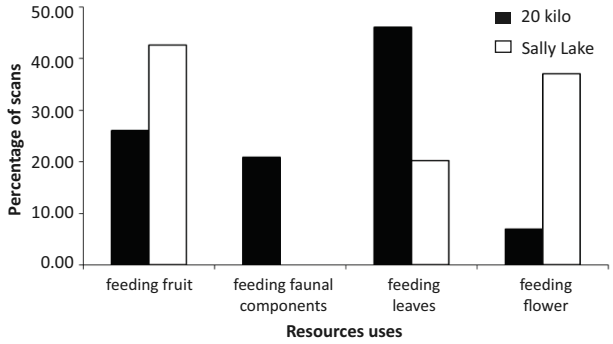

Figure 5. Comparison of resources utilization of gibbon families in two different habitats.

However, the gibbon family from 20 kilo (46.09%, 53 of 115 scans) was observed to consume more leaves than the overall consumption of leaves by the gibbon families at Sally lake site (20.22%, 37 of 183 scans), (χ^2 =22.418; df =1; p<0.01). The overall consumption of flowers by the gibbon families from Sally Lake site was (37.16%, 68 of 183 scans) also observed to be significantly higher than the consumption of the gibbon family of 20 kilo (6.96%, 8 of 115 scans,), (χ^2 =33.905; df =1; p<0.01) (Fig. 5). The consumption on faunal components was only observed on the feeding of the gibbon family of 20 kilo.

Food plant species

Not all the plant species of the two study areas were identified within the limited period of time. Out of the sampled plant species, *Duabanga grandiflora*, *Saurauia armata*, *Vitex* sp, *Bauhinia perpurea*, *Spondias* sp and *Ficus roxburghii* were the major plant species of the Sally Lake site and, *Colona floribunda*, *Ficus* sp, *Litsea* sp, *Alangium* sp, *Randia* sp and *Ficus semicordata* were identified as the major plant species in the 20 kilo site. Epiphytes, climbers and Lianas were not considered for the vegetation estimation. The plants which were observed to be used by the groups were recorded only for identification. There was no analysis for habitat and no estimation on phenology and resource availability also.

DISCUSSION

Previous studies on many other great apes like chimpanzees and gorillas revealed that, there is an evolutionary trait on the foraging strategy at co-species association (Goodall 1986; Watts 1996). The difference of age sex classes on resource utilization is also reported in many greater apes (Boesch 1994; Watts 1998). There are also sex differences in the general activity budget, due to physiological factors like high consumption of nutritious food by the female (Knott 1998, 2001; Takahashi 2002; Fox et al. 2004). This disproportional consumption of diet also leads to social relationships and hierarchical positions (Foster & Janson 1985). In the present study, there was no such significant difference on consumption between age-sex classes. Moreover, as the group size of the Eastern Hoolock Gibbon family in general is small (Chetry 2008), many activity differences between age-sex classes are not expected in a single group unlike the other apes (Cluttion-Brock & Harvey 1977; Fox et al. 2004).

The habitat differentiation causes the vegetation changes for primates to utilize their available resources. Many apes like orangutan, change the habitat location frequently on the basis of food availability (Leighton & Leighton 1989; Tilson et al. 1993). However, it was found that passivity was the most observed activity in all the three groups. The families which were released in Sally Lake site were found to spend a higher amount of time in feeding and in ranging than that of the gibbon family in the 20 kilo area. It was probably because the population from an area of high resource availability, had less time on the feeding and ranging than the population of some other area having a relatively lower plant biomass (Watts 1988). This observation would help to recognize the habitat preferences of gibbon families. It was also found that, groups of some species of apes spent different time frames throughout the day on searching for different food items according to the resource diversity (Watts 1996; Mootnick & Nadler 1997; Cheyne 2004; Masi et al. 2009).

Although the present study was for two and half months, it was observed that there was a selection of resource types between the gibbon families of the two different habitats. The family of the 20 kilo site was mostly observed to consume more leaves than other plant parts, whereas, in the same time period the families from the Sally Lake site were mostly observed to consume fruits and flowers. The capture and release programme were performed in the post winter season when the reproductive parts of many plants like fruits and flowers were hardly available. Moreover, there are several factors like habitat (Abes 2001), abiotic components and seasonal variation (Bollen & Donatl 2000; Zimmerman et al. 2007; Lahann 2008) for the production of fruits, flowers and leaves. There was also an altitudinal difference between 20 kilo (990m) and Sally Lake area (433m) which led to the difference of physical and abiotic factors on phenological aspects.

However, no detailed phenological studies were carried out in these two places, but the availability of fruits and flowers was much higher in Sally Lake area (Himani Nautiyal pers. obs. May 2012). Thus, there would be a chance that gibbon families were also directed to consume the available resources at their nearest reach (Loiselle & Blake 1990; Wich et al. 2002; Di Fiore 2004; Miller & Dietz 2004; Houle et al. 2004; Soyers & Norconk 2008; Go 2010).

It was also observed, that the family from 20 kilo was observed to consume different kind of resource items than that of the family in Sally Lake area. The 20 kilo forest habitat was denser than the Sally Lake site. Although, there was no detailed study on the vegetation sampling, it was recorded that the 20 kilo area was much more untouched and enriched by vegetation than that of Sally Lake area. Probably this led to the choice of resource diversity by gibbons, in 20 kilo area than Sally Lake site. To compare the two different habitats on the basis of available resources only a few species identifications were carried out at the preliminary level. But due to limited period of time and lack of enough specimen collection, not all sampled species were identified. However, as per the utilized data it was understandable that gibbon were mostly seen to consume that kind of resources which were mostly available.

However, all the families were rescued and released only as part of the translocation programme; it seemed very hard to define the ecology on the released gibbon families within the short period. Because many other ecological factors like co-species association, presence or absence of predators, seasonal changes of home range etc. were also important to mention. The overall study was to recognize a significant habitat for further gibbon release as a major job of the project and to monitor their post release survival.

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Author Contribution: HN had collected the major portion of the field records being in Mehao Wildlife Sanctuary, Roing. SD also helped to collect some portion of the data at the initial stage and assisted in post release monitoring works. KR had also collected field data for the first group of released gibbon family. He had also compiled all recorded data for further analysis, major write up and final interference.

Hindi Abstract:

वाईल्ड लाईफ ट्रस्ट आफ इंडिया ने लम्बे समय के लिए गिब्बन परिवार को उपयुक्त वास खोजने की जिम्मेदारी ली है। जिनको अरूणाचल प्रदेश के डेलो नामक गॉव से नजदीकी वन क्षेत्र में विस्थापित किया जा रहा है। यहां पर अभी भी गिब्बन्स को सफलतापूर्वक बचाया जा रहा है नवम्बर 2011 से अभी तक 4 गिब्बन परिवार जो कि कुल 11 कि संख्या में है, निहाओ वन्य जीव विहार के तीन अलग अलग वासो में सफलतापूर्वक विस्थापित कर दिया गया है। गिब्बन को विस्थापित करने के पश्चात किया गया अवलोकन बहुत जरूरी होता है ये जानने के लिये कि गिब्बन का परिवार नये वास मे सफलतापूर्वक जीवन–यापन कर रहे हैं कि नही। लंबे समय तक किये जाने वाले उनके स्वाभाव के अवलोकन से ये समझने में सहायता मिलती है कि वो नये विस्थापित वास में किस तरह से वास में पाये जाने वाले संसाधनो का उपयोग कर रहे है। गिब्बनो को बचाने के साथ ही वाईल्ड लाईफ ट्रस्ट आफ इंडिया ने गिब्बनो के परिवार को विस्थापित करने के लिये उपयुक्त वास खोजने की जिम्मेदारी संभाली। विस्थापित करने के बाद किया गया अवलोकन तात्कालिक नमूना विधि से किया गया जिससे कि अधिकांश उनके दैनिक स्वभाव का अध्ययन किया जाता है। वर्तमान में किये गये अध्ययन से गिब्बनो के दैनिक स्वभाव एवं संसाधनो के उपयोग का अनुमान लगाया जा सकता है। वर्तमान अध्ययन से ये निष्कर्ष निकलता है कि सीमाओं का प्रतिरूप मुख्यतः संसाधनो की मात्रा एवं वन प्रकार पर निर्भर करता है। गिब्बन परिवार जिनको कम घने वनो में विस्थापित किया गया उनके खाने का स्वभाव सामान्य हो गया था तथा परिवार जिनको घने वनो में विस्थापित किया गया वो विशेषज्ञ उपभोक्ता हो गये। हालांकि इनके स्वभाव को पूर्णतः जानने के लिये लम्बे समय के शोध की आवश्यकता है।