Bengal Florican Conservation and Research Initiative in BTAD, India

2008 Future Conservationist Awards

Final Report

2009

Implemented by-

Aaranyak

Supported by-

BirdLife INTERNATIONAL

WILDLIFE CONSERVATION SOCIETY

bp

CONSERVATION INTERNATIONAL

FAUNA & FLORA International
Conserving wildlife since 1903

Conservation Leadership Programme

Project title: Bengal Florican Conservation and Research Initiative in BTAD, India.

Project ID: 101608

Team Leader: Namita Brahma

Team members-

Namita Brahma (namita@aaranyak.org). Namita is 27 years old and M.Sc in Zoology. She is responsible for overall activities of the project.

Kushal Choudhury(Kushalchoudhury@yahoo.co.in). Kushal is 31 years old and M.Sc in Zoology. He is responsible for conducting trainings for local youth, data management and reporting.

Rubi Kumari Sharma(sharma.rubinbq@gmail.com). Rubi is 23 years old and M.Sc in Wildlife and Conservation Biology. She is from Botany background and responsible for vegetation studies.

Mahendra Basumatary. Mahendra is 29 years old and a graduate in Arts. Expertise in conservation education and responsible for organizing awareness programmes.

List of Contents

List of figures

List of tables

List of pictures

Appendices

ACKNOWLEDGEMENTS

We offer our sincere gratitude to Conservation Leadership Programme for financial support and unabated encouragement. We are also thankful to Idea Wild for providing us field equipments for our study.

We are grateful to Mr. Kampa Borgoyari, Deputy Chief and Executive Member, Forest & Tourism, Bodo Territorial Council with their support and cooperation.

We are grateful to Mr. M. C. Malakar, (Retd), former Principal Chief Conservator of Forest (Wildlife), and Mr. S. Chand (IFS) Principal Chief Conservator of Forest (Wildlife), Govt. of Assam, Mr. G. C. Basumatary, IFS, Chief Head of the Department, Forest & Tourism, Bodo Territorial Council and the Park Authority of Manas National Park, Mr. A Swargowary, IFS, Field Director, Manas Tiger Reserve, Mr. C.R. Bhobora, IFS, Deputy Field Director, also thanks to Mr. P. K. Brahma, Range Officer, Bansbari, Manas National Park , Mr. L. Ramchiary, Range Officer, Bhuyanpara, Manas National Park , Mr. K. Patgiri, Range Officer, Panbari, Manas National Park as well as the staff of Manas Natioanl Park for their continuous help and cooperation during the project.

We thank Prof. P. C. Bhattacharjee, Department of Zoology, Gauhati University and Dr. Hilloljyoti Singha and Mr. Bibhuti Prasad Lahkar for their technical support throughout the project.

We offer our sincere thanks to the major mentors and all the supporting members of Aaranyak**.** Special thanks to Dr. Bibhab Kr. Talukdar, Secretary General, Aaranyak, Mr. Ashok Dey, Finance Secretary, Aaranyak for their encouragement and advices and also Mr Dhrubojyoti Kalita for his ideas that I applied during my school programmes. We are indebt to Pranjit Kr. Sharma, Santanu Dey, Jyoti Prasad Das, Naba Krishna Nath, Komal Mushahary and Kumar Brahma for being a helping hand to me all through the project.

We are also thankful to Manas Maozigendri Ecotourism Society for all logistic support and cooperation during my field works and awareness campaigns. We also offer thanks to Manas Agrang Society, Manas Bhuyanpara Ecotourism Society and all Conservation Volunteers at Bansbari, Bhuyapara and Panbari Range for their cooperation during my field works and awareness campaigns.

We are also thankful to the School Authorities of all the twenty schools for their cooperation and allowing us to hold awareness program in their schools.

Summary

Bengal Florican is a critically endangered grassland bird. The global population of Bengal Florican confined to only three countries -- India, Cambodia and Nepal -- is not more than around 1300 birds. They are extremely habitat specialist and restricted to grasslands. The principal objective of the project was to conserve Bengal flroican through research, education and community participation.

The field surveys were carried out during early morning and late evening when the Bengal Florican displays actively. Data were collected on ecological parameters such as comparative study of habitat inside and outside the Bengal Florican territories in Koklabari Agriculture Farm in Baksa district of Assam. Extensive education and awareness programmes were carried out in the villages close to Bengal Florican habitats. Capacity building trainings for local youth and women folks were also conducted.

Estimated population of Bengal Florican is around ‘50’ individuals in Manas National Park in Assam. Around 40% of the Bengal Florican population has been lost since 1989-1990. Grass height seems to be the main factor for the establishment and maintenance of the territory for the endangered bird. It is assumed that they are very site selective in establishing their territory. Wet alluvial grassland is reduced by 47% and succeeding towards savanna grassland.

A total of 789 students and 72 teachers were trained and benefited from awareness campaigns. Altogether 90 youths were trained on biodiversity conservation specially on monitoring of Bengal Florican species. In addition, a total of 80 women from twenty fringe villages were trained on food processing and preservation.

Introduction

Grasslands are the richest and unique ecosystem which supports large number of endangered species (White *et al.* 2000) and at the same time, the grassland ecosystem perhaps is the most threatened ecosystem in the Indian subcontinent at present (Grimmett *et al.* 1998). The tall moist alluvial grasslands that occur on east-west stretch of the northern alluvial lowland of Nepal and floodplains of river Ganges and Brahmaputra is known as the *terai*. Of the total grasslands of Assam, two-third is in the alluvial flood plains of the Brahmaputra River and the remaining one-third in the Terai region. Despite importance and significance, the grasslands and its biodiversity of this region are rather poorly studied (Choudhury, 2003).

Bengal florican is a medium sized ground bird which is about 60 cm tall while standing. It shows distinct sexual dimorphism. The adult males have black head, neck and body with white wings which is distinctly visible while flying. However, when standing the white wings are seen as a thin patch on either side of the body. The back is mottled with buff-brown. However, during the breeding season males have a thick bunch of feathers hanging under the breast. On the other hand, the female and immature male is dull brown and molted on the back. The females are slightly larger in size than its male counterparts. Female Bengal floricans had been found to be elusive and cryptically coloured. Consequently, females were less frequently seen than the conspicuous territorial males. They are omnivorous and known to feed on various seeds, grain, tender shoots of grass and insects like grasshoppers, ants, beetles and even frogs. In burned areas, the Bengal florican is also seen eating burned seeds.

The breeding season of Bengal florican starts from February and lasts till early part of July. During the breeding season the male Bengal Floricans establish individual territories in the open areas in short grasslands. The adult males show a characteristic flight display within the territory to attract female Floricans for mating. In one clutch a Bengal florican lays one to two eggs.

Bengal Florican (*Houbaropsis bengalensis)* is a Critically Endangered (IUCN, 2008) bird, restricted to the *terai* grassland regions of the Indo-gangetic floodplain and the Brahmaputra floodplains. The global population of Bengal Florican is not more than

1300 birds (Birdlife 2009) distributed in India, Nepal and Cambodia. Bengal florican is a grassland habitat specialist which acts as an indicator of a healthy grassland ecosystem (Narayan 1992). In India, it is protected under Schedule I of Wildlife Protection Act, 1972.

Once it was widely distributed from Uttar Pradesh, Bihar, West Bengal, to the foothills of Assam and Arunachal Pradesh in India. However, at present Bengal Florican is found only in the few protected pockets in India viz. Manas National Park, Kaziranga National Park, Orang National Park, Sonai-Rupai Wildlife Sanctuary, Dibru-Saikhoa National Park and Burachapori Wildlife Sanctuary in Assam, D'Ering Wildlife Sanctuary in Arunachal Pradesh, Jaldapara and Gorumara Wildlife Sanctuary in West Bengal and Dudwa National Park in Uttar Pradesh (Birdlife 2001, Narayan 1992).

Populations of Bengal Florican have declined as a result of habitat loss and hunting in the Indian subcontinent, the species no longer occurs outside protected areas (BirdLife International, 2001). In nineties, Bombay Natural History Society (BNHS) had conducted a survey in India and found that Manas had highest number of Bengal Florican population (Rahmani *et al.* 1990). Around 80 birds were estimated during the survey which is perhaps the largest known population of Bengal Florican in any single locality.

However, Manas National Park had been severely affected during more than a decade long Bodo agitation during late eighties to beginning of new century (Rahmani *et al.* 1988). As result of that Manas lost heritage attributes like rhino, swamp deer and along with deterioration of habitat like grassland. This study is the first systematic effort to study Bengal florican population and its habitat in Manas National Park in post Bodo agitation scenario to fill up the gap of information. In this context, the present study was undertaken to initiate bridging research, education and community participation for long-term conservation of Bengal florican and its habitat.

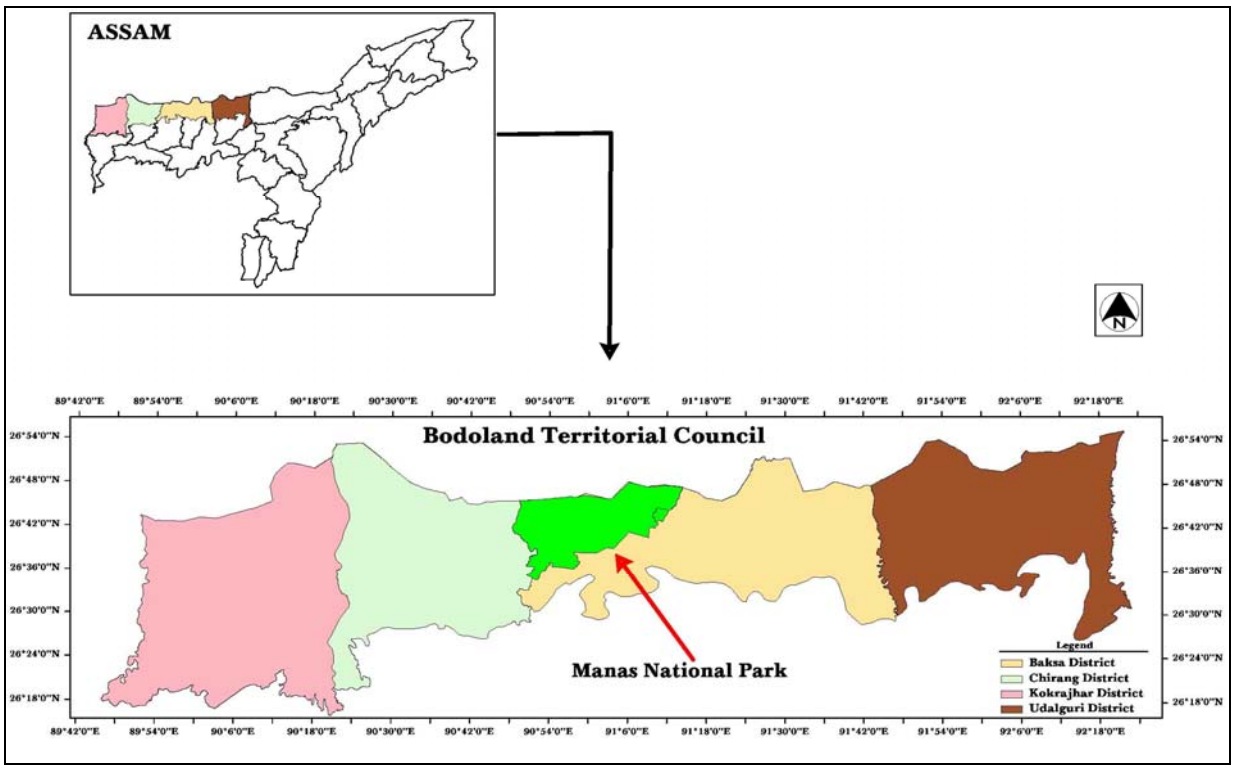


Figure 1: Map of Bodoland Territorial Council

Study area

Bodoland Territorial Areas District (BTAD), now Bodoland Territorial Council (BTC) is an autonomous council under Government of Assam formed in the year 2003. The council comprises of four districts Kokrajhar, Chirang, Baksa and Udalguri. The BTC is situated on the North Bank of the Brahmaputra River along the southern foothills of Bhutan and Arunachal Pradesh. BTC is a part of the eastern Himalayan global biodiversity 'hotspot' and Assam plains Endemic Bird Area (Islam and Rahmani, 2004). The council has forest area of about 3539.95 sq. kms, most of which is located along the border with Bhutan. There are one National Park, two Wildlife Sanctuaries and 43 Reserve Forests in the BTC. The three important protected areas in the BTC are Manas National Park, Barnadi Wildlife Sanctuary and Chakrasila Wildlife Sanctuary.

Manas National Park which is also a World Heritage Site (in danger), a Tiger Reserve, a Biosphere Reserve and an Elephant Reserve, is the integral part that comprises

80% of the forest in the BTC that represents a mosaic of diverse and distinguishing ecosystems, such as forests, grasslands, different water bodies. These ecosystems support a large number of rare, endangered and endemic flora and fauna as well as some habitat specialist wildlife like the Golden langur, Pygmy hog and Bengal florican.

Manas National Park (26°35'-26°50'N, 90°45'-91°15'E) is the core area of Manas Biosphere Reserve with an area of 500 sq. km., located in Baksa and Chirang districts of the BTC. The National Park is surrounded by Reserve Forests to its east and west. To the north of Manas National Park is the Royal Manas National Park (1023 sq. km.) of Bhutan which is a contiguous forest. On the other hand, the southern side is bounded by thickly populated villages. The Manas National Park is located at the junction of Indo-Gangetic, Indo-Malayan and Indo-Bhutan realms and is a key conservation area in the *Jigme Dorji-Manas-Bumdaling* conservation landscape in the eastern Himalayan eco-region (Wikramanayake *et al.* 2001). It is also recognized as an Important Bird Area for its outstanding avifaunal diversity and significant population of some globally threatened species (Birdlife International, 2003). Manas National Park is divided into three ranges viz. Bansbari, which is the central range, Bhuyanpara , the eastern range and Panbari, the western range for smooth management of the Park.

The vegetation types recorded in the Park consist of evergreen forest, semi evergreen forest, mixed moist deciduous forest, grassland, wetlands and riparian forest (Rabha, 2001). The grassland of Manas National Park are the second largest in the entire North-East India (Choudhury, 2003). Among the vegetation types, the wet alluvial grassland, which covers about 42.84% of the area of the Park, and one of the few intact patches left anywhere in the Indo-gangetic plain, deserves special mention(Lahkar *et al.* 2006). Bengal Floricans are found in this type of grasslands, which is being surveyed during this project.

Koklabari Agriculture Farm (KAF) (N 26°45’15.6” E 091°11’38.3”) is situated on eastern boundary of Bhuyanpara Range of Manas National Park. KAF was set up in the year 1971 and its total area is about 9 sq. km. A joint venture of Central Government and State Government, it was named as the Central Seed Farm and presently it is known as Koklabari Agriculture Farm (KAF). The land was taken on

lease from the forest department for thirty years. At that time the KAF was Asia's second largest seed farm that supports people from 57 villages for their livelihood. In the year 2001, the thirty years lease expired and because of prevailing civil unrest in the area at that time, the lease was not extended and the farm was abandoned. However, agricultural activities in the farm areas have been continued by the local villagers in a co-operative basis with support from BTAD government.

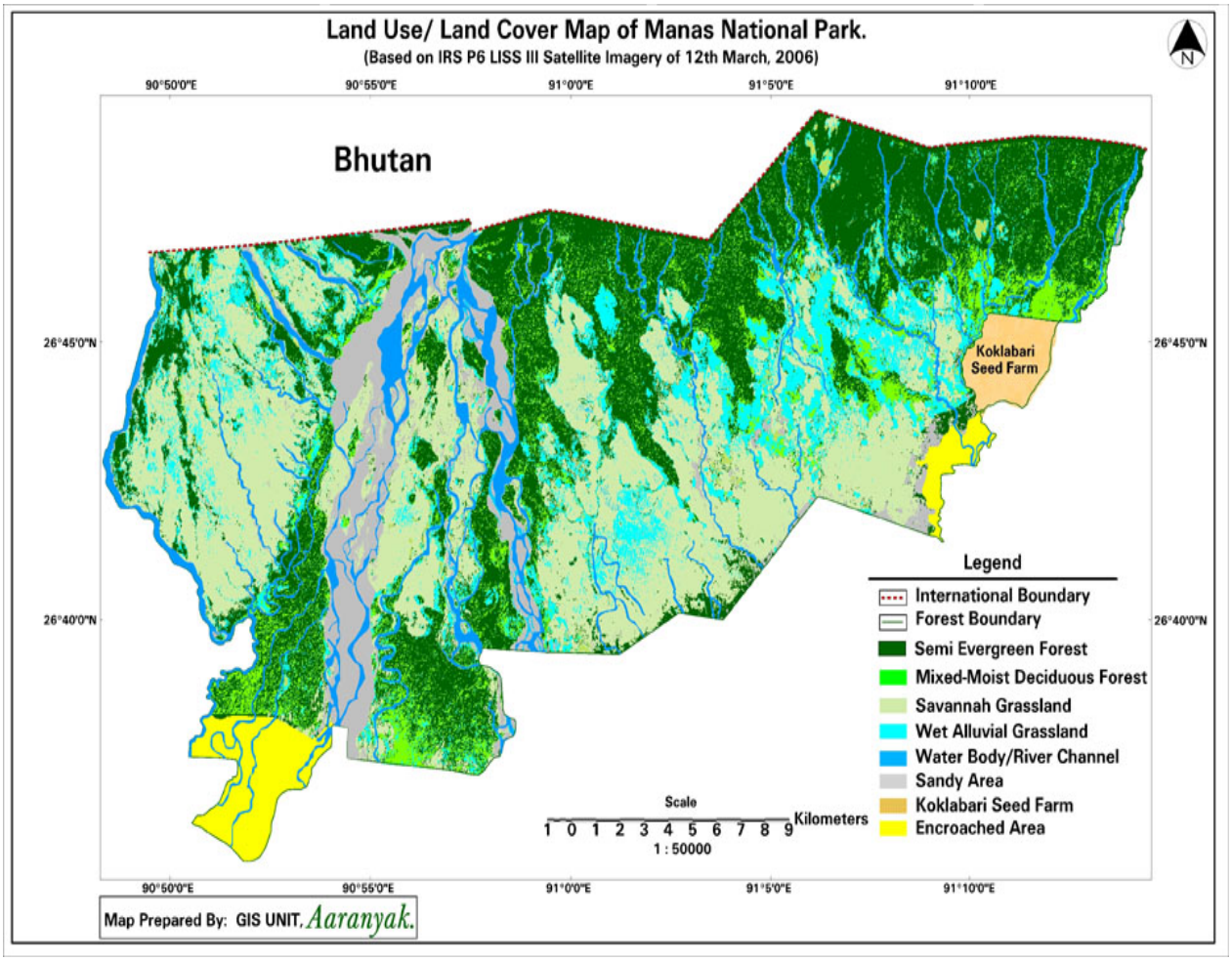


Figure 2: Landuse Map of Manas National Park

Objective 1: To estimate populations and find out the present status of Bengal Florican in Bodoland Territorial Areas District (BTAD), Assam.

Background

Possibly this is the first proper systematic survey of Bengal Florican carried out in BTAD area since nineties after the survey conducted by BNHS. During the project under this first objective we have tried to answer the following questions regarding the status of Bengal Florican—

Which are the grasslands where Bengal Florican is found in BTAD?

What is the current population status in BTAD?

Which grassland area has the highest Bengal Florican territories in BTAD?

For answering the above questions we have followed the following methodologies.

Methodology

Survey-

The survey of Bengal Florican was carried out covering all available grassland patches in the BTAD during its peak breeding season, i.e, February through April counting and getting GPS locations of their presence. Field surveys were carried out during early morning (06:00 hrs to 09:30hrs) and late evening (15:30hrs to 18:00hrs) when the Bengal Florican displays actively. The aim was to locate as many birds as possible. All the potential grasslands within the study areas were surveyed by on foot, from vehicle and also from elephant back. The number of Floricans seen, males and females, activity, time, weather and quality of habitat in each area were noted (Narayan, 1992).

As it has been proved by earlier studies, bustards are very territorial during the breeding period (Sankaran and Rahmani 1986). Thus the location of a territory, i.e. the display site of a male, is the identification of an individual male Bengal florican. So,

different display sites are assumed to belong to different male floricans. Since, female Bengal floricans are not easy to be located, generally only males of an area are sighted. Hence the population estimate is based on the assumption that the sex ratio in Bengal florican is equal.

Picture 1: Bengal Florican survey using vehicle

Picture 2: Bengal Florican survey on foot

Mapping-

All the evidences on Bengal florican were recorded using handheld GPS (Garmin 72) and a GIS base map was produced base on collected evidences using ARCGIS and

ERDAS software to support decision making systems for managers and policy makers.

Result

Survey

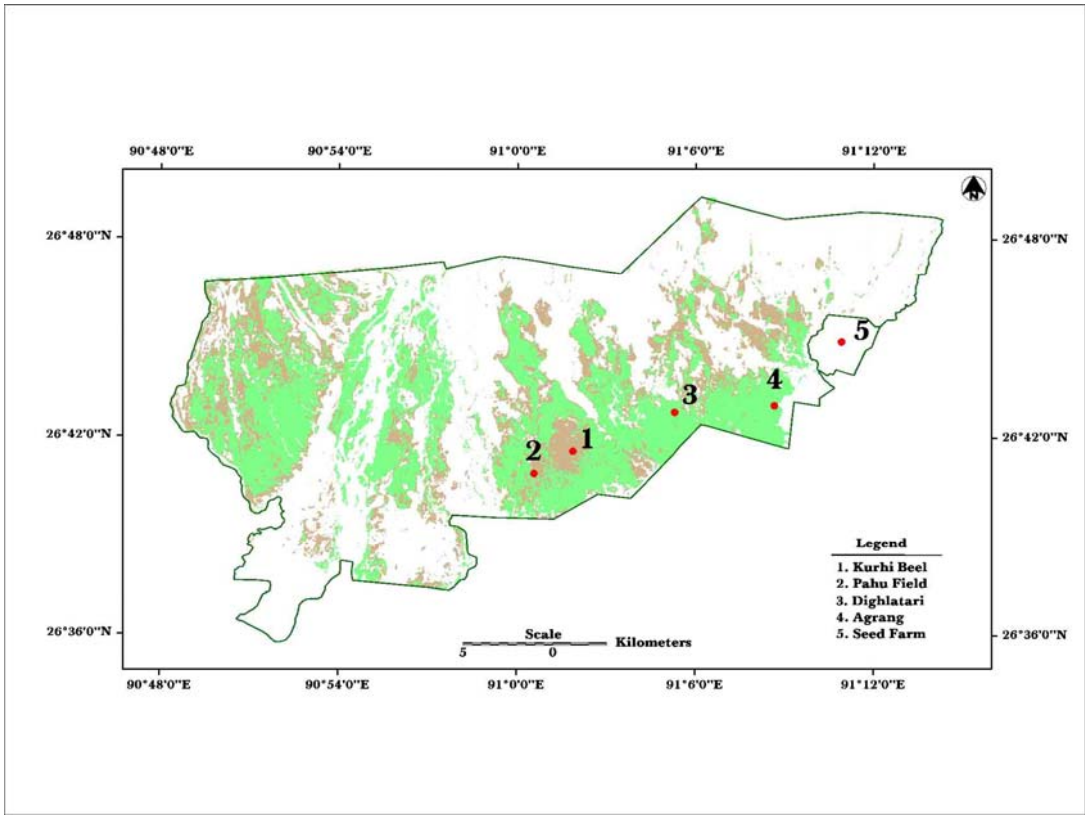


Figure 3: Map of Manas National Park showing sites where Bengal Florican territories are recorded

In the whole of the BTAD, undoubtedly grasslands are present along the terai belt. But except Manas National Park no other area has suitable grasslands habitat for Bengal Florican at present. Even though Manas National Park has around 33% grasslands, there are only five suitable sites are where confirmed Bengal Florican territories have been recorded (Figure 3). These five sites are Pohu field (1), Kuribeel (2), Dighlatari (3), Agrang (4) and Koklabari Agriculture Farm (5). All the five grassland

sites with Bengal Florican territories are near the southern boundary of the National Park and hence close to anthropogenic disturbances.

Most of the Bengal Florican habitats where territories are recorded inside Manas National Park have short grass *Imperata cylindrica* and moderately tall and dense grasses like *Arundinella bengalensis* and *Saccharum spontaneum*.

Table 1: Number of confirmed Bengal Florican territories recorded in different grasslands in Manas National Park

Grassland Sites	**No. of Male Bengal florican territories in 2008**
Pohu Field	1
Kuribeel	3
Dighlatari	3
Agrang	2
Koklabari Agriculture Farm	7
Total	**16**

In Manas National Park, a total of 24 males were recorded. Of which 16 males have confirmed territories (Table 1) and eight (8) were floaters whose territories could not be located. Of these five grassland sites, Pohu field (territory= 1) and Kuribeel (territory= 3) are in the Bansbari range. Dighlatari (territory= 3), Agrang (territory= 2) and Koklabari Agriculture Farm (territory= 7) are under Bhuyanpara range of Manas National Park. In current survey, major part of the Bengal Florican population is found in and around Bhuyanpara Range. Koklabari Agriculture Farm adjacent to the eastern range of Manas National Park has highest number of territories (Table 1) and the highest number of male sightings (10) of all the grassland sites. In addition, six floaters, five females and two sub-adults were also recorded during the survey. In Pohufield we recorded only one (1) male with confirmed territory and no floaters. In Kuribeel, besides the three (3) confirmed male territories one (1) floater was also recorded. On the other hand, in addition to the territories, we have also recorded two

(2) floaters each in Dighlatari and Agrang. However in KAF we have recorded three floaters and two sub-adults during our survey. Moreover, five (5) females were also seen during the survey, all of them in KAF.

As females were more difficult to be located, population estimates were based on the assumption of an equal sex ratio (Baral *et al*., 2003). Assuming equal sex ratio the estimated population of Bengal Florican is around '50' individuals in Manas National Park.

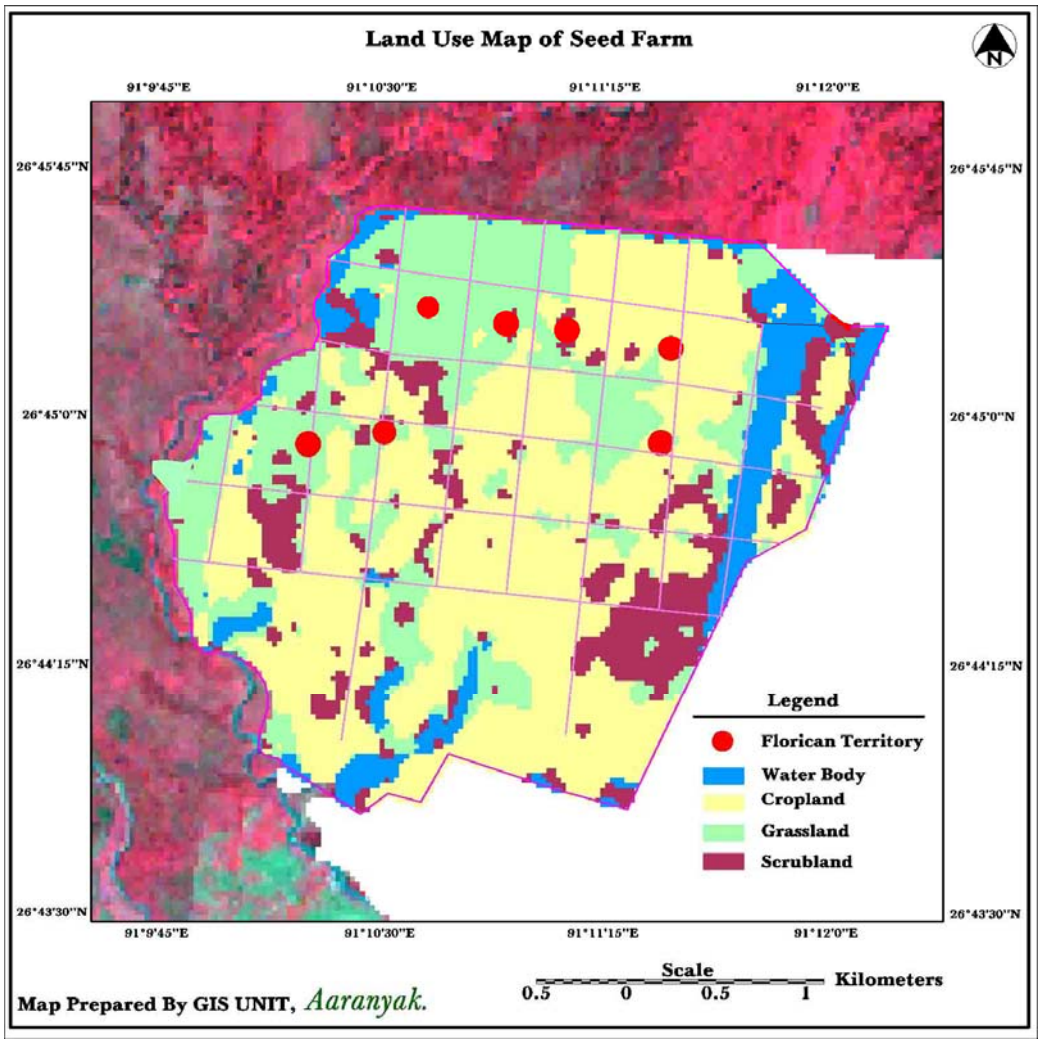


Figure 4: Location map of seven territories in KAF

Besides these five sites, other eight sites viz Mahout Camp, Buraburijhar, Kasimdoha, Palsiguri, Uchila-Bongali Hathdhowa, Kapurpora in Bansbari range, Digjhari in Bhuyanpara range and Gaborukhunda in Panbari range were also surveyed. All of

these eight sites had earlier records of Bengal Florican territories but we have not recorded any territories during our present survey.

Picture 3: Three male Bengal Floricans seen together in KAF

Discussion and Conclusion

Bengal florican is an extremely “habitat specialist”, particularly in terms of the use of short and tall grasslands of terai and flood plain grasslands.

Indiscriminate conversion of grasslands into agricultural land, over grazing, thatch collection, burning, tree and commercial plantations in grasslands, hunting and egg collection have brought the critically endangered species Bengal florican almost in the verge of extinction (Birdlife, 2001).

All the Bengal Florican sites are close to southern boundary. Out of the thirteen sites surveyed only five sites have Bengal Florican sighting as well as territories (Figure 3). However in contrast to this, study carried out in the nineties had recorded ‘24’ territories in the Bansbari range. On the other hand we have recorded ‘24’ individuals as a whole in Manas. In our study we found that the estimated population of Bengal Florican is around fifty individuals. On the other hand, in 1989-90 around eighty birds

were estimated (Narayan, 1992), which was perhaps the largest known population of Bengal Florican at that time in any single locality in India.

During our survey we identified three new grassland sites having Bengal Florican territories namely Dighlatari, Agrang and Koklabari Agriculture Farm (earlier Koklabari Seed Farm) that were not recorded in the earlier survey carried out from 1987 to 1989 (Narayan 1992). The grasslands sites that had Bengal Florican territories during year 1987-1989 are Pohu field, Mahout Camp field, Kasimdoha, Palsiguri, Uchila-Bongali Hathdhowa, Kuribeel, Bura-buri Jhar and Kapurpora. However, it was mentioned that Dighlatari, Dighjari and Koklabari in the Bhuyanpara range are good grasslands for Bengal Florican but could not confirm any territory during 1987-1989.

It seems that the male territories in – Buraburijhar, Palsiguri, Uchila-Bongali Hathdhowa and Mahout Camp might have disappeared in recent past. Moreover, Kasimdoha, Kapurpora, Dighjari and Gabhorukhunda have stray records of Bengal Florican as mention by the Forest staff during our survey. During the period of civil unrest (1990- 2002) both protection and management of habitat was severely affected. Due to heavy grazing pressure, burning by villagers and thatch collection, the quality of grassland along the southern boundary has changed and that may have resulted in the elimination of Bengal florican from these areas.

However, the current population of the species is declining in the Manas NP. This reduction is the result of a decade long socio-political unrest in areas in and around Manas NP. The level of grazing, burning, thatch collection, hunting, and egg collection had increased due to lack of protection during the unrest period which led to the decline in the Bengal florican population. Proper grassland management and protection may support Bengal Florican territories in future in areas like Kasimdoha, Kapurpora, Dighjari and Gabhorukhunda where they were found earlier.

Although we estimated around 50 individuals of Bengal Florican in Manas, it is to be noted that status survey was carried out for the period of only one year. However, for a critically endangered species like Bengal Florican it would not be practical to consider the population estimated on the basis of one year survey. Furthermore, the survey conducted by BNHS was for consecutive three years. As mentioned earlier after political unrest, a new era of wildlife protection and conservation have already

started in BTAD, and with increase in the level of protection in the park Bengal Florican might return to areas not recorded due to disturbances. Hence, a continuous monitoring and consecutive surveys would give a much clearer picture of the status of Bengal Florican in Manas National Park in the coming years.

Objective 2: Identification, monitoring and subsequent conservation of the existing florican habitats and restoration of the degraded habitats in the study area.

Background

From our survey it was found that Koklabari Agriculture Farm that has the highest Bengal Florican territories is adjacent to Bhuyanpara range. However KAF is not inside the protected area. Since KAF is a human intervened habitat of Bengal Florican and there is no protection and most of the earlier studies on Bengal Florican habitat were carried out inside protected area, we, therefore, decided to carry out constant monitoring and detail study of the habitat in KAF which is outside the protected area but adjacent to Manas National Park. In this study we tried to answer the following two questions related to habitat of Bengal Florican—

What is the vegetation composition of KAF?

Is there any significant difference between the micro habitat within the territories and outside the territories of Bengal Florican?

How has the habitat of Bengal Florican in Manas been changing historically?

For answering the above questions we have followed the following methodologies.

Methodology

Habitat study-

First of all, a grid map of the farm and its surrounding areas (Fig. 5) was prepared with the help of GIS. The standardized grid size was 1 km × 1 km each. The total area of the farm was divided into 17 blocks (Table 2). Six blocks were centrally situated and

the rest blocks were in the fringe area of the farm having less than 1 sq km area. To fulfill the objectives, quadrat sampling method (Stohlgren *et al.* 1995) was used for the quantitative study of the vegetation in the farm. Within each 1 sq. km area 10 quadrats of 1m × 1m size were placed randomly for vegetation sampling. Except in the north and north-west (see Fig. 5), the farm is totally surrounded by the villages. Seven quadrats fell in human habitation of seed farm, where data were not collected (Table 2).

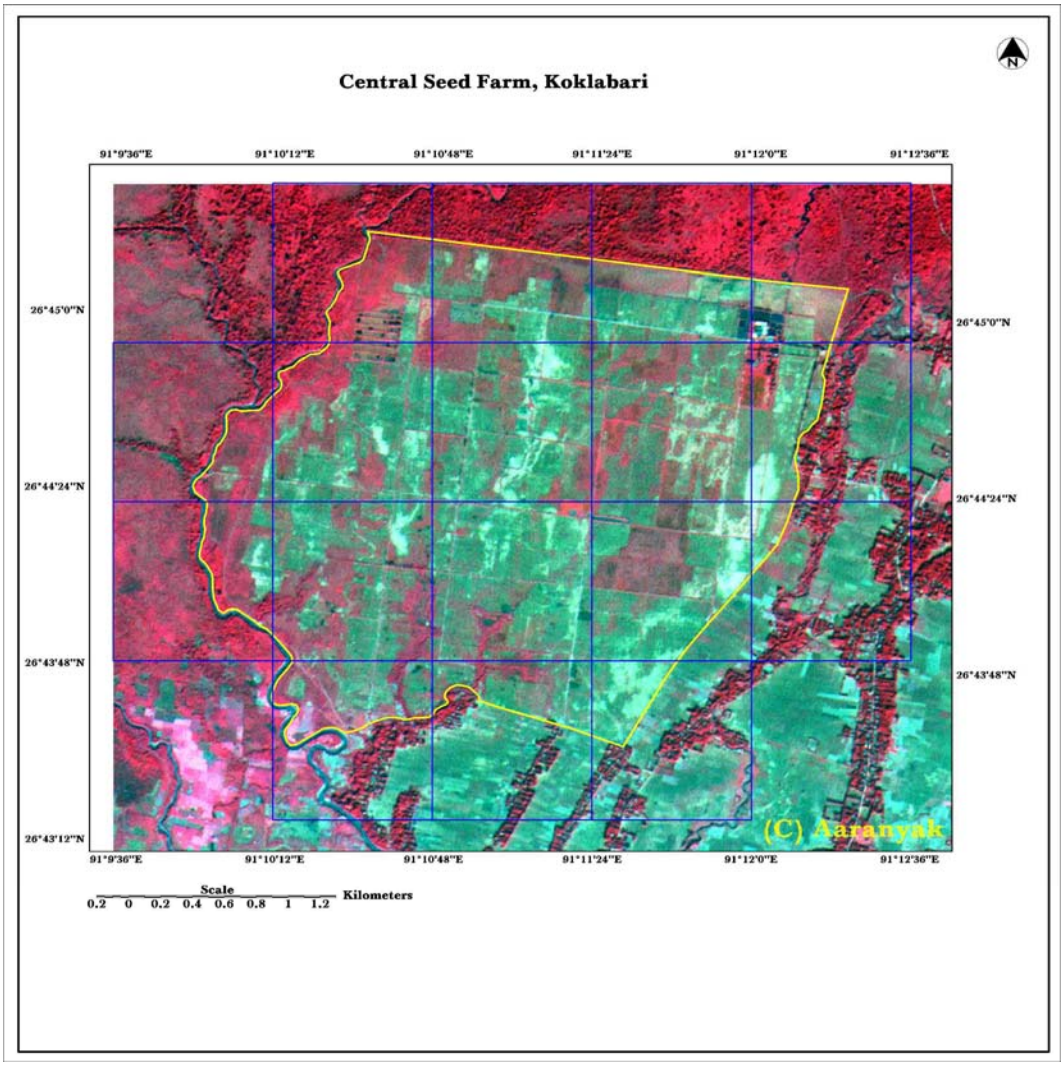


Figure 5: Grid map of Koklabari Agricultural Farm. The yellow polygon denotes the area of the Farm.

Table 2: Plan of quadrat laid in the 17 blocks of the study area.

No. of Blocks	No. of Quadrats laid	No. of Quadrats studied
6 blocks in central area	60	60
11 blocks in the fringe area	30	23

Within each 1 m × 1m quadrat, all the plant species found were recorded. The plant species were identified in the field as far as possible, and unidentified species were tagged and collected to the laboratory as a herbarium. Further identification was done by consulting plant taxonomist, taxonomist of Botanical Survey of India (BSI) at Shillong as well as from related books and literature. A checklist of the plants of Koklabari Agriculture Farm in addition to the 83 quadrats was prepared (Appendix 1). Herbarium of each plant species was made to have a record of all the plants.

In order to do a comparative study of inside and outside territory habitat of Bengal Florican, 16 additional 1 m × 1 m quadrat within (8) and outside (8) the territory were plotted during the month of May to June 2009.

Data collection within and outside the territory was same as that was done in 83 quadrat for the vegetation sampling of the KAF. During this study, the maximum area of the farm was submerged due to rainfall. The water submergence level was measured within each quadrat with the help measuring scale.

Vegetation data were analyzed using Shanon-weiner index, Wilcoxon-match paired test, z-test and t-test.

Picture 4: Vegetation sampling

Picture 5: Monitoring habitat

Mapping-

Change detection of the grassland habitat for the year 1977, 1998 and 2006 was analyzed using image processing software ERDAS IMAGINE 9.0 and a GIS base map was produced to support decision making systems for managers and policy makers.

Result

During the vegetation survey in KAF, 131 species of plants were found belonging to 45 families (Appendix II); Cypereceae, Poaceae and Astereceae contain 13 species each followed by Polygonaceae (10) and Fabaceae (7).

There were 89 species of plants (belonging to six categories) found within 83 quadrats (Table 3). Herbs have the maximum number of species with 48 and the maximum number of individuals with 4602. Though there were 11 grass species recorded in Table 3, in fact there were 11,490 unidentified individuals. The rests 2,420 individuals were identified under 11 species of grass (Table 3). The species diversity index value of the Farm vegetation was 0.95. Among the six categories of plants, herbs had highest species diversity.

Table 3: Categories of plants found in Koklabari Agriculture Farm with number of species, number of individuals and Shanon-weiner index value

Sl no	**Plant category**	**No of species**	**Total individuals**	**Shanon-wiener index(H´)**
1	Herb	48	4602	1.19
2	Runner	21	2112	0.89
3	Grass	11	2420	0.66
4	Shrub	4	31	0.41
5	Climber	2	23	0.20
6	Fern	3	58	0.31
	Total	**89**	**9246**	

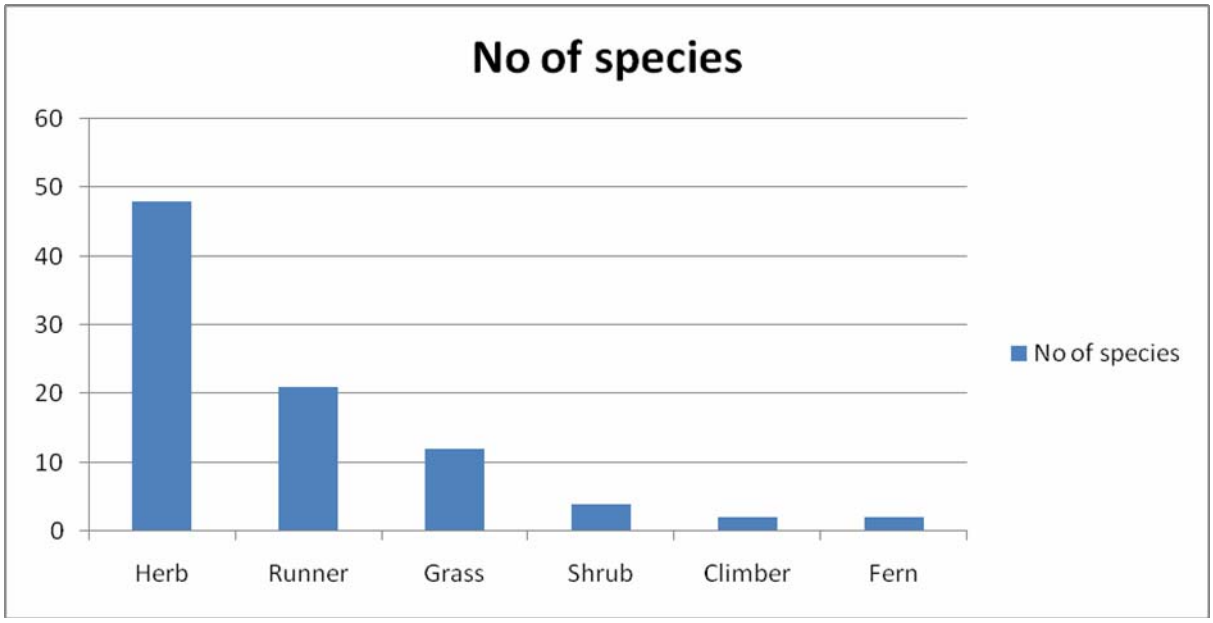


Figure 6: Graph showing number of Species in six categories of plants

Among the herbs, *Ageratum conyzoides* has the highest density 9.36 per sq m and *Vandelia crustacean* has the maximum frequency 73.49% (Appendix III). *Linum usitatissimum* was highly abundant.

In the runners category, *Hedyotis corymbosa* had the maximum density 6.75 per sq m, while *Hydrocotyle sibthorpioides* had highest frequency 74.7% (Appendix III). *Oxalis corniculata* had the maximum abundance.

Among the grasses, *Oriza sativa* had the maximum density (9.51 per sq m) and frequency (67.47%). Abundance was maximum of *Fimbristylis dichotama* and the species diversity index value was 0.66

There were only four species of plants belongs to shrub category. *Desmodium concinnum* had the maximum density (0.25 per sq m) and frequency (6.02%). The species diversity value was 0.41.

The fern and climber each had 3 and 2 species, respectively. Out of three species of fern *Marshilia quadrifolia* had the maximum density and frequency, while *Deplenzium esculentum* had the maximum abundance. Among climbers, *Mikania micranthus* had the highest density, frequency and abundance.

Comparative analysis of vegetation within territorial and non territorial vegetation-

In Territorial and Non territorial vegetation analysis, there were 39 species of plant within the territorial area of Bengal Florican. However, there were three unidentified species. *Ageratum conyzoides* (herb) had the highest density (57.25 per sq m) and abundance (3.11 per sq m). *Polygonum minus* (herb) and *Cyperus kyllingia* (grass) both had 100% frequency. The species diversity index value was 1.24. The height of the vegetation ranged from 7.31-56.44 cm among which grass species *Sataria gluca* had the maximum height.

On the other hand, there were 31 species of plants outside the territory of the Bengal Florican. *Hemarthria protensa* (grass) had the highest density 160.87 per sq m and 100 % frequency. It also had the maximum height 70.28 cm. 100% of the quadrats placed outside the territory contained stagnant water up to 6 cm on average due to the rainfall during this period.

It appears from Fig. 7 that there was difference in the number of plant species found in each quadrat within and outside the territory, but there was no statistically significant difference in the number of species of plants within and outside the territory (Wilcoxon-match paired test). However, there was significant difference in the number of individuals belonging to different plant species within and outside the territory ($Z = 2.62$, $df = 84$, $p < 0.01$). There was significantly highest number of individual plants belonging to 20-30 cm height class than the other height ranges within the territory ($\chi 2 = 178.11$, $df = 5$, $P < 0.01$) as well as outside the territory ($\chi 2 = 16.69$, $df = 5$, $P < 0.01$) (Fig. 7).

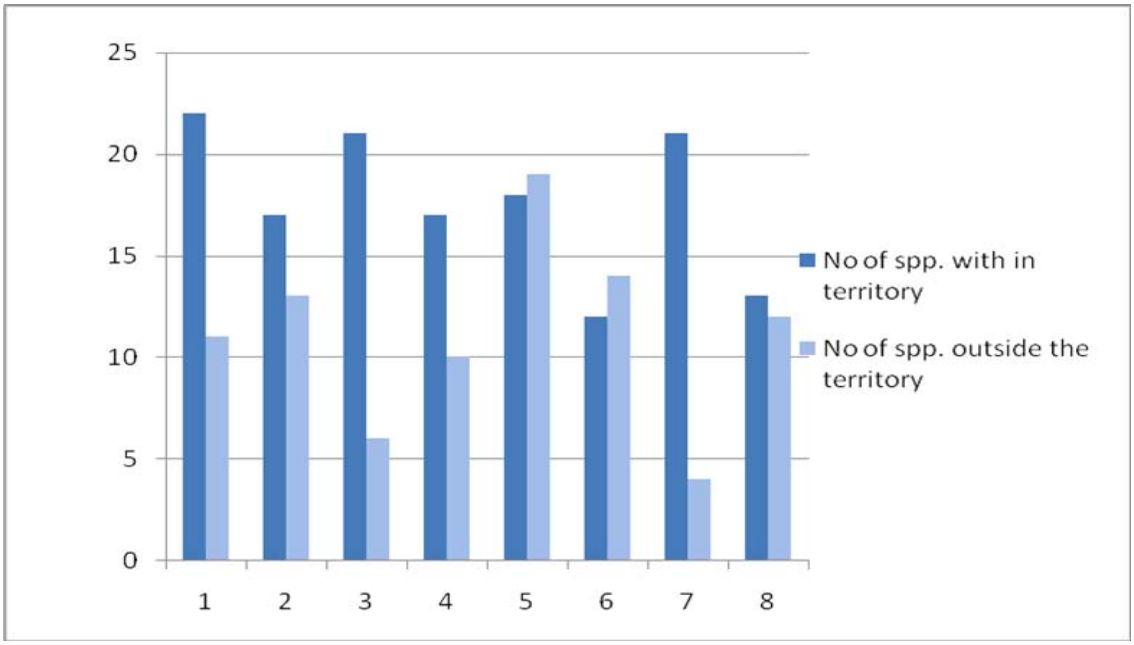


Figure 7: Comparative display of number of species of plants in eight quadrats studied within and outside the territory. The digits on the x- scale denote serial number of quadrat.

Significantly more number of individual plants were higher inside the territory than outside (χ^2 = 27.74 df = 5, p<0.01). As referred in the Methodology, plants were classified into six height classes both inside and outside territory. The height of plants between inside and outside territory in every height class were then compared. And there was no significant difference of height in all height classes between inside and outside territory except in 61-70 cm (t= 7.32, df= 39, P< 0.01).

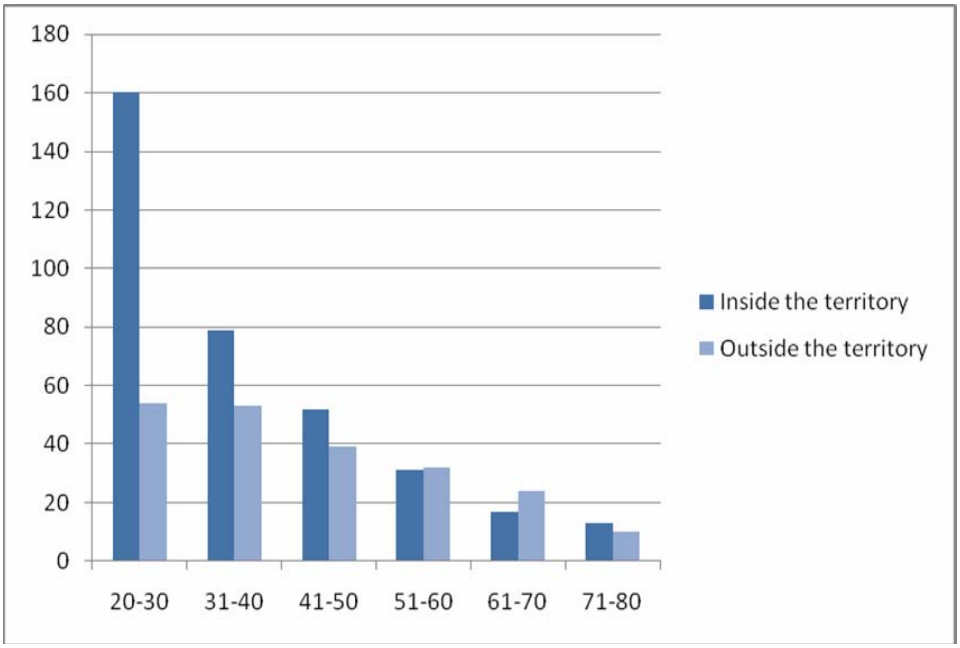


Figure 8: Number of individuals of plant species belonging to six height classes within and outside the territory.

The species diversity index value within the territory was 1.24 and outside the territory was 0.74. The similarity index value of the territory was 0.71.

Change detection analysis

There were crucial alterations of land use pattern within the Park from 1977 to 2006 (Figure 9). An overview of satellite imageries showing the changes is shown in Figure 9 and Table 4. An area of 20.05 sq. km. has been deforested within the Park boundary during these years; out of which 15.33 sq. km. has been cleared in the southwestern part of the Park whereas 4.72 sq. km. has been cleared in the eastern most part of the Park.

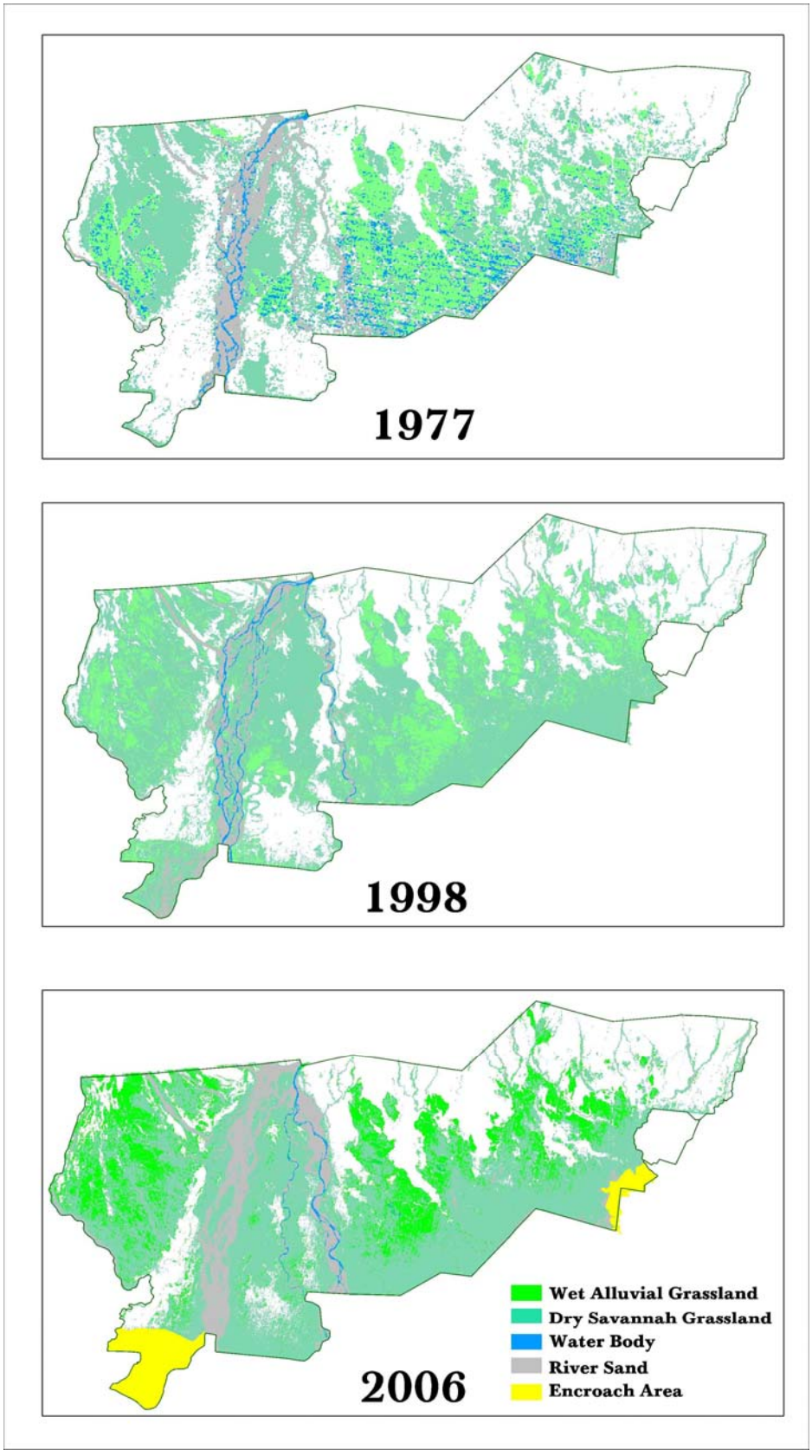


Figure 9: Change detection map of grasslands of Manas

Table 4: Change detection data of grasslands

Landscape elements type	1977	1998	2006
Savanna grassland	120.86	132.84	161.97
Wet alluvial Swampy grassland	94.38	83.21	44.37
Encroached area	0	15.54	20.47

The wet alluvial swampy grassland in the Park reduced drastically (47.01 percent) (Figure 9). Grasslands play a vital role for many of the wildlife species like Bengal Florican, Pygmy hog, Hispid Hare, and even for the elephants in Manas. Their reduction in size paused serious concerns over these grassland dwelling species.

Discussion and Conclusion

The vegetation in Koklabari Agriculture Farm mainly composed of grass and herbs. Koklabari Agriculture Farm had been a habitat intervened by human interferences mainly in the form of agriculture and livestock grazing. This farm was a man-made or artificially maintained grassland habitat for the Bengal florican. In winter, the vegetation in the seed farm is found to be dry and during that time paddy is also harvested. During the pre-monsoon season when the rain starts, the land use pattern changes to a much greener cover. With the pre-monsoon shower the dry tufts of paddy get decayed and grass starts regeneration. March to May is the peak breeding period of Bengal florican and they are easily visible due to shorter vegetation cover.

Inside the Manas National Park areas where Bengal florican inhabits is dominated by *Imperata cylindrica, Narenga porphyrocoma* and *Saccharum spontaneum* (Narayan, 1992). Some other common grasses were *Desmostachya bippinnata, Cymbopogon spp., Themeda spp., Vetiveria zizanoides and Arundinella spp* and several other small grasses were (e.g. *Setaria pumila, Eragrostris spp., Digtaria spp., Paspalum sp. Chrysopogon sp*.) (Narayan,1992). But in KAF which is a man-made i.e., artificial

habitat where *Cyperus kyllingia, Paspalum scrobilatum, Cyperus iria, Hemarthria protensa, Cyperus cuspidatus, Digitaria longiflora, Eleusine indica, Cyperus pilosus, Fimbristylis dichotama and Sataria glauca* etc. were more common. Some invasive herbaceous plants species like *Smithia sensitive, Ageratum conyzoides, Chromolaena odorata, Eclipta prostrate, Lantana camara, Mikania micrantha, Mimosa pudica, Urena lobata* and *Xanthium strumarium* etc. were dominant in the farm.

Oriza sativa (Dry paddy straw) was the most dominant species (9.50 per sq m) in the KAF. *Vandelia crustacean* had the maximum frequency (73.49%). The species diversity was more in herbs than runners and grasses. According to Narayan (1992) the florican usually prefers shorter and densely growing grass rather then the tall grass. During our study, it was found that the florican used the dry paddy straws left after rice harvesting instead of the grasses as the cover to hide.

When we compared the vegetation within Florican's territory and outside of that, it was observed that the number of plant species was not statistically different in both the habitats (Wilcoxson-matched pair test) but there was a significant difference in their number of individuals. The vegetation inside the territory was also significantly higher than the vegetation outside the territory. However, though vegetation height classified in different height classes, number of individuals was significantly more in the height class of 20-30 cm both inside and outside of the territory. Looking into these results mentioned above, it seems that Bengal Florican seems to prefer thick vegetation cover in the territory. The number of species and specific plant species may not be important, other than the number of individual plants that makes it denser. Moreover, they probably need higher vegetation and that too within the range in between 20-30 cm of height.

One more reason for making their territory to those particular areas may be lack of water logging. On average, it was found that stagnant water of average 6 cm in depth was recorded in the farm during the month of June which was sufficient to destroy egg of Bengal Florican before hatching. But fortunately none of the territory contains stagnant water because they were all situated in slightly highland areas. So it could be assumed that Bengal floricans are very much site selective for their territories.

In historical change detection analysis it has been found that the wet alluvial grassland habitat of Manas has been declining and converting into savanna grassland. The major causes of the decline are unscientific management of grasslands resulting in the reduction of water holding capacity of the soil, massive invasion of few exotic weeds like *Chromolaena odorata*, *Leea umbriculifera* and marked augmentation of *Bombax ceiba* saplings.

The wet alluvial swampy grasslands were severely affected in post Bodo agitation period. Consequently, during the 1990s there was no proper management primarily because of the break down of the law and order situation, which stimulated to the change in land use pattern.

Furthermore, the interesting trends e.g. Bengal Florican avoiding water logged areas for establishing territory, preferring denser vegetation, that we observed during the habitat studies in KAF, should also be extended in other Bengal Florican grassland sites. Besides conducting an elaborate study on comparison of Bengal Florican in KAF and habitat inside Manas National Park might reveal the reasons why Bengal Florican territories are more in KAF then grassland sites inside the Park.

Objective 3: To promote Bengal Florican as a symbol of the rich natural heritage and spread the message of conservation of the unique grassland ecosystem and its endangered biota.

Background

Awareness is the only tool to spread the message of conservation among the masses. In order to target the different sections of the society in the fringe villages of Manas National Park, awareness meetings, informal discussions, audio-visual presentations along with interactive discussions were organised. These programmes were organised in collaboration with local village level NGOs in schools and other strategic places. Conservation Awareness Campaign was attempted to make the local people aware about the need of conservation of Bengal florican and its habitat and wildlife in general

and the targeted sections were school students, teachers, women, local communities, grazers and local NGOs close to Bengal florican habitat. In our awareness campaigns though we targeted the local community in general but we particularly focused on school children.

Methodology

Education-

Before and after the audio-visual presentations in schools, quiz were conducted through ‘10’ questions related to Bengal Florican for evaluation.

The audio-visual presentation comprises of the detail information of Bengal Florican but much generalized picture of male and female Bengal Florican, picture of its habitat, nest and egg, picture depicting its threats etc.

After audio-visual presentations we conducted competition on drawing of Bengal florican among the children. Education materials related to Bengal florican were distributed among the stakeholders in fringe areas.

Informal discussions, awareness meeting were also organised for local people.

Picture 6: Team leader in a school awareness program

Picture 7: School Children in an awareness program

Results

Altogether 20 awareness programs were conducted in 20 different Lower Primary Schools of the fringe villages close to Bengal florican habitat in Manas National Park. A total of 907 students and 89 teachers were trained and benefited from the audio-visual awareness campaigns (Table 5). After the audio-visual awareness campaign, leaflets in Bodo and Assamese were distributed among the students and teachers. During the discussion we gathered information about the species and tried to clear the misconception and wrong ideas prevailing among villagers by providing more information about the species and its importance.

Table 5: Number of Schools awareness programme conducted and number of teachers and students benefited

Sl. No	Name of School	No. of Teachers	No. of Students
1	Gorumara L P School	2	57
2	Randhanpara L P School	1	44
3	264 No. Kamardwisa L P School	2	46
4	Rangapani L P School	2	79
5	314 No. Kumguri L P School	4	43
6	282 No. Bormajra L P School	3	55
7	1986 No. Agranguri L P School	2	37
8	Bhabarsing L P School	2	41

9	Lanthibari L P School	2	35
10	763 No. Natun Betbari L P School	2	28
11	Gwdan Bargaon Majormakha L P School	2	38
12	Simlaguri L P School	2	24
13	Thaijauguri L P School	2	39
14	421 Chal Chali L P School	2	33
15	Kamardwisa L P School	2	47
16	Ravanguri L P School	3	74
17	1186 Agranguri Forest L P School (Ranidara)	2	69
18	Bheguri L P School	2	49
19	Giati L P School	2	28
20	Panbari L P School	3	41

Picture 8: Bengal Florican team member with school children

Picture 9: A girl drawing sketch of Bengal Florican in a school programme

Picture 10: School students with their drawing of Bengal Florican

In addition, the team leader was invited as a resource person to a training programme for the teachers (a total of 45 teachers) around Manas National Park organized by Pygmy Hog Conservation Programme and two awareness programmes was organized by local NGOs (Manas Agrang Society and Manas Maozigendri Ecotourism Society).

Awareness materials like posters, stickers and notebooks on Bengal Florican were produced and distributed during the awareness campaigns.

Discussion and Conclusion

The audio-visual porgramme was very popular among the masses. It was found that about 80% of the local people including teachers, students, members of local NGOs and front line forest staff, did not have proper knowledge on the importance of the Bengal florican and its conservation status. This lack of awareness leads to killing of Florican and collection of eggs.

We found that the audio-visual porgramme followed by drawing competition was an important tool for changing the behavior of the school children. When our team later randomly revisited some of the school where we had organized education programme, children could easily answers the questions asked about Bengal Florican.

There are 62 fringe villages around Manas National Park and during this year long project period we could cover 30% of total villages. However, for long-term conservation of Bengal florican and its habitat, we must facilitate sustained awareness drive in all the fringe villages targeting mainly school children.

The awareness drive in rest of 70% fringe villages in our following projects will be of immense importance for safe future of this critically endangered bird and its habitat as well as for the protection Manas National Park. Additionally, follow-up programmes in already conducted areas will also be important in terms of the success of long term impact of protection of Bengal Florican and conservation of its threatened habitat.

Objective 4: To focus Bengal Florican as one of the attractions and encourage ecotourism as source of livelihood for local unemployed youth in and around the study area.

Background

Local NGOs groups and local youth who are involved in protection and conservation of Manas National Park, have very limited knowledge on conservation. Through this project capacity building training were conducted to encourage the local youth and members of NGOs and to take interest in ecotourism as a source of livelihood.

Methodology

Community works-

Selected local youths were trained and motivated to help the team in monitoring Bengal florican and as a nature guide in the long run.

The training was conducted for a period of five days and experts on different topics were invited to deliver lectures. Of these five days, three days were class room lectures and two days were field orientations. Local youth were trained on the importance of biodiversity and also about different tools to identify birds, record the presence of animals and trained how to guide tourist.

Picture 11: Local youth are being trained by team member Kushal Choudhury

Picture 12: In field with resource person Bibhuti P. Lahkar

Picture 13: Namita Brahma with local youths during one of the training

Result

The trainings were organized in collaboration with local grassroot level NGOs namely Manas Maozigendri Ecotourism Society, Manas Bhuyanpara Conservation and Ecotourism Society and Panbari Manas Conservation and Ecotourism Society for their members and local youths. Altogether 90 youths were trained on biodiversity conservation and benifited from the training.

Discussion and Conclusion

Although we are successful in training and motivation 90 local youths in and around Manas National Park, however our work does not end here. Infact after encouraging them for ecotourism we have a bigger responsibity of linking them to both domestic international tourism market. This will be targeted in the following programmes and project we are planning.

Objective 5: To give training to local women for alternate livelihood to minimize dependency on grassland habitat.

Background

Women are an integral part of the society. But it is sad that they are hardly given as much importance as deserved by them for representing the 50% of the population. Moreover, they are also never targetted for awareness on biodiversity and environment issues. Infact, women in fringe villages are more close to nature as they are the one who manage the house. They are involved in varies household activies like firewood collection, thatch collection for building the roof of the house, collection of herb to sell in local market for food, etc. All these activities are directly related to forest and grasslands of Manas National Park. In addition the people in the fringe areas are economically backward. These reasons prompted us to target women as part of our project and train them to build their capacity for exploration of alternative livelihood means suitable in those areas. This also will minimize their dependancy on forest and grasslands as they will get economic benefit and freedom to turn to other alternatives live cooking gas instead of firewood etc.

Methodology

Community work

Selected women were trained on suitable livelihood means like food processing and preservation.

The food-processing and preservation training was conducted for four days. Theoretical class was conducted for one whole day followed by practical classes in rest three days.

In the food-processing preservation training, women were trained to prepare squash of lemon and different varieties of fruits, pineapple jam, guava jelly, jackfruit jelly, eggplant pickle, that are locally available.

Result

The main objective of this training was to make the women folk capable of making a profitable business by tapping locally available resources. A total of 80 women from twenty fringe villages were trained on food processing and preservation.

The people in the fringe villages do not know the proper use of fruits and vegetables that mostly go wasted. Through this programme we trained them to consume the locally avialable seasonal vegetables besides curry and make and preserve different food product out of those.

The resource person of the training programme being an entrepreneur in food processing and preservation herself, assured the participants of marketing linkage for their finished product. In addition she also assured to be constantly in touch with the participants for any help and suggestions in future.

Picture 14: Women folks participating in information sharing

Picture 15: Local women participating in a food processing training


Picture 16: Eighty local women participated in food processing training

Discussion and Conclusion

Feedback of trainees revealed that training was interesting for them as they learned to prepare food products for daily use as well as for commercial purposes that too from locally available materials. They also said that they are happy to get the training on food processing and preparing organized for first time around Manas National Park.

The success of this training will be achieved only if we are able to link trainees to the marketing agencies to be able to sell their products and get an economic benefit. To enable this we are planning a series of exposure trips for trainees to national and international trade fairs in city like Guwahati.

Communication and Publicity

Information on Bengal Florican Conservation Initiative, which is supported by Conservation Leadership Conservation is available in Aaranyak's website http://www.aaranyak.org/Programmes/ARCP.htm . The activities of the project was also been published in Aaranyak's Bi-annual report for the year 2007-2009. We have also published an article in '*Biolink*' a quarterly newsletter of Aaranyak which is widely circulated among the conservationists and conservation organizations in North-East India with a title **"Let us know Bengal Florican"**. In addition one more article was published in '*The Rhino*' a newsletter of Kaziranga Wildlife Society with the title **"Bengal Florican: living on the edge"** Volume –XV September 2009 page no 14. Kaziranga Wildlife Society is the oldest wildlife society in Assam and the newsletter is widely distributed among the conservation community and as well as organizations working for conservation in North-East India. An article title **"Bengal Florican and its habitat in Assam"** was also published in *'**Environ**'* (Volume X No.3) a semi scientific wildlife magazine circulated all over India. Futhermore, two articles on Bengal Florican were also published in regional newspapers in local language.

An oral presentation title **"An overview of the current status of Bengal florican (*Houbaropsis bengalensis)* in north bank landscape, Assam"** showing the results of Bengal Florican Conservation and Research initiative have been presented in Aaranyak's annual research seminar.

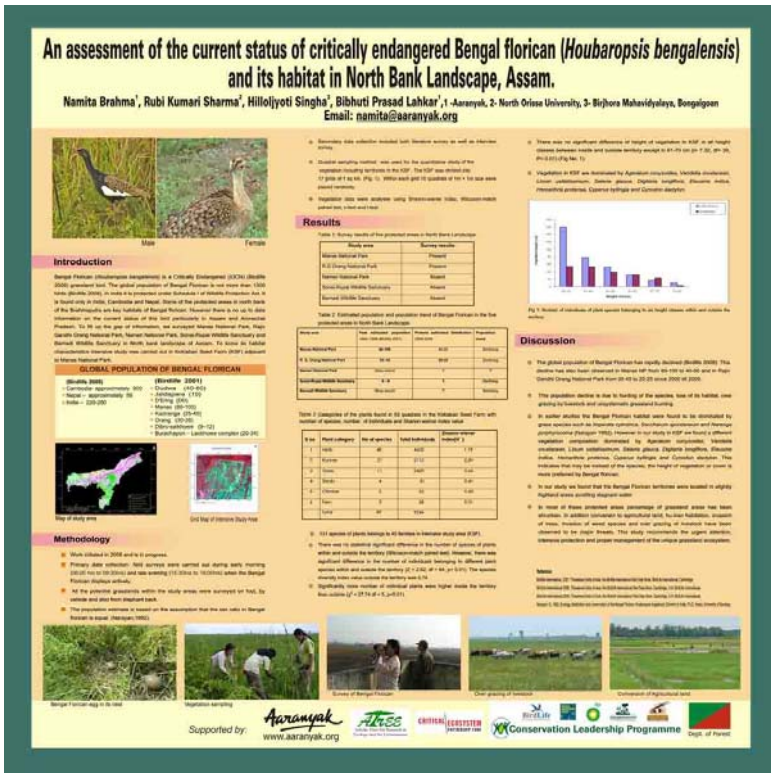
Additionally, the results of the project have also been presented in the form of scientific poster title **"An assessment of the current status of critically endangered Bengal florican (*Houbaropsis bengalensis)* and its habitat in North Bank Landscape, Assam."** in Young Ecologist Talk and Interact (YETI) organized by students of Indian Institute of Science, Bangalore.

Besides all these, a paper title **"Preliminary survey of Bengal Florican *(Houbaropsis bengalensis)* in four protected areas of North Bank Landscape, Assam"** was also submitted to the *'Newsletters and Journal of the Rhino Foundation'* (in press).

A short video on Bengal Florican with the message of the importance of the species and its conservation is also prepared for using in awareness programmes.

Picture 17. Notebook of Bengal Florican

Picture 18. Sticker of Bengal Florican



Picture 19. Scientific poster on Bengal Florican presented in YETI

Picture 20. Florican hoarding displayed in central place close to its habitat

Conclusion

Bengal Florican is a critically endangered bird and its habitat the grasslands is also under severe threats. As Bengal florican is a habitat sensitive species, it would be expected to be strongly influenced by habitat degradation.

Any conservation works on this bird and its habitat would be a vital contribution for conservation of the species and management of their habitat. Due to the lack of management intervention the swampy grassland of Manas National Park has been converted into savanna grasslands during political unrest period. The savanna grassland which is dominated by the tall grass and fire resistance trees like *Bombax*, *Dillenia* may not be suitable for species like Bengal florican. Currently in the Manas NP among different ecosystems the grassland is the most disturbed ecosystems. In addition conversion to agricultural land, human habitation, invasion of trees, invasion of weed species and over grazing of livestock have been observed to be major threats.

This project has also been important in bridging the gap of information on Bengal Florican and in particular its grassland habitat in Manas. We are also successful in linking conservation to community through community participation involving school children, local youths and women folks.

The main strength of our project is our team leader. She being a woman from local community has been very helpful for us in getting support and cooperation from the communities in Manas.

Table 6: Table of objective wise achievement with comments

Objectives	Achievement	Comments
Objective 1	Fully (95%)	
Objective 2	Fully (95%)	
Objective 3	Fully (85%)	There are 62 fringe villages around Manas National Park and during this year long project period we could cover only 30% of total villages.
Objective 4	Fully (80%)	There are three ranges in Manas National Park; we could only cover the youths from the villages under two ranges Panbari and Bhuyanpara. We selected Panbari as it the most disturbed range and Bhuyanpara as most of the Bengal Florican areas are under this range.
Objective 5	Fully (85%)	There are 62 fringe villages around Manas National Park and during this year long project period we could cover 30% of total villages.

Some of the key findings of our project are:—

- One of the important achievements of this project is that we are able to estimate the current population and know the status of Bengal Florican in BTAD after a gap of twenty years. The current estimated population of Bengal Florican in BTAD is around fifty (50) birds. The current status of Bengal Florican in BTAD shows a declining trend.

- In the Manas NP the Bengal florican are distributed close to southern boundary and in close proximity of thickly populated villages. Hence prone to disturbances.

- 131 species of plants belongs to 45 families in intensive study area (Koklabari Agricultural Farm).
- There was no statistical significant difference in the number of species of plants within and outside the territory (Wilcoxon-match paired test). However, there was significant difference in the number of individuals belonging to different plant species within and outside the territory ($Z = 2.62$, $df = 84$, $p < 0.01$). The species diversity index value outside the territory was 0.74.
- Significantly more number of individual plants were higher inside the territory than outside ($\chi^2 = 27.74$ $df = 5$, $p<0.01$).

- There was no significant difference of height of vegetation in Koklabari Agricultural Farm in all height classes between inside and outside territory except in 61-70 cm ($t= 7.32$, $df= 39$, $P< 0.01$).
- Vegetation in Kokilabari Agricultural Farm are dominated by *Ageratum conyzoides, Vandelia crustacean, Linum usitatissimum*, *Seteria glauca, Digitaria longiflora, Eleusine indica, Hemarthria protensa, Cyperus kyllingia and Cynodon dactylon*.

- Vegetation height and cover appears to be the main factors for the establishment and maintenance of the territoriality.

- It was also observed that Bengal Florican seems to avoid water logging areas while establishing their territories.

- A total of 907 students and 89 teachers were trained and benefited from the audio-visual awareness campaigns.

- Collection of eggs and hunting were direct harm by human to this bird. Hence, awareness drive that we have started through this project has been successful in changing behavior of local people. After knowing importance of Bengal Florican, people are now willing to safeguard the future of this critically endangered bird. Moreover, this year there had been no reports of egg collection and hunting.

- Altogether 90 youths were trained on biodiversity conservation and benifited from the training.
- A total of 80 women from twenty fringe villages were trained on food processing and preservation as source of alternative livelihood.
- We published four general article, one poster and a scientific paper on Bengal Florican.

Recommendations

Since Bengal florican are distributed close to southern boundary and in close proximity of thickly populated villages. There should be strict monitoring along the southern boundary to check livestock venturing into Bengal Florican habitats. Grazing by livestock should be stopped in the Bengal Florican habitats. Burning should be completed by late January or early February before Bengal Floricans establishes their territories. Patch burning system should be followed during burning. The study recommends that these grassland habitats must get urgent attention, intensive protection and proper management.

References

Baral, N., Timilsina, N., Tamang, B., (2003) Status of Bengal florican *Houbaropsis bengalensis* in Nepal. Forktail 19, 51–56.

BirdLife International, (2001) Threatened birds of Asia: the BirdLife International Red Data Book. BirdLife International, Cambridge.

BirdLife International (2003) Saving Asia's Threatened Birds: A guide for government and civil society. BirdLife International, Cambridge, U.K.

BirdLife International, (2009) Threatened birds of Asia: the BirdLife International Red Data Book Cambridge, U.K. BirdLife International.

Choudhury, A. (2003) Current status and conservation of Bengal florican *Houbaropsis bengalensis* in North-East India. Proc. Bombay Natural History society.

Grimmett, R.F., Inskipp, C. and Inskipp, P. (1988) Birds of the Indian subcontinent. Chistopher Helm, London.

Islam, M.Z. & Rahmani, A.R. (2004) Important Bird Areas in India: Priority sites for conservation. Indian Bird Conservation Network. Bombay Natural History Society and Birdlife International.

IUCN (2008) IUCN Redlist of threatened animals. IUCN, Gland, Switzerland

Narayan, G. (1992) Ecology, distribution and conservation of the Bengal Florican *Houbaropsis begalensis* (Gmelin) in India. PhD thesis, University of Bombay.

Rahmani, A. R. and Sankaran, R (1990) Status of the Lesser Florican in western India. Pp.101–111 in Status and ecology of the Lesser and Bengal Floricans with reports on Jerdon's Courser and Mountain Quail: final report. Bombay: Bombay Natural History Society

Sankaran, R. and Rahmani, A. R. (1986) Study of ecology of certain species of wildlife and their habitats: the Lesser Florican. Annual report 2, 1985–86. Bombay: Bombay Natural History Society.

Sankaran, R. and Rahmani, A. R. (1988) Status of Bengal Florican in Dudwa National Park. Pp.43 - 64 in A. R. Rahmani, G. Narayan, R. Sankaran and L. Rosalind The Bengal Florican, status and ecology, annual report 1986–87. Bombay: Bombay Natural History Society.

Stohlgren T.J., Falkner M.B., and Schell L.D. (1995) A Modified-Whittaker nested vegetation sampling method. Kluwer Academic Publishers. Printed in Belgium. Vegetation 117: 113-121, 1995.

White, R., Murray, S. and Rohweder, M. (2000) Pilot assessment of Global Ecosystems-Grassland ecosystems. Published by World Resource Institute.

Wikramanayake, E. D., C. Carpentert, H. Strand, and M. McKnight, (2001) Eco region-based conservation in the Eastern Himalaya. Identifying important areas for biodiversity conservation. WWF and ICIMOD.

Appendix I- Financial Report

Project Preparation	Amount Received from CLP (US$)	Aaranyak Contribution (US$)	Total Expenditure (US$)
Communications (telephone/internet/postage)	200	50	250
Printing Journal articles/material	100	110	210
Team training	200		200
Reconnaissance	100		100
Medical supplies/first aids	100		100
Scientific/field equipment and supplies	200	200	400
Field guides	100	150	250
Maps	500	500	1000
Satellite imagery	500	600	1100
Fuel	1500	100	1600
Project implementation			
Insurance	200		200
Accommodation	1000		1000
Food for team members	1500		1500
Transportation	1800		1800
Workshops	500	300	800
Outreach/education activities and materials	500	900	1400
Post project expenses			
Administration	88	100	188
Report production and result dissemination	100	52	152
Total	**9188**	**3062**	**12250**

Total CLP award	US$ 12250
Grant payment received from CLP in May 2008 (75% of total grant)	US$ 9188
Contribution of Aaranyak (25% to the total grant)	US$ 3062
Balance payment to Aaranyak from CLP	**US$ 3062**

Appendix II- Checklist of plant found in Koklabari Seed Farm during February-June 2009

Sl no.	Family	Scientific name	Group
1	**Aizoaceae**	*Glinus lotoide* O. Kuntze.	Herb
2	**Acantheceae**	*Justicia prostata* (C.B. D) Gamble	Herb
3	**Acanthaceae**	*Rungia parviflora* Nees.	Herb
4		*Nelsonia canescens* (Lam.) Spreng	Herb
5	**Amaranthaceae**	*Chenopodium album* L.	Herb
6		*Alternanthera sessilis* (L.) R.Br. ex DC.	Herb
7		*Amaranthus viridis* L.	Herb
8	**Apiaceae**	*Centella asiatica* (L.) Urban.	Herb
9		*Oenanthe Javanica* (Bl.) DC.	Herb
10		*Foeniculum vulgare* Gaertn.	Herb
11		*Hydrocotyle sibthorpioides* Lam.	Herb
12	**Araceae**	*Colocasia esculenta*	Herb
13	**Asteraceae**	*Eclipta prostata* L.	Herb
14		*Wedlelia calendulacea* Less.	Herb
15		*Gnaphalium pensylvanicum* Willd.	Herb

16		*Spilanthes paniculata* Wall. ex DC.	Herb
17		*Eclipta alba* L.	Herb
18		*Xanthium strumarium* L.	Herb
19		*Grangea maderaspatana* (L.) Poir.	Herb
20		*Eupatorium odoratum* L.	Under shrub
21		*Ageratum conyzoides* L.	Herb
22		*Sonchus brachyotus* DC.	Herb
23		*Crassoclephalum crepidioides* (Genth). S. Moore.	Herb
24		*Mikania micrantha* Kunth ex H.B.K.	Climber
25		*Centipeda orbicularis* Lour.	Herb
26	**Brassicaceae**	*Nasturtium indicum* (L.) DC.	Herb
27	**Caryophyllaceae**	*Polycarpon leoflingiae* Bth. H.k.f.	Herb
28		*Stellaria media* (L.) Villars.	Herb
29		*Drymaria diandra* Bl.	Herb
30	**Cleomaceae**	*Cleome viscose*	Herb
31	**Commelinaceae**	*Commelina benghalensis* L.	Herb
32		*Commelina longifolia* Lamk.	Herb
33	**Convolvulaceae**	*Ipomea aquatica* Forsk.	Shrub
34		*Ipomoea obscura* (L.) Ker-Gawl.	Climber
35	**Cucurbitaceae**	*Melathria heterophylla* Boiss.	Climber
36	**Campanulaceae**	*Wanlenbergia marginata* A.dc.	Herb
37	**Cyperaceae**	*Scripus eractus* Poir.	Grass
38		*Fimbristylis dichotama* L.	Grass
39		*Cyperus tenuispica* Steaud.	Grass

40		*Cyperus pilosus* Vahl.	Grass
41		*Cyperus distans* L.F.	Grass
42		*Cyperus cuspidatus* H.B.K.	Grass
43		*Bulbostylis barbata* (Roxb.) Cl.	Grass
44		*Cyperus flavidus* Retz.	Grass
45		*Fimbristylis quinuangularis* Kunth.	Grass
46		*Cyperus iria* L.	Grass
47		*Fimbristylis dichotoma* L.	Grass
48		*Cyperus kyllingia* Endl.	Grass
49		*Cyperus dilutan* Vahl.	Grass
50	**Elatinaceae**	*Bergia ammannides* Roxb.	Herb
51	**Euphorbiaceae**	*Jatropha curcas*	Shrub
52		*Euphorbia hirta* L.	Herb
53		*Phyllanthus fraternus* Webster.	Herb
54	**Fabaceae**	*Smithia sensitive* Ait.	Herb
55		*Lathyrus aphaca*	Herb
56		*Desmodium triflorum* (L.) DC.	Herb
57		*Desmodium gangaticum* DC.	Herb
58		*Desmodium heterocarpum* DC.	Herb
59		*Desmodium concinnum* DC.	Herb
60		*Cassia tora* L.	Herb
61	**Hydrophllaceae**	*Hydrolea zeylanica* Vahl.	Herb
62	**Hypericaceae**	*Hypericum japonicum* Thunb.	Herb
63	**Lamiaceae**	*Dysophylla auricularia* Bl.	Herb
64		*Hyptis suaveolens* (L.) Poit.	Shrub

65		*Anisomeles ovate* Br.	Herb
66		*Leucas aspera*	Herb
67	**Leeaceae**	*Leea asiatica* (L.) Ridsale.	Herb
68	**Linaceae**	*Linum usitatissimum* L.	Herb
69	**Lytharaceae**	*Cuphea balsamona* Cham. & schlecht.	Herb
70		*Ammania rotundifolia* Ham.	Herb
71		*Ammania multiflora* Roxb.	Herb
72	**Malvaceae**	*Malvastrum coromandelianum* (L.) Garcke	Herb
73		*Malvastrum tricesfidatum*	Herb
74		*Urena lobata* L.	Herb
75	**Marseliaceae**	*Marselia quadrifolia* L.	Herb
76	**Menispermaceae**	*Cissampelos pareira* L.	Climber
77	**Meyanthaceae**	*Nymphoides indicum* (L.) O. Kuntze.	Herb
78	**Mimosaceae**	*Mimosa spp.*	Herb
79		*Mimosa pudica* L.	Herb
80	**Moraceae**	*Ficus heterophylla* Var. assamica.	Herb
81	**Onagraceae**	*Ludwigia perennis* L.	Herb
82		*Ludwigia adscendens* (L.) Hara.	Herb
83	**Oxilidaceae**	*Oxalis corniculata* L.	Herb
84	**Poaceae**	*Cynodon dactylon* (L.) Pers.	Grass
85		*Digitaria longiflora* (Retz.) Pers.	Grass
86		*Seteria glauca* (L.) P.Beauv.	Grass
87		*Polytoca digitata* (Linn.f.) S. Druce.	Grass
88		*Eleusine indica* (L.) Graertn.	Grass
89		*Saccoicpsis indica* A.Chase.	Grass

90		*Sacchrum spontaneum* L.	Grass
91		*Chrysopogon aciculatus* (Retz.) Trin.	Grass
92		*Echinochloa frumentacea* Link.	Grass
93		*Paspalum scrobilatum* L.	Garss
94		*Imperata cylindrical* (L.).	Grass
95		*Hemarthria protensa* Steud.	Grass
96		*Phragmites karka* (L.).	Grass
97	**Polygonaceae**	*Polygonum oriantale* Linn.	Herb
98		*Polygonum minus* Lag. ex Meissm.	Herb
99		*Polygonum glabrum* Willd.	Herb
100		*Polygonum flaccidum* Meissn.	Herb
101		*Polygonum plebium* Br.	Herb
102		*Persicaria strigosa.*	Herb
103		*Polygonum serrulatum* Lagase.	Herb
104		*Polygonum chinensis* Linn.	Herb
105		*Polygonum lapathifolium*	Herb
106		*Polygonum hydropiper* L.	Herb
107		*Polygonum viscosum* Bast. ex Meissn.	Herb
108		*Polygonum perfoliatum*	Herb
109	**Pontederiaceae**	*Monochoria hastata* (L.) Solms.	Herb
110		*Eichhornia crassipes* (Mart.) Solms.	Herb
111	**Primubaceae**	*Anagalus asvensis* L.	Herb
112	**Rosaceae**	*Duchesnea indica* (Ander.) Focke.	Herb
113	**Rubiaceae**	*Spermacoce hispida* (Linn.) shum.	Herb
114		*Hedyotis corymbosa* (L.) Lamk.	Herb

115	**Scrophulariaceae**	*Scoparia dulcis* L.	Herb
116		*Vandellia crustacea* Benth.	Herb
117		*Vandelia pedunculata* Benth.	Herb
118		*Mazus japonicus* Bonati.	Herb
119		*Mazus rugosus* Lour.	Herb
120	**Solanaceae**	*Physalis minima* L.	Herb
121		*Solanum nigrum* L.	Herb
122		*Solanum xanthocarpum* Schard. & Wendl.	Herb
123	**Thelypteridaceae**	*Christella parasitica* (L.) lev.	Herb
124	**Urticaceae**	*Pouzolgia sp.*	Herb
125	**Verbenaceae**	*Lippia javanica* (Burm.f.) Spreng.	Herb
126		*Clerodendrum viscosum.* Vent.	Herb
127		*Phylla nudiflora*	Herb
128		*Lantana camara* L. var. aculata (L.) Mold.	Herb
129	**Woodsiaceae**	*Diplenzium esculentum* (Retz.) sw.	Herb
131	**Zingiberaceae**	*Alpinia nigra* (Gaertn.) B. L. Burtt.	Herb

Appendix III- List of herbecous plant species found within the 83 quadrats along with their density, frequency, abundance and height in Koklabari Agriculture Farm during February-June 2009

Sl no.	Name of the species	Density (Per sq m)	Frequency (%)	Abundance (Per sq cm)	Height (cm)
1	*Ageratum conyzoides*	9.36	62.650	14.94	20.6
2	*Eclipta alba*	0.05	2.41	2	8.2
3	*Monochoria hastata*	1.22	24.09	5.05	10.2
4	*Physalis minima*	0.04	2.41	1.5	16.3
5	*Grangea maderaspatana*	0.24	9.64	2.5	20.5
6	*Phyllanthus amarus*	0.11	7.23	1.5	5.23
7	*Chenopodium album*	0.15	7.23	2	19
8	*Mazus japonicus*	0.57	14.46	3.92	9.72
9	*Linum usitatissimum*	4.06	7.23	56.17	35.2
10	*Vandelia pedunculata*	3.06	49.39	6.19	8.88
11	*Lathyrus aphaca*	0.47	9.64	4.88	17.1
12	*Gnephalium lauto*	3.96	61.45	6.45	12.4
13	*Hydrolea zeylanica*	0.82	14.46	5.67	13.8
14	*Ammania multiflora*	0.36	12.05	3	22.4
15	*Vandellia crustacea*	6.07	73.49	8.26	22.4
16	*Wedlelia conymbosa*	7.19	62.65	11.48	16.3
17	*Spilanthes paniculata*	2.33	27.71	8.39	14.6
18	*Smithia sensitive*	0.13	10.84	1.22	29.1

19	*Malvastrum coromandelianum*	1.12	25.30	4.43	12.4
20	*Nasturtium indicum*	0.58	8.43	6.86	9.2
21	*Mazus rugosus*	0.06	2.41	2.5	9.9
22	*Polygonum oriantale*	2.81	15.66	17.92	21.6
23	*Polygonum flaccidum*	5.51	27.71	19.87	26.6
24	*Polygonum glabrum*	0.69	13.25	5.18	28.6
25	*Urena lobata*	0.07	3.61	2	25.1
26	*Malvastrum tricesfidatum*	0.23	8.43	2.71	11
27	*Polygonum perfoliatum*	0.12	3.61	3.33	16.7
28	*Solanum nigrum*	0.07	4.82	1.25	15.6
29	*Ludwigia adscendens*	0.05	2.41	2	18.7
30	*Polycarpon leoflingiae*	1.58	9.64	16.38	8.26
31	*Stellaria media*	0.10	3.61	2.67	4.13
32	*Pouzolgia sp.*	0.24	7.23	3.33	7.38
33	*Mimosa pudica*	0.84	9.64	8.75	14.8
34	*Glinus lotoides*	0.29	2.41	12	12.3
35	*Persicaria strigosa*	0.02	1.21	2	9.16
36	*Oenanthe Javanica*	0.04	2.41	1.5	14.4
37	*Sonchus brachyotus*	0.02	2.41	1	12.2
38	*Xanthium strumarium*	0.41	14.46	2.83	30.1
39	*Wanlenbergia marginata*	0.28	2.41	11.5	26.8
40	*Clerodendrum viscosum*	0.02	1.21	2	30.1
41	*Leucas aspera*	0.05	1.21	4	17.2

42	*Amaranthus viridis*	0.04	1.21	3	18.7
43	*Cassia tora*	0.07	3.61	2	8.26
44	*Chomelena odorata*	0.01	1.21	1	40.5
45	*Lippia javanica.*	0.02	1.21	2	24.8
46	*Foeniculum vulgare*	0.02	1.21	2	12.8
47	*Desmodium gangaticum*	0.02	1.21	2	9.75
48	*Cuphea balsamona*	0.12	2.41	5	16.4

Appendix IV- Checklist of birds recorded in Koklabari Agriculture Farm

No	**Family**	**Scientific name**	**Common name**
1	Phalacrocoracidae	*Phalacrocorax niger*	Little cormorant
2		*Phalacrocorax carbo*	Great cormorant
3	Ardeidae	*Ardea purpurea*	Purple heron
4		*Bubulcus ibis*	Cattle egret
5		*Ardeola grayii*	Indian pond heron
6		*Dupetor flavicollis*	Black bittern
7	Ciconiidae	*Anastomus oscitans*	Asian openbill stork
8		*Leptoptilos javanicus*	Lesser adjutant stork
9		*Leptoptilos dubius*	Greater Adjutant Stork
10	Anatidae	*Dendrocygna javanica*	Lesser whistling duck
11		*Anas platyrhynchos*	Mallard
12	Accipitridae	*Elanus caeruleus*	Black shouldered kite
13		*Spilornis cheela*	Creasted serpent eagle

14		*Circus melanoleucos*	Pied harrier
15		*Accipiter badius*	Shikra
16	Pandionidae	*Pandion haliaetus*	Osphrey
17	Falconidae	*Falco naumanni*	Lesser Kestrel
18		*Falco chicquera*	Red headed falcon
19	Phasianidae	*Francolinus gularis*	Swamp francolin
20		*Francolinus francolinus*	Black francolin
21		*Gallus gallus*	Red jungle fowl
22		*Pavo cristatus*	Indian peafowl
23	Rallidae	*Gallicrex cinerea*	Watercock
24	Rostratulidae	*Rostratula benghalensis*	Greater painted Snipe
25	Charadriidae	*Vanellus vanellus*	Northern lapwing
26		*Vanellus cinereus*	Grey headed Lapwing
27		Vanellus indicus	Red wattle Lapwing
28	Scolopacidae	*Tringa ochropus*	Green Sandpiper
29	Columbidae	*Streptopelia orientalis*	Oriental Turtle Dove
30		*Streptopelia chinensis*	Spotted dove
31		*Treron phoenicoptera*	Yellow footed Green pigeon
32	Psittacidae	*Psittacula krameri*	Rose-ringed parakeet
33	Cuculidae	*Eudynamys scolopacea*	Asian Koel
34		*Centropus bengalensis*	Lesser Coucal
35	Tytonidae	*Tyto capensis*	Grass owl
36	Strigidae	*Athene brama*	Spotted owlet
37		*Asio flammeus*	Short-eared owl
38	Caprimulgidae	*Caprimulgus asiaticus*	Common Indian Nightjar

39	Apodidae	*Cypsiurus balasiensis*	Asian Palm swift
40		*Apus affinis*	House swift
41	Alcedinidae	*Alcedo atthis*	Small Blue Kingfisher
42		*Halcyon capensis*	Stork-Billed Kingfisher
43		*Halcyon smyrnensis*	White Breasted Kingfisher
44	Meropidae	*Merops philippinus*	Blue-Tailed Bee-Eater
45		*Merops orientalis*	Green Bee-eater
46	Coraciidae	*Coracias benghalensis*	Indian roller
47	Upupidae	*Upupa epops*	Common hoopoe
48	Capitonidae	*Megalaima asiatica*	Blue-throated Barbet
49	Picidae	*Dinopium benghalense*	Lesser Golden-backed Woodpecker
50	Hirundinidae	*Hirundo rustica*	Common swallow
51	Motacillidae	*Motacilla alba*	White Wagtail
52		*Motacilla citreola*	Citrine Wagtail
53		*Anthus hodgsoni*	Oriental Tree Pipit
54	Pycnonotidae	*Pycnonotus jocosus*	Red whiskered bulbul
55		*Pycnonotus cafer*	Red vented bulbul
56	Laniidae	*Lanius schach*	Rufous-backed shrike
57		*Lanius tephronotus*	Grey backed shrike
58		*Lanius cristatus*	Brown shrike
59	Turdinae	*Luscinia svecica*	Blue throat
60		*Copsychus saularis*	Oriental magpie robin
61		*Saxicola torquata*	Common stone chat
62	Sylviinae	*Cisticola juncidis*	Streaked Fantail-Warbler

63		*Prinia inornata*	Plain prinia
64		*Megalurus palustris*	Striated Marsh-Warbler
65	Zosteropidae	*Zosterops palpebrosus*	Oriental white eye
66	Ploceinae	*Ploceus philippinus*	Baya weaver
67	Sturnidae	*Acridotheres tristis*	Common myna
68		*Sturnus contra*	Asian Pied starling
69	Oriolidae	*Oriolus xanthornus*	Black headed oriole
70	Dicruridae	*Dicrurus macrocercus*	Black drongo
71	Corvidae	*Dendrocitta vagabunda*	Indian tree pie

Appendix V- List of butterflies recorded in Koklabari Agriculture Farm

No	**Family**	**Scientific Name**	**Common Name**
1	Peiridae	Eurema sp.	Grass Yellow
2		Appias albina	Common Albatros
3	Nymphalidae	Danaus chrysipus	Common Tiger
4		Tirumala limniace	Blue Tiger
5		Junonia almana	Peacock Pensy
6		Junonia atlites	Grey Pensy
7		Lunonia lemonias	Lemon Pensy
8		Junonia hierta	Yellow Pensy
9		Heliophorus epicles	Purple Sepphire
10		Atrophaneura aristolochiae	Common Rose