Documentation of Baseline information of Floral and Faunal Diversity in Two selected Fenced Areas of Dhanaulti Reserve Forest, Mussoorie Forest Division, Uttarakhand.

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Summer Training Report

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Certificate

This is to certify that ***Ms. Preeti S. Virkar*** a Post Graduate student, Department of Environmental Sciences, Pune University, Pune has completed her summer training entitled "**Documentation of Baseline Information of Floral and Faunal Diversity in Two Selected Fenced Area of Dhanolti Reserve Forest, Mussoori Forest Division, Uttarakhand**" during May 2008. The field work for this dissertation was carried out under my supervision at the Wildlife Institute of India, Dehradun.

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Introduction

Biodiversity is not a simple collection of species but a reference to diversity of life. The present rate of destruction of wildlife is a great threat to the biodiversity of our planet. This is a threat to human life as well. Areas where biodiversity is at a greater threat are areas of grazing pressure, demands of economic growth, Tourism etc. Efforts for conservation of biodiversity and its monitoring is something we need to put in.
For this we need to approach the issue to its various levels, they are

- Genetic
- Species
- Ecosystem
- Landscape

To bring about some amount of change in this state of the biodiversity Protected Area system was adopted. But we live in a civilized world which does not keep the connections between various PA and makes them discontinuous. Even then efforts are made to maintain and protect the resources they hold.
But, does only a system of PAs work? If time to time monitoring is done then it is possible to understand the status of a particular area. Further research in the area can be done only if we have a previous record which is being regularly assessed. This can be possible when monitoring is done after specific duration according to the requirement.

Monitoring can always be accompanied with research. Monitoring can be done for the following

- Monitoring for large mammals
- Monitoring for ecological changes
- Monitoring of visitors
- Meteorological monitoring
- Socioeconomic monitoring

Other than these, monitoring can be for specific animal or plant species or various components of the ecosystem.

Biodiversity Monitoring

Monitoring is one of the most essential and inseparable parts of maintaining a check on the resources of the forest. The status of an ecosystem is to be understood. A sound ecosystem is the indicator of its stable components.
Regular monitoring plays a vital role in the following ways

- Gives an account of the present status of biodiversity
- Forms the basis for future assessment
- Gives the status of individual species
- Can show the impact of external interferences

Recently monitoring has become an integral part of any research work or even to plan out remedies for sustainability of resources.

Monitoring is essentially with a goal to identify the different aspects responsible for changes in the biodiversity. After monitoring one can easily lay down a foundation for the measures to be taken if any type of disturbance is detected.

Let us understand the need for monitoring. Protected areas are to conserve its flora and fauna. But just setting up boundaries will not help us to protect the species present in it. It is important to keep a track on the changing situation of any PA. This is possible through monitoring.
The monitoring can be used as record to refer to in future. Sufficient idea of past status can be obtained form monitoring reports.
How far a particular activity of human has damaged the biodiversity or the impact of visitors on a particular site can be studied by monitoring.
For management of PAs monitoring is very useful.
Many of the forest reserves and PAs do not even have the inventories of the flora and fauna of their respective areas, therefore it very important to carry out the monitoring of the various PAs and reserved forests.

What, When, Where, and How to monitor?

One should know these aspects of monitoring and how to go about with it. There are two approaches in this regard

- Periodic 'blind' or 'total' data gathering on each and every species or element of the habitat those are occurring on a fixed, permanent transect, plot, etc.
- Based on the preliminary data available or the knowledge of the study area, selected taxa are identified as "Indicator" or "Vital signs" for monitoring.

In the first approach data are gathered about each and every species which occurs in the study area. This data are kept as a record and subsequent periodic analysis is done on the species richness, diversity, productivity, succession, etc. Monitoring of this type helps to keep track on status of the study area prior and after the conservation measures have been taken.
In case of the second approach certain taxa are identified. This can be the indicator species which shows any change or disturbances from the normal. Here monitoring can be done with reference to various parameters of population such as abundance, distribution, age, structure, reproductive effort, and growth are relatively easy to measure. Many of them are sensitive to various stresses and can give an estimate of the future.
This approach is also sensitive wide variety of environmental conditions since organisms show the integrated effect of influence like predation, competition, and pollution. This is easily measurable from the population parameters.
Davis (1992) suggested criteria for selecting "indicator species or vital signs or taxa
They are as follows:

i Exceptionally common or dominant entire community,
ii With special status (endangered, rare, keystone, etc.),

iii. Endemic or exotic,
iv. Harvested and,
v. Popularly recognized as heroic species (flagship sp.) for monitoring.

Objectives

The main objectives of the study were as follows

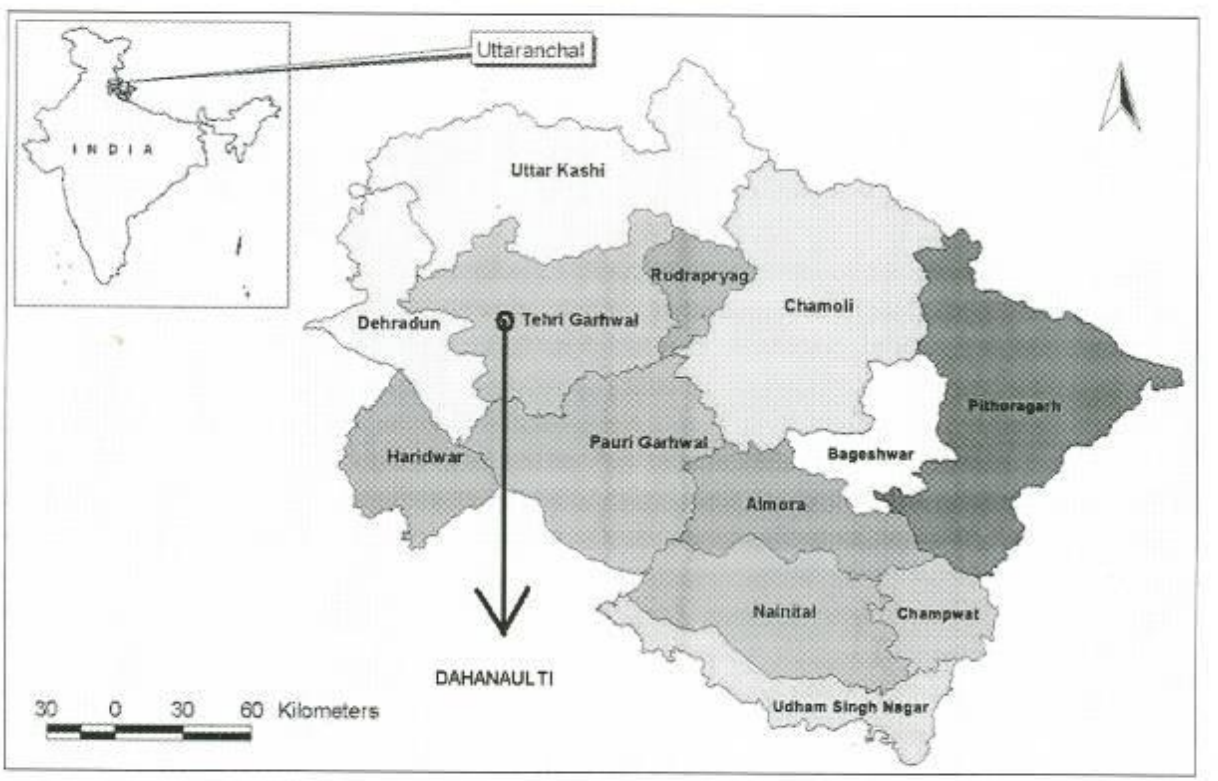
1. To document the biodiversity of the newly fenced areas (site 1, site 6) in Dhanaulti reserved forest.
2. To establish monitoring location for the future research and or studies.

Study Area

Dhanaulti lies on a ridge at an altitude of 2286 meters. Tucked away in the midst of deep forests of deodhar, oak, conifer, rhododendron and flame of the forest, Dhanaulti is a woody paradise that homes a rich floral and faunal biodiversity.

Located on the Mussoorie-Chamba track, Dhanaulti is the launching point for numerous treks into the snow-capped Himalayas, especially to the Tehri region of Garhwal.

Map of Uttarakhand



You can say that Dhanaulti is the launch pad for the mountain treks and to the pilgrim centers like to Badrinath, Kedarnath, Gangotri and Yamnotri glaciers. Due to the various places of visit one can observe endless visitors throughout the year except during the monsoons. This area attracts tourists on a large scale.

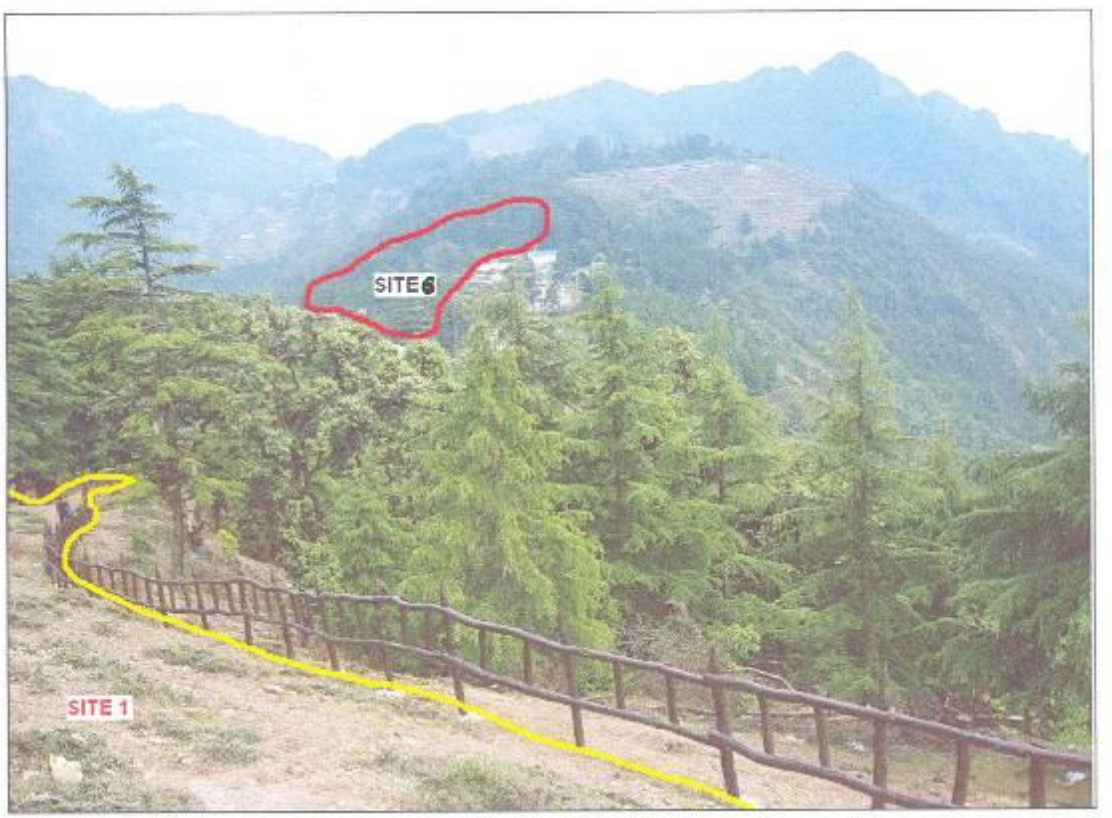
The present monitoring of biodiversity has been done in two patchs of Dhanaulti Reserved Forest. These two patches come under the denotation of Dhanaulti Reserved Forest 2A and the two areas denoted as Site-1 and Site-6.

Geographical Status and Climate of Dhanaulti

The annual rainfall of this area is 1600 according to the records in the forest office.

Minimum temperature is about -10° Celsius.
Maximum temperature is about 28° Celsius.

The Relative humidity ranges from 25 to 90%.

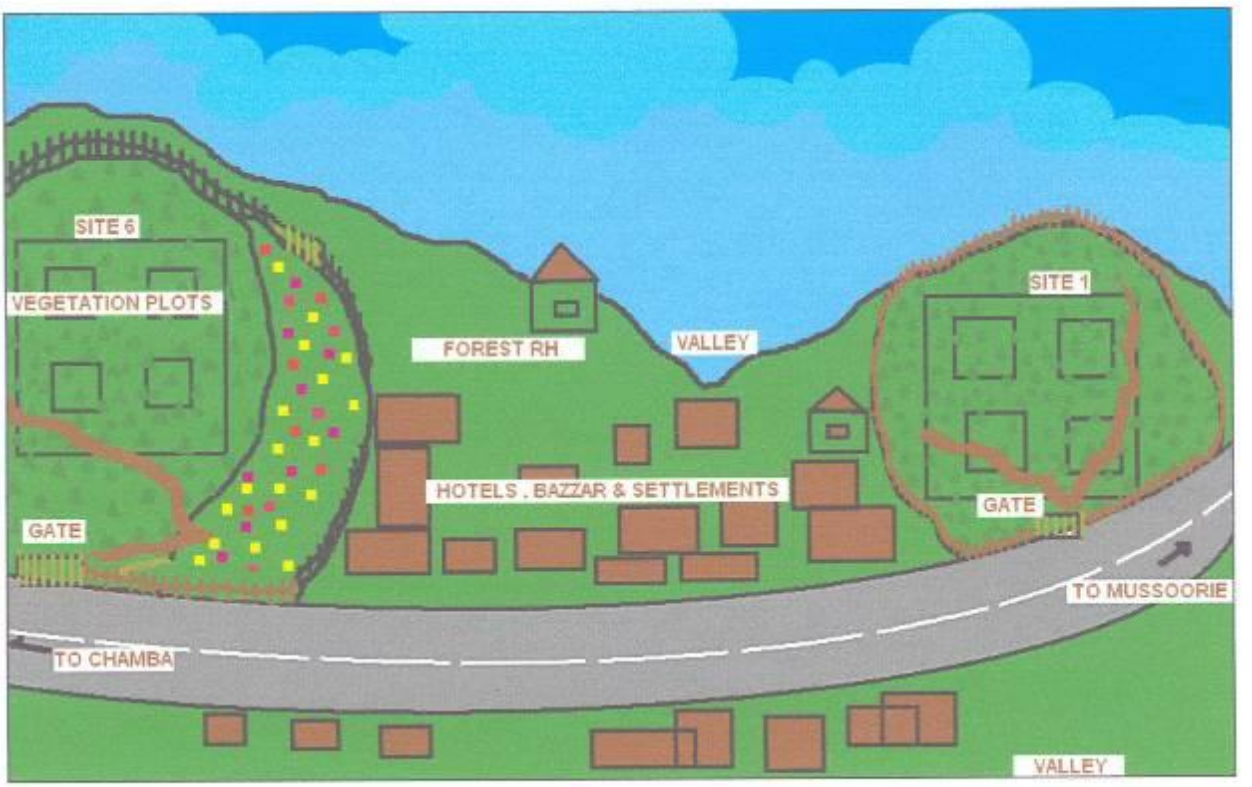


The Study Sites

Site	1	6
Altitude	2250 m	2300 m
Location	N 30° 25' 41.9" E 78° 14' 32"	N 30° 25' E 78° 15'
Area	1 hectare	1 hectare

Problem of the area

As mentioned earlier Dhanaulti is the start off for various trekking and pilgrim centers, the halt being at Dhanaulti. Lot of tourists visits this place which is one of the pressures that disturbs the biodiversity. Tourism also gave rise to the garbage problem.



Map of Study Area (NOT TO SCALE)

Another pressure which affects the diversity of the area is the grazing stress due to mules and other domestic grazers and browsers like cattle and goats. This has affected the ground vegetation cover on a very large extent especially in Site-1. The whole area is littered with packets of various eatables and drinks. To stop this, the forest department fenced two areas denoted as Site-1 and Site-6.

Methods Employed

Vegetation Monitoring- 33 plant species (14 trees, 11shrubs, 11herbs) were selected for monitoring on the basis of their economic importance, conservation significance and threats to survival. The following methods were used to monitor the vegetation

i. Tree species- For monitoring tree species plots of 100x100 meters were put up in each of the monitoring sites. The numbers of individuals, seedlings, saplings, lopped, stumped and cut individuals of each species were recorded.
ii. Shrub species- These were monitored by putting up four quadrates of 10x10meters. Counting of individual species was carried out and recorded.
iii. Herb species- Square plots of 1x1meters were used to record individual herb species. Ground cover percentage and their ecological importance were recorded.

Monitoring of Birds- Identification of the various birds were done .16 birds were recorded.

Monitoring of mammals- Direct and indirect sighting of animals was recorded. These were based on direct sighting of mammals, indirect sightings such as pallets etc.

Monitoring Insects- Insects were collected hand picking in the early hours of the morning.

Results

As mentioned before monitoring of the various plants, insect and bird species were done. Plants species especially those of economic significance were monitored. At present the ground cover is rather less due to overgrazing. On the following pages are the tables showing various monitored species:

The lists are in the following order

1. Lists of Vegetation
   - Table 1 (Site 1, Trees)
   - Table 2 (Site 6, Trees)
   - Table 3 (Site 1, Shrubs)
   - Table 4 (Site 6, Shrubs)
   - Table 5 (Site 1, Herbs)
   - Table 6 (Site 6, Herbs)

2. List of Insects
   - Table 7

3. List of Birds
   - Table 8

TABLE 1 Monitering trees 100 x 100 meters (Dhanaulti Forest 2A , Site 1)									
Name of tree species		Total Trees	Total Saplings	Total Seedlings	Stumps	Frequency	Relative frequency	Density	Relative Density
Botanical Name	Local Name								
Cedrus deodhara	Deodhar	232	0	0	45	232	0.5	2.32	53.9
Machilus odoratissima	Kol	192	4	7	0	192	0.5	1.92	44.6
Lyonia ovalifolia	Aiyar	2	0	0	0	2	0.005	0.02	0.5
Rhododendron arboreum	Buranj	2	0	0	0	2	0.005	0.02	0.5
Quercus floribunda	Banj	1	2	0	0	1	0.002	0.01	0.2
Pyrus communis	Nashpati	0	1	0	0	0	0	0	0
Quercus semicarpefolia	Moru	1	2	0	0	1	0.002	0.01	0.2
Aesculus indica	Chestnut	0	1	0	0	0	0	0	0
Ilex dipyrena	Kandara	0	0	7		0	0	0	0
		430							

TABLE 2 Monitering trees 100 x 100 meters (Dhanaulti Forest 2A , Site 6)									
Name of tree species		Total trees	Total; Saplings	Total seedlings	Stumps	Frequency	Relative Frequency	Density	Relative Density
Botanical Name	Local Name								
Cedrus deodhara	Deodhar	178	18	2	49	178	0.5	1.78	49.3
Machilus odoratissima	Kol	98	11	7	0	98	0.3	0.98	27.2
Aesculus indica	Pangar	0	0	1	0	0	0	0	0
Quercus semicarpefolia	Moru	24	0	0	0	24	0.07	0.24	6.6
Quercus floribunda	Banj	25	0	0	0	25	0.07	0.25	6.9
Rhododendron arboreum	Buranj	1	0	0	0	1	0.003	0.01	0.3
Ilex dipyrena	Kandara	17	5	1	0	17	0.05	0.17	4.7
Cornus macrophylla	Khaksi	2	1	2	0	2	0.006	0.02	0.6
Viburnum mullaha	Rindso	8	0	3	0	8	0.022	0.08	2.2
Lonicera sps.	Ghugti	7	3	1	0	7	0.02	0.07	1.9
Pyrus pashia	Mol	1	0	0	0	1	0.003	0.01	0.3
		361							

TABLE 3 Monitering shrubs 10 x 10 meters (Dhanaulti Forest 2A , Site 1)									
Name of shrub species		Quadrats				%Frequency	Relative Frequency	Density	Relative Density
Botanical Name	Local Name	1	2	3	4				
Clematice gauriana		4	7	0	0	50	11.77	2.75	12.94
Sarcoca saligna		15	0	0	20	50	11.77	8.75	41.2
Rosa lavigata	Wild rose	1	1	2	0	75	17.65	1	4.71
Cotoneaster microphyllus		0	12	0	1	50	11.77	3.25	15.29
Berberis asiatica	Kingod	0	9	1	0	50	11.77	2.5	11.77
Prinsepia utilis	Bekad	0	1	0	0	25	5.9	0.25	1.18
Girardiana diversifolia	Bicchu Ghas	0	0	2	2	50	11.77	1	4.71
Rumex nepalensis	Khoia	0	0	3	1	50	11.77	1	4.71
Cotoneaster bacillaris	Ruins	0	0	3	0	25	5.9	0.75	3.53

TABLE 4 Monitering shrubs 10 x 10 meters (Dhanaulti Forest 2A , Site 6)									
Name of shrub species		Quadrats				%Frequency	Relative Frequency	Density	Relative Density
Botanical Names	Local names	1	2	3	4				
Astrobilanthus		156	16	42	0	75	20	53.5	27.4
Sarcoca saligna		28	113	175	58	100	26.67	93.5	47.88
Cotoneaster bacillaris		6	0	0	0	25	6.67	1.5	0.77
Jasminum multiflorum		8	0	0	0	25	6.67	1.6	1.02
Girardiana diversifolia	Bicchu Ghass	1	121	28	0	75	20	37.5	19.21
Rumex nepalansis	Khoia	0	10	11	8	75	20	7.25	3.71

TABLE 5 Monitering herbs 1 x 1meter (Dhanaulti Forest 2A , Site 1)									
Name of herb species		Quadrats				%Frequency	Relative Frequency	Density	Relative Density
Botanical Names	Local Name	1	2	3	4				
Fragaria nubicola	Wild strawberry, Kaphal	92	47	155	23	100	21.1	79.3	34.5
Viola bentonicifolia		19	0	16	0	50	10.5	8.8	3.8
Trifolium repens		30	38	71	0	75	15.8	34.8	15.1
Oxalis corniculata		15	15	23	76	100	21.1	32.3	14.1
Galium aprine		0	49	5	17	75	15.8	17.8	7.7
Astrobilanthus purpurines		0	40	0	0	25	5.2	10	4.4
Erigeron bellidioides		0	0	52	0	25	5.2	13	5.7
Clinopodium umbrosum		0	0	0	135	25	5.2	33.8	14.7

TABLE 6 Monitering herbs 1 x 1 meter (Dhanaulti Forest 2A , Site 6)									
Name of herb species		Quadrats				%Frequency	Relative Frequency	Density	Relative Density
Botanical Names	Local Names	1	2	3	4				
Trifolium repens		91	14	61	38	100	22.22	51	50.12
Oxalis corniculata		0	17	20	55	75	16.7	23	22.6
Dracocephalum wallichii		0	5	1	0	50	11.11	1.5	1.5
Astrobilanthus purpurines		0	14	5	12	75	16.7	7.8	7.6
Galium aprine		0	22	0	0	25	5.6	5.5	5.4
Fragaria nubicola	Wild strawberry , Kaphal	0	3	0	0	25	5.6	0.8	0.7
Stellaria media		0	39	2	0	50	11.11	10.3	10.1
Giranium wallichiana		0	4	0	0	25	5.6	1	1
Clinopodium umbrosum		0	0	0	4	25	5.6	1	1

List of Insects

Order	Suborder	Family	Species found
Hemiptera	Heteroptera	Reduviidae	1
		Pyrrochoridae	2
	Homoptera	Fulgoridae	1
Coleoptera	Adephaga	Carabidae	1
	Polyphaga	Chrysomelidae	1
		Coccinalidae	1
Diptera			1
Lepidoptera	Ditrysia	Noctuidae	2
Hymenoptera	Apocrita	Formicidae	1

Table 7

The Hemipterans have piercing and sucking type of mouth parts. They suck up sap from various plant matter.
Coleopterns exhibit show a variety of species; the ladybug beetle, ground beetle ect.
Dipterans consists of the common house fly (*Musca domestica*), and other types of flies.

Lepidopterans consist of the butterflies and moths. These feed on sap of various flowers.
List of Butterflies (See plate for pictures)

1. Cabbage White
2. Dark Clouded Yellow
3. Indian Fritillary
4. Indian Tortoiseshell
5. Painted Lady

Hymenopterans consists mostly the Social Insects. Ants and honeybees were found.

The birds found in the area are brightly coloured. Various birds found in the study area were as follows: (see pictures in plates)

List of Birds

No.	Names of Birds	
	Scientific Names	**Common Birds**
1	*Streptopelia oriantalis*	Orintal turtle dove
2	*Garulax striatus*	Striated laughing thrush
3	*Regulus regulus*	Gold crest
4	*Turdus boulboul*	Grey-winged Blackbird
5	*Ficedula westermanni*	Little pied flycatcher
6	*Culicicapa ceylonesis*	Grey headed canary flycatcher
7	*Glaucidium radiatum*	Jungle owlet
8	*Dendrocopos himalayensis*	Himalayan Woodpecker
9	*Picus xanthopygaeus*	Streak-throated woodpecker
10	*Mycerobas icterioides*	Black-and-yellow Grosbeak
11	*Niltava sundara*	Rufous-bellied Niltava
12	*Eumyias thalassina*	Verditer flycatcher
13	*Saxicola ferrea*	Grey bush chat
14	*Acridotheres fucus*	Jungle myna
15	*Corvus splendens*	Common crow

Table 8

The Mammals which are found are:
Rhesus macaque (*Macaca radiata*)
Common Langur (*Presbytis entellus*)
These were identified by direct sightings.

Some other mammals which are sighted only during winter include Leopard, Himalayan Black Bear and the Barasinga

Discussion

The monitoring that was carried out brought forth some very important aspects of the forest.
Some important species of trees such as the *Cedrus deodhara* are of great economical significance. They form the most dominant tree species. This species is actionable and we can see the consequences in the form of stumps i.e. trees of *Cedrus deodhara* have been stumped by local people.
The next dominant species of trees is *Machilus odotessima* which is used as timber. We can see a number of stumps of the above mentioned trees.
Some other plants include the *Cotoneaster bacillaris* soil binders which you can see in Site 1 in ample.
There are other plants like Rumex nepelansis which forms the ground cover. It bears berries which are edible (Locally known as kaphal).

The vegetation that was monitored considering the following criteria:

- Economic importance
- Conservation significance
- Threats to survival

33 plant species (14 trees, 11shrubs, 11herbs) were selected for monitoring on the basis of their economic importance, conservation significance and threats to survival. The plant species were monitored by putting up plots of various areas depending on the plant group.

As mentioned earlier the vegetation is been affected due to grazing by cattles which were previously left on the open forest land.
Another reason for disturbance to the vegetation is due to thin layer of soil. This condition is resulting into tree fall. When the patches were not fenced the people would stump the trees.
As a result of all these activities many economically valuable species were being exploited especially the auction able species of *Cedrus deodhara* (deodhar).

Other than flora, fauna has also been monitored. The various birds and insects have been recorded in the results and their pictures can be seen in the plates displayed.
Identification of the various birds were done .16 birds were recorded.

Lastly we hope to get better results as the areas have now been fenced and are away from tourist as well as local public. Grazing of cattles and selling any eatables and drinks has been strictly prohibited so as to improve the condition of the two sites. People are allowed to visit the sites only by purchasing entrance tickets which is mandatory if one wants to visit the parks.

Conclusion

Few months have passed since the fencing of these two sites (Sit1 and Site 6) has been done. This had brought about some changes like conflicts of the foresters with the local people. But this will gradually subside once people adapt to this condition. A park has been started with a ticket of some fare which will benefit the Forest Division of Mussoorie to develop the park. Strict actions have been taken by prohibition of eatables and drinks inside the park. Also the rides on mules and horses inside the fenced areas are prohibited.

The baseline information that has been derived will be useful to monitor the flora and fauna in future. It will also help in keeping a record on changes on grazing, cutting trees, fruit collection and collection of medicinal herbs for commercial purpose post fencing. During the long term people can be made to understand the usefulness of the forests through their participation in various ecodevelopment programmes. With a little more efforts from the management and scientific groups it will be possible to involve the local people in the long term monitoring of the area.

Plates (Study Area)

Berberis lycium (Kingod, medicinal)

Rosa webbiana (Wild rose, pink)

Rosa lavigata (Wild rose, White)

Iris

Erigeron bellidiodes

Cotneaster bacillaris (soil binder)

Machilus odoratissima (Kol)

Stump of *Cedrus deodhara*

Tourists visiting the Fenced Patch

Previously Grazed patch

Site 1

Site 2

Fencing at Site 6

Roots of uprooted trees (will be use to make benches in the park)

The 'Natural Trail'for walking around the park

Insects

Family Reduviidae

Family Fulgoridae

Cabbage White

Clouded Yellow

Indian Fritillary

Birds

Orientle Turtle Dove
(Streptopelia orientalis)

Striated Laughing Thrush
(Garrulax striatus)

Gold crest
(Regulus regulus)

Grey-Winged Blackbird
(Turdus boulboul)

Little Pied Flycatcher
(Fiecedula westermanni)

Grey-Headed canary Flycatcher
(Culicapa ceylonensis)

Himalayan Woodpecker
(Dendrocopos himalayensis)

Streak-Throated Woodpecker
(Picus xanthopygaeus)

Black-and-yellow Grosbeak
(Mycerobas icterioides)

Rufous-bellied Niltava
(Niltava sundara)

Verditer Flycatcher
(Eumyias thalassina)

Grey Bush chat
(Saxicola ferrea)

Jungle Owlet
(Glaucidium radiatum)

Common Myna
(Sturnus malbaricus)

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Professor Emeritus, FRI & Colleges, Dehradun.
AND
Hari Om Saxena (MSc, PhD) Regional Research Laboratory, Bhubaneshwar.

Flowers of Himalaya, Oleg Polunin and Adam Stainton
Flowers of Himalaya, A supplement by Adam Stainton

Birds of the Indian Sub Continent, Bickram Grewal

The World of Insects, Adriano Zanetti

Site Referred For Animal Pictures:
http://www.nerdybirders.com/html/birds.html

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