

RAPID BIODIVERSITY SURVEY REPORT – VIII

*INVENTORY OF BIODIVERSITY
AND SEASONAL STUDY*



Sikkim Biodiversity Conservation and Forest Management Project (SBFP)

Forest and Environment Department

Government of Sikkim

2020

RAPID BIODIVERSITY SURVEY-VIII

Inventory of Biodiversity and Seasonal Study



Sikkim Biodiversity Conservation and Forest Management Project (SBFP)

Forest and Environment Department

Government of Sikkim

2020

Published by:

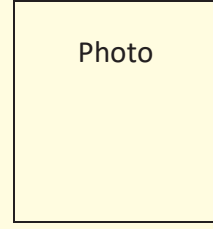
Sikkim Biodiversity Conservation and Forest Management Project (SBFP)

Forest and Environment Department

Government of Sikkim,

Deorali, Gangtok - 737102, Sikkim, India

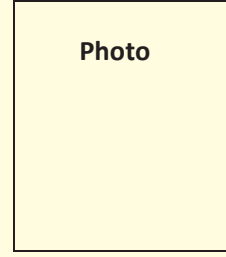
All rights reserved. No part of this publication may be reproduced, or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage or retrieval system, without permission in writing from the Forest and Environment Department, Government of Sikkim. Enquiries concerning reproduction outside the scope of the above should be sent to the Project Director, Sikkim Biodiversity Conservation and Forest Management Project, Forest and Environment Department, Government of Sikkim.



Prem Singh Tamang
Chief Minister of Sikkim
Tel. No.: 03592 201093
E-mail: cm-skm@nic.in

MESSAGE

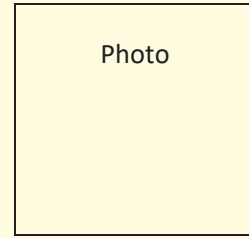
Prem Singh Tamang
Chief Minister of Sikkim



Shri Karma Loday Bhutia

FOREWORD

Shri Karma Loday Bhutia
Minister
Forest and Environment Department,
Mines and Geology, Science and Technology
Government of Sikkim



Shri M. L. Srivastava (IFS)

PREFACE

Shri M. L. Srivastava (IFS)
Principal Chief Conservator of Forest - cum-Principal Secretary
Sikkim Biodiversity Conservation and Forest Management Project
Forest & Environment Department
Government of Sikkim

ACKNOWLEDGEMENT

This book titled “Rapid Biodiversity Survey Report – VIII Inventory of Biodiversity” is a compilation of study reports of Rapid Biodiversity Survey works, done in Reserve Forests of North Sikkim and Pangolakha Wildlife Sanctuary. It is the final series in Rapid Biodiversity Survey publications. We are hopeful that this compilation will be in use for better management of forest & wildlife in Sikkim. The making and compilation of this book consumed a lot of hard work, research and dedication. On behalf of Sikkim Biodiversity Conservation and Forest Management Project, Forest and Environment Department, Government of Sikkim, I would like to acknowledge the significant contribution of the following institutions and individuals without whose support and guidance it would not have been possible to come out with RBS Report I - VIII.

Firstly, I am thankful to Japanese International Co-operation Agency (JICA) for their support and for providing necessary guidance concerning project implementation. I am grateful to the Government of Sikkim for their support and encouragement in publishing such scientific reports. I also acknowledge the efforts of Rapid Biodiversity Survey Team of SBFP for compilation of this report with diligence and hard work.

I extend my humble and sincere gratitude to Shri Karma Loday Bhutia, Minister, Forest and Environment Department, and Shri Mukund Lall Srivastava (IFS), Pr. Secretary-cum-PCCF, Forest and Environment Department. I also acknowledge the positive role played by the “Steering Committee” of the project for their periodical review, critical comments and appreciation of efforts by the project team. We are thankful to our collaborating partners for their constant support and other management activities.

N.W. Tamang (IFS)

Project Director

Sikkim Biodiversity Conservation and Forest Management Project (SBFP), JICA
Forest and Environment Department Government of Sikkim

Sl. No.	CONTENTS	Page No.
1	Introduction	9
2	Inventory and Monitoring	9
3	Rapid Biodiversity Survey of Chawang Reserve Forest, North Sikkim	12
4	Rapid Biodiversity Survey of Labrang Reserve Forest, North Sikkim	22
5	Rapid Biodiversity Survey of Mongrangang Reserve Forest, North Sikkim	44
6	Rapid Biodiversity Survey of Phodong Reserve Forest, North Sikkim	52
7	Rapid Biodiversity Survey of Chungthang Reserve Forest, North Sikkim	69
8	Rapid Biodiversity Survey of Pangolakha Wildlife Sanctuary, East Sikkim	90
11	Seasonal Variation Floral Inventory of Singbha Rhododendron Sanctuary – Shiv Mandir Sampling Path, North Sikkim	107
9	Seasonal Variation Floral Inventory of Barsey Rhododendron Sanctuary, West Sikkim	123
10	Seasonal Variation Floral Inventory of Yakchey - Singbha Rhododendron Sanctuary Sampling Path, North Sikkim	133

INTRODUCTION

Sikkim, the second smallest state of India lying in the Eastern Himalaya forms a part of Indo-Burmese biodiversity hotspot. Covering a total geographical area of 7096sq.km, the state covers 82.31 percent of the forest area harbouring a rich floral and faunal diversity.

The altitudinal gradient of 250m asl to 8586m above sea level has a diverse topography, leading to a vast biodiversity. The forest ecosystem changes along the increasing altitude from tropical to temperate to alpine meadows. With such diverse ecosystem, vegetation of Sikkim habitats about 5500 species of flowering plants, with more than 450 species of trees, 480 sp. of ferns and its allies, 11 oak species, 37 species of rhododendrons, over 500 species of medicinal plants, over 500 species of orchids and 11 species of bamboo, etc. The state also harbors wide variety of faunal diversity which includes 150 species of mammals, around 568 species of birds, more than 600 species of butterflies, 48 species of fishes, 29 species of reptiles and 10 species of amphibian species.

Exploration of floral and faunal wealth is a foundation for determining the status of our ecosystem and an approach towards conservation of biological diversity. The richness of biological diversity of Sikkim has now been recognized as India's FIRST "Mixed World Heritage Site" on UNESCO WORLD HERITAGE SITE LIST on July 17, 2016.

This great diversity of plants, habitats and topography are the major factors, which influences distribution, diversity and abundance.

INVENTORY AND MONITORING OF BIODIVERSITY

Biodiversity Conservation aims to enhance the global, social and economic value of biodiversity and improve livelihoods in and around protected areas (PAs), buffer zones and reserve forests. It aims to achieve this objective through the establishment and implementation of sound management plans and the dissemination of biodiversity information for promoting public awareness on the significance of biodiversity.

Biodiversity Conservation is one of the components of JICA-assisted SBF Project, having different subcomponents including **Inventory and Monitoring of Biodiversity**; the basic objectives of which are:

1. To develop baseline information on key biological elements in forest, alpine, freshwater and agro-ecosystem for monitoring and evaluation of the impacts of forest and biodiversity management.
2. To identify critical areas that requires immediate protection. To achieve this objective, Rapid Biodiversity Survey was conducted by laying 1000 random plots in whole of the state of Sikkim covering all the four ecosystems. Simultaneously, 300 additional

plots in the known biodiversity hotspot of the state were laid covering all the four ecosystems.

1. The output of the same was used in:
 1. Generation of biodiversity information on four ecosystems which was used in the production of thematic maps for management of these areas stored at the GIS/RS laboratory;
 2. Rapid Biodiversity Survey (RBS) was carried out in different parts of Sikkim. In the first phase, protected areas were targeted for carrying out the survey for which an inventory and monitoring for the same has been fulfilled and published in Rapid Biodiversity Survey - I and
 2. Rapid Biodiversity Survey - II. Rapid Biodiversity Survey - III highlights the inventory of biodiversity of the remaining Protected Areas of Sikkim including the published research papers and articles. Rapid Biodiversity Survey - IV is a compilation of the biodiversity of forest areas surveyed in various Reserve Forests of Sikkim. Rapid Biodiversity Survey - V is a compilation of the analysis report of some of the Reserve Forests. Rapid Biodiversity Survey – VI is a compilation of inventory and monitoring of biodiversity of Protected Areas of North Sikkim. Rapid Biodiversity Survey – VII is a compilation of Revisit and Seasonal variation studies to monitor changes in vegetation composition. This Rapid Biodiversity Survey – VIII book is the final compilation of the RBS book series highlighting the inventory of the remaining Reserve Forests of North and East Sikkim.

MATERIALS AND METHODS

Prior to field survey, the entire area (vegetation map) of the present study was prepared into 0.5 km X 0.5 km grids in GIS laboratory. Based on this, each vegetation/forest types and forest density on the total grids in the specific vegetation type was sampled for the rapid biodiversity assessment (flora and fauna) inventorization.

The selection of grids was done by taking the following aspects of consideration.

1. Covering forest types, forest density (dense and moderate forest).
2. Based on compartment.

FLORA

The sampling plot of 10 X 10 m was laid, depending upon the site feasibility. Within the main plot, all the standing tree species were enumerated & measured (cbh) at 1.37 m from the ground by using measuring tape. Circumference at breast height (1.37 m) was taken for the determination of tree basal area. Total basal area is the sum of basal area of all species present in the forest.

Basal area (m² / ha) was used to determine the relative dominance of a tree species. Within the subplots, 5 m X 5m were laid for recording the sapling (no. of species & its height) &

shrub for the percent cover was recorded. Within this, 1 m X 1m were laid in 4 corner and 1 point at centre for seedling species were enumerated, in the same plot was used for recording the herb percentage in the area. The location and altitude of the plots were recorded by calibrating the global positioning system (GPS; Garmin eTrex) and the humus depth was measured with the help of measuring scale. Plant species were identified through herbarium record and flora published (Hooker JD, 1888-1890, Hooker JD 1849, Pradhan & Lachungpa, 1990, Kholia, 2010). The unidentified plants species in the field were photographed, and later identified by consulting plant taxonomist, & BSI and web references (www.efloras.org; www.flowersofindia.net & www.floraofchina.org) were made and by referring to local people too. All the sampling plots were geo-tagged for reference under long-term monitoring.

FAUNA

Presence and relative abundance of most of the small and large fauna species was evaluated using methods that rely on indirect evidence such as animal burrows/holes, dung, pellets, scats, feeding signs, tracks, nests, digging and antler thrashing.

RAPID BIODIVERSITY SURVEY OF CHAWANG RESERVE FOREST SAMPLING PATH, PHODONG BLOCK, NORTH SIKKIM



INTRODUCTION

Chawang Reserve Forest under Upper Chawang ward in Phodong block falls under the Phodong Range. The Reserve Forest (RF) is spread in an area of 6125.95 ha. It is located between 27°26'35.41"- 27°26'43.41" Latitude(N) and 88°35'06.03"- 88°35'42.23" Longitude (E). The elevation of the reserve forest range from 2131m-2611m above mean sea level (msl). The slope angle varies from 10°-50° with an average humus depth of 4 cm and canopy cover of 30%-95%. The forest is comprised of one compartment and is divided into two forest types viz., East Himalayan Wet Temperate Forest and East Himalayan Moist Mixed Coniferous Forest. Both these forest are the sub-category of Montane Wet Temperate Forest. The forest vegetation is healthy and densely covered with tree canopy mainly of Oak species viz., *Castanopsis hystrix*, *Quercus lamellosa*, *Castanopsis tribuloides*, etc.

To decentralize the power like in other RF the forest department has formed the Joint Forest Management Committee (JFMC) in Chawang RF. The JFMC is run by President whose tenure is of two years. The main motive of JFMC is to protect, conserve and to implement the work related to plantation in the RF. They play a role of coordinator between the forest department and the villagers.

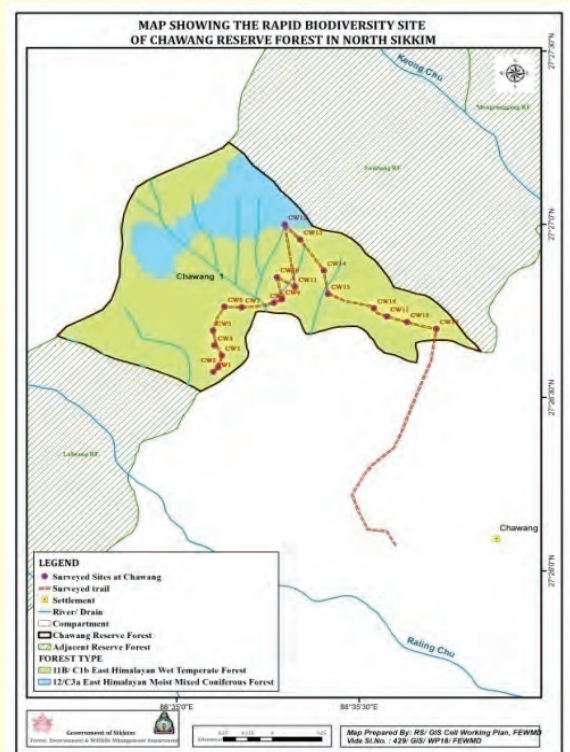
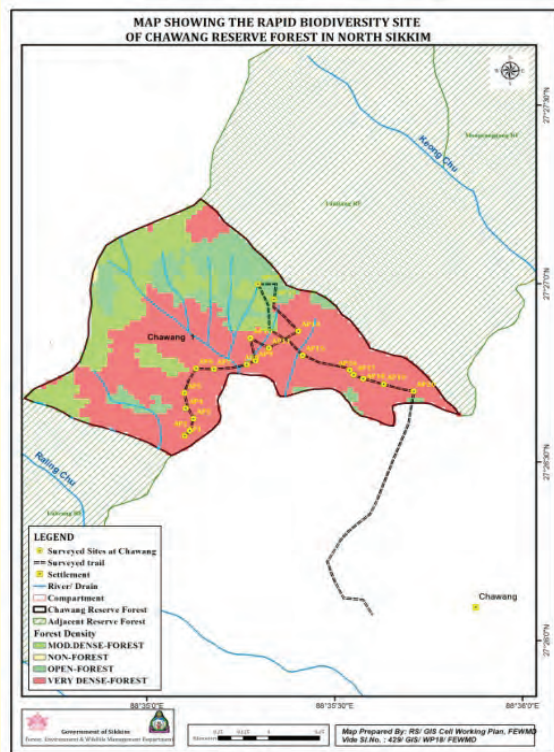
The RF is been categorized into two types viz., East Himalayan Wet Temperate Forest and East Himalayan Moist Mixed Coniferous Forest. The East Himalayan Wet Temperate Forest is mostly dominated by tree species viz., *Acer campbellii*, *Castanopsis hystrix*, *Castanopsis tribuloides*,

Engelhardtia spicata, *Lithocarpus pachyphyllus*, *Quercus lamellosa*, *Quercus lineata*, *Machilus edulis*, *Symplocos glomerata*, *Symplocos glomerata*, etc. While, the East Himalayan Moist Mixed Coniferous Forest is mainly dominated by *Abies densa*, *Acer campbellii*, *Betula utilis*, *Abies densa*, *Taxus baccata*, *Tsuga dumosa*, *Larix griffithianum*.

From the locals of the Chawang village we came to know that the forest host habitats to some faunal species such as Wild pig, Barking Deer, Himalayan Palm Civet, Jungle Cat, Himalayan Black Bear, Orange-bellied Himalayan Squirrel, Rhesus macaque, etc. The JFMC president also informed us that the forest used to host habitat to our state animal, the Red Panda, adding to it he mentioned that the charm of the state animal has been faded away from the forest in a recent year, which is a matter of concern. Apart from these the forest is also home to many avian-fauna and butterfly species.

STUDY AREA

The current survey was carried out along the sampling path of Chawang Reserve Forest, Podong Block, North Sikkim. The altitude of the surveyed path ranged from 2131m-2611m (msl). The forest lies between 27°26'35.41"- 27°26'43.41" Latitude(N) and 88°35'06.03"- 88°35'42.23" Longitude (E).The slope angle of the surveyed area ranged from 10° to 50° and the aspect facing towards E, N,W, SW,NE and NW. The average depth of the humus is 4 cm and the Canopy Cover ranged from 10%-95%. Top canopy cover was mostly dominated by the Oak species. There was not much erosion inside the forest because the top canopy was covered by Oak species, as this canopy protects the floor from the direct contact of water droplets entering the forest floor during heavy shower. The field visit was during the month of July 2018.



Maps 1 & 2: Chawang Reserve Forest Density and Forest Types

FINDINGS AND DISCUSSIONS

During our survey in the RF a total of 79 plant species were recorded from 19 sampling plots, which covered an area of 0.019 ha. From the total species recorded, a total of 27 tree species, 12 shrubs species, 21 herb species, 9 fern and fern-allies species, 2 bamboo species & 10 orchids/epiphytes/climbers species were recorded. Some of the common Avian-faunal species recorded are Ashy Drongo, Blue Whistling Thrush, Common Myna, Common Pigeon, Kalij Pheasant, Common Tailor bird, Oriental Turtle Dove, Verditer Flycatcher, etc. were sighted during our survey. Apart from this we also could sight some of the common butterfly species such as Cabbage White, Golden Sapphire, Punchinello, Common Bushbrown, Indian Tortoiseshell, etc.

The common faunal species found in the forest are Wild pig, Himalayan black bear, Barking deer, Flying squirrel, Jungle cat, Goral, Rhesus macaque, Red fox, etc. From the Ward Panchayat, the JFMC President and Vice-President, we also came to know that the forest is also sometimes visited by Central Himalayan Langur. They informed us that the forest was once the habitat to our state animal Red Panda, but these days they haven't seen it yet.

The Large chunk of the forest was mostly occupied by East Himalayan Wet Temperate Forest. Only few portions were covered by East Himalayan Moist Mixed Coniferous Forest. So during our survey most of the plots were laid in wet temperate forest and few in moist mixed coniferous forest. Most of the plots laid were under moderately dense forest and very dense forest. As per the methodology, especially for RF only the very dense and moderately dense forest portions were surveyed mainly to study the forest density, species richness under these portions of the forest.

The East Himalayan Wet Temperate Forest were mostly dominated by *Acer campbellii*, *Castanopsis hystrix*, *Castanopsis tribuloides*, *Engelhardtia spicata*, *Lithocarpus pachyphyllus*, *Quercus lamellosa*, *Quercus lineata*, *Machilus edulis*, *Symplocos glomerata*, *Symplocos glomerata*, etc. The ground vegetaion in most of the sampling plots were covered by *Aconogonum molle*, *Cynodon dactylon*, *Eragrostis sp*, *Eupatorium adenophorum*, *Hedychium gardnerianum*, *Hedychium Spicatum*, *Houttuynia cordata*, *Persicaria capitata*, *Rumex nepalensis*, *Urtica dioica*, *Urtica parviflora*, *Vaccinium nummaruloides*, etc. While, the common shrub species recorded in the forest were *Ardisia macrocarpa*, *Brassaiopsis hispida*, *Daphne cannabina*, *Edgeworthia gardenerii*, *Laurocerasus acumanata*, *Osbeckia stellata*, *Viburnus erubescence*, *Rubus ellipticus*, etc.

Apart from these we found two varieties of bamboo species during the survey viz. *Arundinaria maling* & *Chimnobambusa hookeriana*. The common species of fern and fern-allies in the forest were *Asplenium ensiforme*, *Equisetum debile*, *Gleichenia gigantean*, *Lycopodium japonicum*, *Microsorium membranaceum*, *Odontosoria chinensis* *Pteris wallichiana*, etc. While the common species of climbers/epiphytes in the forest were *Cissus elongate*, *Clematis buchananiana*, *Piper boehmeriifolium*, *Rhaphidophora decursiva*, *Trichosanthes lepiniana*, *Viscum articulatum*, etc.

FIELD ACTIVITIES



CBH Measurement



Seedling Height Measurement



GPS Reading



Species Documentation



Canopy Estimation CBH Measurement

Site characteristics of the sampling plots of Chawang Reserve Forest

SL. No	Site Code	District	Range	Forest Types	Latitude (N)	Longitude (E)	Elevation (m)	Slope Aspect	Slope Angle
1	CW1	Mangan	Phodong	Wet Temperate Forest	27°26'35.41"	88°35'06.03"	2131	SW	45
2	CW2	Mangan	Phodong	Wet Temperate Forest	27°26'36.05"	88°35'06.65"	2135	NW	10
3	CW3	Mangan	Phodong	Wet Temperate Forest	27°26'38.15"	88°35'07.40"	2160	NE	25
4	CW4	Mangan	Phodong	Wet Temperate Forest	27°26'39.93"	88°35'32.96"	2251	NE	45
5	CW5	Mangan	Phodong	Wet Temperate Forest	27°26'43.51"	88°35'32.96"	2257	N	50
6	CW6	Mangan	Phodong	Wet Temperate Forest	27°26'43.51"	88°35'32.96"	2261	E	30
7	CW7	Mangan	Phodong	Wet Temperate Forest	27°26'42.00"	88°35'15.45"	2197	SW	40
8	CW8	Mangan	Phodong	Wet Temperate Forest	27°26'42.41"	88°35'15.45"	2197	SE	20
9	CW9	Mangan	Phodong	Wet Temperate Forest	27°26'35.41"	88°35'06.03"	2197	W	20
10	CW10	Mangan	Phodong	Wet Temperate Forest	27°26'51.48"	88°35'16.28"	2428	NE	50
11	CW11	Mangan	Phodong	Wet Temperate Forest	27°26'49.15"	88°55'19.33"	2407	SW	20
12	CW12	Mangan	Phodong	Wet Temperate Forest	27°26'00.92"	88°35'77.33"	2611	NW	30
13	CW13	Mangan	Phodong	Wet Temperate Forest	27°26'53.25"	88°35'14.96"	2481	NE	40
14	CW14	Mangan	Phodong	Wet Temperate Forest	27°26'53.12"	88°35'23.64"	2462	NW	20
15	CW15	Mangan	Phodong	Wet Temperate Forest	27°26'35.41"	88°35'06.03"	2411	SW	35
16	CW16	Mangan	Phodong	Wet Temperate Forest	27°26'45.03"	88°35'30.21"	2301	W	25

17	CW1 7	Mangan	Phodong	Wet Temperate Forest	27°26'45.02"	88°35'32.92"	2271	SW	30
18	CW1 8	Mangan	Phodong	Wet Temperate Forest	27°26'43.51"	88°35'32.96"	2251	W	20
19	CW1 9	Mangan	Phodong	Wet Temperate Forest	27°26'43.41"	88°35'42.23"	2153	E	25

Checklist of floral Species recorded in Chawang Reserve forest, North Sikkim

S. NO	Botanical Name	Local Name	Family
	TREES		
1	<i>Acer campbellii</i> Hook. & Thom. Ex Hiern.	Kapasey	Aceraceae
2	<i>Actinodaphne sikkimensis</i> Meisn.	Sissi	Lauraceaea
3	<i>Beilschmiedia sikkimensis</i> King ex Hook. f.	Tarsing	Lauraceaea
4	<i>Castanopsis hystrix</i> Hook. & Thomson ex. A. DC.	Patley katush	Fagaceae
5	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Musrey katush	Fagaceae
6	<i>Cinnamomum impressinervium</i> Meisn.	lekh Sinkouli	Lauraceaea
7	<i>Elaeocarpus lanceaefolius</i> Roxb.	Bhadrasey	Elaeocarpaceae
8	<i>Engelhardtia spicata</i> Lechen ex Blume.	Mauwa	Juglandaceae
9	<i>Eurya acuminata</i> DC.	Jhingni	Theaceae
10	<i>Ficus nemarolis</i> Wall.	Dudhilo	Moraceae
11	<i>Lithocarpus pachyphyllus</i> Roxb.	Bantey	Fagaceae
12	<i>Macaranga denticulata</i> (Blume) Müll.Arg.	Malata	Euphorbiaceae
13	<i>Machilus odoratissima</i> Wall. ex. Nees	Ghew kawlo/Lali Kawlo	Lauraceae
14	<i>Machilus</i> sp.	Kawlo	Lauraceae
15	<i>Magnolia campbellii</i> Hook.f. & Thom.	Ghogeyp chanp	Magnoliaceae
16	<i>Prunus nepalensis</i> (Ser) Stendel	Arupatey	Rosaceae
17	<i>Quercus lamellosa</i> Smith.	Buk/Bajranth	Fagaceae
18	<i>Quercus lineata</i> Blume.	Phlant	Fagaceae
19	<i>Rhododendron griffithianum</i> Wight.	Seto chimal	Ericaceae
20	<i>Schefflera impressa</i> (C.B. Clarke) Harms.	Bhalu Chinde	Araliaceae
21	<i>Symplocos glomerata</i> King ex C. B. Clarke	Kholmey	Symplocaceae
22	<i>Symplocos glomerata</i> King ex C. B. Clarke	Kharaney	Symplocaceae
23	<i>Tetradium fraxinifolia</i> (Hook.) T.G. Hartley	Khanakpa	Rutaceae
24	<i>Viburnum erubescens</i> Wall ex DC	Asarey	Caprifoliaceae
25	<i>Zanthoxylum acanthopodium</i> DC	Bhaley timbur	Rutaceae
	SHRUB & SHRUBLET		
1	<i>Ardisia macrocarpa</i> Wall.	Damai phal	Myrsinaceae
2	<i>Brassaiopsis hispida</i> Seem.	Phutta	Araliaceae
3	<i>Brassaiopsis mitis</i> CB Clarke	Chuletro	Araliaceae
4	<i>Daphne cannabina</i> Wall.	Kalo algeri/Kagate	Thymeleaceae
5	<i>Dichroa febrifuga</i> Lour	Basak	Hydrangeaceae
6	<i>Edgeworthia gardenerii</i> Meissn.	Algeri/Lokti	Thymeliaceae
7	<i>Laurocerasus acumanata</i> Roem.	Lali	Rosaceae
8	<i>Maesa chisia</i> Buch. –Ham ex. D. Don	Bilauney	Myrsinaceae

9	<i>Mahonia sikkimensis</i> Takeda	Kesari/Chutro	Berberidaceae
10	<i>Osbeckia stellata</i> Buch.-Ham. ex D. Don	Chulesi	Melastomataceae
11	<i>Rubus ellipticus</i> Smith.	Aiselu	Rosaceae
12	<i>Viburnus erubescence</i> Wall ex. DC	Asarey	Caprifoliaceae
	HERB		
1	<i>Artemisia wallichiana</i> Besser	Titeypati	Asteraceae
2	<i>Begonia rubella</i> Buch. – Ham. Ex D.Don	Magarkachi	Begoniaceae
3	<i>Carex</i> sp.	Harkatto	Cyperaceae
4	<i>Cynodon dactylon</i> Linn.	Dubo	Poaceae
5	<i>Elatostema platyphyllum</i> Weddell.	Gagleto	Urticaceae
6	<i>Eragrostis</i> sp.	Banso	Poaceae
7	<i>Eupatorium adenophorum</i> Spreng.	Kali jhar	Compositae
8	<i>Gerardiana diversifolia</i> (Link) Friis	Bhangre sisnu	Urticaceae
9	<i>Hedychium gardnerianum</i> Sheppard ex Ker Gawl	Sara	Zingiberaceae
10	<i>Hedychium Spicatum</i> Smith in Rees.	Zingiberaceae	Sara
11	<i>Houttuynia cordata</i> Thunb.	Padey jhar	Saururaceae
12	<i>Persicaria capitata</i> (D. Don) H. Gross	Ratnaulo	Polygonaceae
13	<i>Rumex nepalensis</i> Spreng.	Halhalley	Polygonaceae
14	<i>Solanum nigrum</i> Linn.	Junglee bihee	Solanaceae
15	<i>Strobilanthes</i> sp.	Kibu ghans	Acanthaceae
16	<i>Swertia bimaculata</i> Hooker & Thomson ex	Gentianaceae	Bhaley Chirowto
17	<i>Urtica dioica</i> Linn.	Patley sisnu	Urticaceae
18	<i>Urtica parviflora</i> Roxb.	Patle sisnu	Urticaceae
19	<i>Vaccinium nummaruloides</i>	Mussikane	Ericaceae
20	<i>Artemisia wallichiana</i> Besser	Titeypati	Asteraceae
21	<i>Begonia rubella</i> Buch. – Ham. Ex D.Don	Magarkachi	Begoniaceae
	FERNS AND FERNS-ALLIES		
1	<i>Asplenium ensiforme</i> Wall. ex Hook. & Grev.	Uniu	Aspleniaceae
2	<i>Dicranopteris</i> sp.	Sottar	Gleicheniaceae
3	<i>Diplazium</i> sp.	Ningro	Woodsiaceae
4	<i>Equisetum debile</i> Roxb. ex Vaucher	Salli – Bisalli	Equisetaceae
5	<i>Gleichenia gigantean</i> Wall. ex Hook	Kalamey	Gleicheniaceae
6	<i>Lycopodium japonicum</i> Thunb.	Nagbelli	Lycopodiaceae
7	<i>Microsorium membranaceum</i> (D.Don) Cing		Polypodiaceae
8	<i>Odontosoria chinensis</i> (L.) J. Smith	Uniu	Lindsaeaceae
9	<i>Pteris wallichiana</i> J. Agardh	Chatey uniu	Pteridaceae
	ORCHIDS/EPIPHYTES/CLIMBERS		
1	<i>Cissus elongata</i> Roxb.	Charcharey lahara	Vitaceae
2	<i>Clematis buchananiana</i> DC	Pinasey lahara	Ranunculaceae
3	<i>Piper boehmerifolium</i> (Miquel.) Wall. ex C. DC	Chambo	Piperaceae
4	<i>Rhaphidophora decursiva</i> (Roxb.) Schott	Kanchirno	Araceae
5	<i>Rubia cordifolia</i> Roxb.	Manjith	Rubiaceae
6	<i>Smilax zeylanica</i> Linn.	Kukur dainey	Liliaceae
7	<i>Trichosanthes lepiniana</i> (Naud.) Cogn.	Indreni	Cucurbitaceae
8	<i>Viscum articulatum</i> Burm. F.		Santaceae
9	<i>Cissus elongata</i> Roxb.	Pani lahara	
10	<i>Clematis buchananiana</i> DC	Bhalayo lahara	
	BAMBOO		
1	<i>Arundinaria maling</i> Gamble	Malingo	Poaceae
2	<i>Chimnobambusa hookeriana</i>	Sigane bans	Poaceae



Dendrobium chrysanthum



Dryopteris redactopinnata



Hypholoma fasciculare



Ficus auriculata



Engelhardtia spicata



Acer campbellii

**Checklist of fauna and avifauna species encountered
at Chawang Reserve Forest, North Sikkim**

FAUNA				
S.No	Zoological Name	Common Name	Local Name	Family
1	<i>Sus scrofa</i>	Wild pig	Bhodel	Suidae
2	<i>Cuon alpinus</i>	Wild dog	Dhole	Canidae
3	<i>Hylopetes alboniger</i>	Flying squirrel	Malsapra	Sciuridae
4	<i>Muntiacus muntjak</i>	Barking deer	Mirgha	Cervidae
5	<i>Naemorhedus goral</i>	Goral		Bovidae
6	<i>Semnopithecus achilles</i>	Himalayan langur	Langur	Cercopithecidae
7	<i>Vulpes vulpes</i>	Red fox		Canidae
8	<i>Ursus thibetanus</i>	Himalayan black Bear	Bhalu	Ursidae
Avi-Fauna				
S.No	Zoological Name	Common Name	Local Name	Family
1	<i>Dicrurus leucophaeus</i>	Ashy Drongo	Chibey	Phasianidae
2	<i>Myophonus caeruleus</i>	Blue Whistling Thrush	Kalchura	Muscicapidae
3	<i>Acridotheres tristis</i>	Common Myna	Ruppi	Sturnidae
4	<i>Columba livia</i>	Common Pigeon	Parhewa	Columbidae
5	<i>Parus monticulus</i>	Green Backed Tit	Chichink Kotey	Paridae
6	<i>Lophura leucomelanos</i>	Kalij Pheasant	Kalij	Phasianidae
7	<i>Streptopelia orientalis</i>	Oriental Turtle Dove	Dhukur	Columbidae
8	<i>Eumyias thalassinus</i>	Verditer Flycatcher	Hareney	Muscicapidae
Butterfly				
	Zoological Name	Common Name	Local Name	Family
1	<i>Pieris sp.</i>	Cabbage White		Pieridae
2	<i>Heliophorus brahma</i>	Golden Sapphire		Lycanidae
3	<i>Zemeros flegyas</i>	Punchinello		Lycanidae
4	<i>Mycalesis perseus</i>	Common Bushbrown		Nymphalidae
5	<i>Aglaia cashmiriensis</i>	Indian Tortiseshell		Nymphalidae



Indian Fritillary



Ashy Drongo

Recommendations:

1. JFMC President, Vice-President and member advice that there should be plantation of fodder species in the land adjoining to the reserve forest. As per them, local fodder species should be given priority because it gives aesthetic value as well as a natural fence between the adjoining areas.
2. During our survey in the RF we came across many natural regeneration of *Acer* spp and the regeneration was healthy, so if proper fencing is been done in these regeneration areas there will be good growing stock of these species.
3. The village Panchayat and the JFMC President of Chawang has requested the forest department in promoting their village as an ecotourism destination because most of the locals here are entirely dependent on paddy and other agricultural activities, so they want sustainable development in their livelihood through forest in the form of sustainable ecotourism.
4. They also informed us that most of the youths in the village are unemployed, so if ecotourism is promoted these youths can be engaged in bird watching, butterfly and plant identifications of the forest through proper training and guidance. Through such activities the youths can avail benefits for their livelihood.

RAPID BIODIVERSITY SURVEY OF LABRANG RESERVE FOREST NORTH SIKKIM

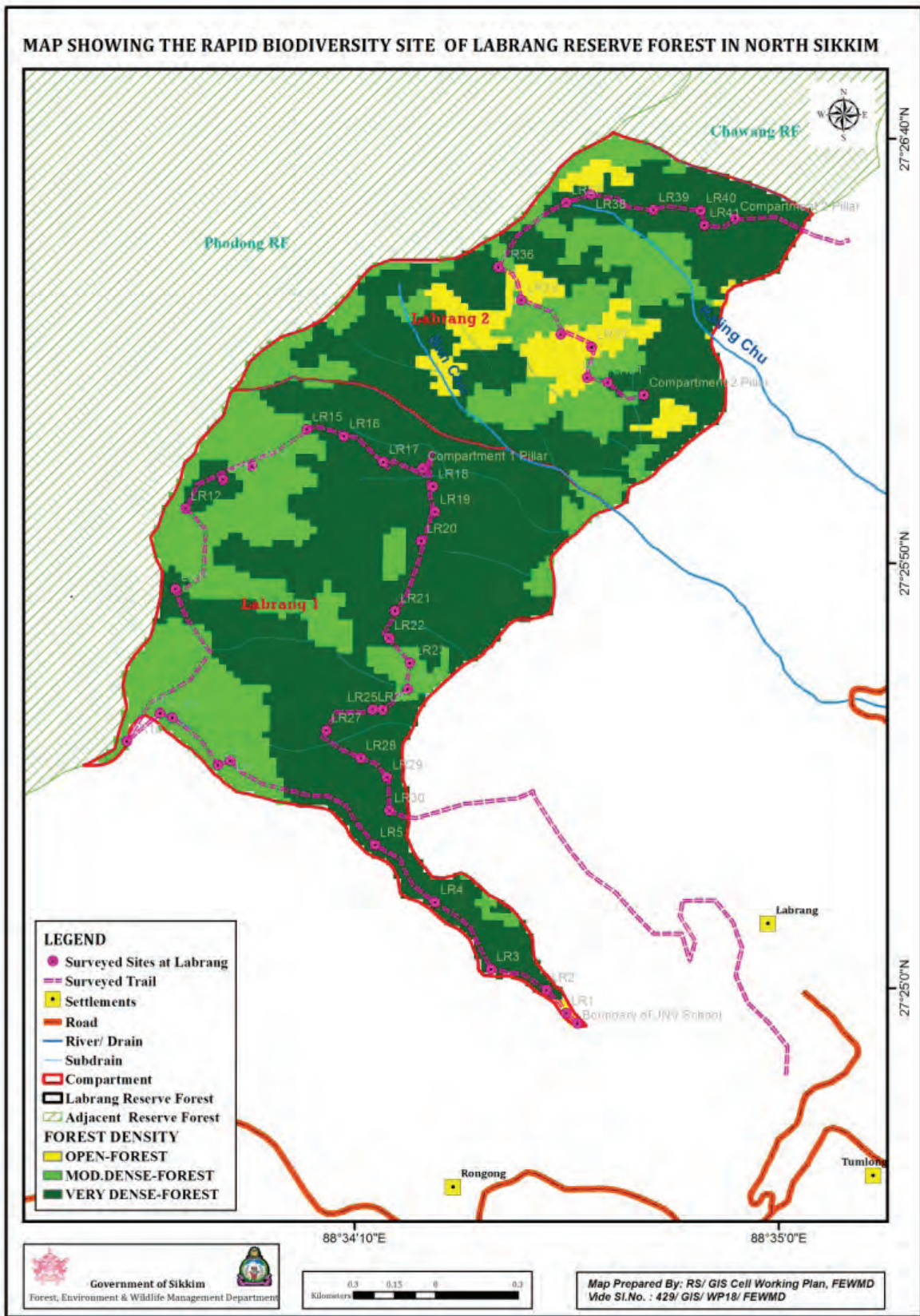
INTRODUCTION

Labrang Reserve Forest is located in the district of North Sikkim covering a total area of 2.89sq.kms (288.82ha). Based on the toposheet, the RF is broadly categorized into East Himalayan Wet Temperate forest, East Himalayan Subtropical Wet Hill forest and East Himalayan Sub Alpine Birch/Fir forest. The topography of the forest is a hilly terrain with steep mountains, flat landscapes and numerous small streams passing through the forest. As per the topo-sheet, the Bim Chu River separates the forest into 2 compartments namely “Labrang 1” and “Labrang 2” of the Phodong Beat. The forest falls under the jurisdiction of Phodong Block in Phodong Range and is bounded by Chawang Reserve Forest in the north, Phodong Reserve Forest in the west and Rongong village in the south. Lying between 27°24'55.593"N – 27°26'40.756"N latitude and 88°33'37.883"E – 88°35'3.836"E longitude, the altitude ranges from 2060m above sea level (asl) to 2250m asl.

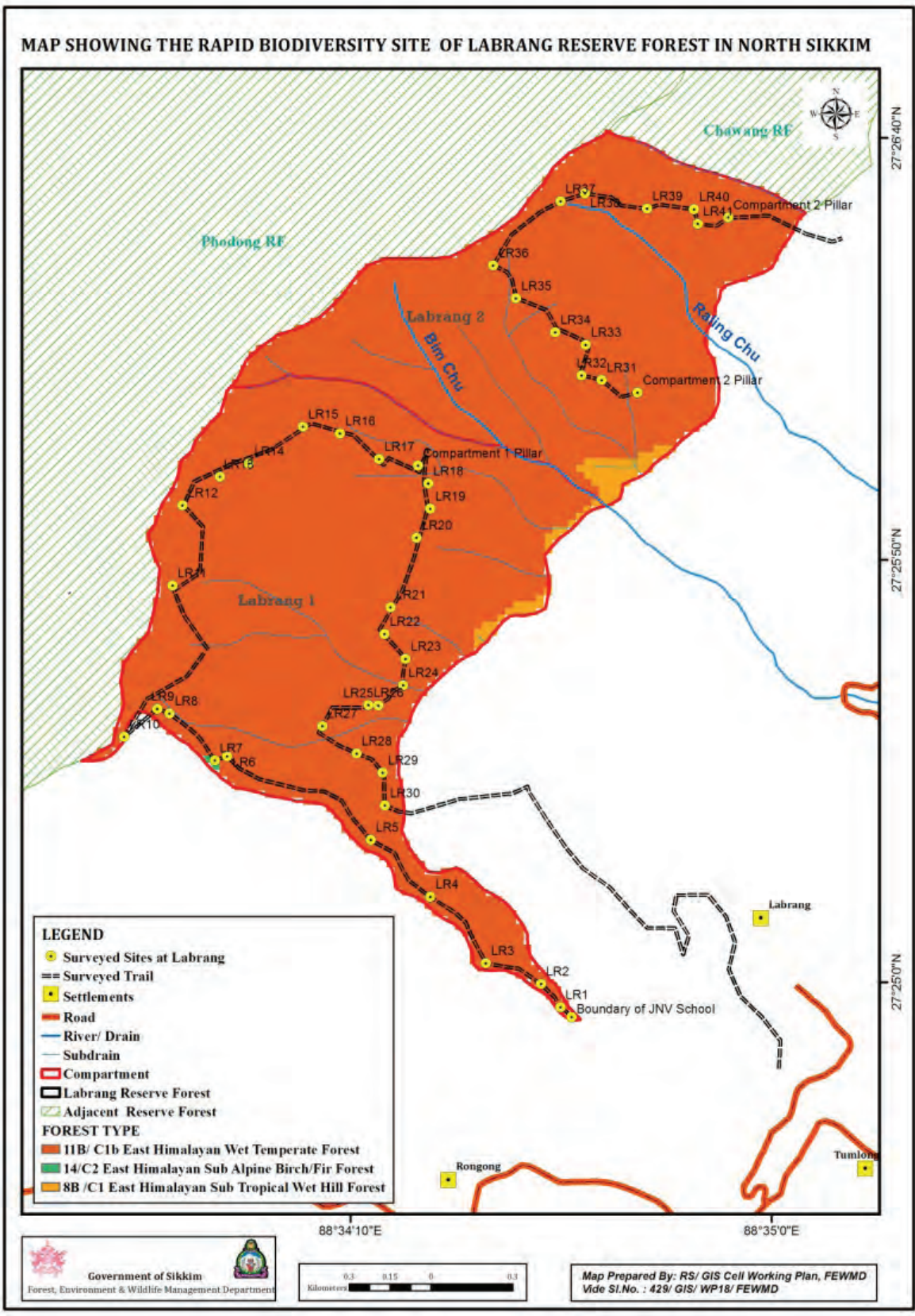
SURVEY AREA

The objective of this study was to perform Rapid Biodiversity Survey of the vegetation of Labrang Reserve Forest based on the density of the forest (moderate and dense) and the types of forest (wet temperate and sub-tropical) covering all the compartments by laying plots as per the vegetation variation and preparing an inventory for the same.

Accordingly, a field trip was carried out along the sampling path from Jawaharlal Navodaya Vidyalaya School near Selephang covering an area of 0.41ha. The survey was conducted along the altitudinal range from 1988m to 2548m asl lying between 27°24'54.6"N – 27°26'1.9"N latitude and 88°33'58.2"E – 88°35'14.7"E longitude. A total of 41 plots were laid in 2 compartments namely, Labrang 1 and Labrang 2 covering a distance of 10.26kms (**Maps**). Thirty sampling plots were laid in compartment “Labrang 1” while the remaining 11 plots were laid in compartment “Labrang 2”. The maximum sampling path covered in the survey was of a “dense temperate forest” type which was encountered in “Labrang 1” and was dominated by Oak and *Machilus* species. While compartment “Labrang 2” was mostly a “moderate wet temperate forest”. The slope angle of the area ranged from mild to stiff (60 degrees) facing South-West, North-East, North, North-West, East, South, South-East and West aspects. The survey was conducted during the month of June – July, 2018 (**Table 1**).



Map showing RBS plots along the sampling path of Labrang RF covering the compartments and forest density



Map showing RBS plots along the sampling path of Labrang RF covering the compartments and forest types.

Table 1: Site characteristics of the sampling plots along Labrang Reserve Forest in North Sikkim

Site Code	Forest Type	Location Name/ Landmark	Elevation (m)	GPS coordinates		Slope Aspect	Slope Angle (°)	Canopy Cover (%) Forest Density	Dominant Taxa
				Latitude (N)	Longitude (E)				
LR 1	Wet Temperate	Jawaharlal Navodaya Vidyalaya School	2048	27°24'54.6"	88°34'32.7"	SW	25	40%, moderately dense	Shrubs
LR 2	Wet Temperate	Phodong - Ramthang border / 1st pillar	2073	27°24'55.3"	88°34'26.1"	NE	60	60%, moderately dense	Trees
LR 3	Wet Temperate	3rd pillar	2141	27°25'01.0"	88°34'19.1"	NE	45	80%, very dense	Trees
LR 4	Wet Temperate	Mir Rakha / digging sign of wild boar	2153	27°25'09.6"	88°34'08.3"	NE	30	80%, very dense	Trees
LR 5	Wet Temperate		2189	27°25'18.9"	88°33'58.2"	N	35	60%, moderately dense	Shrubs
LR 6	Wet Temperate	Laku / 4th pillar	2267	27°25'22.3"	88°33'48.9"	NW	45	80%, very dense	Trees
LR 7	Wet Temperate	Dharjey Dara	2285	27°25'22.5"	88°34'46.6"	E	55	80%, very dense	Trees
LR 8	Wet Temperate		2385	27°25'42.0"	88°34'32.4"	SE	45	60%, moderately dense	Trees
LR 9	Wet Temperate	Near Laku	2332	27°25'25.8"	88°33'44.5"	S	45	85%, very dense	Trees
LR 10	Wet Temperate		2292	27°25'39.0"	88°33'52.6"	NW	15	80%, very dense	Trees
LRF1 1	Wet Temperate		2392	27°25'46.9"	88°33'48.8"	S	45	80%, very dense	Trees
LR 12	Wet Temperate	Khiben	2367	27°25'56.5"	88°33'50.1"	SW	35	60%, moderately dense	Shrubs
LR 13	Wet Temperate		2375	27°25'59.9"	88°33'54.5"	SE	40	60%, moderately dense	Shrubs
LR 14	Wet Temperate	Deoseto chowk	2366	27°26'01.4"	88°33'57.9"	SE	15	80%, very dense	Trees
LR 15	Wet Temperate		2355	27°26'05.7"	88°34'04.3"	E	45	60%, moderately dense	Trees
LR 16	Wet Temperate	Dudiley chowk	2357	27°26'04.9"	88°34'08.7"	SE	45	40%, moderately dense	Shrubs

LR 17	Wet Temperate	Near Gairi chowk	2378	27°26'01.9"	88°34'13.4"	E	10	75%, very dense	Trees
LR 18	Wet Temperate	Near Chawang RF pillar	2166	27°25'59.0"	88°34'19.2"	SE	10	60%, moderately dense	Trees
LR 19	Wet Temperate		2153	27°25'56.0"	88°34'19.4"	SE	45	85%, very dense	Trees
LR 20	Wet Temperate		2138	27°25'52.6"	88°34'17.8"	E	15	80%, very dense	Trees
LR 21	Wet Temperate	Near Bheri chowk	2107	27°25'34.4"	88°35'14.7"	NE	45	80%, very dense	Trees
LR 22	Wet Temperate		2067	27°25'41.2"	88°34'14.0"	S	35	45%, moderately dense	Shrubs
LR 23	Wet Temperate		2039	27°25'38.2"	88°34'16.5"	SE	45	45%, moderately dense	Shrubs
LR 24	Wet Temperate		1988	27°25'35.1"	88°34'16.3"	NE	45	65%, moderately dense	Trees
LR 25	Wet Temperate		1990	27°25'43.7"	88°34'13.3"	SW	30	80%, very dense	Trees
LR 26	Wet Temperate		2012	27°25'32.8"	88°34'12.1"	NE	45	60%, moderately dense	Shrubs
LR 27	Wet Temperate		2079	27°25'33.5"	88°34'06.6"	W	15	65%, moderately dense	Shrubs
LRF 28	Wet Temperate		2076	27°25'21.5"	88°34'12.0"	N	25	70%, very dense	Trees
LR 29	Wet Temperate		2057	27°25'20.5"	88°34'15.5"	N	60	80%, very dense	Trees
LR 30	Wet Temperate		2040	27°25'20.8"	88°34'21.0"	N	35	50%, moderately dense	Shrubs
LR 31	Wet Temperate		2178	27°26'29.8"	88°34'51.2"	NW	45	68%, moderately dense	Shrubs
LR 32	Wet Temperate		2237	27°26'31.5"	88°34'50.8"	SW	45	60%, moderately dense	Shrubs
LR 33	Wet Temperate		2294	27°26'31.6"	88°34'42.2"	NW	45	70%, very dense	Trees
LR 34	Wet Temperate		2364	27°26'33.4"	88°34'37.8"	N	35	99%, very dense	Trees
LR 35	Wet Temperate		2463	27°26'33.9"	88°34'29.7"	SW	35	65%, moderately dense	Shrubs

LR 36	Wet Temperate		2548	27°26'28.8"	88°34'22.8"	W	10	85%, very dense	Trees
LR 37	Wet Temperate		2372	27°26'16.9"	88°34'34.3"	SE	35	97%, very dense	Trees
LR 38	Wet Temperate		2304	27°26'15.5"	88°34'37.9"	E	35	80%, very dense	Trees
LR 39	Wet Temperate		2274	27°26'11.8"	88°34'37.4"	SE	40	80%, very dense	Trees
LR 40	Wet Temperate		2251	27°26'11.3"	88°34'39.8"	NE	45	85%, very dense	Trees
LR 41	Wet Temperate		2224	27°26'30.6"	88°34'50.6"	SE	40	85%, very dense	Trees
Note: SW, South-West; NE, North-East; N, North; NW, North-West; E, East; S, South; SE, South-East; E, East; W, West									

METHODOLOGY

Vegetation sampling and collection of field data

Prior to the field visit, a base map was prepared using the Geographic Information System (GIS) in the GIS laboratory of the Department for supplementary information of the reserve forest and its adjoining areas showing drainages, rivers, roads and villages. Forest cover map was also prepared highlighting the forest types and its density. Literature review was also done to have a general idea about the biodiversity of the area and a checklist for both flora and fauna was prepared to confirm their presence in the study area.

The **floral** diversity of the area was recorded by laying plots of 10m x 10m for the trees, 5m x 5m for the saplings and percent cover of shrubs, and 1m x 1m for the herbs/seedlings. The plots were laid at places of variable vegetation growth. With the help of GPS, latitude and longitude along with their elevations were calibrated in the entire sampling plot.

Within the plots, trees of CBH >30cms at 1.37m above the ground level were measured using measuring tape. The unidentified species were photographed or collected and identified later by consulting plant taxonomists, herbaria and literature. An inventory of the species within and outside the plots was prepared and all the sampling plots were geo-tagged for reference under long-term monitoring.



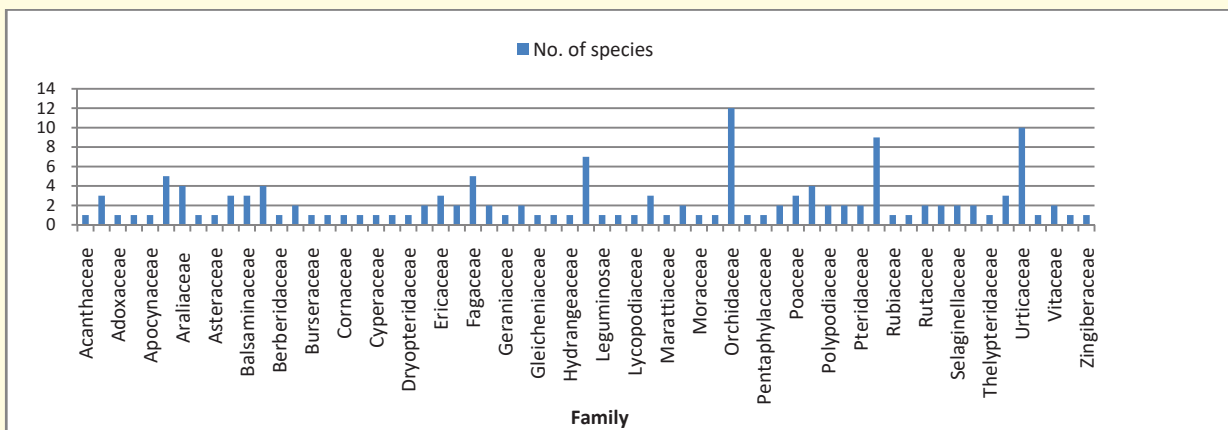
Field activity with the Survey team and Forest staff

To record the **faunal** and avi-faunal species, direct and indirect signs were taken into consideration while walking along the sampling path. Recordings of digging signs of mammals, pellets, scats, calls and feathers were documented and photo capture was done depending upon the feasibility. Some of the common butterfly species were also recorded during the survey.

RESULTS AND DISCUSSION

Floral Diversity of the Forest

A total of 165 species belonging to 68 families were recorded along the entire trail covering an area of 0.41ha of Labrang Reserve Forest. However, in the 41 plots laid, 150 species were recorded belonging to 63 families. Of which the highest family composition of the species belonged to Orchidaceae (12 species), Urticaceae (10 species), Rosaceae (9 species), Lauraceae (7 species), Fagaceae and Araceae (5 species each; **Graph**).



Graph: Family-wise species composition

The highest diversity of species, out of the 151 species was recorded for trees with 48 species (5 unidentified) belonging to 33 genera and 21 families were recorded. The highest tree species was recorded from Lauraceae family representing 7 species (*Actinodaphne sikkimensis*, *Beilschmiedia sikkimensis*, *Cinnamomum impressinervium*, *Litsea kingii*,

Machilus gamblei and *M. odoratissima*) followed by Fagaceae representing 5 Oak species (*Castanopsis tribuloides*, *C. hystrix*, *Lithocarpus pachyphyllus*, *Quercus glauca* and *Q. lamellosa*). Magnoliaceae represented 3 species of Magnolia (*Magnolia campbellii*, *M. cathcartii* and *M. doltsopa*) while 3 species of Aceraceae represented Maple of *Acer palmatum*, *A. campbellii* and *Acer* sp. However, the dominant trees within the plot was recorded from families Fagaceae representing *Quercus lamellosa*, *Castanopsis hystrix* and *Lithocarpus pachyphyllus* followed by Symplocaceae representing *Symplocos lucida* and Lauraceae representing *Machilus odoratissima*. These species were found to be distributed along the entire sampling path.

Herbs represented 41 species (3 unidentified) belonging to 26 genera and 20 families. The dominant herb species belonged to Urticaceae family representing *Boehmeria platyphylla*, *Elatostema sessile*, *Gerardiana diversifolia*, *Pilea scripta*, *P. umbrosa* and *Urtica parviflora* followed by Begoniaceae representing *Begonia* species. Similarly, 17 shrub species (2 unidentified) belonging to 11 genera and 9 families, 18 ferns and fern-allies (14 genera and 13 families), 13 epiphytes and climbers (13 genera and 10 families), 12 orchid species (8 genera and 1 family of Orchidaceae) and only 2 species of bamboo (Poaceae family) were encountered in the entire sampling path. Diversity was found most in the case of ground vegetation in comparison to trees and shrubs (Table 2).

Habit	Species	Genera	Family
Tree	48	33	21
Shrub	17	11	9
Herb	41	26	20
Fern and fern-allies	18	14	13
Climber/Epiphyte	13	13	10
Bamboo	2	2	1
Orchid	12	8	1
Total	151	107	75

The Reserve Forest is classified into the East Himalayan Wet Temperate, East Himalayan Subtropical Wet Hill and East Himalayan Sub Alpine Birch/Fir forests of which the “very dense” wet temperate forest was the most covered during the survey. The “open” forest was, however, almost absent of trees and other woody vegetation and hence, such areas were not evaluated for study. The dense forests were characterized by broad-leaved evergreen trees with short boles and branchy attaining large girths clothed with mosses, ferns and other epiphytes. Woody climbers and dense shrubby vegetation were the common characteristics of the forest.

The floral diversity was a “dense” wet temperate forest dominated with large number of tree species especially the Oak and *Machilus* species, constituting the greater part of the top

canopy. Amongst the oak species, the trees widely distributed in the region were *Castanopsis hystrix*, *C. tribuloides*, *Lithocarpus pachyphyllus*, *Quercus glauca* and *Q. lamellosa*. Some of the important timber yielding tree species found in the region was *Alnus nepalensis*, *Betula cylindrostachya*, *Castanopsis tribuloides*, *Magnolia cathcartii*, *M. doltsopa* and *Santalum* sp. Fuel wood yielding species in the area were *Acer campbellii*, *Alnus nepalensis*, *Betula cylindrostachya* and *Cryptomeria japonica*. Other trees distributed in the region were *Acer palmatum*, *Actinodaphne sikkimensis*, *Alangium chinense*, *Beilschmiedia sikkimensis*, *Cinnamomum impressinervium*, *Echinocarpus dasycarpus*, *Elaeocarpus lanceaefolius*, *Endospermum chinensis*, *Eurya acuminata*, *Exbucklandia populnea*, *Ficus nemoralis*, *Garuga pinnata*, *Machilus odoratissima*, *M. gamblei*, *Magnolia campbellii*, *Maesa rugosa*, *Prunus bracteopadus*, *Pyrularia edulis*, *Rhododendron griffithianum*, *Symplocos glomerata*, *S. lucida* and *Tetradium fraxinifolium*. Regeneration of saplings and seedlings of *Symplocos lucida* and *S. glomerata* were healthy while that of other trees were rarely dispersed while regeneration of seedlings of *Acer campbellii* and *Quercus lamellosa* were distributed in patches.



Dense and moderate wet temperate forest

The middle storey of the forest was mainly covered with shrubby species and seen to be dominating the area with *Daphne cannabina*, *Edgeworthia gardneri*, *Maesa chisia*, *Mahonia napaulensis*, *Osbeckia stellata*, *Rubus ellipticus*, *R. parviflorus*, *Vaccinium vacciniaceum* and *Viburnum erubescens*.



Viburnum erubescens



Daphne sp.



Vaccinium vacciniaceum



Rubus parviflorus

In moist areas, these forests were interspersed by bamboo species such as a candy cane Singanay bans (*Himalayacalamus falconeri*) and Hangey malingo (*Yushani maling*) forming dense thickets. Bamboos are utilized extensively for manufacturing strong and sturdy furniture, handicrafts and novelty items. The ability to control soil erosion, carbon dioxide sequestering and the ability to generate more oxygen makes bamboo one of the most important forest species balancing the ecosystem.

The epiphytic flora was found to be rich and diverse forming dense thickets on the bark of trees. Some widely spread epiphytes were *Aeschynanthus sikkimensis*, *Agapetes serpens*, *Cissus elongata*, *Hoya linearis*, *Peperomia heyneana*, *Remusatia pumila* and *Tetrastigma serrulatum* (whose leaf paste is applied on wounds and boils to liberate puss).



Peperomia heyneana



Tetrastigma serrulatum



Hedera nepalensis



Spadix of *Rhaphidophora decursiva*

The growth of epiphytic ferns such as *Asplenium nidus*, *Lepisorus pseudonudus*, *Polypodiodes lachnopus* and *Vittaria* sp. and climbers of *Clematis buchnaniana*, *Hedera nepalensis*, *Rhaphidophora decursiva*, *Rubia cordifolia* formed suitable habitat on trees. The lower storey of the forest comprises the ground vegetation of herbaceous species, fern and fern-allies and ground orchids. Ferns and fern-allies of various species covered the ground inhibiting the growth of other herb species. *Selaginella chrysocaulos*, *Dryopteris redactopinnata*, *Diplazium giganteum*, *Pteris wallichiana*, *Pteridium revolutum*, *Lycopodium japonicum*, *Diplazium dilatatum* and *Thelypteris* species are some commonly found ferns.



Diplazium giganteum



Oleandra wallichii

Orchid diversity formed one of the beautiful sights to the forest mainly covered with *Bulbophyllum* sp., *Calanthe brevicornu*, *Coelogyne longipes*, *Dendrobium* sp., *Liparis petiolata*, *Mycaranthes pannea* and *Pholidota imbricata*.



Mycaranthes pannea



Calanthe brevicornu



Coelogyne longipes



Liparis petiolata

Some of the commonly found herbs were *Arisaema concinnum*, *A. speciosum*, *A. tortosum*, *Begonia cathcartii*, *Carex* sp., *Elatostema sessile*, *Eragrostis* sp., *Hedychium spicatum*, *Henckelia urticifolia*, *Hydrocotyle* sp., *Impatiens arguta*, *I. stenantha*, *Lysimachia japonica*, *Pilea umbrosa*, *P. scripta*, *Rubus calycinus*, *Swertia bimaculata*, etc.



Lysimachia sp.



Impatiens arguta



Begonia cathcartii



Theropogon pallidus

Some of the herbs possessing medicinal values were also encountered along the trail imposing an important aspect of the forest. Decoction of leaves of *Ageratina adenophora* is used to treat stomachache and the paste prepared from apical leaves and is used to stop bleeding from cuts and injuries. Extracts from stalks of *Begonia picta* is used for venereal disease. The bulbs/rootstock of *Begonia josephi* is eaten raw in case of indigestion and stomach ache¹. Also, the guide said the nodules are eaten raw in case of food poisoning.



Begonia josephi leaves and rootstalk

The leaves of *Centella asiatica* are used for asthma and skin disease, urinary discharges and improving memory. The aerial plant of *Drymaria cordata* is steamed and smelled during sinus trouble. The whole plant is crushed and its paste is used for fever, cold and cough and also for dog bites and headache; the juice is applied for burns and skin diseases. The whole plant of *Swertia chiraita* is used as a tonic, for skin diseases and chronic fever. Fresh leaves of *Prunella vulgaris* is coated with castor oil and used externally to cure piles¹. *Hedychium spicatum*, an important but a vulnerable herb as per the IUCN criteria due to reduction in population, is distributed in the region which is used in cough, ulcer and inflammation, and reported to treat liver disorders, vomiting and stomach ailments.

Selinum wallichianum is a tall glabrous perennial herb belonging to the family of Apiaceae locally called Bhutkesh/Gurang. It grows in Himalayan forests at an altitude of 2300 – 4500m asl in moist fertile soil in full or partial shade. This species has medicinal as well as used as incense made from its roots. Its powdered leaves and flowers are consumed with hot water to

cure stomach ache, cough, cold and fever. The paste of leaves and flowers is applied on cuts and wounds for rapid cure. Decoction of roots is taken against cough and fever. Leaves are carminative. Decoction of roots is taken against cough and fever. Leaves are carminative.



Prunella vulgaris and *Selinum wallichianum*

Cardiocrinum giganteum is the largest species of any of the lily plants belonging to the family *Liliaceae*, growing upto 3.5m tall, at an altitude from 1200m to 3600m asl. Also known as the Giant Himalayan Lily, this species was found in the forests of northern parts of Sikkim during the Rapid Biodiversity Survey (Tholung – Kisong, Shingbha Rhododendron Sanctuary, Labrang Reserve Forest, Phodong Reserve Forest). The leaves are used as an external cooling application to alleviate the pains of wounds and bruises. The paste of root is applied as a poultice to treat dislocated bones, the bulbs are used as a diuretic and tonic for cough and fever. The hollow stems are, however, used to make flute.



Cardiocrinum giganteum

Random sampling plots from 1 to 30 were laid in Compartment “Labrang 1” ranging from elevation 1988m to 2392m asl representing a “dense” wet temperate forest dominated with Oak and Machilus species. While plots 31 – 41 were laid in Compartment “Labrang 2” ranging at an altitude from 2178m to 2548m asl representing a “moderate” wet temperate forest dominating with *Acer campbellii*, *Castanopsis tribuloides*, *Machilus odoratissima* and

Quercus lamellosa. According to the Forest Survey of India, trees of CBH 20 – 26feet are demarcated as heritage trees and such trees of oak were recorded in the forest during the survey some of which had a girth size of maximum 914.4cm (30ft of *Quercus lamellosa*; 2178m asl; 27°26'29.8"N – 88°34'51.2"E) forming dense canopy. Saplings and seedlings of *Quercus lamellosa*, *Symplocos lucida* and *S. glomerata* was widely dispersed indicating good regeneration.

Table 3: Checklist of floral species encountered along the sampling path of Labrang Reserve Forest in North Sikkim

TREES				
S. No	Botanical Name	Local Name	Family	Altitudinal gradient
1	<i>Acer palmatum</i> Thunb.	Kapasey	Aceraceae	
2	<i>Acer</i> sp.	Kapasey	Aceraceae	
3	<i>Acer campbellii</i> Hook.f. & Thomson ex Hiern	Kapasey	Aceraceae	1800-2700
4	<i>Actinodaphne sikkimensis</i> Meisn.	Sissi	Lauraceae	700-1700
5	<i>Alangium chinense</i> (Lour.) Harms	Akhanay	Cornaceae	
6	<i>Alnus nepalensis</i> Don.	Utis	Betulaceae	200-2800
7	<i>Bauhinia purpurea</i> L.	Tanki	Leguminosae	
8	<i>Beilschmiedia sikkimensis</i> King ex Hook. f.	Tarsing	Lauraceae	300-2400
9	<i>Betula cylindrostachya</i> Lindl. ex Wall.	Saur	Betulaceae	1400-2800
10	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Musrey katus	Fagaceae	450-2300
11	<i>Castanopsis hystrix</i> Hook.f. & Thomson ex A. DC.	Patley katus	Fagaceae	600-1600
12	<i>Cinnamomum impressinervium</i> Meisn.	Sinkoli	Lauraceae	
13	<i>Cryptomeria japonica</i> (Thunb. ex L.f.) D.Don	Dhuppi	Cupressaceae	1100-2500
14	<i>Echinocarpus dasycarpus</i> Benth.	Gobre	Elaeocarpaceae	
15	<i>Elaeocarpus lanceaefolius</i> Roxb.	Bhadrasey	Elaeocarpaceae	1800-2500
16	<i>Endospermum chinensis</i>	Seti kath	Euphorbiaceae	
17	<i>Eurya acuminata</i> DC.	Jhinganey	Pentaphylacaceae	700-3000
18	<i>Exbucklandia populnea</i> (R.Br. ex Griff.)R.W.Br.	Piplee	Hamamelidaceae	1200-2000
19	<i>Ficus nemoralis</i> Wall.	Dudilo	Moraceae	
20	<i>Garuga pinnata</i> Roxb.	Dabdabay	Bursaceae	
21	<i>Lithocarpus pachyphyllus</i> (Kurz) Rehder	Sungure katus/Bante	Fagaceae	1800-2700
22	<i>Litsea kingii</i> Hook.	Siltimmur	Lauraceae	300-3200
23	<i>Lyonia ovalifolia</i> (Wall.)Drude	Angeri	Ericaceae	200-3400
24	<i>Machilus gamblei</i> King ex J. D. Hooker	Seto kawlo/Ghew kawlo	Lauraceae	
25	<i>Machilus odoratissima</i> Nees.	Lali kawla	Lauraceae	
26	<i>Machilus</i> sp.	Rato kawlo	Lauraceae	

27	<i>Maesa rugosa</i> C.B. Clarke	Lekh bilaune	Euphorbiaceae	
28	<i>Magnolia campbellii</i> Hook.f. & Thom.	Ghogeey champ	Magnoliaceae	
29	<i>Magnolia cathcartii</i> (Hook. f. & Thomson) Noot.	Titey champ	Magnoliaceae	1400-2700
30	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.)Figlar	Rani champ	Magnoliaceae	1500-2400
31	<i>Prunus bracteopadus</i> Koehne	Arupatey	Rosaceae	1700-2000
32	<i>Prunus wallichii</i> Steud.	Lali	Rosaceae	
33	<i>Pyrularia edulis</i> (Wallich) A.	Amphi	Santalaceae	1700-2700
34	<i>Quercus glauca</i> Thunb.	Phlant	Fagaceae	
35	<i>Quercus lamellosa</i> Sm.	Buk bajranth	Fagaceae	1600-2800
36	<i>Rhododendron griffithianum</i> Wight.	Seto chimal	Ericaceae	
37	<i>Rhus succedanea</i> Linn.	Rani bhalayo	Anacardiaceae	1000-1500
38	<i>Santalum</i> sp.	Seto chandan	Santalaceae	
39	<i>Schefflera rhododendrifolia</i> (Griff.) Frodin	Bhalu chinde	Araliaceae	
40	<i>Symplocos glomerata</i> King ex C.B. Clarke	Kholmey	Symplocaceae	1200-2700
41	<i>Symplocos lucida</i> (Thunb.) Siebold & Zucc.	Kharanay	Symplocaceae	1500-3000
42	<i>Tetradium fraxinifolium</i> (Hook.) Hartley	Khanakpa	Rutaceae	1200-2500
43	<i>Zanthoxylum acanthopodium</i> DC	Boke timmur	Rutaceae	
44	Unidentified	Harisay		
45	Unidentified	Jhatre		
46	Unidentified	Kursinge		
47	Unidentified	Chamre		
48	Unidentified	Paheli		
SHRUBS				
1	<i>Daphne cannabina</i> Lour.	Kalo argeli	Thymelaeaceae	1900-2700
2	<i>Daphnesp.</i>	Aul argeli	Thymelaeaceae	
3	<i>Dichroa febrifuga</i> Lour.*	Basak	Hydrangeaceae	200-2000
4	<i>Edgeworthia gardneri</i> (Wall.) Meisn.	Argayle/Kagate	Thymelaeaceae	1000-2500
5	<i>Elatostema platyphyllum</i> Weddell.	Gagleto	Urticaceae	
6	<i>Hydrangea heteromalla</i> D. Don	Bhogote	Hydrangeaceae	
7	<i>Maesa chisia</i> Buch. –Ham ex. D. Don	Bilauney	Primulaceae	
8	<i>Mahonia napaulensis</i> DC.	Chutro	Berberidaceae	1500-2500
9	<i>Osbeckia stellata</i> Buch.-Ham. ex Ker Gawl.	Chulesi	Melastomataceae	500-2300
10	<i>Oxyspora paniculata</i> (D.Don) DC	Chulesee	Melastomataceae	500-2000
11	<i>Polygonum molle</i> D. Don	Thotney	Polygonaceae	
12	<i>Rubus paniculatus</i> Sm.	Bhalu aiselu	Rosaceae	
13	<i>Rubus parviflorus</i>	Thulo aiselu	Rosaceae	
14	<i>Rubus</i> sp.	Ghampey aiselu	Rosaceae	
15	<i>Rubus ellipticus</i> Sm.	Aiselu	Rosaceae	1000-2600
16	<i>Vaccinium vacciniaceum</i> (Roxb.) Sleumer*		Ericaceae	
17	<i>Viburnum erubescens</i> Wall.	Asare	Adoxaceae	1400-3950

18	Unidentified	Chaure		
19	Unidentified	Dhapre		
HERBS				
1	<i>Ageratina adenophora</i> (Spreng.) R.M. King & H. Rob.	Banmara	Compositae	900-2200
2	<i>Anaphalis contorta</i> (D. Don.) Hook. f.	Bukiful	Asteraceae	
3	<i>Arisaema concinnum</i> Schott.	Larua/Banko	Araceae	
4	<i>Arisaema consanguinem</i> *	Larua/Banko	Araceae	
5	<i>Arisaema speciosum</i> (Wall.) Mart	Larua/Banko	Araceae	
6	<i>Arisaema tortuosum</i> (Wall.) Schott	Banko/Sap ko phool	Araceae	
7	<i>Begonia dioica</i> *	Magar kajey	Begoniaceae	
8	<i>Begonia picta</i> Smith	Magar kajey	Begoniaceae	600-2800
9	<i>Begonia tessaricarpa</i> C.B. Clarke	Magar kajey	Begoniaceae	
10	<i>Begonia thomsonii</i> *	Magar kajey	Begoniaceae	2100-2700
11	<i>Begonia cathcartii</i> Hook.f. & Thomson	Magar kajey	Begoniaceae	1800-2800
12	<i>Begonia josephi</i> A.DC.*	Magar kajey	Begoniaceae	1800-2700
13	<i>Boehmeria platyphylla</i> D. Don.	Kamley	Urticaceae	700-1500
14	<i>Cardiocrinum giganteum</i> (Wall.) Makino		Liliaceae	1200-3600
15	<i>Carex</i> sp.	Harkatto	Cyperaceae	200-2700
16	<i>Centella asiatica</i> (L.) Urb.*	Golpatta	Apiaceae	
17	<i>Cotoneaster</i> sp.		Rosaceae	
18	<i>Drymaria cordata</i> (L.) Willd. ex Schult.*	Abhijalo	Caryophyllaceae	
19	<i>Elatostema sessile</i> J.R.Forst. & G.Forst.	Gagleto	Urticaceae	1200-2600
20	<i>Eragrostis</i> sp.	Banso ghans	Poeceae	
21	<i>Fragaria nubicola</i> (Lindl. ex Hook.f.) Lacaita	Bhui ainselu	Rosaceae	1800-3800
22	<i>Geranium</i> sp.		Geraniaceae	
23	<i>Gerardiana diversifolia</i> (Link) Friis	Bhangre Sisnu	Urticaceae	
24	<i>Hedychium spicatum</i> Smith	Sara	Zingiberaceae	1800-2800
25	<i>Hemiphragma heterophyllum</i> Wall.*	Lalgeri/Nash Jhaar, Lahare Phool, Raato Gedi	Plantaginaceae	
26	<i>Henckelia urticifolia</i> (Buch.-Ham. ex D.Don) A.Dietr	Aankle, Bhende	Gesneriaceae	1000-2400
27	<i>Hydrocotyle himalaica</i> P.K.Mukh.	Ghoda Tapre	Araliaceae	100-2400
28	<i>Hydrocotyle javanica</i> Thunb.	Dhungri jhar	Araliaceae	1300 above
29	<i>Impatiens racemosa</i> DC.	Tantari, Anchirna	Balsaminaceae	1200-3900
30	<i>Impatiens stenantha</i> Hook.f.	Tantari, Anchirna	Balsaminaceae	1800-2600
31	<i>Impatiens arguta</i> Hook.f. & Thomson (purple flower)	Mujuro	Balsaminaceae	1800-3200
32	<i>Lysimachia japonica</i>		Primulaceae	
33	<i>Lysimachia</i> sp.*		Primulaceae	

34	<i>Oplismenus burmanni</i> (Retz.) P.Beauv.*	Banso	Poaceae	
35	<i>Oxalis corniculata</i> Linn.	Amilo jhar	Oxalidaceae	1400-1900
36	<i>Persicaria capitata</i> (Buch.Ham.ex D.Don) Gross	Ratneulo	Polygonaceae	600-2400
37	<i>Persicaria runcinata</i> (Buch. – Ham. ex D.Don.) Masam.	Ratneulo	Polygonaceae	
38	<i>Persicaria wallichii</i> Greuter & Burdet	Rani thotney (like shrub)	Polygonaceae	
39	<i>Pilea scripta</i> (Buch.-Ham ex D.Don) Weddell	Chipleghans	Urticaceae	
40	<i>Pilea spruceana</i> *	Chipleghans	Urticaceae	
41	<i>Pilea umbrosa</i>	Chipleghans	Urticaceae	1200-2500
42	<i>Prunella vulgaris</i> L.*		Lamiaceae	
43	<i>Rubus calycinus</i> Wall. ex D.Don	Bhui ainselu	Rosaceae	2100-3000
44	<i>Selinum wallichianum</i> (DC.) Raizada & H.O. Saxena*	Bhutkesh / Gurang	Apiaceae	2300-4000
45	<i>Strobilanthes</i> sp.	Kibu ghans	Acanthaceae	
46	<i>Swertia bimaculata</i> (Siebold & Zuccarini) Hook. & Thom. ex CB Clarke	Bhaley chirowto	Gentianaceae	200-3500
47	<i>Swertia chirayita</i> H. Karsten	Chirowto	Gentianaceae	
48	<i>Theropogon pallidus</i> (Wall. ex Kunth) Maxim.*		Asparagaceae	2300-2600
49	<i>Urtica parviflora</i> Roxb.	Patley sisnu	Urticaceae	
50	<i>Viola</i> sp.		Violaceae	
51		Kharanay sisnu	Urticaceae	
52		Lata sisnu	Urticaceae	
53		jogi sisnu	Urticaceae	
EPIPHYTES/CLIMBERS				
1	<i>Aeschynanthus sikkimensis</i> Stapf.	Baklay patay	Gesneriaceae	
2	<i>Agapetes serpens</i> (Wight) Sleumer	Glass flower/Chewre	Ericaceae	
3	<i>Cissus elongata</i> Roxb.	Charcharey lahara	Vitaceae	
4	<i>Clematis acuminata</i> DC	Pinasay lahara	Rununculaceae	
5	<i>Hedera nepalensis</i> K.Koch		Araliaceae	1000-3000
6	<i>Hoya linearis</i> Wall. ex D.Don	Dudey lahara	Apocynaceae	
7	<i>Peperomia heyneana</i> Miq.*		Piperaceae	900-2500
8	<i>Piper boehmeriaefolia</i> (Miq.) DC.*	Chabo / Jungali pan	Piperaceae	1000-2400
9	<i>Remusatia pumila</i> (D.Don) H.Li & A.Hay	Mane	Araceae	
10	<i>Rhaphidophora decursiva</i> (Roxb.) Scott	Kanchirna	Araceae	
11	<i>Rubia cordifolia</i> L	Majito	Rubiaceae	300-2800
12	<i>Tetrastigma serrulatum</i> (Roxb.) Planch.	Charcharey lahara	Vitaceae	1800-2500
13	<i>Trichosanthes lepiniana</i> (Naudin) Cogn.	Indreni	Cucurbitaceae	700-2000
FERNS & FERN ALLIES				
1	<i>Angiopteris indica</i> Desv.	Gai khure ningro	Marattiaceae	400-1600
2	<i>Asplenium nidus</i> L.	Bird's nest fern	Aspleniaceae	

3	<i>Diplazium</i> sp.	Bhaley ningro	Athyriaceae	
4	<i>Diplazium</i> sp.	Doko uniu	Athyriaceae	
5	<i>Diplazium stoliczkae</i>	Kalo uniu	Woodsiaceae	
6	<i>Diplazium dilatatum</i> Blume	Lek Chipley ningro	Athyriaceae	
7	<i>Diplopterygium giganteum</i> (Wall. ex Hook.) Nakai	Sottar	Gleicheniaceae	800-2800
8	<i>Dryopteris redactopinnata</i> S.K. Basu & Panigrahi	Thumsey uniu	Dryopteridaceae	2400-3400
9	<i>Lepisorus pseudonudus</i> Ching		Polypodiaceae	
10	<i>Lycopodium japonicum</i> Thunb.	Nagbeli	Lycopodiaceae	
11	<i>Oleandra wallichii</i> (Hook.) C. Presl	Stilt fern	Oleandraceae	
12	<i>Polypodiodes lachnopus</i> (Wall. ex Hook.) Ching		Polypodiaceae	
13	<i>Pteridium revolutum</i> (Blume) Nakai	Thado uniu	Dennstaedtiaceae	
14	<i>Pteris wallichiana</i> J. Agardh	Chatey uniu	Pteridaceae	800-2700
15	<i>Selaginella</i> sp.	Sindure	Selaginellaceae	
16	<i>Selaginella chrysocaulos</i> (Hook. & Grev.) Spring	SIndure	Selaginellaceae	1800-3000
17	<i>Thelypteris</i> sp.	Pirey sottar	Thelypteridaceae	
18	<i>Vittaria</i> sp.		Pteridaceae	
ORCHIDS				
1	<i>Anthogonium gracile</i> Wall. ex Lindl.	Bamboo orchid	Orchidaceae	1200-2300
2	<i>Bulbophyllum</i> sp.	Sunakhari	Orchidaceae	
3	<i>Calanthe brevicornu</i> Lindl.		Orchidaceae	1600-3100
4	<i>Coelogyne corymbosa</i> Lindl.	Sunakhari	Orchidaceae	1300-3500
5	<i>Coelogyne cristata</i> Lindl.	Sunakhari	Orchidaceae	1700-1900
6	<i>Coelogyne longipes</i> Lindl.	Sunakhari	Orchidaceae	1000-2600
7	<i>Dendrobium amoenum</i>	Sunakhari	Orchidaceae	1000-2000
8	<i>Dendrobium fimbriatum</i> Hook.	Sunakhari	Orchidaceae	500-2400
9	<i>Dendrobium</i> sp.	Sunakhari	Orchidaceae	
10	<i>Liparis petiolata</i> (D.Don) P.F.Hunt & Summerh.		Orchidaceae	1000-2900
11	<i>Mycaranthes pannea</i> (Lindl.) S.C.Chen & J.J.Wood		Orchidaceae	800-2200
12	<i>Pholidota imbricata</i> Lindl.		Orchidaceae	600-2900
BAMBOO				
1	<i>Himalayacalamus falconeri</i> (Hook. F. ex Munro) Keng f.	Singanay bans	Poaceae	Upto 2400
2	<i>Yushani maling</i> (Gamble) R.B.Majumdar & Karthik	Hangey malingo	Poaceae	
Note: * indicates the species outside the plot				

Faunal Diversity of the Forest

The dense forest provides shelter as well as abundant food in the form of fruits indicating the presence of faunal species. Digging signs of Wild Pig was seen along the forest trail that confirmed its presence. The scattered oak seeds on the forest floor indicated the presence of Himalayan Black Bear. Other reported mammal species in the forest are Barking Deer, Flying Squirrel, Civet Cat, Spotted Deer, Goral, Monkey, Red Fox, Himalayan Langur and Red Panda.



Digging sign of Wild boar

Birds such as Common Myna, Common Pigeon, Black Bulbul, Black Eagle, Oriental Turtle Dove and Red-vented Bulbul were sighted during the survey. Some species were confirmed based on their calling such as that of Red-tailed Minla, White-capped Redstart, Himalayan Bulbul, Blue Whistling Thrush and Ashy Dongo. Other reported birds in the area are House Crow, House Sparrow and Large-billed Crow.

S. No	Common Name	Scientific Name	Family	Local Name	IUCN Status
Mammalian species					
1	Barking Deer	<i>Muntiacus muntjak</i>	Cervidae	Mirga	LC
2	Flying Squirrel	<i>Hylopetes</i> sp.	Sciuridae	Rajpankhi	LC
3	Fox	<i>Vulpes</i> sp.	Canidae	Syaal	LC
4	Goral	<i>Naemorhedus goral</i>	Bovidae		NT
5	Himalayan black Bear	<i>Ursus thibetanus</i>	Ursidae	Bhalu	VU
6	Himalayan Langur	<i>Presbytes entellus</i>	Cercopithecidae		NA
7	Jungle Cat	<i>Felis chaus</i>	Felidae		LC
8	Leopard Cat	<i>Prionailurus bengalensis</i>	Malsapr		Lc

9	Monkey	<i>Macaca sp.</i>	Cebidae	Badar	LC
10	Asian palm civet	<i>Paradoxurus hermaphroditus</i>	Viverridae		LC
11	Red Fox	<i>Vulpes vulpes</i>	Canidae	Ursusthibetanus	LC
12	Red Panda	<i>Ailurus fulgens</i>	Ailuridae	Pudey kudo	EN
13	Spotted Deer	<i>Axis axis</i>	Cervidae	Mirga	LC
14	Wild Boar	<i>Sus scrofa</i>	Suidae	Bodyal	LC
15	Wild Dog	<i>Cuon alpinus</i>	Canidae	Ban kukur	EN
Avi-fauna					
1	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Chibey	Dicruridae	LC
2	Black Bulbull	<i>Hypsipetes leucocephalus</i>	Jureli	Pycnonotidae	LC
3	Black Eagle	<i>Ictinaetus malayensis</i>	Cheel	Accipitridae	LC
4	Blue Whistling Thrush	<i>Myophoneus caeruleus</i>	Kalchura	Turdidae	NA
5	Common Myna	<i>Acridotheres tristis</i>	Ruppi	Sturnidae	LC
6	Common Pigeon	<i>Columba livia</i>	Parewa	Columbidae	LC
7	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>		Pycnonotidae	LC
8	House Crow	<i>Corvus splendens</i>		Corvidae	LC
9	House Sparrow	<i>Passer domesticus</i>		Passeridae	LC
10	Large-billed Crow	<i>Corvus macrorhyncus</i>	Kaag	Corvidae	NA
11	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Dhukur	Columbidae	LC
12	Red-tailed Minla	<i>Minla ignotincta</i>		Leiothrichidae	LC
13	Red-vented Bulbull	<i>Pycnonotus cafer</i>	Jureli	Pycnonotidae	LC
14	Verditer Flycatcher	<i>Eumyiasthalassinus</i>	Chibey	Muscicapidae	
15	White-capped Redstart	<i>Chaimarrornis leucocephalus</i>	Dhobi Chara	Muscicapidae	LC

CONSERVATION RECOMMENDATION

As per the observation, some area of the forest was open or scarce of vegetation indicating low species diversity. Livestock grazing is one of the factor disturbing the ecology of the forest which affects vegetative structure, species composition of a plant community and decreases the biomass production. Hence, a strategic management plan must be adopted to control such activities in order to preserve the diversity of the forest. The forest also habitats a large number of species that are of medicinal value and must be conserved for future purpose as some species are being widely harvested for making medicines which may reduce or sadly, wiped out before time. Such species of importance can be preserved by cultivating them in the areas available. A regular monitoring of the forest can manage and control the exploitation of species. Plantation of soil-binding and water-holding capacity tree species such as that of oak can be done for strengthening the forest ecology.

Over the past few decades, there has been a huge modification in the vegetative structure, owing to several socio-cultural practices and traditional knowledge on the use of medicinal plants. Therefore, the unexplored area till date is found to be rich in terms of diversity of the species and it becomes important to document the plant biodiversity of the entire state before many of the species occurring in the state is wiped out for ever.

REFERENCES

3. R. R. Rao. Ethnobotany of Meghalaya: Medicinal Plants Used by Khasi and Garo Tribes. *Economic Botany*, 35(1), 1981, pp. 4-9.
4. S.Bhattarai, R.P.Chaudhary, R.S.L.Taylor, S.K. Ghimire. *Nepal J.Sci.Technol.*, 10, 83 (2009).
5. M.B. Gewali. Aspects of Traditional Medicine Aspects of Traditional Medicine in Nepal. Institute of Natural Medicine, University of Toyama 2630 Sugitani, Toyama 930-0194, Japan, <http://sureshawale.blogspot.com>(2008).
6. Y.C.Lama, S.K.Ghimire, Y.A. Thomos. Medicinal Plants of Dolpo, Amchis Knowledge and conservation. WWF Nepal Program, Kathmandu, Nepal (2011).
7. N.P. Manandhar. Plants and People of Nepal. Timber Press, Inc.Portland, Oregon, USA (2000).
8. S.Bhattarai, R.P.Chaudhary, R.S.L. Taylor. *J.Ethnobiol.Ethnomed.*, 2, 41 (2005).
9. *Selinum Wallichianum*. Royal Horticulture Society,
URL: <http://apps.rhs.org.uk/plantselector/plant?plantid=1822>(2011).
10. N. P. Manandhar. Plants and People of Nepal Timber Press. Oregon. ISBN 0-88192-527-6 (2002-00-00).

RAPID BIODIVERSITY OF MONGRANGANG RESERVE FOREST SAMPLING PATH, NORTH SIKKIM



Mongranggang Reserve Forest lies in the small Mongranggang hamlet about 32.6km away from the Gangtok. It takes around 1hour from Gangtok. The Reserve Forest is spread in an area of about 165.52 ha. The RF falls under Mongranggang Ward in Phodong Block under the purview of Phodong Range. The responsibility has been given to Mongranggang JFMC to look after the activities of forest department related with plantation, conservation and protection of the RF. The JFMC works along with the Phodong Range office.

The Reserve Forest is located between 27°26'38.7"- 27°26'54.7" Latitude(N) and 88°36'11.7"- 88°37'11.0" Longitude (E). The elevation of the RF varies from 1796m-2236m from mean sea level (msl). Similarly the slope angle varies from 30°-55° with an average humus depth of 4 cm. The forest vegetation is healthy and densely covered by the canopy of most dominant and more superior tree species, namely by *Quercus* sp, *Castanopsis* sp, etc.

The Reserve Forest is divided into two compartments. The compartment 1 has an area of 113.16 ha and compartment 2 has an area of 52.36 ha. Similarly, Forest is divided into 4 Forest types viz. East Himalayan Wet Temperate Forest, East Himalayan Moist Mixed Coniferous Forest, East Himalayan Sub Alpine Birch/Fir Forest & East Himalayan Sub Tropical Wet Hill Forest.

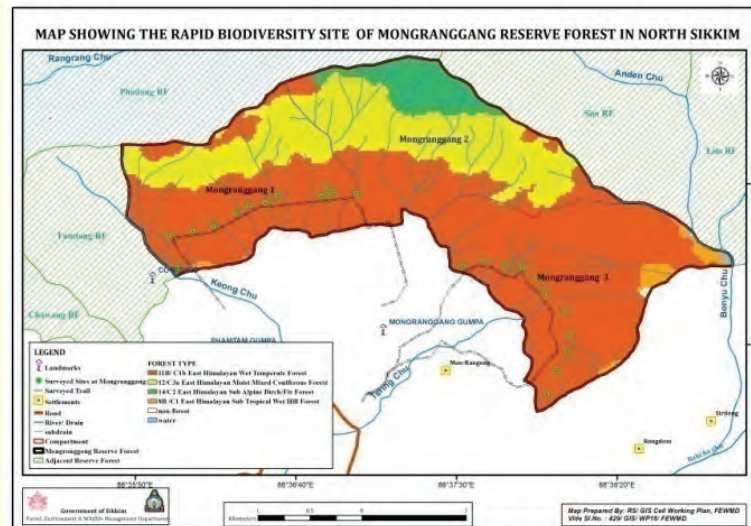
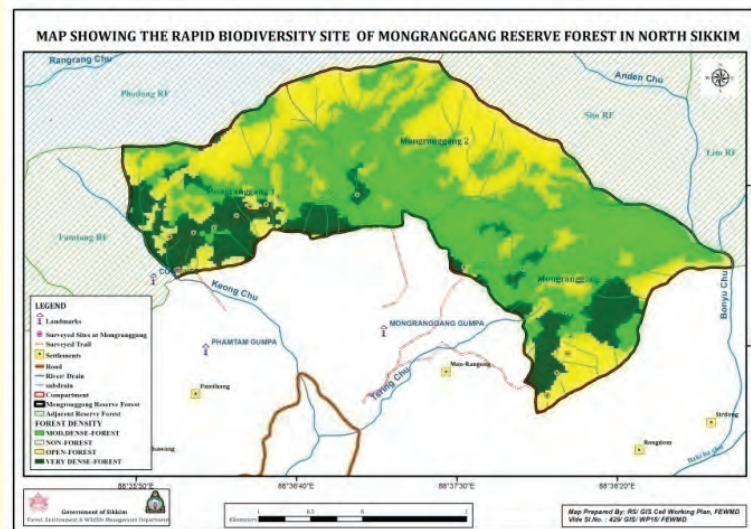
Among the forest type we mostly came across East Himalayan Wet Temperate Forest. This forest had a well synchronization of tree species such as *Acer campbellii*, *Castanopsis hystrix*, *Castanopsis tribuloides*, *Engelhardtia spicata*, *Lithocarpus pachyphyllus*, *Quercus lamellosa*, *Quercus lineata*, *Machilus edulis*, *Symplocos glomerata*, *Symplocos glomerata*, *Castanopsis tribuloides*, *Elaeocarpus lanceifolius*, etc. East Himalayan Sub

Tropical Wet Hill Forest was occupied by *Castanopsis indica*, *Schima wallichii*, *Alnus nepalensis*, *Macaranga denticulata*, *Michelia champaca*, etc.

From the information provided by the Mongranggang JFMC president the RF is home to many faunal species such as Wild pig, Barking Deer, Himalayan Palm Civet, Red Panda, Jungle Cat, Himalayan black bear, Orange-bellied himalayan squirrel, Rhesus macaque, etc. He further added that the RF is home to several avian-fauna and butterfly.

STUDY AREA

The current survey was carried out along the sampling path of Mongranggang Reserve Forest. The altitude of the surveyed path ranged from 2131m-2611m (msl). The forest lies between 27°26'38.7"- 27°26'54.7" Latitude(N) and 88°36'11.7"- 88°37'11.0" Longitude (E). The slope angle of the surveyed area ranged from 30°-55° and the aspect facing towards N, E, S, NE, SE & SW. The average depth of the humus was 4 cm. These parameters play a crucial role in overall growth and development of a healthy forest. The field visit was during the month of July 2018.



Map 1&2: Mongranggang Reserve Forest Density and Forest Types

FINDINGS AND DISCUSSION

During our survey in the RF a total of 80 plant species were recorded from 20 sampling plots which covered an area of 0.020 ha. A total of 30 tree species, 10 shrubs species, 25 herb species, 5 fern and fern-allies species and 10 orchids/epiphytes/climbers species were recorded. Some of the common Avian-faunal species sighted during our survey were Ashy Drongo, Blue Whistling Thrush, Common Myna, Common Pigeon, Oriental Turtle Dove, Verditer Flycatcher, etc. We also sighted some of the common butterfly species such as Golden Sapphire, Punchinello, Common Bushbrown, Indian Tortiseshell, etc. The Reserve Forest is divided into four forest types viz. East Himalayan Wet Temperate Forest, East Himalayan Moist Mixed Coniferous Forest, and East Himalayan Sub Alpine Birch/Fir Forest & East Himalayan Sub Tropical Wet Hill Forest. Among all the forest types, the East Himalayan Wet Temperate Forest and East Himalayan Sub Tropical Wet Hill Forest were the common forest types which we came across during our survey.

The East Himalayan Wet Temperate Forest was mostly dominated by *Acer campbellii*, *Castanopsis hystrix*, *Castanopsis tribuloides*, *Engelhardtia spicata*, *Lithocarpus pachyphyllus*, *Quercus lamellosa*, *Quercus lineata*, *Machilus edulis*, *Symplocos glomerata*, *Symplocos glomerata*, etc. While, the East Himalayan Sub Tropical Wet Hill Forest was mainly occupied by *Castanopsis indica*, *Schima wallichii*, *Alnus nepalensis*, *Macaranga denticulate*, *Michelia champaca*, *Ficus hookeri*, etc.

The ground vegetation was healthy and most of the sampling plots were covered with *Persicaria capitata*, *Artemisia wallichiana*, *Eupatorium adenophorum*, *Laportea terminalis*, *Aconogonum molle*, *Carex pulchra*, *Begonia rubella*, *Bidens pilosa*, *Laportea terminalis*, *Strobilanthes Sp.*, *Cyanodon dactylon*, etc. The common species of fern and fern-allies in the forest were *Asplenium ensiforme*, *Diplazium stoliczkae*, *Lycopodium japonicum*, *Boehmeria platyphylla*, etc.

Site characteristics of the sampling plots of Mongranggang Reserve Forest, Phodong Range, North Sikkim

Sl. No	Site code	District	Range	Forest Types	Lat (N)	Long (E)	Elevation (m)	Slope Aspect	Slope Angle
1	M-RF1	Mangan	Phodong	Wet Temperate Forest	27°26'38.7"	88°36'11.7"	1796	N	45
2	M-RF2	Mangan	Phodong	Wet Temperate Forest	27°27'03.7"	88°36'03.1"	1804	NW	40
3	M-RF3	Mangan	Phodong	Wet Temperate Forest	27°27'02.7"	88°36'07.4"	2058	NW	30
4	M-RF4	Mangan	Phodong	Wet Temperate Forest	27°27'07.6"	88°36'14.3"	2072	NW	45
5	M-RF5	Mangan	Phodong	Wet Temperate Forest	27°27'10.2"	88°36'19.5"	2073	NW	40
6	M-RF6	Mangan	Phodong	Wet Temperate Forest	27°27'10.2"	88°36'25.3"	2061	NW	45
7	M-RF7	Mangan	Phodong	Wet Temperate Forest	27°27'12.3"	88°36'29.3"	2079	N	35
8	M-RF8	Mangan	Phodong	Wet Temperate Forest	27°27'13.5"	88°36'42.1"	2140	NW	45

9	M-RF9	Mangan	Phodong	Wet Temperate Forest	27°27'12.9"	88°36'47.0"	2124	N	45
10	M-RF10	Mangan	Phodong	Wet Temperate Forest	27°27'13.5"	88°36'53.6"	2148	N	45
11	M-RF11	Mangan	Phodong	Wet Temperate Forest	27°26'35.5"	88°37'45.0"	2183	E	45
12	M-RF12	Mangan	Phodong	Wet Temperate Forest	27°26'40.6"	88°37'41.8"	2197	S	45
13	M-RF13	Mangan	Phodong	Wet Temperate Forest	27°26'46.2"	88°37'42.5"	2164	SW	30
14	M-RF14	Mangan	Phodong	Wet Temperate Forest	27°26'48.6"	88°37'41.4"	2185	SW	40
15	M-RF15	Mangan	Phodong	Wet Temperate Forest	27°26'52.6"	88°37'39.7"	2229	NE	50
16	M-RF16	Mangan	Phodong	Wet Temperate Forest	27°26'54.3"	88°37'35.9"	2236	SE	45
17	M-RF17	Mangan	Phodong	Wet Temperate Forest	27°26'58.1"	88°37'03.3"	2203	SW	45
8	M-RF18	Mangan	Phodong	Wet Temperate Forest	27°27'01.7"	88°37'21.3"	2161	W	45
19	M-RF19	Mangan	Phodong	Wet Temperate Forest	27°26'58.8"	88°47'15.3"	2102	E	45
20	M-RF20	Mangan	Phodong	Wet Temperate Forest	27°26'54.7"	88°37'11.0"	2072	NE	55

**Checklist of floral Species recorded in Mongranggang Reserve forest,
Phodong Range, North Sikkim**

S.NO	Botanical Name	Local Name	Family
	TREES		
1	<i>Ficus hookeri</i> Miq.	Nabara	Moraceae
2	<i>Eurya acuminata</i> DC.	Jhingni	Theaceae
3	<i>Zanthoxylum acanthopodium</i> DC	Boke timmur	Rutaceae
4	<i>Exbucklandia populnea</i> (R. Br. Ex Griff) R. W. Br	Piplee	Hamamelidaceae
5	<i>Macaranga denticulata</i> (Blume) Müll.Arg.	Malata	Euphorbiaceae
6	<i>Elaeocarpus lanceifolius</i> Roxb.	Bhadrasey	Elaeocarpaceae
7	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Musrey katush	Fagaceae
8	<i>Engelhardtia spicata</i> Lechen ex Blume.	Mauwa	Juglandaceae
9	<i>Symplocos glomerata</i> King ex C.B. Clarke	Kholme	Symplocaceae
10	<i>Saurauia napaulensis</i> Dc.	Gogun	Saurauiaceae
11	<i>Lyonia ovalifolia</i> var. <i>ovalifolia</i>	Angeri	Ericaceae
12	<i>Betula cylindrostachya</i> Lindl. ex Wall.	Saur	Betulaceae
13	<i>Machilus</i> sp.	Kawlo	Lauraceae
14	<i>Brassaiopsis mitis</i> C.B.Clarke	Phutta	Araliaceae
15	<i>Cryptomeria japonica</i> (Thunberg ex. Linn. F.) D. Don	Dhupi	Taxodiaceae
16	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.) Figlar	Ranichamp	Magnoliaceae
17	<i>Castanopsis hystrix</i> Hook. & Thomson ex. A. DC.	Patley katush	Fagaceae
18	<i>Acer campbellii</i> Hook. & Thom. Ex Hiern.	Kapasey	Sapindaceae
19	<i>Quercus lineata</i> Blume	Phalut	Fagaceae
20	<i>Symplocos lucida</i> (Thunb.) Siebold & Zucc	Kharane	Symplocaceae

21	<i>Alnus nepalensis</i> Don.	Utis	Betulaceae
22	<i>Quercus lamellosa</i> Sm.	Buk/Bajranth	Fagaceae
23	<i>Machilus edulis</i> King.	Pomsi	Lauraceae
24	<i>Leucosceptrum canum</i> Sm.	Gurpis	Lamiaceae
25	<i>Lithocarpus fenestrata</i> Roxb.	Arkawlo	Fagaceae
26	<i>Rhus succedanea</i> Linn.	Rani bhalayo	Anacardiaceae
27	<i>Leucosceptrum canum</i> Sm.	Gurpis	Lamiaceae
28	<i>Rhododendron arboreum</i> ssp. <i>arboreum</i> (CB Clarke) Ridley.	Guras	Ericaceae
29	<i>Schima wallichii</i> Choisy	Chilaune	Theaceae
30	<i>Prunus bracteopadus</i> Koehne	Arupatey	Rosaceae
	SHRUB & SHRUBLET		
1	<i>Ardisia macrocarpa</i> Wall.	Damai phal	Myrsinaceae
2	<i>Edgeworthia gardenieri</i> Meissn.	Algeri/Lokti	Thymeleaceae
3	<i>Rubus ellipticus</i> sp.	Aiselu	Rosaceae
4	<i>viburnum erubescence</i> Wall.ex DC	Asarey	Adoxaceae
5	<i>Maesa chisia</i> Don	Bilauney	Myrsinaceae
6	<i>Dichroa febrifuga</i> Lour.	Basak	Hydrangaceae
7	<i>Osbeckia stellata</i> Buch.-Ham.ex D. Don	Chulesi	Melastomataceae
8	<i>Mahonia napaulensis</i> DC	Chutro	Berberidaceae
9	<i>Urtica parviflora</i>	<i>Bhangray Sisnu</i>	Urticaceae
10	<i>Mussendra roxburghii</i>	Dhobi phool	Myrsinaceae
	HERB		
1	<i>Eragrostis</i> sp.	Banso	Poaceae
2	<i>Persicaria capitata</i> (Buch.Ham.ex D.Don) Gross	Ratneulo	Polygonaceae
4	<i>Centella asiatica</i> Linn.	Golpatta	Apiaceae
5	<i>Artemisia wallichiana</i> Bess.	Titepati	Asteraceae
6	<i>Arisaema intermedium</i> Blume	Larua/Banko	Araceae
7	<i>Solanum khasianum</i> CB Clarke	Solanaceae	Boksi kara
8	<i>Eragrostis</i> sp.	Chitrey banso	Poaceae
9	<i>Pilea umbrosa</i> Wall.ex Blume	Chipley	Urticaceae
10	<i>Eupatorium adenophorum</i> Spreng.	Kalizhar	Asteraceae
11	<i>Laportea terminallis</i> Wight.	Gharia sisnu	Urticaceae
12	<i>Swertia bimaculata</i> Hooker & Thomson ex C.B. Clarke	Bhaley Chirowto	Gentianaceae
13	<i>Carex pulchra</i> Boott.	Harkatto	Cyperaceae
14	<i>Elatostema</i> sp.	Gagleto	Urticaceae
15	<i>Polygonum molle</i> D.Don	Thotney	Polygonaceae
16	<i>Begonia rubella</i> Buch.-Ham.Ex D.Don`	Magar kajey	Begoniaceae
17	<i>Bidens pilosa</i> Linn.	Kuro	Asteraceae
18	<i>Campylandra aurantica</i> Baker.	Jungali Nakima	Liliaceae
19	<i>Laportea terminalis</i> Wight.	Patle sisnu	Urticaceae
20	<i>Hedychium Spicatum</i> Smith in Rees.	Sara	Zingiberaceae
21	<i>Strobilanthes</i> Sp.	Kibu ghans	Acanthaceae
22	<i>Boehmeria platyphylla</i> D.Don	Kamley	Urticaceae
23	<i>Anaphalis margaritaceae</i> (Linn.)Benth.	Bukiful	Asteraceae
24	<i>Houttuynia cordata</i> Thunb.	Gandey jhar	Saururaceae
25	<i>Cyanodon dactylon</i>	Dubo	Poaceae
	Ferns and Ferns-allies		
1	<i>Diplazium stoliczkae</i> Beddome	Ningro	Woodsiaceae
2	<i>Asplenium ensiforme</i> wall.	Uniu	Aspleniaceae

3	<i>Diplazium sp.</i>	Kalo ningro	Woodsiaceae
4	<i>Selaginella chrysocaulos (Hook. & Grev.) Spring</i>	Phusphusay	Selaginellaceae
5	<i>Lycopodium japonicum Thunb.</i>	Nagbelli	Lycopodiaceae
	Orchids/Epiphytes/Climbers		
1	<i>Stephania sp.</i>	Tamarkey	Menispermaceae
2	<i>Piper boechmeriaefolium (Miq.) DC.</i>	Chambo	Piperaceae
3	<i>Clematis buchananiana DC.</i>	Pinasey lahara	Ranunculaceae
4	<i>Rubia cordifolia L</i>	Manjith	Rubiaceae
5	<i>Rhapidiphora decursiva (Roxb.) Schott.</i>	Kanchirno	Araceae
6	<i>Mussendra sp.</i>		Dhobi phool
7	<i>Pleione hookeriana (Lindl.) Rollisson</i>	Orchid	Orchidaceae
8	<i>Tetrastigma serrulatum (Roxb.) Planch.</i>	Charcharey lahara	Vitaceae
9	<i>Trichosanthes lepiniana (Naudin) Cogn.</i>	Indreni	Cucurbitaceae
10	<i>Coelogyne sp.</i>	Sunakhari	Orchidaceae

**Checklist of fauna & avifauna species encountered at
Mongranggang Reserve Forest, North Sikkim.**

S.No	Zoological Name	Common Name	Local Name	Family
FAUNA				
1	<i>Ursus thibetanus</i>	Himalayan black bear	Bhalu	Ursidae
2	<i>Vulpes vulpes</i>	Red fox		Canidae
3	<i>Muntiacus muntjak</i>	Barking deer	Mirgha	Cervidae
4	<i>Sus scrofa</i>	Wild pig	Bhodel	Suidae
5	<i>Felis chaus</i>	Jungle cat		Felidae
6	<i>Paguma larvata</i>	Himalayan palm civet		Viverridae
Avi-Fauna				
1	<i>Acridotheres tristis</i>	Common Myna	Ruppi	Sturnidae
2	<i>Columba livia</i>	Common Pigeon	Parewa	Columbidae
3	<i>Parus monticulus</i>	Green Backed Tit	Chichinkkotey	Paridae
4	<i>Lophura leucomelanos</i>	Kalij Pheasant	Kaleej	Phasianidae
5	<i>Streptopelia orientalis</i>	Oriental Turtle Dove	Dhukur	Columbidae
6	<i>Eumyias thalassinus</i>	Verditer Flycatcher	Hareney	Muscicapidae
7	<i>Dicrurus leucophaeus</i>	Ashy Drongo	Chibey	Phasianidae
8	<i>Myophonus caeruleus</i>	Blue Whistling Thrush	Kalchura	Muscicapidae
Butterfly				
1	<i>Mycalesis perseus</i>	Common Bushbrown		Nymphalidae
2	<i>Aglais cashmiriensis</i>	Indian Tortiseshell		Nymphalidae
3	<i>Pieris sp.</i>	Cabbage White		Pieridae
4	<i>Heliophorus brahma</i>	Golden Sapphire		Lycanidae
5	<i>Zemeros flegyas</i>	Punchinello		Lycanidae

FIELD ACTIVITIES



Species Documentation



Species Photography



Aeschynanthus sikkimensis



Zanthoxylum acanthopodium



Solanum sp.



Golden Sapphire

Recommendations

1. Promoting Ecotourism by providing training to the rural youths in bird watching, butterfly and plant identifications through such activities the unemployed youths can avail the benefits and helps in sustaining their life.
2. During the survey we observed most of the open patches where colonised mostly by the *Symplocos glomerata* and *Symplocos lucida*, even the natural regeneration of these species were healthy and good in numbers. We noticed that the species had suppressed the natural regeneration of Oak species in particular and other valuable species of the forest. These invasive species should be controlled otherwise keystone species such as oak will be depleted from the ecosystem of this forest.
3. Plantation of Oak species such as *Castanopsis tribuloides*, *Quercus lamellose*, *Castanopsis hystrix* and *Quercus lineate*, etc should be the top priority, because as per our observation the natural regeneration of these species was nil and most of the trees present in the forest were old. So the species being a keystone species act as the backbone of the ecosystem, and without which the ecosystem would fail. So conservation of these species should be our top priority.
4. The plantation of the *Cryptomeria japonica* stand needs to be maintained properly because some of the trees growth was inferior and stunted, some have decayed and died. So proper thinning and cleaning is required so that it will not infest and damage the other trees in the stand. Similarly, Cleaning of the tree needles of the plantation site should be done periodically to protect from forest fire.

RAPID BIODIVERSITY OF PHODONG RESERVE FOREST SAMPLING PATH, NORTH SIKKIM



Fig 1: Overview of Phodong Reserve Forest, North Sikkim

Rapid Biodiversity Survey was conducted in Phodong Reserve Forest, covering an elevation ranges between 1393m to 2248m above sea level which is lying latitude 27°26'26.24" N to 27°30'01.89" N and Longitude 88°32'37.85" E to 88°35'54.51" E. The random 41 sampling plots were laid in the forest. Phodong RF constitute different types of forest viz., very moist Sal Bearing forest, East Himalayan Sub –tropical wet hill forest, East Himalayan Wet Temperate forest, East Himalayan Moist mixed coniferous forest, East Himalayan Sub-alpine Birch/Fir Forest, Birch-Rhododendron scrub forest and Dwarf Juniper scrub, etc. Reserve forest encompasses 15 different compartments in various forest types in North Sikkim. Such as compartment 1 (Gethang RF), compartment 2 (Phodong RF), compartment 3 (Namok RF), compartment 4 (Tingchim RF), compartment 5 (Rangrang RF), compartment 6 (Kaley RF), compartment 7 (Pamthang RF), compartment 8 (Manul RF), compartment 9 (Chakung RF), compartment 10 (Phensang RF), compartment 11 (Myong RF) and compartment 12 (Naga RF) and compartment 13, 14 & 15, sharing its border with Chungthang in the North, Mangan in the West, Chawang & Men Rong in the South direction in the North Sikkim. According to the forest density, two compartments has very dense and moderately dense forest canopy cover in the entire reserve forest. The team focused on two compartments, i.e., Kaley locally called “Kalow” and “Tingchim” near Rangrang Chu. Kaley compartment shares its border with Upper Singhik in the north and Kalow-Nampatam in the West, Rangrang RF in the South and Pamthang RF in the East over the Rangrang Khola in the North Sikkim. Similarly,

Tingchim compartment shares its border with Rangrang Chu in the north, Tingchim in the West, Lower Mangshila in the South and Chawang RF and Pamthang RF in the East. This area has water stream which flow in-between the Rangrang RF and Kaley RF is Rangrang Khola. The river called “Mayang Chu” which flow in the Manul RF and “Ri Chu” which flow over Chakung RF. The slope angle of the surveyed area ranged from 25 to 65-degree and aspect facing towards, N, E, W and S. The field survey was done during June 2018.

Table 1: Site characteristic of Phodong Reserve Forest in North Sikkim

Site code	Forest type	Altitude (m)	Aspect	Slope (°)	GPS		Disturbance	Canopy cover (%)
					Lat (N)	Long (E)		
PRF 1	Temperate Broad-leaved Forest	2064	N	65	27°29'02.91	88°33'50.86	Natural	65
PRF 2	Temperate Broad-leaved Forest	2111	N	55	27°28'57.86	88°35'54.51	Natural	55
PRF 3	Temperate Broad-leaved Forest	2174	N	35	27°28'52.86	88°34'03.50	Natural	55
PRF 4	Temperate Broad-leaved Forest	2172	N	45	27°28'59.56	88°34'17.05	Natural	40
PRF 5	Temperate Broad-leaved Forest	2127	NW	75	27°28'55.81	88°34'22.26	Natural	60
PRF 6	Temperate Broad-leaved Forest	2154	NW	25	27°28'57.99	88°34'19.98	Natural	45
PRF 7	Temperate Broad-leaved Forest	2180	NW	45	27°28'59.59	88°34'16.15	Natural	40
PRF 8	Temperate Broad-leaved Forest	2222	SW	45	27°28'58.97	88°34'09.16	Natural	50
PRF 9	Temperate Broad-leaved Forest	2215	NW	35	27°28'35.14	88°34'04.03	Natural	45
PRF 10	Temperate Broad-leaved Forest	2248	W	65	27°29'04.11	88°33'59.27	Natural	45
PRF 11	Temperate Broad-leaved Forest	2226	SW	35	27°29'16.06	88°33'56.48	Natural	30
PRF 12	Temperate Broad-leaved Forest	2192	N	50	27°29'19.92	88°33'50.22	Natural	45
PRF 13	Temperate Broad-leaved Forest		SE	45	27°29'23.43	88°33'32.75	Natural	65
PRF 14	Temperate Broad-leaved Forest	2133	S	35	27°29'26.83	88°33'42.11	Natural	60
PRF 15	Temperate Broad-leaved Forest	2062	SW	45	27°30'01.89	88°33'43.05	Natural	55
PRF 16	Temperate Broad-leaved Forest	2089	SW	35	27°30'00.73	88°34'15.61	Natural	35
PRF 17	Temperate Broad-leaved Forest	2087	N	45	27°29'58.98	88°34'09.87	Natural	60
PRF 18	Temperate Broad-leaved Forest	2058	NW	45	27°30'00.76	88°33'58.53	Natural	60

PRF 19	Temperate Broad-leaved Forest	2059	NE	35	27'30" 00.17	88'33"54. 28	Natural	65
PRF 20	Temperate Broad-leaved Forest	2061	NE	45	27'30" 00.25	88'33"50. 36	Natural	70
PRF 21	Temperate Broad-leaved Forest	2020	NE	40	27'26" 52.34	88'32"50. 89	Natural	45
PRF 22	Temperate Broad-leaved Forest	2013	N	45	27'26" 30.09	88'32"41. 25	Natural	40
PRF 23	Temperate Broad-leaved Forest	2044	SW	40	27'26" 38.93	88'32"45. 34	Natural	45
PRF 24	Temperate Broad-leaved Forest	2069	W	40	27'26" 46.32	88'32"51. 78	Natural	25
PRF 25	Temperate Broad-leaved Forest	2065	NE	35	27'26" 47.52	88'32"53. 53	Natural	40
PRF 26	Temperate Broad-leaved Forest	2062	N	40	27'26" 43.29	88'32"58. 41	Natural	35
PRF 27	Temperate Broad-leaved Forest	2049	N	35	27'26" 46.7	88'32"55. 5.4	Natural	35
PRF 28	Temperate Broad-leaved Forest	2020	N	40	27'26" 26.24	88'32"37. 85	Natural	55
PRF 29	Temperate Broad-leaved Forest	1924	W	45	27'27" 00.35	88'32"63. 89	Natural	50
PRF 30	Temperate Broad-leaved Forest	1882	SE	30	27'86" 56.97	88'32"08. .03	Natural	40
PRF 31	Temperate Broad-leaved Forest	1896	SE	40	27'27" 02.48	88'33"20. 04	Natural	36
PRF 32	Temperate Broad-leaved Forest	1833	SW	45	27'27" 20.76	88'33"37. 55	Natural	40
PRF 33	Temperate Broad-leaved Forest	1684	S	45	27'27" 25.49	88'32"43. 21	Natural	55
PRF 34	Temperate Broad-leaved Forest	1620	NW	45	27'27" 22.72	88'32"51. 31	Natural	45
PRF 35	Temperate Broad-leaved Forest	1671	NW	0	27'27" 22.38	88'33"08. 25	Natural	55
PRF 36	Temperate Broad-leaved Forest	1608	E	45	27'27" 26.01	88'32"57. 0	Natural	60
PRF 37	Sub-tropical forest	1560	SW	35	27'27" 31.54	88'32"51. 52	Natural	50
PRF 38	Sub-tropical forest	1593	SW	35	27'27" 31.91	88'33"03. 40	Natural	62
PRF 39	Sub-tropical forest	1573	N	40	27'27" 35.32	88'33"06. 89	Natural	65
PRF 40	Sub-tropical forest	1544	N	45	27'27"37 .32	88'32"59. 44	Natural	65
PRF 41	Sub-tropical forest	1393	N	50	27'27" 16.61	88'32"46. 50	Natural	50



Fig 2: Survey Team along with JFMs and Forest Staff of North Sikkim

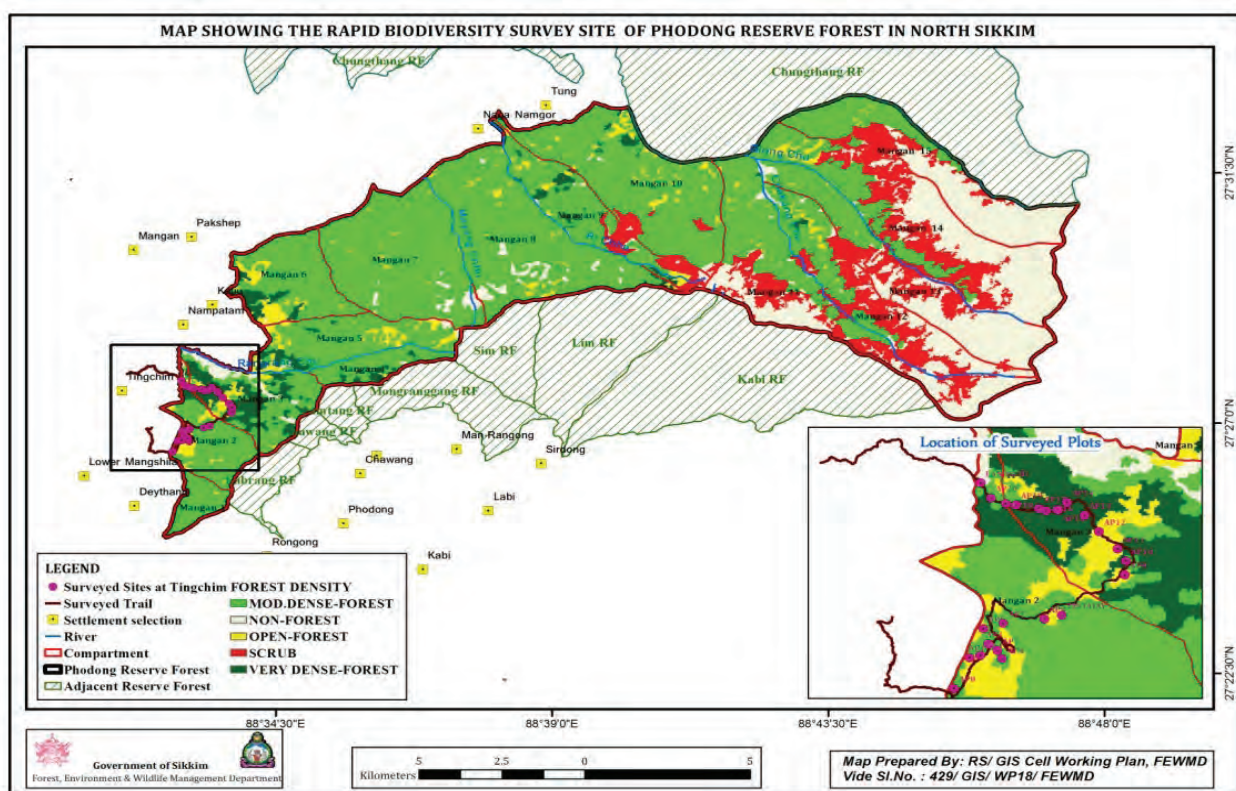
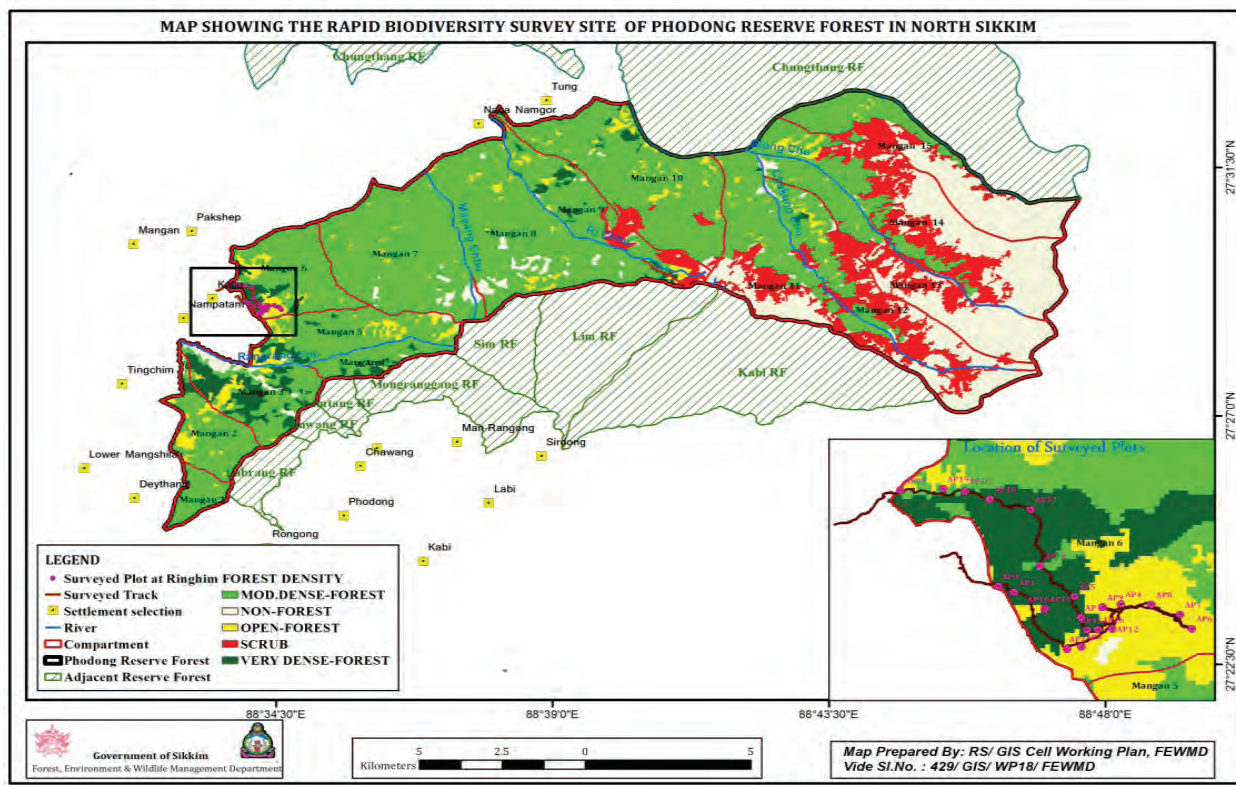


Fig 3: Map showing the rapid biodiversity survey site of Phodong reserve forest in North Sikkim

FIELD ACTIVITIES



Fig4-9: Survey Team with JFMs and forest field staff during the survey period.

FINDINGS AND DISCUSSION

A total of 145 plants species were recorded in 41 sampling plots, covering an area of 0.41 ha in reserve forest. Of which 45 tree species, 28 sapling species and 29 seedling species, 21 shrubs species, 69 herb species and many other ferns and fern-allies, 10 orchids species, lichen and mosses were inventoried in the entire sampling plots. Diversity of vegetation was found most in the case of ground flora as comparison to tree and shrubs, which are listed in the below [Table 3]. Random sampling plots 1 to 21 were laid in Kaley Reserve forest, and the remaining 22 to 41 sampling plots were laid in Tingchim reserve forest. The main vegetation in the sub-tropical forests such as *Alnus nepalensis*, *Macaranga denticulata*, *M. pustulata* and *Choerospondias axillaris*, etc., and *Castanopsis* sp., *Quercus* sp., *Magnolia* sp., *Machilus* sp., *Elaeocarpus* sp., *Eurya* sp., *Symplocos* sp., etc., were densely distributed in wet temperate forest.

SIGNIFICANCE OF THE RESERVE FOREST

1. High value medicinal plants and NTF product were inventoried all along the sampling plots.
2. Giant Himalayan Lily habitat was encountered along the sampling plots which is rarely distributed in the forest.
3. Over 10 orchid species diversity were inventoried.

Reserve forest has harbored a variety of medicinal plant species such as *Heracleum nepalense*, *Houttuynia cordata*, *Hemiphragma heterophyllum*, *Astilbe rivularis*, *Acorus calamus*, *Euphorbia hirta*, *Achyranthus bidentata*, *Spermacoce ocymoides*, *Crassocephalum crepidioides*, *Centella asiatica*, *Eupatorium odoratum*, *Bidens pilosa*, *Crassocephalum crepidioides*, *Ageratum conyzoides* and *Galinsoga parviflora* etc. *Heracleum nepalense* is one of them which have valuable resources for people to sustain livelihood options. It is high demand in local market fetching Rs. 10 per umbel. The umbels are used to treat headache, vomiting sensation, stomachache and indigestion problem. According to my personnel observation, the life span of *H. nepalense* is only three years. So, it is recommended that the sustainable harvesting practice is needed for the conservation of valuable natural resources in Sikkim. *H. nepalense* was found under the canopy of *Eurya acuminata*, *Symplocos lucida*, *Symplocos glomerata*, *Castanopsis tribuloides* associated with edible ferns *Allantodia maximum* (Sauney Nigro). The young shoots of *Allantodia maximum* have also good demand in local market during harvesting season. Both the plants were used to make pickles by Govt. of Sikkim. Other NTFP products are bamboo (shoots) *Tupistra nutans* (inflorescence) were high demand in local market which was encountered along the sampling plots. These species needs to be conserved in natural habitat mostly in temperate forest of Sikkim himalayan region. The ecological conditions and physiological factors existing in temperate forest are most favorable for the growth of these species. Restoration of medicinal plants and their conservation in nature promotes the existence of other biodiversity too. Instant conservation and management approaches of valuable plants with the involvement of local indigenous people of Sikkim will encourage the sustainable conservation of both biological and cultural diversity.



Fig 10: Good habitat of Heracleum nepalense

Giant Himalayan Lily: Giant Himalayan lily occurs in the Himalayas and may reach a height of two-three meters with almost 20 cm long fragrant trumpet-shaped flowers and large heart shaped leaves. The middle flowers of the raceme open first. The buds have an upright position in the raceme while the flowers in the beginning are oriented perpendicular to the axis but later on become hanging. The white flowers (maroon interior markings) are beautiful and fragrant. After pollination the petals fall off and the swelling ovary lengthens and turns upright from its formerly pendant position. The flower stalks age beautifully in the fall and on a dry day, the seed pods split open and shimmering drifts of delicate seed float down to the ground (<http://www.flowersofindia.net/catalog/slides/Giant%20Himalayan%20Lily.html>). This species is found growing in the Tingchim reserve forest, at an elevation of 1700m asl associated with common shrub species such as *Viburnum* sp., *Polygonum molle* and *Persicaria* sp. etc. This plant has various medicinal properties such as the leaves are used as an external cooling application to alleviate the pains of wounds and bruises. A paste of the roots is applied as a poultice to treat dislocated bones. (<http://www.naturalmedicinalherbs.net/herbs/c/cardiocrinum-giganteum.php>).



Fig 11 & 12:Cardiocrinum giganteum habitatat Phodong reserve forest

ORCHID DIVERSITY

Over 10 orchid species diversity was found in Phodong Reserve Forest along the sampling paths.

Sl. No	Botanical Name
1.	<i>Bulbophyllum</i> sp.
2.	<i>Calanthe brevicornu</i> Lindl
3.	<i>Coelogyne</i> sp.
4.	<i>Coelogyne brevicornu</i> Lindl
5.	<i>Dendrobium amoenum</i> Wall. ex Lindl.
6.	<i>Dendrobium</i> sp.
7.	<i>Crepidium acuminatum</i>
8.	<i>Liparis</i> sp.
9.	<i>Pholidota imbricata</i> Lindl
10.	<i>Pleione praecox</i> (Sm.) D. Don



Fig 13: Calanthe brevicornu Lindl



Fig 14: Coelogyne brevicornu Lindl



Fig 15: Dendrobium amoenum Wall. ex Lindl.

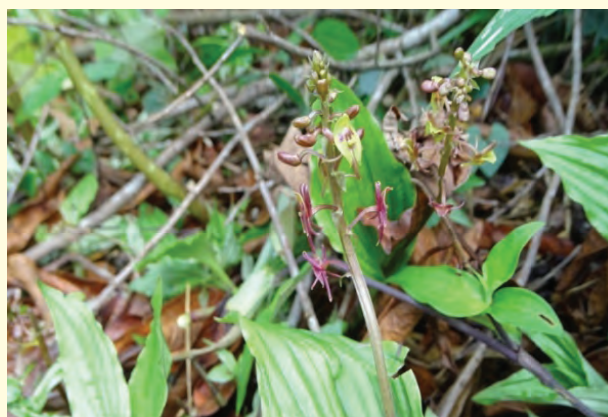


Fig 16: Crepidium acuminatum (D. Don) Szlach

FAUNAL DIVERSITY

During the field survey, a number of faunal, butterflies and avi-faunal species were sighted and indirect evidences were encountered. A total of 39 avi-fauna species followed by 16 butterflies and 9 fauna species were encountered by direct and indirect evidences. The digging signs of Wildpig were common along the forest trail in the forest floor that confirmed its presence and richness. Pellets of Barking deer and Goral were observed in the forest. Many other indirect evidences were observed in the forest like scattered tree bark which indicate the presence of Himalayan Black Bear. Other species such as Yellow-throated Marten, Jackel, Kalij pheasant, squirrels and Himalayan palm civet were encountered along the sampling paths.



Fig 17: Wild pig digging sign



Fig 18: Civet drooping



Fig 19: Wild Fox (Scats)

MAJOR THREATS

1. Human wildlife conflict is main problem in the forest as per the local people. The fringe forest is frequently visited by Himalayan black bear especially cattleshed for food. Phodong RF is the habitat of Himalayan black bear as per the indirect evidences were observed during the survey period.
- 2.

CONSERVATION RECOMMENDATION AND CONCLUSIONS

1. Through the rapid biodiversity survey, it has been found that, part of the forest has anthropogenic disturbances by grazing and some other parts remain rich in biodiversity.
2. Some other parts of the reserve forest revealed that floral diversity including tree, shrub, herb, orchid, climber, ferns and fern-allies, bamboo, which provides the edible shoots, flowers, fruits and seeds etc.
3. The forest has more landslide areas as observed during the field survey. Landslide is one of the major problems for biodiversity loss, habitat destruction and fragmentation of both floral and faunal species. Many sides of the reserve forest areas are constantly threatened by soil erosion and landslides. So, it is recommended that soil binding species along with fruits bearing trees species should be planted in affected areas.

For the point of biodiversity conservation in the reserve forest, grazing ban should be strictly imposed, anthropogenic disturbance like collection of NTFP product should be regulated through sustainable harvesting practice and plantation of soil binding species in affected landslide prone zones. Due to anthropogenic disturbances, the forest resources are decreasing due to negative impact on food and shelter for wildlife. Human-wildlife conflict is major problem in the Phodong reserve forest. When humans try to harvest natural resources, automatically the shortage of food resources in the forest also occurs. It is concluded that, the reserve forest needs to manage effectively by plantation drive in landslide affected areas, open areas and mostly host plant of Himalayan black bear should be planted in the forest.

Table 3: Checklist of Floral species encountered along the sampling plots of Phodong Reserve Forest, North Sikkim

	Botanical Name	Local name	Family
	TREE		
1	<i>Acer campbellii</i> Hook. & Thom. Ex Hiern.	Kapasey	Sapindaceae
2	<i>Acer palmatum</i>	Kapasey	Sapindaceae
3	<i>Actinodaphne sikkimensis</i>	Sisi	Lauraceae
4	<i>Alnus nepalensis</i> Don.	Utis	Betulaceae
5	<i>Beilschmiedia sikkimensis</i> King ex Hook. f.	Tarsing	Lauraceae
6	<i>Betula cylindrostachya</i> Lindl. ex Wall.	Saur	Betulaceae
7	<i>Brassaiopsis mitis</i> C.B. Clarke	Phutta	Araliaceae
8	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Musrey katush	Fagaceae
9	<i>Cryptomeria japonica</i> (Thunberg ex. Linn. F.) D. Don	Dhupi	Taxodiaceae
10	<i>Daphniphyllum himalayense</i> (Benth.)	Lal Chandan	Euphorbiaceae
11	<i>Echinocarpus dasycarpus</i> Benth.	Gobrey	Elaeocarpaceae
12	<i>Elaeocarpus lanceifolius</i> Roxb.	Bhadrasay	Elaeocarpaceae
13	<i>Erythrina arborescens</i> Roxb.	Phalado	Fabaceae
14	<i>Eurya acuminata</i> DC.	Jhingni	Theaceae
15	<i>Exbucklandia populnea</i> (R. Br. Ex Griff) R. W. Br	Piplee	Hamamelidaceae
16	<i>Ficus nemarolis</i> Wall.	Dudhilo	Moraceae
17	<i>Hovenia dulcis</i> Thunb.	Bangi	Thymelaeaceae
18	<i>Juglans regia</i> Linn.	Okhar	Juglandaceae
19	<i>Leucosceptrum canum</i> Sm.	Ghurpis	Lamiaceae
20	<i>Lithocarpus pachyphylla</i>	Katus	Fagaceae
21	<i>Litsea kingii</i> Hook.	Siltimur	Lauraceae
22	<i>Lyonia ovalifolia</i> var. <i>ovalifolia</i>	Angeri	Ericaceae
23	<i>Macaranga denticulata</i> (Blume) Müll.Arg.	Malata	Euphorbiaceae
24	<i>Machilus</i> sp.	Kawlo	Lauraceae
25	<i>Machilus</i> sp.	Kawlo	Lauraceae
26	<i>Machilus</i> sp.	Kawlo	Lauraceae
27	<i>Maesa</i> sp.	Bilauney	Myrtaceae
28	<i>Maesa</i> sp.	Bilauney	Myrtaceae
29	<i>Magnolia cathcartii</i>	Titey champ	Magnoliaceae
30	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.) Figlar	Rani Champ	Magnoliaceae
31	<i>Meliosma arnottiana</i> (Wight) Walp.	Dabdabey	Sabiaceae
32	<i>Michelia velutina</i> DC.	Phusrey champ	Magnoliaceae
33	<i>Nyssa javanica</i> (Blume) Wangerin	Lek chilauney	Cornaceae
34	<i>Oxydendron paniculata</i> (D. Don) DC	Chulesee	Melastomaceae
35	<i>Pentapanax leschenaultii</i> Seem	Chindey	Araliaceae
36	<i>Prunus nepalensis</i> (Ser.) Stud.	Arupatey	Rosaceae
37	<i>Pyrularia edulis</i> (Wall.) A. DC.	Amphi	Santalaceae
38	<i>Quercus lamellosa</i> Sm.	Buk/Bajranth	Fagaceae
39	<i>Rhus succedanea</i> Linn.	Rani bhalayo	Anacardiaceae
40	<i>Saurauia napaulensis</i> DC	Gagun	Actinidaceae
41	<i>Schima wallichii</i> Choisy.	Chilaune	Theaceae
42	<i>Symplocos glomerata</i> D. Don	Kholmey	Symplocaceae

43	<i>Symplocos lucida</i> D. Don	Kharaney	Symplocaceae
44	<i>Tetradium fraxinifolium</i>	Khanakpa	Rutaceae
45	<i>Zanthoxylum acanthopodium</i> DC	Bokey timmur	Rutaceae
	SHRUB		
1	<i>Ardisia macrocarpa</i> Wall.	Damai dana	Myrsinaceae
2	<i>Brassaiopsis mitis</i> Clarke	chuletro	Araliaceae
3	<i>Daphne cannabina</i> Wall.	Kalo argeli	Thymelaeaceae
4	<i>Dichroa febrifuga</i> Lour.	Basak	Hydrangaceae
5	<i>Edgeworthia gardenerii</i> Meissn.	Algeri/Lokti	Thymeleaceae
6	<i>Gerardiana diversifolia</i> (Link) Friis	Bhangrey sisnu	Urticaceae
7	<i>Cardiocrinum giganteum</i>		Liliaceae
8	<i>Hedychium</i> sp.	Saro	Zingiberaceae
9	<i>Ilex</i> sp.		Aquifoliaceae
10	<i>Maesa chisia</i> Don	Bilauney	Myrsinaceae
11	<i>Mohania</i> sp.	Kesar	Berberidaceae
12	<i>Mussaenda roxburghii</i> Hook.f.	Dhobini phul	Rubiaceae
13	<i>Osbeckia stellata</i> Buch.-Ham.ex D. Don	Chulesi	Melastomataceae
14	<i>Rubus ellipticus</i>	Aiselu	Rosaceae
15	<i>Viburnum erubescence</i> Wall.ex DC	Asarey	Adoxaceae
16	<i>Zanthozylum acanthopodium</i>	Bokey timbur	Rutaceae
17		Ghew path	
18		Chimchimey	
19		Bokey Sak	
	HERB		
1	<i>Acorus calamus</i> Linn.	Bojo	Acoraceae
2	<i>Agapetes</i> sp.		
3	<i>Ageratum conyzoides</i> Linn.	Elamey zhar	Asteraceae
4	<i>Anaphalis</i> sp.	Buki phul	Compositae
5	<i>Arisaema concinnum</i>	Banko	Araceae
6	<i>Arisaema consaguinum</i>	Banko	Araceae
7	<i>Arisaema speciosum</i>	Sapko makai	Araceae
8	<i>Arisaema tortuosum</i>	Sapko makai	Araceae
9	<i>Artemesia vulgaris</i> Linn.	Asteraceae	Titepati
10	<i>Artemesia wallichiana</i> Bess.	Titepati	Asteraceae
11	<i>Astilbe rivularis</i>	Buro okhati	Saxifragaceae
12	<i>Begonia</i> sp.	Magar kajey	Begoniaceae
13	<i>Begoniapicta</i> Sm.	Magar kachi	Asteraceae
14	<i>Bidens pilosa</i> Linn.	Kuro	Asteraceae
15	<i>Boehmeria platyphylla</i> D.Don	Kamley	Urticaceae
16	<i>Campylandra aurantica</i> Baker.	Jungali Nakima	Liliaceae
17	<i>Carex pulchra</i> Boott.	Harkatto	Cyperaceae
18	<i>Centella asiatica</i> Linn.	Golpatta	Apiaceae
19	<i>Colocasia esculanta</i> (L). Schott.	Maney	Araceae
20	<i>Commelina beghalensis</i> Linn.	Kaney jhar	Commelinaceae
21	<i>Cyanodon</i> sp.	Dubo	Poaceae

22	<i>Diplazium dilatatum</i> Blume	chipleý ningro	Woodsiaceae
23	<i>Diplazium</i> sp.	Ningro	Woodsiaceae
24	<i>Diplazium stoliczkae</i> Beddome	Lekh Kalo ningro	Woodsiaceae
25	<i>Drymaria cordata</i> (L.) Willd. ex Schult.	Abhijalo	Caryophyllaceae
26	<i>Elatostema</i> sp.	Gagleto	Urticaceae
27	<i>Eragrostis</i> sp.	Banso	Poaceae
28	<i>Eupatorium adenophorum</i> Spreng.	Kalizhar	Asteraceae
29	<i>Fagopyrum dibotrys</i> (D.Don.) H. Hara	Fapar	Polygonaceae
30	<i>Fragaria nubicola</i> Lindley ex Lacaita	Bhui aiselu	Rosaceae
31	<i>Geranium</i> sp.		Gerniaceae
32	<i>Girardinia diversifolia</i> (Link) Friis	Sisnu Bhangray	Urticaceae
33	<i>Gleichenia gigantean</i> Wall.ex Hook	Kalamey	Gleicheniaceae
34	<i>Hedychium Spicatum</i> Smith in Rees.	Sara	Zingiberaceae
35	<i>Hemiphragma heterophyllum</i>	Nash Jhar	Plantaginaceae
36	<i>Henckelia urticifolia</i> (Bunch-Ham. ex D.Don)		Gesneriaceae
37	<i>Heracleum wallichii</i> DC	Chimphing	Asteraceae
38	<i>Houttuynia cordata</i> Thunb.	Padey jhar	Saururaceae
39	<i>Hydrocolyle javanica</i> Thunb.	Dhungri jhar	Umbellifera
40	<i>Hypericum uralum</i> Buch-Ham. ex D.Don	Urilo	Hypericaceae
41	<i>Impatiens racemosa</i> DC.	Sanu ghas	Balsaminaceae
42	<i>Imperata cylindrica</i>	Seru	poaceae
43	<i>Laportea bulbifera</i> (Siebold & Zucc.) Wedd.	Patley sisnu	Urticaceae
44	<i>Laportea terminallis</i> Wight.	Gharia sisnu	Urticaceae
45	<i>Lycopodium japonicum</i> Thunb	Nagbelli	Lycopodiaceae
46	<i>Neillia rubiflora</i> D.Don	Kirkirey jhar	Rosaceae
47	<i>Nephrolepis cordifolia</i> (Linn.) C. Presl.	Pani amala	Davalliaceae
48	<i>Oxalis corniculata</i> Linn.	Amilo jhar	Oxalidaceae
49	<i>Persicaria capitata</i> (Buch.Ham.ex D.Don) Gross	Ratneulo	Polygonaceae
50	<i>Pilea umbrosa</i> Wall.ex Blume	Chipleý	Urticaceae
51	<i>Polygonum molle</i> D.Don	Thotney	Polygonaceae
52	<i>Rumex nepalensis</i> Spreng.	Halhaley	Polygonaceae
53	<i>Selaginella</i> sp.	Phusphusey	Selaginellaceae
54	<i>Solanum</i> sp.	Jungle bee	Solanaceae
55	<i>Strobilanthes</i> sp.	Kibu ghans	Acanthaceae
56	<i>Swertia bimaculata</i> (Roxb.ex Zflem.) Kartsen	Bhaley chirowto	Gentianaceae
57	<i>Swertia</i> sp.	chiraita	Gentianaceae
58	<i>Urtica</i> sp.	Lata sisnu	Urticaceae
59	<i>Viola sikkimensis</i> W.Becker	Silamey jhar	Violaceae
	FERNS AND FERN-ALLIES		
1	<i>Angiopteris indica</i> (G. Forster) Hoffmann		Marattiaceae
2	<i>Asplenium lacinatedum</i> D.Don		Aspleniaceae
3	<i>Dicranopteris</i> sp.	Sottar	Gleicheniaceae
4	<i>Diplazium dilatatum</i> Blume	chipleý ningro	Woodsiaceae
5	<i>Diplazium</i> sp.	Sauney ningro	Athyriaceae
6	<i>Diplazium</i> sp.	Ningro	Woodsiaceae

7	<i>Diplazium stoliczkae</i> Beddome	Lekh Kalo ningro	Woodsiaceae
8	<i>Diplopterygium giganteum</i> Wall. ex Hook		Gleicheniaceae
9	<i>Drynaria propinqua</i> (Wall. ex metz.) J. Sm.		Polypodiaceae
10	<i>Gleichenia gigantean</i> Wall.ex Hook	Kalamey	Gleicheniaceae
11	<i>Huperzia</i> sp.		Lycopodiaceae
12	<i>Lycopodium japonicum</i> Thunb.	Nagbelli	Lycopodiaceae
13	<i>Nephrolepis cordifolia</i> (Linn.)C. Presl.	Pani amala	Davalliaceae
14	<i>Plagiogyria pycnophylla</i> (Kunze) Mett		Plagiogyriaceae
15	<i>Selaginella</i> sp.		Selaginellaceae

Table 4: Checklist of faunal species encountered at Phodong Reserve Forest, North Sikkim

Sl. No	Scientific Name	Common Name	IUCN Status	Evidences
1.	<i>Canis aurens</i>	Jackal	LC	Sc
2.	<i>Capricornis thar</i>	Himalayan serow	NT	P
3.	<i>Hylopetes alboniger</i>	Particolored flying squirrel	LC	Sc
4.	<i>Martes flavigula</i>	Yellow-throated marten	LC	Sc
5.	<i>Muntiacus muntjak</i>	barking deer	LC	S, P,
6.	<i>Naemorhaedus goral</i>	Goral	NT	P
7.	<i>Paguma larvata</i>	Himalayan palm civet	LC	Sc
8.	<i>Sus scrofa</i>	Wild pig	LC	D
9.	<i>Ursus thibetanus</i>	Himalayan black bear		Sm

NOTE: S: Sighting, Pc: Photo capture, Sc: Scat, P: Pellet, HM: Hoof mark, C: Call, F: Feather, D: Droppings, Sm: scratch marks, Ds: Digging sign,

Table 5: Checklist of avi-faunal species of Phodong Reserve Forest, North Sikkim

	Common Name	Scientific Name	Family
1	Ashy drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
2	Barred cuckoo-dove	<i>Macropygia unchall</i>	Columbidae
3	Black bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae
4	Blue-throated barbet	<i>Megalaima asiatica</i>	Megalaimidae
5	Blue whistling thrush	<i>Myophonus caeruleus</i>	Muscicapidae
6	Blue-fronted redstart	<i>Phoenicurus frontalis</i>	Muscicapidae
7	Chestnut-bellied rock thrush	<i>Monticola rufiventris</i>	Muscicapidae
8	Common green magpie	<i>Cissa chinensis</i>	Corvidae
9	Common myna	<i>Acridotheres tristis</i>	Sturnidae
10	Common pigeon	<i>Columba livia</i>	Columbidae
11	Common tailor bird	<i>Orthotomus sutorius</i>	Cisticolidae
12	Crimson sunbird	<i>Aethopyga siparaja</i>	Nectariniidae
13	Fire-tailed myzornis	<i>Myzornis pyrrhoura</i>	Sylviidae
14	Great barbet	<i>Megalaima virens</i>	Megalaimidae

15	Greater yellownape	<i>Chrysophlegma flavinucha</i>	Picidae
16	Green-backed tit	<i>Parus monticolus</i>	Paridae
17	Green-tailed sunbird	<i>Aethopyga nipalensis</i>	Nectariniidae
18	Grey-backed shrike	<i>Lanius tephronotus</i>	Laniidae
19	Hoary-throated barwing	<i>Actinodura nipalensis</i>	Leiothrichidae
20	Kalij pheasant	<i>Lophura leucomelanos</i>	Phasianidae
21	Large-billed crow	<i>Corvus macrorhynchos</i>	Corvidae
22	Lesser yellownape	<i>Picus chlorolophus</i>	Picidae
23	Oriental turtle dove	<i>Streptopelia orientalis</i>	Columbidae
24	Oriental magpie-robin	<i>Copsychus saularis</i>	Muscicapidae
25	Red-billed leiothrix	<i>Leiothrix lutea</i>	Leiothrichidae
26	Red-tailed minla	<i>Minla ignotincta</i>	Leiothrichidae
27	Red-vented bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae
28	Rufous bellied niltava	<i>Niltava sundara</i>	Muscicapidae
29	Rufous sibia	<i>Heterophasia capistrata</i>	Leiothrichidae
30	Scaly thrush	<i>Zoothera dauma</i>	Turdidae
31	Scarlet minivet	<i>Pericrocotus speciosus</i>	Campephagidae
32	Spangled drongo	<i>Dicrurus bracteatus</i>	Dicruridae
33	Spotted dove	<i>Spilopelia chinensis</i>	Columbidae
34	Verditer flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae
35	Wedge-tailed green pigeon	<i>Treron sphenurus</i>	Columbidae
36	Whiskered yuhina	<i>Yuhina flavicollis</i>	Zosteropidae
37	White-browed fantail	<i>Rhipidura aureola</i>	Rhipiduridae
38	White-browed fulvetta	<i>Fulvetta vinipectus</i>	Sylviidae
39	White-capped redstart	<i>Chaimarrornis leucocephalus</i>	Muscicapidae

Table 6: Checklist of butterflies of Phodong Reserve Forest, North Sikkim

1	Common small flat	<i>Sarangesa dasahara</i>	Hesperiidae
2	Fulvous pied flat	<i>Pseudocoladenia dan</i>	Hesperiidae
3	Common dartlet	<i>Oriens goloides</i>	Hesperiidae
4	Great swift	<i>Pelopidas assamensis</i>	Hesperiidae
5	Restricted demon	<i>Notocrypta curvifascia</i>	Hesperiidae
6	Red helen	<i>Papilio helenus</i>	Papilionidae
7	Paris peacock	<i>Papilio paris</i>	Papilionidae
8	Three spot grass yellow	<i>Eurema blanda</i>	Pieridae
9	Common grass yellow	<i>Eurema hecabe</i>	Pieridae
10	Clouded yellow	<i>Colias sp.</i>	Pieridae
11	Cabbage white	<i>Pieris sp.</i>	Pieridae
12	Golden sapphire	<i>Heliophorus brahma</i>	Lycanidae
13	Punchinello	<i>Zemeros flegyas</i>	Lycanidae

RAPID BIODIVERSITY SURVEY OF CHUNGTHANG RESERVE FOREST, NORTH SIKKIM

-Sabita Dahal



STUDY AREA

A field trip for conducting Rapid Biodiversity Survey of Chungthang Reserve Forest, North Sikkim was carried out during June-July 2018 under Sikkim Biodiversity Conservation and Forest Management Project. The trip was aimed for inventory and monitoring of the biodiversity of the area.

The survey area encompasses Rabong - Chungthang - Rangma range – Rangma Top-sampling path, the forest type of which is represented by East Himalayan wet temperate forest, East Himalayan mixed temperate forest, East Himalayan mixed conifer forest, East Himalayan sub-alpine forest, Birch-Rhododendron scrub. The elevation range covered during the survey was from 1700-3400m which is represented by **Figure 1**. The slope angle of the

area ranged between mild (30 degree) to stiff (80 degree) slope and is facing towards E, NE and SE aspect; the characteristics of the sampled plots are shown in **Table I**.

Forest being temperate to subalpine types, tree are the most predominant taxa in the area, followed by herbs, shrubs and shrublets, ferns, climbers and epiphytes. The area constitutes a diverse habitat for both flora and fauna of the temperate to subalpine belt. The area is highly dominated with trees and small tree species namely *Symplocos theifolia* Don., *Lithocarpus fenestrata* Roxb., *Castanopsis tribuloides* (Smith) A. DC., *Castanopsis hystrix* Hook. & Thomson ex. A. DC., *Brassaiopsis mitis* C.B. Clarke, *Quercus pachyphylla* Kurz., *Quercus lamellosa* Smith., *Pyrularia edulis* (Wallich) A., *Pieris ovalifolia* D. Don, *Micheliacathcartii* Hook. f. Thomson, *Maesachisia* Buch.-Ham. ex D. Don, *Machilus gammieana* King ex. Hook. f., *Antidesma acuminatum* Wight, *Acer caudatum* Wallich, etc. Common shrub species of the area are *Rubus ellipticus* Smith., *Rubus niveus* Thunb., *Rubus paniculatus* (Smith) Rees., *Viburnum erubescens* Wallich ex DC., *Dichroa febrifuga* Lour., *Maesachisia* Don, *Oxysporan paniculata* (D. Don) DC, *Polygala arillata* Buch.- Ham ex D. Don, etc.

Vegetation composition of Chungthang RF



Rhododendron maddenii



Aeschynanthus hookeri



Ceropegia sp.



Eurya acuminata



Mallotus nepalensis var.
ochraceo-albidus



Gynocardia odorata

Forest harbours common mammals such as Himalayan Langur, Jackel, Squirrel, Goral, Himalayan Palm Civet, Wild Pig; avi-faunal species such as Common Pigeon, Common Myna, Great Barbet, Himalayan Bulbul, House Crow, House sparrow, Kalij Pheasant, Large-billed Crow, Oriental Turtle Dove, Oriental White-eye Ashy Drongo, Verditer flycatcher, Red-tailed Minla, etc.

Some of the faunal species of Chungthang RF



Plumbeous Water Redstart



White Throated Laughing Thrush



Black Bulbul



Long Tailed Shrike

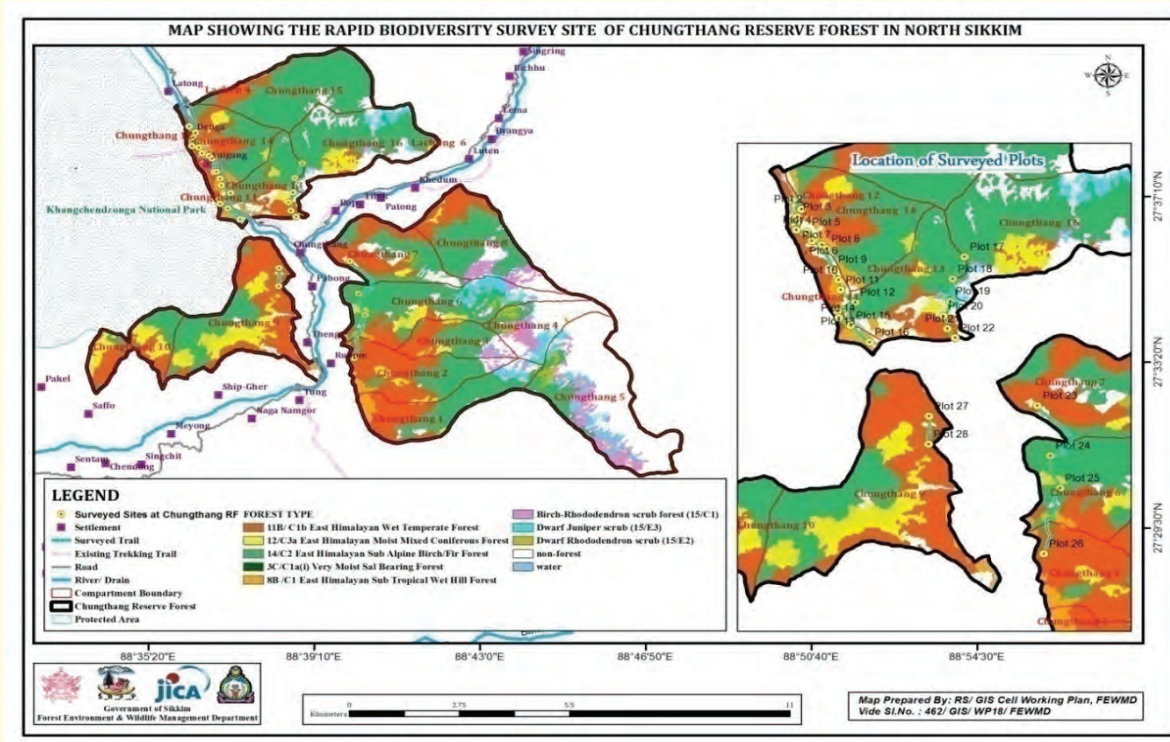


Figure 1: Map showing survey plots at Chungthang Reserve Forest, North Sikkim.



Semnopithecus schistaceus (Himalayan Gray Langur), PC, Chungthang RF

**Table 1: Field characteristics of the survey plots at
Chungthang Reserve Forest, North Sikkim.**

Site code	Forest type	Elevation	GPS Co-ordinates		Canopy cover (%)	Location name
			Latitude	Longitude		
Plot 1	Temperate forest	2018	27.651267	88.60740556	70	Rabong
Plot 2	Temperate forest	2160	27.648878	88.60988611	72	Below Rabong
Plot 3	Temperate forest	2078	27.647036	88.60880278	70	
Plot 4	Temperate forest	1902	27.643656	88.60840278	65	Below Rabong
Plot 5	Temperate forest	1918	27.643122	88.61105833	80	Selethang
Plot 6	Temperate forest	1891	27.640856	88.61225556	70	Selethang
Plot 7	Temperate forest	1990	27.639822	88.61481389	65	Mensithang
Plot 8	Temperate forest	1919	27.638825	88.61595833	60	Mensithang
Plot 9	Temperate forest	1876	27.633569	88.61760278	75	Mensithang
Plot 10	Temperate forest	1890	27.630942	88.61896111	80	Mensithang
Plot 11	Temperate forest	1815	27.628397	88.61944167	85	Chogan
Plot 12	Temperate forest	1894	27.625236	88.62303889	70	Fim Khola
Plot 13	Temperate forest	1827	27.623039	88.61851389	75	Fincho Nala

Plot 14	Temperate forest	1789	27.621344	88.61893333	75	
Plot 15	Temperate forest	1779	27.619436	88.62188333	70	Ranmgma range
Plot 16	Temperate forest	1726	27.615119	88.62652222	70	Rangma range
Plot 17	Subalpine forest	3392	27.636433	88.65090556	50	Rangma top
Plot 18	Subalpine forest	3381	27.630853	88.64775278	35	Rangma 1
Plot 19	Subalpine forest	3008	27.625267	88.64712778	35	
Plot 20	Subalpine forest	2768	27.621483	88.64522778	30	Gumpa top
Plot 21	Temperate forest	2626	27.618275	88.64626389	30	
Plot 22	Temperate forest	2471	27.61595	88.64817222	50	Gumpa top
Plot 23	Temperate forest	2276	27.598589	88.66875833	65	
Plot 24	Temperate forest	2482	27.585869	88.67185833	60	
Plot 25	Temperate forest	2806	27.577722	88.67416944	70	
Plot 26	Temperate forest	2458	27.561189	88.66978889	45	
Plot 27	Temperate forest	2206	27.596283	88.64129444	70	Above Shipgyar
Plot 28	Temperate forest	2528	27.567122	88.62325278	60	

FINDINGS

FLORA

During the survey, a total of 28 plots were laid covering 0.28 ha area (Table 1 & Figure 1). A general checklist of the floral species of the area (including the areas outside of the plots) were prepared of which, trees and small trees represented the highest number of species with 61 species followed by herbs with 59 species, 29 species of climbers and epiphytes, 19 species of shrubs and shrublets, 26 numbers of ferns and fern allies, 8 numbers of bamboos and cane were recorded from the area during the survey (Table 2).

Table 2: Checklist of floral species in Chungthang Reserve Forest, North Sikkim.

Sl. No.	Botanical Name	Family	Common name
1.	<i>Acer caudatum</i> Wallich.	Aceraceae	Kapasey
2.	<i>Acer pectinatum</i> Wall.	Aceraceae	Lek Kapasay
3.	<i>Actinodaphne sikkimensis</i> Meissn.	Lauraceae	Phurkey Sissi
4.	<i>Alangium begoniaefolium</i> (Roxb.) Baill	Alangiaceae	Akhanay
5.	<i>Alnus nepalensis</i> D. Don.	Betulaceae	Utis
6.	<i>Antidesma acuminatum</i> Wight	Euphorbiaceae	Lekh bilaune
7.	<i>Betula alnoides</i> Wall. ex Diels	Betulaceae	Saur
8.	<i>Brassaiopsis mitis</i> C.B.Clarke	Araliaceae	Phutta
9.	<i>Castanopsis hystrix</i> Hook. & Thomson ex. A. DC.	Fagaceae	Patley katush
10.	<i>Castanopsis indica</i> (Roxb.ex Lindl.) A.DC.	Fagaceae	Dhalne kattus

11.	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Fagaceae	Musrey katus
12.	<i>Cedrela febrifuga</i> Blume.	Meliaceae	Tuni
13.	<i>Cinnamomum impressinervium</i> Meisn.	Lauraceae	Sinkoli
14.	<i>Cryptomeria japonica</i> (Thunberg ex. Linn. F.) D. Don	Taxodiaceae	Dhuppi
15.	<i>Daphniphyllum himalayense</i> (Benth.) Mull. Arg.	Euphorbiaceae	Lal Chandan
16.	<i>Elaeocarpus lanceaefolius</i> Roxburgh.	Elaeocarpaceae	Bhadrasey
17.	<i>Engelhardtia spicata</i> Blume	Juglandaceae	Mauwa
18.	<i>Erythrina arborescens</i> Roxb	Leguminosae	Phaledo
19.	<i>Eurya acuminata</i> DC.	Theaceae	Jhingni
20.	<i>Exbucklandia populnea</i> R. Br. Ex Griff	Hamamelidaceae	Piplee
21.	<i>Ficus hookeri</i> Miq.	Moraceae	Nebharo
22.	<i>Ficus nemoralis</i> Wall.	Moraceae	Dudilo
23.	<i>Garuga pinnata</i> Roxb.	Burseraceae	Dabdabay
24.	<i>Glochidion acuminatum</i> Muell.	Euphorbiaceae	Latikaath
25.	<i>Gynocardia odorata</i> Roxburgh	Flacourtiaceae	Bandre/Gante
26.	<i>Hovenia dulcis</i> Thunb.	Thymelaeaceae	Bangi
27.	<i>Juglans regia</i> Linn.	Juglandaceae	Okhar
28.	<i>Leucosceptum cannum</i> Smith	Lamiaceae	Ghurpis

29.	<i>Lithocarpus fenestrata</i> Roxb.	Fagaceae	Arkaulo
30.	<i>Litsea kingii</i> Hook.	Lauraceae	Siltimmur
31.	<i>Macaranga pustulata</i> King.	Euphorbiaceae	Malato
32.	<i>Machilus edulis</i> King.	Lauraceae	Pumsee / Funchey
33.	<i>Machilus gamblei</i> King ex J. D. Hooker	Lauraceae	Ghew Kaulo / Lapche Kaulo / Chiplay Kaulo
34.	<i>Machilus gammieana</i> King ex. Hook. f.	Lauraceae	Kawla
35.	<i>Machilus odoratissimus</i> Nees		Ghew funchey
36.	<i>Maesa chisia</i> Buch.-Ham. ex D. Don	Myrsinaceae	Bilaune
37.	<i>Magnolia cathcartii</i> (Hook.f. & Thomson) Noot.	Magnoliaceae	Tite champ
38.	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.) Figlar	Magnoliaceae	Rani champ
39.	<i>Myrica esculenta</i> Buch. Ham.	Myricaceae	Kafal
40.	<i>Myrsine semiserrata</i> Wall.	Myrsinaceae	Phalame
41.	<i>Nyssa sessiliflora</i> Hook. f. & Thomson ex Benth	Cornaceae	Lek chilauney
42.	<i>Ostedes paniculatus</i> Blume.	Euphorbiaceae	Bepari
43.	<i>Pieris ovalifolia</i> D. Don	Ericaceae	Angari
44.	<i>Prunus cerasoides</i> Don.	Rosaceae	Paiyun
45.	<i>Prunus nepalensis</i> (Ser) Stendel	Rosaceae	Arupatey
46.	<i>Pyralia edulis</i> (Wallich) A.	Santalaceae	Amphi

47.	<i>Quercus lamellosa</i> Smith.	Fagaceae	Buk/ Bajranth
48.	<i>Quercus pachyphylla</i> Kurz.	Fagaceae	Sungure Katus/ Bantay/ Oitay.
49.	<i>Rhododendron arboreum</i> ssp. <i>arboreum</i> (CB Clarke) Ridley.	Ericaceae	Lali gurans
50.	<i>Rhododendron falconeri</i> Hook.f.	Ericaceae	Korlinga
51.	<i>Rhododendron grande</i> Wright.	Ericaceae	Patle korlinga
52.	<i>Rhus succedanea</i> Linn.	Anacardiaceae	Bhalayo
53.	<i>Rhus succedanea</i> Linn.var. <i>acuminata</i>	Anacardiaceae	Rani bhalayo
54.	<i>Schima wallichii</i> (DC) Korth.	Theaceae	Chilaune
55.	<i>Spondias axillaris</i> Roxb.	Anacardiaceae	Lapsi
56.	<i>Symingtonia populnea</i> (R. Br. Ex Griff.)	Hamamelidaceae	Piple
57.	<i>Symplocos glomerata</i> King, ex. C.B. Clarke	Symplocaceae	Kholme
58.	<i>Symplocos theifolia</i> Don.	Symplocaceae	Kharanay
59.	<i>Tetradium fraxinifolium</i> (Hook.) Hartley	Rutaceae	Khanakpa
60.	<i>Tetrameles nudiflora</i> R.Br.	Tetramelaceae	Mayna
61.	<i>Calicarpa arborea</i> Roxb.	Lamiaceae	Guenlo

	Shrubs and shrublets		
1.	<i>Ardisia macrocarpa</i> Wall.	Myrsinaceae	Damai phal

2.	<i>Daphne cannabina</i> Wall.	Thymeleaceae	Kalo Argeli/Kagate
3.	<i>Dichroa febrifuga</i> Lour	Hydrangeaceae	Basak
4.	<i>Edgeworthia gardenerii</i> Meissn.	Thymeliaceae	Argali
5.	<i>Eupatorium adenophorum</i> Sprengel	Asteraceae	Kalijhar
6.	<i>Hypericum oblongifolium</i> Choisy	Hypericaceae	Urilo
7.	<i>Maesa chisia</i> Don	Myrsinaceae	Bilauney
8.	<i>Mahonia napaulensis</i> DC	Berberidaceae	Chutro
9.	<i>Neillia rubiflora</i> D.Don	Rosaceae	Khareto jhar
10.	<i>Oxyspora paniculata</i> (D.Don) DC	Melastomataceaea	Chulesi
11.	<i>Polygala arillata</i> Buch.- Ham ex D.Don.	Polygalaceae	Marcha jhar
12.	<i>Rhododendron dalhausiae</i> Hook.f.	Ericaceae	Lahare chimal
13.	<i>Rhododendron maddenii</i> Hook.f.	Ericaceae	Major Madden's Rhododendron
14.	<i>Rubus ellipticus</i> Smith.	Rosaceae	Aiselu
15.	<i>Rubus niveus</i> Thunb	Rosaceae	Aiselu / Biralu kanra
16.	<i>Rubus paniculatus</i> (Smith) Rees.	Rosaceae	Kalo Aiselu
17.	<i>Viburnum erubescens</i> Wallich ex DC	Sambucaceae	Asaray
18.	<i>Gaultheria fragrantissima</i> Wall.	Ericaceae	Dhasingarey
19.	<i>Gaultheria nummularioides</i> D.Don	Ericaceae	Kaligedi

	Herbs		
1.	<i>Aconogonum campanulatum</i> (Hook.f.) Hara	Polygonaceae	Kukur thotnay
2.	<i>Aconogonum molle</i> D. Don	Polygonaceae	Thotnay
3.	<i>Acorus calamus</i> Linn.	Acoraceae	Bojo
4.	<i>Aeschynanthus parviflorus</i> (D.Don) Spreng.	Gesneriaceae	Baklay patay
5.	<i>Aeschynanthus hookeri</i> C.B. Clarke	Gesneriaceae	Baklay patay
6.	<i>Ampelocissus latifolia</i> (Roxb.) Planch	Vitaceae	Pani lahara
7.	<i>Anaphalis triplinervis</i> C.B. Clarke	Asteraceae	Bukey Phool
8.	<i>Arisaema intermedium</i> Blume	Araceae	Larua/Banko
9.	<i>Arisaema flavum</i> (Forsskal) Schott	Araceae	Sap ko makai
10.	<i>Arisaema speciosum</i> (Wall.) Mart.	Araceae	Sap ko Makai
11.	<i>Artemisia vulgaris</i> Linn.	Asteraceae	Titaypati
12.	<i>Astilbe rivularis</i> Ham	Saxifragaceae	Burokhati
13.	<i>Begonia picta</i> Sm.	Asteraceae	Magar kanje
14.	<i>Boehmeria platyphylla</i> D.Don	Urticaceae	Kamley
15.	<i>Campylandra aurantiaca</i> Baker	Asparagaceae	Jangali nakima
16.	<i>Carex</i> sp.	Cyperaceae	Harkatto
17.	<i>Cautleya spicata</i> – (J. M. Sm.) Bak	Zingiberaceae	Sara
18.	<i>Centella asiatica</i> (L.) Urban	Umbelliferae	Golpatta

19.	<i>Commelina benghalensis</i> L.	Commelinaceae	Kanay
20.	<i>Cyanotis vaga</i> (Loour.) Roem & Schult.	Commelinaceae	Kanay
21.	<i>Cynodon dactylon</i> Linn	Poaceae	Dubo
22.	<i>Digitaria sanguinalis</i> (Linn.) Scopoli.	Poaceae	Banso
23.	<i>Drymaria cordata</i> Wild. ex. Roem & Schult.	Caryophyllaceae	Abhijalo
24.	<i>Elatostema platyphyllum</i> Weddell.	Urticaceae	Gagleto
25.	<i>Elatostema sessile</i> J.R.Forst. & G.Forst.	Urticaceae	Gagleto
26.	<i>Eragrostis cilianensis</i> (All.) Lut. ex	Poaceae	Banso
27.	<i>Eupatorium adenophorum</i> Spreng.	Asteraceae	Kali jhar
28.	<i>Fragaria nubicola</i> Lindley ex. Lacaita	Rosaceae	Bhui-aiselu
29.	<i>Gerardiana diversifolia</i> (Link) Friis	Urticaceae	Bhangre sisnu
30.	<i>Hedychium spicatum</i> Sm.	Zingiberaceae	Gai sara
31.	<i>Hedychium gardnerianum</i> Roscoe	Zingiberaceae	
32.	<i>Hemiphragma heterophyllum</i> Wall.	Plantaginaceae	Nash jhar
33.	<i>Houttuynia cordata</i> Thunb	Saururaceae	Raktha-jhar
34.	<i>Impatiens stenantha</i> Hook. f.	Balsaminaceae	Mujuro
35.	<i>Impatiens urticifolia</i> Wallich	Balsaminaceae	Mujuro

36.	<i>Lecanthus peduncularis</i> (Wall. ex Royle) Wedd.	Urticaceae	Gagleto
37.	<i>Osbeckia stellata</i> Hook.f	Melastomataceae	Arbal
38.	<i>Oxalis corniculata</i> Linn.		Chariamilo
39.	<i>Persicaria capitata</i> (Buch.- Ham. ex D.Don) H. Gross	Polygonaceae	Ratnaulo
40.	<i>Pilea stricta</i> (Buchanan-Hamilton ex D. Don) Weddell	Urticaceae	Chiple
41.	<i>Pilea umbrosa</i> Blume.	Urticaceae	Chiple
42.	<i>Pouzolzia sanguine</i> (Blume) Merrill	Urticaceae	Chiple
43.	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Halhalley
44.	<i>Selaginella biformis</i> A. Br. ex Kuhn	Selaginellaceae	Jhew
45.	<i>Selaginella chrysocaulos</i> (Hook. & Grev.) Spring.	Selaginellaceae	Jhew
46.	<i>Selaginella monospora</i> Spring.	Selaginellaceae	Jhew
47.	<i>Smilax</i> sp.	Smilacaceae	Madaney kara / Kirney ghans
48.	<i>Strobilanthes</i> sp.	Acanthaceae	Kibu ghans
49.	<i>Swertia bimaculata</i> (Roxb. ex Flem.) Karsten	Gentianaceae	Bhaley chiraito
50.	<i>Swertia chirayita</i> H. Karsten	Gentianaceae	Chiraito
51.	<i>Urtica dioica</i> Linn.	Urticaceae	Patley sisnu

52.	<i>Urtica parviflora</i> Roxburgh	Urticaceae	Gharia sisnu
53.	<i>Villebrunea frutescens</i> (Thunb.) Blume	Urticaceae	Chiple
54.	<i>Viola sikkimensis</i> W. Becker	Violaceae	Silamey jhar
55.	<i>Hedychium</i> sp.	Zingiberaceae	Qiura
56.	<i>Heracleum wallichii</i> DC.	Umbelliferae	Chimphing
57.	<i>Digitaria ciliaris</i> (Retzius) Koeler	Poaceae	Chitray Bansa
58.	<i>Holboellia angustifolia</i> Diels.	Lardizabalaceae	Gulfa
59.	<i>Stephania glabra</i> (Roxb.) Miers	Menispermaceae	Tambarkay

	Epiphytes / Climbers		
1.	<i>Aconogonum molle</i> (D. Don) H. Hara	Polygonaceae	Thotne
2.	<i>Arisaema intermedium</i> Blume	Araceae	Larua/Banko
3.	<i>Boehmeria</i> sp.	Urticaceae	Kamley
4.	<i>Cardamine hirsuta</i> L.	Brassicaceae	Titey
5.	<i>Carex</i> sp.	Cyperaceae	Harkatto
6.	<i>Clematis acuminata</i> DC	Ranunculaceae	Pinasay lahara
7.	<i>Clematis buchananiana</i> DC.	Ranunculaceae	Pinasey lahara
8.	<i>Codonopsis viridis</i> Wallich.	Campanulaceae	Padey lahara
9.	<i>Coelogyne flaccida</i> (Lindl.) Kuntz.	Orchidaceae	Sunakhari
10.	<i>Davallodes membranulosa</i> (Hook.) Copel.	Davalliaceae	Uniu

11.	<i>Digitaria sanguinalis</i> (Linn.) Scopoli.	Poaceae	Banso
12.	<i>Diplazium dilatatum</i> Blume Lek	Woodsiaceae	Chibley Ningro
13.	<i>Diplazium stoliczkae</i> Beddome	Woodsiaceae	Lek kalo ningro
14.	<i>Elatostema platyphyllum</i> Weddell.	Urticaceae	Gagleto
15.	<i>Eragrostis cilianensis</i> (All.) Lut. ex Janchen	Poaceae	Banso
16.	<i>Galium</i> sp.	Rubiaceae	-
17.	<i>Machilus gamblei</i> King ex J. D. Hooker		Seti kaulo / Ghew kaulo
18.	<i>Mucuna macrocarpa</i> Wall.	Leguminosae	Baldengra
19.	<i>Pleione praecox</i> (Lindl.)	Orchidaceae	-
20.	<i>Piper</i> sp.	Piperaceae	
21.	<i>Piper boehmeriaefolia</i> (Miq.) DC.	Piperaceae	Chabo / Jungali pan
22.	<i>Rhapidiphora decursiva</i> (Roxb.) Schott.	Araceae	Kanchirno
23.	<i>Rubia cordifolia</i> Linn.	Rubiaceae	Majito
24.	<i>Smilax zeylanica</i> Linn.	Liliaceae	Kukur dainey
25.	<i>Smilax aspara</i> L.	Liliaceae	Kukurdaina
26.	<i>Tetrastigma serrulatum</i> (Roxb.) Planchon	Vitaceae	Charcharey lahara
27.	<i>Trichosanthes lepiniana</i> (Naud.) Cogn.	Cucurbitaceae	Indreni
28.	<i>Viscum articulatum</i> Burm. f.	Lorantahceae	Harchur
29.	<i>Wrightia gigantea</i>		Bauni Kath

	Ferns and fern- allies		
1.	<i>Asplenium laciniatum</i> D. Don.	Aspleniaceae	Uniu
2.	<i>Blechnum orientale</i> L.	Blechnaceae	Deer Fern
3.	<i>Coniogramme intermedia</i> Heiron.	Pteridaceae	Uniu
4.	<i>Coniogramme fraxinea</i> (D.Don) Fee ex Diels	Pteridaceae	Bamboo leaf fern
5.	<i>Cyathea spinulosa</i> Wall.ex Hook	Cyatheaceae	Rukh uniu
6.	<i>Dennstaedtia appendiculata</i> (Wall.ex Hook.) J.Sm	Dennstaedtiaceae	Piray uniu
7.	<i>Diplazium dilatatum</i> Blume	Woodsiaceae	Lek Chipley Ningro
8.	<i>Diplazium esculentum</i> (Retz.) Sw	Woodsiaceae	Chiplay ningro
9.	<i>Diplazium stoliczkae</i> Beddome	Woodsiaceae	Lek Kalo Ningro
10.	<i>Drynaria</i> sp.	Polypodiaceae	Basket fern
11.	<i>Equisetum diffusum</i> D.Don.	Equiaetaceae	Salli bisalli
12.	<i>Gleichenia gigantean</i> Wall. ex Hook	Dryopteridaceae	Kalamey Uniu
13.	<i>Gleichenia longissima</i> Blume	Dryopteridaceae	Sottarey uniu
14.	<i>Lepisorus</i> sp.	Polypodiaceae	Polypods
15.	<i>Lycopodium japonicum</i> Thunb	Lycopodiaceae	Nagbelli
16.	<i>Monachosoram henryi</i> Christ.	Monachosoraceae	Uniu
17.	<i>Microsorium membranaceum</i> (D.Don) Cing	Polypodiaceae	Uniu
18.	<i>Nephrolepis cordifolia</i> (Linn.) C. Presl.	Davalliaceae	Pani amala
19.	<i>Odontosoria chinensis</i> (L.) J.Smith	Lindsaeaceae	Uneu
20.	<i>Plagiogyria pycnophylla</i> (Kunze.) Mett.	Plagiogyriaceae	Uniu

21.	<i>Pseudodrynaria coronans</i> (Wall.ex Mett.) T.Moore	Polypodiaceae	Kamray lahara
22.	<i>Pteridium revolutum</i> (Blume) Nakai	Pteridaceae	Uniu
23.	<i>Pteris biaurita</i> L.	Pteridaceae	Uniu
24.	<i>Pteris wallichiana</i> J. Agardh	Pteridaceae	Uneu
25.	<i>Vittaria elongata</i> Sw	Vittariaceae	Uniu

	Bamboo / Cane		
1	<i>Costus speciosus</i> Koenig Sm.	Costaceae	Bethlauri
3	<i>Phylostachys aurea</i> Riviere & C.Rivire	Poaceae	Katha Bans
5	<i>Schizostachyum capitatum</i> (Munro) R.B.Majumdar	Poaceae	Gope Bans
6	<i>Sinarundinaria intermedia</i> (Munro) C.S.Chao & Renvoize	Poaceae	Nigalo/Tite Nigalo
7	<i>Themnocalamus falconeri</i> Hook.f. ex. Munro.	Poaceae	Singanay Bans
8	<i>Yushania maling</i> (Gamble) R.B.Majumdar & Karthik.	Poaceae	Malingo

FAUNA

During the biodiversity survey in Chungthang Reserve forest, the existence of a total of 14 mammalian species and 55 birds' species were recorded through direct sightings and indirect evidences, which are listed in table 3.

Table: 3 Checklist of Faunal species, including Mammals and Avi-fauna of Chungthang RF and surrounding area in North Sikkim.

Sl.No	Common name	Scientific name	Family
Mamalian Species			
1.	Jackel	<i>Cannis aurens</i>	Canidae
2.	Himalayan Serow	<i>Capricornis thar</i>	Bovidae
3.	Parti-colored flying squirrel	<i>Hylopetes alboniger</i>	Sciuridae
4.	Kalij pheasant	<i>Lophura leucomelana</i>	Phasianidae
5.	Yellow-Throated marten	<i>Martes flavigula</i>	Mustelids
6.	Barking Deer	<i>Muntiacus muntjak</i>	Cervidae

7.	Goral	<i>Naemorhedus goral</i>	Bovidae
8.	Himalayan palm civet	<i>Paguma larvata</i>	Viverridae
9.	Wild Pig	<i>Sus scrofa</i>	Suidae
10.	Himalayan black Bear	<i>Ursus thibetanus</i>	Ursidae
11.	Himalayan Crestless Porcupine	<i>Hystrix brachyura</i>	Hystricidae
12.	Hoary Bellied Himalayan Squirrel	<i>Callosciurus pygarythrus</i>	Sciuridae
13.	Himalayan Thar	<i>Hemitragus jemlahicus</i>	Bovidae
14.	Himalayan Langur	<i>Semnopithecus</i> sp.	Cercopithecidae
Avi – Fauna			
1.	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
2.	Barred Cuckoo Dove	<i>Macropygia unchall</i>	Columbidae
3.	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Turdidae
4.	Blue-fronted Redstart	<i>Phoenicurus frontalis</i>	Muscicapidae
5.	Blue-winged Siva	<i>Siva cyanouroptera</i>	Timaliidae
6.	Black bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae
7.	Common Green Magpie	<i>Cissa chinensis</i>	Corvidae
8.	Common Hoopoe	<i>Upupa epops</i>	Upupidae
9.	Common Myna	<i>Acridotheres tristis</i>	Sturnidae
10.	Common pigeon	<i>Columba libia</i>	Columbidae
11.	Common Tailored Bird	<i>Orthotomus sutorius</i>	Cisticolidae
12.	Golden-breasted Fulvetta	<i>Lioparus chrysotis</i>	Sylviidae
13.	Great Barbet	<i>Megalaima virens</i>	Ramphastidae
14.	Greater Yellownape	<i>Picus flavinucha</i>	Picidae
15.	Green-backed Tit	<i>Parus monticolus</i>	Paridae
16.	Green-tailed Sunbird	<i>Aethopyga nipalensis</i>	Nectariniidae
17.	Grey-backed Shrike	<i>Lanius tephronotus</i>	Laniidae
18.	Grey-headed Canary Flycatcher	<i>Culicicapa ceylonensis</i>	Stenostiridae
19.	Grey-headed Parakeet	<i>Psittacula finschii</i>	Psittacidae
20.	Himalayan Bluetail	<i>Tarsiger rufilatus</i>	Muscicapidae
21.	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	Pycnonotidae
22.	Hodgson's Redstart	<i>Phoenicurus hodgsoni</i>	Muscicapidae
23.	House Crow	<i>Corvus splendens</i>	Corvidae
24.	House Sparrow	<i>Passer domesticus</i>	Passeridae
25.	Kalij Pheasant	<i>Lophura leucomelanos</i>	Phasianidae
26.	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae
27.	Lesser Yellownape	<i>Picus chlorolophus</i>	Picidae
28.	Little Spiderhunter	<i>Aracanothra longirostra</i>	Nectariniidae

29.	Long Tailed Shrike	<i>Lanius schach</i>	Laniidae
30.	Nepal Fulvetta	<i>Alcippe nipalensis</i>	Sylviidae
31.	Oriental Magpie Robin	<i>Copsychus saularis</i>	Muscicapidae
32.	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Columbidae
33.	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae
34.	Plumbeous Water Redstart	<i>Rhyacornis fuliginosa</i>	Muscicapidae
35.	Red-billed Leiothrix	<i>Leiothrix lutea</i>	Timaliidae
36.	Red-tailed Minla	<i>Minla ignotincta</i>	Leiothrichidae
37.	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae
38.	Rufous sibia	<i>Malacias capistratus</i>	Timaliidae
39.	Rufous-bellied Niltava	<i>Niltava sundara</i>	Muscicapidae
40.	Rufous-gorgeted Flycatcher	<i>Ficedula strophiata</i>	Muscicapidae
41.	Scaly Laughingthrush	<i>Garrulax austeni</i>	Turdidae
42.	Scarlet Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae
43.	Silver-eared Mesia	<i>Mesia argenteauris</i>	Leiothrichidae
44.	Slender-billed Scimitar Babbler	<i>Xiphirhynchus superciliaris</i>	Timaliidae
45.	Spangled Drongo	<i>Dicrurus hottentottus</i>	Dicruridae
46.	Stripe-throated Yuhina	<i>Yuhina gularis</i>	Zosteropidae
47.	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sittidae
48.	Verditer flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae
49.	Whiskered Yuhina	<i>Yuhina flavicollis</i>	Zosteropidae
50.	White-browed Fulvetta	<i>Fulvetta vinipectus</i>	Sylviidae
51.	White-browed Piculat	<i>Sasia ochracea</i>	Picidae
52.	White-capped Redstart	<i>Chaimarrornis leucocephalus</i>	Muscicapidae
53.	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	Turdidae
54.	White Throated Laughing Thrush	<i>Garrulax albogularis</i>	Leiothrichidae
55.	Yellow-bellied Fantail	<i>Chelidorhynch hypoxantha</i>	Rhipiduridae

CONCLUSION

Most of the places inside Chungthang RF constitutes tough terrain, which was inaccessible for the survey, as there observed falling of boulders continuously; even then approaches were made to at least inventories the biodiversity of an area. The forest of an area is thick and lush, has not much impacted by any natural as well as an anthropogenic disturbances. Since, an impact of climate change on biodiversity is a global issue, this study also recommend long term monitoring on climate change and its impact on biodiversity of an area. The portion of the forest constitute thick and lush vegetation dominated by the species of Oaks, however, their regeneration in the form of seedlings and saplings recorded very low, which is a matter of serious concern for the stability wet temperate forest.

Plate 1: Field activities and interaction with the local inhabitant's at Chungthang Reserve Forest at North Sikkim



RAPID BIODIVERSITY SURVEY OF PANGOLAKHA WILDLIFE SANCTUARY, EAST SIKKIM

Sabita Dahal, Bharat Kumar Pradhan, Sanchi Subba



STUDY AREA

A field trip to Pangolakha Wildlife Sanctuary were carried out during September 2015 by the SBFP survey team. The trip was aimed for inventory and monitoring of the biodiversity of the area.

Pangolakha wildlife Sanctuary was established in 2002 vide declaration number 10/9/WLC/02/127. The sanctuary lies towards the eastern part of the east district of Sikkim bordering China, Bhutan and West Bengal state of India in between latitude 27° 10' N to 27° 23' N and longitude 88° 29' E to 88° 35' E. The total area of the sanctuary is 128 km² and the altitude ranges from 1800-4345m. The Jaldakha river which flows through Bhutan and West Bengal originates from the Sanctuary. The sanctuary is very rich in floral and faunal components, high altitude wetlands/water bodies forming the catchments for the streams and

rivers of the Rongli Sub-Division of Sikkim, the Kalimpong Sub-Division of West Bengal and even the some region of Bhutan. The high altitude lakes like the Bidang tsho “the lake of the cow-yak” are in the north-western part of the sanctuary.

The forest types of the sanctuary were represented by East Himalayan sub-tropical wet hill forest, East Himalayan wet temperate forest, East Himalayan mixed temperate forest, East Himalayan mixed conifer forest, East Himalayan sub-alpine forest, Birch-Rhododendron scrub and alpine scrub. The vegetation of the sanctuary were highly dominated by the different species of *Bamboos*, *Rhododendron falconeri*, *Rhododendron arboreum*, *Abies densa*, *Castanopsis tribuloides*, *Lithocarpus sp.* *Acer campbellii*, *Acer caudatum*, and different species of *Anaphalis*, *Artemisia*, *Impatiens*, *Polygonatum*, *Juncus*, *Polygonum* and so on (photo plate 1). The sanctuary is also a home for different faunal species such as *Ailurus fulgens*, *Panthera pardus*, *Lophurs leucomelana*, *Felis chaus*, *Selenarctos thebetanus*, *Vulpes bengalensis*, *Nemorhaedus sp.* *Satyr Tragopan*, *Blood Pheasant* and many more.



**Photo plate 1: Forest types and vegetation composition
of Pangolakha Wildlife Sanctuary**



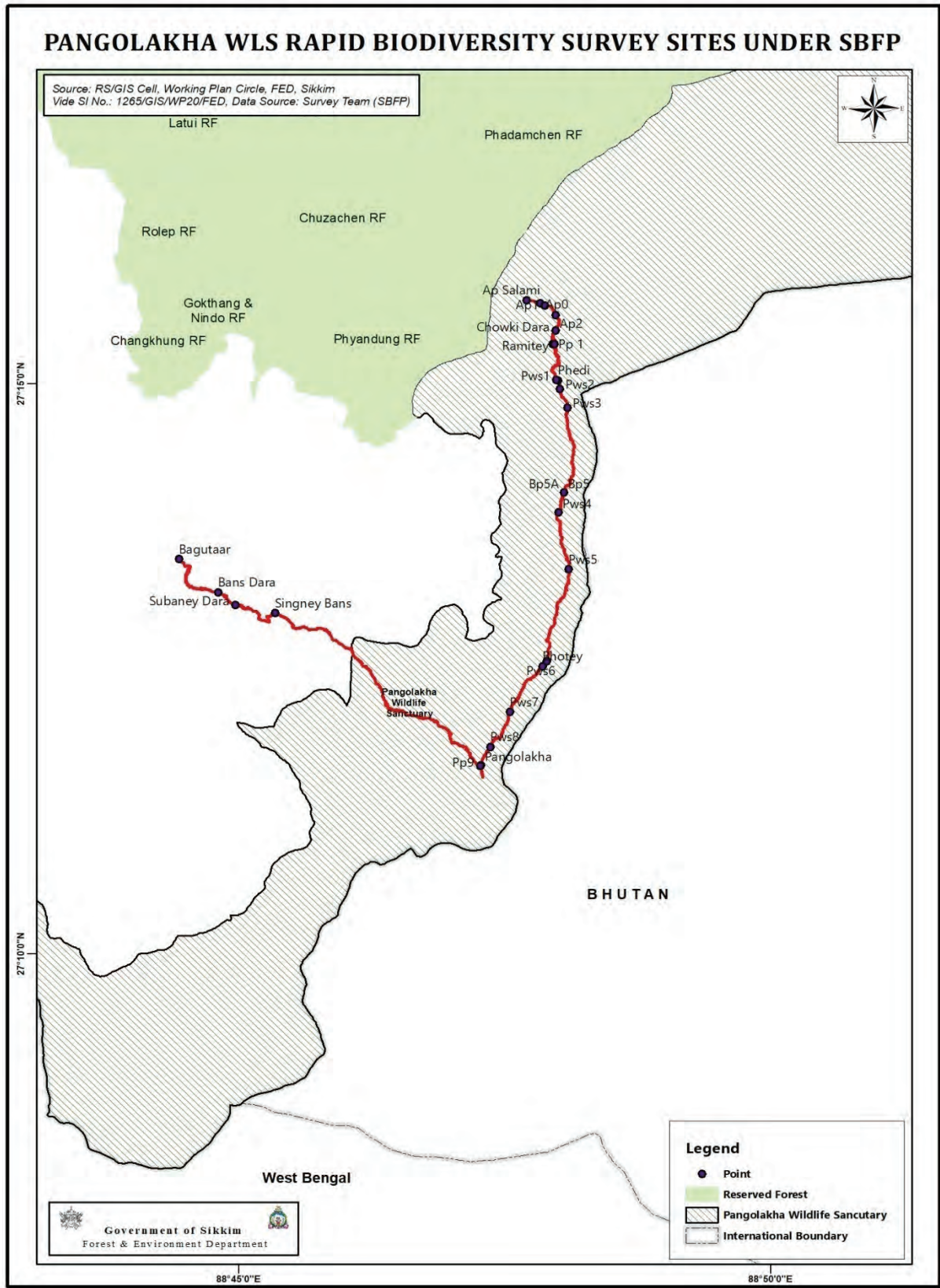


Figure 1: Pangolakha Wildlife Sanctuary showing sampling path From AP Salami to Subaney Dara, East Sikkim.

Table 1: Field characteristics of the survey area along AP Salame – Subaney Dara sampling path in Pangolakha Wildlife Sanctuary, East Sikkim.

Serial No	Plots	Forest type	Elevation (M)	GPS co-ordinates		Location name
	Plot 1	Sub alpine	3588	27.26075	88.79939	AP Salami
	Plot 2	Sub alpine	3620	27.26125	88.79726	AP Salami
	Plot 3	Sub alpine	3545	27.25677	88.80179	Chowki Dara
	Plot 4	Sub alpine	3384	27.25475	88.80154	Ramitey
	Plot 5	Temperate	2999	27.24947	88.80204	Phedi
	Plot 6	Sub alpine	3559	27.25475	88.80129	
	Plot 7	Sub alpine	2998	27.24958	88.80176	
	Plot 8	Sub alpine	2957	27.24817	88.80228	
	Plot9	Sub alpine	2939	27.24543	88.80342	
	Plot10	Temperate	2915	27.23308	88.80267	
	Plot 11	Temperate	2786	27.20774	88.79893	Bhotey
	Plot 12	Temperate	2852	27.20111	88.79376	
	Plot 13	Temperate	2973	27.19601	88.79054	
	Plot 14	Sub alpine	3044	27.19341	88.78903	
	Plot 15	Temperate	2744	27.20137	88.77708	
	Plot 16	Temperate	2137	27.21602	88.75713	Singney Bans
	Plot 17	Temperate	1830	27.21731	88.75098	
	Plot 18	Temperate	1830	27.21731	88.75098	Subaney Dara

Table 1: Floral species recorded in Pangolakha Wildlife Sanctuary and surrounding areas in East Sikkim.

Sl No	Botanical name	Family	Common Name
	Tree		
1.	<i>Acer campbellii</i> Hook.f.& Thomson ex Hiern	Aceraceae	Kapasey
2.	<i>Acer caudatum</i> Wallich.	Aceraceae	Kapasey
3.	<i>Acer pectinatum</i> wall.ex G.Nicholson	Aceraceae	Lek Kapasay
4.	<i>Actinodaphne sikkimensis</i> Meissn.	Lauraceae	Phurkey Sissi
5.	<i>Alangium begoniaefolium</i> (Roxb.) Baill	Alangiaceae	Akhanay
6.	<i>Alnus nepalensis</i> D. Don.	Betulaceae	Utis
7.	<i>Antidesma acuminatum</i> Wight	Euphorbiaceae	Lekh bilaune
8.	<i>Betula alnoides</i> Wall. ex Diels	Betulaceae	Saur
9.	<i>Betula utilis</i> D.don	Betulaceae	Bhojpatra
10.	<i>Brassaiopsis mitis</i> C.B.Clarke	Araliaceae	Phutta
11.	<i>Castanopsis hystrix</i> Hook. & Thomson ex. A. DC.	Fagaceae	Patley katush
12.	<i>Castanopsis indica</i> (Roxb.ex Lindl.) A.DC.	Fagaceae	Dhalne kattus
13.	<i>Castanopsis tribuloides</i> (Smith) A. DC.	Fagaceae	Musrey katus
14.	<i>Cedrela febrifuga</i> Blume.	Meliaceae	Tuni
15.	<i>Cinnamomum impressinervium</i> Meisn.	Lauraceae	Sinkoli
16.	<i>Cryptomeria japonica</i> (Thunberg ex. Linn. F.) D. Don	Taxodiaceae	Dhuppi
17.	<i>Daphniphyllum himalayense</i> (Benth.) Mull. Arg.	Euphorbiaceae	Lal chandan
18.	<i>Elaeocarpus lanceaefolius</i> Roxburgh.	Elaeocarpaceae	Bhadrasey
19.	<i>Engelhardtia spicata</i> Blume	Juglandaceae	Mauwa
20.	<i>Erythrina arborescens</i> Roxb	Leguminosae	Phaledo
21.	<i>Eurya acuminata</i> DC.	Theaceae	Jhingni
22.	<i>Exbucklandia populnea</i> R. Br. Ex Griff	Hamamelidaceae	Piplee

23.	<i>Ficus hookeri</i> Miq.	Moraceae	Nebharo
24.	<i>Ficus nemoralis</i> Wall.	Moraceae	Dudilo
25.	<i>Garuga pinnata</i> Roxb.	Burseraceae	Dabdabay
26.	<i>Glochidion acuminatum</i> Muell.	Euphorbiaceae	Latikaath
27.	<i>Gynocardia odorata</i> Roxburgh	Flacourtiaceae	Bandre/Gante
28.	<i>Hovenia dulcis</i> Thunb.	Thymelaeaceae	Bangi
29.	<i>Juglans regia</i> Linn.	Juglandaceae	Okhar
30.	<i>Leucosceptrum cannum</i> Smith	Lamiaceae	Ghurpis
31.	<i>Lithocarpus fenestrata</i> Roxb.	Fagaceae	Arkaulo
32.	<i>Litsea kingii</i> Hook.	Lauraceae	Siltimmur
33.	<i>Macaranga pustulata</i> King.	Euphorbiaceae	Malato
34.	<i>Machilus edulis</i> King.	Lauraceae	Pumsee / Funchey
35.	<i>Machilus gamblei</i> King ex J. D. Hooker	Lauraceae	Ghew Kaulo / Lapche Kaulo / Chiplay Kaulo
36.	<i>Machilus gammieana</i> King ex. Hook. f.	Lauraceae	Kawla
37.	<i>Machilus odoratissimus</i> Nees		Ghew funchey
38.	<i>Maesa chisia</i> Buch.-Ham. ex D. Don	Myrsinaceae	Bilaune
39.	<i>Magnolia campbellii</i>	Magnoliaceae	Ghoge chanp
40.	<i>Magnolia cathcartii</i> (Hook.f. & Thomson) Noot.	Magnoliaceae	Tite chanp
41.	<i>Magnolia doltsopa</i> (Buch.-Ham. ex DC.) Figlar	Magnoliaceae	Rani champ
42.	<i>Myrica esculenta</i> Buch. Ham.	Myricaceae	Kafal
43.	<i>Myrsine semiserrata</i> Wall.	Myrsinaceae	Phalame
44.	<i>Nyssa sessiliflora</i> Hook. f. & Thomson ex Benth	Cornaceae	Lek chilauney
45.	<i>Ostedes paniculatus</i> Blume.	Euphorbiaceae	Bepari
46.	<i>Pieris ovalifolia</i> D. Don	Ericaceae	Angari
47.	<i>Prunus cerasoides</i> Don.	Rosaceae	Paiyun
48.	<i>Prunus nepalensis</i> (Ser) Stendel	Rosaceae	Arupatey
49.	<i>Pyrularia edulis</i> (Wallich) A.	Santalaceae	Amphi

50.	<i>Quercus lamellosa</i> Smith.	Fagaceae	Buk/ Bajranth
51.	<i>Lithocarpus pachyphyllus</i> (Kurtz.) Rehder	Thick-leaved Oak	Sungurey Katus, Bante
52.	<i>Rhododendron arboreum</i> ssp. <i>arboreum</i> (CB Clarke) Ridley.	Ericaceae	Lali gurans
53.	<i>Rhododendron falconeri</i> Hook.f.	Ericaceae	Korlinga
54.	<i>Rhododendron grande</i> Wright.	Ericaceae	Patle korlinga
55.	<i>Rhododendron hodgsonii</i> Hook.f.	Ericaceae	
56.	<i>Rhus succedanea</i> Linn.var. <i>acuminata</i>	Anacardiaceae	Rani bhalayo
57.	<i>Symingtonia populnea</i> (R. Br. Ex Griff.)	Hamamelidaceae	Piple
58.	<i>Symplocos glomerata</i> King, ex. C.B. Clarke	Symplocaceae	Kholme
59.	<i>Symplocos theifolia</i> Don.	Symplocaceae	Kharanay
60.	<i>Tetradium fraxinifolium</i> (Hook.) Hartley	Rutaceae	Khanakpa
61.	<i>Tsuga dumosa</i> (D. Don) Eichler	Himalayan Hemlock	Tengre Salla
	Shrubs / Shrublets		
1.	<i>Ardisia macrocarpa</i> Wall.	Myrsinaceae	Damai phal
2.	<i>Daphne cannabina</i> Wall.	Thymeleaceae	Kalo Argeli/Kagate
3.	<i>Dichroa febrifuga</i> Lour	Hydrangeaceae	Basak
4.	<i>Edgeworthia gardenerii</i> Meissn.	Thymeliaceae	Argali
5.	<i>Eupatorium adenophorum</i> Sprengel	Asteraceae	Kalijhar
6.	<i>Gaultheria fragrantissima</i> Wall.	Ericaceae	Dhasingarey
7.	<i>Gaultheria nummularioides</i> D.Don	Ericaceae	Kalligedi
8.	<i>Gaultheria trichophylla</i> Royle	Ericaceae	Kalligedi
9.	<i>Maesa chisia</i> Don	Myrsinaceae	Bilauney
10.	<i>Mahonia napaulensis</i> DC	Berberidaceae	Chutro
11.	<i>Neillia rubiflora</i> D.Don	Rosaceae	Khareto jhar
12.	<i>Oxyspora paniculata</i> (D.Don) DC	Melastomataceae a	Chulesi
13.	<i>Polygala arillata</i> Buch.- Ham ex D.Don.	Polygalaceae	Marcha jhar

14.	<i>Rhododendron anthopogon</i> D.Don	Ericaceae	Sunpati
15.	<i>Rhododendron barbatum</i> Wall. ex G.Don	Ericaceae	
16.	<i>Rhododendron campanulatum</i> D.Don subsp <i>aeruginosum</i> Hook.f.	Ericaceae	Nilo Chimal
17.	<i>Rhododendron campanulatum</i> D.Don subsp sp. <i>campanulatum</i> D.Don	Ericaceae	Nilo Patey Chimal
18.	<i>Ribes griffithii</i> Hook.f.& Thomson	Grossulariaceae	
19.	<i>Ribes himalense</i> Royle ex Decne.	Grossulariaceae	
20.	<i>Rosa sericea</i> Lindley	Rosaceae	Lek gulab
21.	<i>Rubus ellipticus</i> Smith.	Rosaceae	Aiselu
22.	<i>Rubus niveus</i> Thunb	Rosaceae	Aiselu / Biralu kanra
23.	<i>Rubus paniculatus</i> (Smith) Rees.	Rosaceae	Kalo Aiselu
24.	<i>Viburnum erubescens</i> Wallich ex DC	Sambucaceae	Asaray
	Herbs		
1.	<i>Acomastylis elata</i> var. <i>elata</i> Wall. ex G. Don	Rosaceae	
2.	<i>Aconitum ferox</i> Wall.ex Ser.	Ranunculaceae	Bikhma
3.	<i>Aconitum laciniatum</i> (Bruhl) Stapf	Ranunculaceae	Kalo Bikhma
4.	<i>Allium wallichii</i> Kunth	Amaryllidaceae	Banlasun
5.	<i>Anaphalis contorta</i> D.Don	Asteraceae	Buki phool
6.	<i>Anaphalis triplinervis</i> (Sims) C.B.Clarke	Asteraceae	Bukiphool
7.	<i>Arisaema erubescens</i> (Wall.) Schott	Araceae	Sanp ko makai
8.	<i>Arisaema griffithii</i> Schott	Araceae	Sanp ko makai
9.	<i>Arisaema jacquemontii</i> Schott	Araceae	Sanp ko makai
10.	<i>Astilbe rivularis</i> Buch.-Ham. Ex D.Don	Saxifragaceae	Buri Okhati
11.	<i>Bergenia purpurascens</i> (Hook. & Thomson) Engler	Saxifragaceae	Lekh Pakhenbed
12.	<i>Bistorta affinis</i> (D.Don) Greene	Polygonaceae	The Himalayan Bistort
13.	<i>Bistorta amplexicaulii</i> (D.Don) Greene	Polygonaceae	Red Bistort

14.	<i>Calceolaria tripartita</i> Ruiz & Pav.	Scrophulariaceae	
15.	<i>Clematis napaulensis</i> DC.	Ranunculaceae	Clematis
16.	<i>Clintonia udensis</i> Trautv.& C.A.Mey	Liliaceae	
17.	<i>Codonopsis clematidea</i> (Schrenk) Cl.	Campanulaceae	Clematis Bonnet Bellflower
18.	<i>Corydalis elegans</i> Wallich ex Hooker	Papaveraceae	
19.	<i>Cremanthodium reniforme</i> (DC.) Benth	Asteraceae	
20.	<i>Cynanthus inflatus</i> Hook.f.& Thoms.	Campanulaceae	
21.	<i>Cynoglossum zeylanicum</i> (Vahl) Thunb. ex Lehm	Boraginaceae	Kanike Kuro
22.	<i>Cynotis vaga</i> (Loureiro) Schultes	Commelinaceae	
23.	<i>Dracocephalum heterophyllum</i> Edgeworth ex Bentham	Lamiaceae	
24.	<i>Dubyaea hispida</i> Candolle	Asteraceae	
25.	<i>Epilobium wallichianum</i> Haussknecht	Onagraceae	
26.	<i>Erigeron multiradiatus</i> (Lindl.ex DC.) Benth.ex Cl.	Asteraceae	Himalayan Fleabane
27.	<i>Euphorbia wallichii</i> Hook.f.	Euphorbiaceae	Wallich Spurge
28.	<i>Fragaria nubicola</i> Lindley ex Lacaita	Rosaceae	Bhui Aiselu
29.	<i>Fritillaria cirrhosa</i> D. Don	Liliaceae	Kakoli
30.	<i>Galinsoga parviflora</i> Cavanilles	Asteraceae	Udasey
31.	<i>Galium</i> sp	Rubiaceae	
32.	<i>Gentiana algida</i> Pallas	Gentianaceae	Whitish Gentian
33.	<i>Gentiana prolata</i> I.B.Balfour	Gentianaceae	
34.	<i>Gentiana sikkimensis</i> C.B.Clarke	Gentianaceae	Sikkim Gentian
35.	<i>Gentiana stylophora</i> C.B.Clarke	Gentianaceae	
36.	<i>Geranium wallichianum</i> Don ex. Sw.	Geraniaceae	Wallich Geranium
37.	<i>Goddera repens</i> (L) Br.	Orchidaceae	
38.	<i>Halenia elliptica</i> D.Don	Gentianaceae	Tikta
39.	<i>Hedychium spicatum</i> Sm.	Zingiberaceae	Sara
40.	<i>Impatiens bicornuta</i> Wall.	Balsaminaceae	Horned Balsam
41.	<i>Impatiens pradhanii</i> H.Hara	Balsaminaceae	Balsam

42.	<i>Impatiens racemosa</i> Candolle	Balsaminaceae	Balsam
43.	<i>Impatiens radiata</i> Hook.	Balsaminaceae	Balsam
44.	<i>Impatiens urticifolia</i> Wallich	Balsaminaceae	Balsam
45.	<i>Iris clarkei</i> Baker ex Hook.f.	Iridaceae	Clarks Iris
46.	<i>Juncus inflexus</i> L.	Juncaceae	
47.	<i>Juncus alpinoarticulatus</i> Chaix	Juncaceae	
48.	<i>Juncus himalensis</i> Klotzsch	Juncaceae	
49.	<i>Juncus thomsonii</i> Buchenau	Juncaceae	
50.	<i>Ligularia amplexicaulis</i> DC	Asteraceae	Stem Clasping Ligularia
51.	<i>Ligularia fischeri</i> (Ledebour) Turczaninow	Asteraceae	Fischer's Ligularia
52.	<i>Lilium nanum</i> Klotzsch & Garcke	Liliaceae	Tiny Lily, Dwarf Lily
53.	<i>Lobelia</i> sp.	Campanulaceae	
54.	<i>Maharanga emodi</i> (Wallich) A de Candolle	Boraginaceae	
55.	<i>Meconopsis paniculata</i> (D.Don) Prain	Papaveraceae	Panicled Yellow Poppy
56.	<i>Myricaria rosea</i> W.W.Smith	Tamaricaceae	Rose False Tamarisk
57.	<i>Nepeta floccosa</i> Benth.	Lamiaceae	
58.	<i>Oxyria digyna</i> (L.) Hill	Polygonaceae	Mountain Sorrel
59.	<i>Paris polyphylla</i> Sm.	Melanthiaceae	Satua
60.	<i>Parnassia nubicola</i> Wall.ex Royle	Parnassiaceae	Himalayan Bog Star
61.	<i>Polygonatum cirrhifolium</i> (Wallich) Royle	Polygonaceae	Meda
62.	<i>Polygonatum verticellatum</i> (L.) All.	Polygonaceae	Meda
63.	<i>Polygonum vacciniifolium</i> Wall. ex Meisner	Polygonaceae	Knotweed
64.	<i>Rhodiola cretinii</i> (Raymond-Hamet)	Crassulaceae	
65.	<i>Satyrium nepalense</i> D.Don	Orchidaceae	Nepal Satyrium

66.	<i>Saxifraga brachypoda</i> D.Don	Saxifragaceae	
67.	<i>Scutellaria discolor</i> Colebr.	Lamiaceae	
68.	<i>Selenium wallichianum</i> (DC.) Raizada & H.O.Saxena	Umbelliferae	Bhut Kesh
69.	<i>Senecio raphanifolius</i> Wall.ex DC.	Asteraceae	Radish leaved Senecio
70.	<i>Senecio scandens</i> Buch.Ham. ex D. Don	Asteraceae	Climbing senecio
71.	<i>Silene nigrescens</i> L.	Caryophyllaceae	
72.	<i>Sinopodophyllum hexandrum</i> (Royle) T.S.Ying	Lardizabalaceae	
73.	<i>Streptopus simplex</i> D.Don	Liliaceae	Simple Twisted Stalk
74.	<i>Swertia</i> sp.	Gentianaceae	
75.	<i>Torenia</i> sp.	Scrophulariaceae	
76.	<i>Valeriana hardwickii</i> Wallich	Dipsacaceae	Nakali Jatamasi
77.	<i>Valeriana jatamansii</i> Jones	Dipsacaceae	Jatamasi
	Ferns and fern- allies		
1.	<i>Asplenium laciniatum</i> D. Don.	Aspleniaceae	Uniu
2.	<i>Blechnum orientale</i> L.	Blechnaceae	Deer Fern
3.	<i>Coniogramme fraxinea</i> (D.Don) Fee ex Diels	Pteridaceae	Bamboo leaf fern
4.	<i>Coniogramme intermedia</i> Heiron.	Pteridaceae	Uniu
5.	<i>Cyathea spinulosa</i> Wall.ex Hook	Cyatheaceae	Rukh uniu
6.	<i>Dennstaedtia appendiculata</i> (Wall.ex Hook.) J.Sm	Dennstaedtiaceae	Piray uniu
7.	<i>Diplazium dilatatum</i> Blume	Woodsiaceae	Lek Chipley Ningro

8.	<i>Diplazium esculentum</i> (Retz.) Sw	Woodsiaceae	Chiplay ningro
9.	<i>Diplazium stoliczkae</i> Beddome	Woodsiaceae	Lek Kalo Ningro
10.	<i>Drynaria</i> sp.	Polypodiaceae	Basket fern
11.	<i>Equisetum diffusum</i> D.Don.	Equiaetaceae	Salli bisalli
12.	<i>Gleichenia gigantean</i> Wall. ex Hook	Dryopteridaceae	Kalamey Uniu
13.	<i>Gleichenia longissima</i> Blume	Dryopteridaceae	Sottarey uniu
14.	<i>Lepisorus</i> sp.	Polypodiaceae	Polypods
15.	<i>Leucostegia truncata</i> (D.Don) Fras.- Jenk.	Davalliaceae	Deer fern
16.	<i>Lycopodium japonicum</i> Thunb	Lycopodiaceae	Nagbelli
17.	<i>Microsorium membranaceum</i> (D.Don) Cing	Polypodiaceae	Uniu
18.	<i>Monachosora henryi</i> Christ.	Monachosoraceae	Uniu
19.	<i>Nephrolepis cordifolia</i> (Linn.) C. Presl.	Davalliaceae	Pani amala
20.	<i>Odontosoria chinensis</i> (L.) J.Smith	Lindsaeaceae	Uneu
21.	<i>Plagiogyria pycnophylla</i> (Kunze.) Mett.	Plagiogyriaceae	Uniu
22.	<i>Pseudodrynaria coronans</i> (Wall.ex Mett.) T.Moore	Polypodiaceae	Kamray lahara
23.	<i>Pteridium revolutum</i> (Blume) Nakai	Pteridaceae	Uniu
24.	<i>Pteris biaurita</i> L.	Pteridaceae	Uniu
25.	<i>Pteris wallichiana</i> J. Agardh	Pteridaceae	Uneu
26.	<i>Vittaria elongata</i> Sw	Vittariaceae	Uniu

	Bamboo & Cane		
1.	<i>Thamnocalamus aristatus</i> (Gamble) E.G.Camus	Poaceae	Rato nigalo
2.	<i>Yushania maling</i> (Gamble) R.B.Majumdar & Karthik	Poaceae	Malingo
3.	<i>Themnocalamus falconeri</i> Hook.f.ex.Munro	Poaceae	Singaney Bans
4.	<i>Costus speciosus</i>	Costaceae	Bethlauri
5.	<i>Sinarundinaria intermedia</i> (Munro) C.S.Chao & Renvoize	Poaceae	Nigalo

Checklist of Faunal species of Pangolakha Wildlife Sanctuary and surrounding areas in East Sikkim.

Sl. No	Common name	Scientific name	Family
Mammalian Species			
1	Jackel	<i>Cannis aurens</i>	Canidae
2	Himalayan Serow	<i>Capricornis thar</i>	Bovidae
3	Parti-colored flying squirrel	<i>Hylopetes alboniger</i>	Sciuridae
5	Yellow-Throated marten	<i>Martes flavigula</i>	Mustelids
6	Barking Deer	<i>Muntiacus muntjak</i>	Cervidae
7	Goral	<i>Naemorhedus goral</i>	Bovidae
8	Himalayan palm civet	<i>Paguma larvata</i>	Viverridae
9	Wild Pig	<i>Sus scrofa</i>	Suidae
11	Himalayan black Bear	<i>Ursus thibetanus</i>	Ursidae
12	Himalayan Crestless Porcupine	<i>Hystrix brachyura</i>	Hystricidae
13	Hoary Bellied Himalayan Squirrel	<i>Callosciurus pygarythrus</i>	Sciuridae
14	Himalayan Thar	<i>Hemitragus jemlahicus</i>	Bovidae
Avi - Fauna			
1	Ashy Drongo	<i>Dicrurus leucophaeus</i>	Dicruridae
2	Barred Cuckoo Dove	<i>Macropygia unchall</i>	Columbidae
3	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Turdidae
4	Blue-fronted Redstart	<i>Phoenicurus frontalis</i>	Muscicapidae

5	Blue-winged Siva	<i>Siva cyanouroptera</i>	Timaliidae
6	Black bulbul	<i>Hypsipetes leucocephalus</i>	Pycnonotidae
7	Common Green Magpie	<i>Cissa chinensis</i>	Corvidae
8	Common Hoopoe	<i>Upupa epops</i>	Upupidae
9	Common Myna	<i>Acridotheres tristis</i>	Sturnidae
10	Common pigeon	<i>Columba libia</i>	Columbidae
11	Common Tailored Bird	<i>Orthotomus sutorius</i>	Cisticolidae
12	Golden-breasted Fulvetta	<i>Lioparus chrysotis</i>	Sylviidae
13	Great Barbet	<i>Megalaima virens</i>	Ramphastidae
14	Greater Yellownape	<i>Picus flavinucha</i>	Picidae
15	Green-backed Tit	<i>Parus monticolus</i>	Paridae
16	Green-tailed Sunbird	<i>Aethopyga nipalensis</i>	Nectariniidae
17	Grey-backed Shrike	<i>Lanius tephronotus</i>	Laniidae
18	Grey-headed Canary Flycatcher	<i>Culicicapa ceylonensis</i>	Stenostiridae
19	Grey-headed Parakeet	<i>Psittacula finschii</i>	Psittacidae
20	Himalayan Bluetail	<i>Tarsiger rufilatus</i>	Muscicapidae
21	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	Pycnonotidae
22	Hodgson's Redstart	<i>Phoenicurus hodgsoni</i>	Muscicapidae
23	House Crow	<i>Corvus splendens</i>	Corvidae
24	House Sparrow	<i>Passer domesticus</i>	Passeridae
25	Kalij Pheasant	<i>Lophura leucomelanos</i>	Phasianidae
26	Large-billed Crow	<i>Corvus macrorhynchos</i>	Corvidae
27	Lesser Yellownape	<i>Picus chlorolophus</i>	Picidae
28	Little Spiderhunter	<i>Arcanothera longirostra</i>	Nectariniidae
29	Nepal Fulvetta	<i>Alcippe nipalensis</i>	Sylviidae
30	Oriental Magpie Robin	<i>Copsychus saularis</i>	Muscicapidae
31	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	Columbidae
32	Oriental White-eye	<i>Zosterops palpebrosus</i>	Zosteropidae
33	Red-billed Leiothrix	<i>Leiothrix lutea</i>	Timaliidae
34	Red-tailed Minla	<i>Minla ignotincta</i>	Leiothrichidae
35	Red-vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae
36	Rufous sibia	<i>Malacias capistratus</i>	Timaliidae
37	Rufous-bellied Niltava	<i>Niltava sundara</i>	Muscicapidae
38	Rufous-gorgeted Flycatcher	<i>Ficedula strophiat</i>	Muscicapidae

39	Scaly Laughingthrush	<i>Garrulax austeni</i>	Turdidae
40	Scarlet Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagidae
41	Silver-eared Mesia	<i>Mesia argenteauris</i>	Leiothrichidae
42	Slender-billed Scimitar Babbler	<i>Xiphirhynchus superciliaris</i>	Timaliidae
43	Spangled Drongo	<i>Dicrurus hottentottus</i>	Dicruridae
44	Stripe-throated Yuhina	<i>Yuhina gularis</i>	Zosteropidae
45	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	Sittidae
46	Verditer flycatcher	<i>Eumyias thalassinus</i>	Muscicapidae
47	Whiskered Yuhina	<i>Yuhina flavicollis</i>	Zosteropidae
48	White-browed Fulvetta	<i>Fulvetta vinipectus</i>	Sylviidae
49	White-browed Piculat	<i>Sasia ochracea</i>	Picidae
50	White-capped Redstart	<i>Chaimarrornis leucocephalus</i>	Muscicapidae
51	White-crested Laughingthrush	<i>Garrulax leucolophus</i>	Turdidae
52	Yellow-bellied Fantail	<i>Chelidorhynx hypoxantha</i>	Rhipiduridae

CONCLUSION AND RECOMMENDATION

From the conservation viewpoint, Pangolakha Wildlife Sanctuary has remarkable relevance in preservation of subtropical to alpine gene bank of Sikkim in the form of protected area. Our survey witnessed an occurrence of around 200 floral species, including some globally rare and threatened species. Since the area is far away from the human habitation, the anthropogenic pressure is still not marked and the impact of tourism has also not much marked at least inside the sanctuary, hence biodiversity of the area still remain intact. It can be recommended that the sanctuary and its surrounding area should keep untouched in terms of tourism and any kind of construction works to preserve the natural habitat of all these precious gene bank. Natural disturbances including the impact of climate change needs to be studied well. The better conservation strategies can be adopted for the rare and threatened species of areas through *ex-situ* conservation. The sanctuary is rich in medicinal plants too, for which, an unauthorized collection or unsustainable harvesting should be checked for which awareness should be given through trainings and workshops among the collectors and growers (in the fringe villages) on importance of conservation, establishment of herbal nurseries, cultivation technologies and commercial cultivation of rare and high value species, which may reduce the rate of unauthorized collection from the wild.

FIELD ACTIVITIES OF THE TEAM



SEASONAL VARIATION STUDY (PRE & POST MONSOON) OF SHINGBA RHODODENDRON SANCTUARY TO SHIV MANDIR SAMPLING PATH IN NORTH SIKKIM, INDIA

Sanjyoti Subba & Sanchi Subba



Fig: Shingba Rhododendron Sanctuary, North Sikkim

INTRODUCTION

Shingba Rhododendron Sanctuary is located in Lachung up to Yumthang valley in North Sikkim. Shingba Rhododendron Sanctuary is officially notified no. & date (46/WL/F/92/1585/F&WL dt: 05.12.1992), located in North District of Sikkim. The sanctuary is surrounded on the east by Chuba-sagochen mountain ranges and on the west by Chomzomei Tso that extends till the Lava Pass. The total area of the sanctuary is 43.00 sq.km and the altitudinal ranges between 3048m to 4575m asl, lying between latitude 27°43 to 27°48 and longitude 88°03 to 88°39 in the Eastern Himalayan Region. The upper most strata

in the top most canopy cover in the temperate coniferous forest are coniferous tree species *Abies densa*, *Tsuga dumosa*, *Larix griffithii* and *Picea spinulosa*, etc., were dominant and associated with *Rhododendrons*, *Betula utilis*, *Acer* and *Juniperus* etc. The sanctuary is harbour over 29 rhododendron species by (Pradhan and Lachungpa, 2015). Shingba Rhododendron Sanctuary is home to *Rhododendron niveum*, an endangered plant and an endemic for the region. The climatic structures are long moist season followed by dry spell during the winters. Snow is common and heavy at the site, frequently occurs avalanches and the high winds. Apart from the floral species, the area is home to many faunal species. Sanctuary is known to harbour many of the rare and endangered wildlife species such as Red panda, Yellow throated marten, Common leopard and Himalayan black bear. Shingba Rhododendron Sanctuary is one of the Important Bird Area (IBA) of Sikkim by (Islam & Rahmani, 2004), represents a unique mountain system comprising the temperate coniferous forest, tree line and snowline.

Therefore, the present survey was carried out with the suggestion of biodiversity evaluation team of rapid biodiversity survey for seasonal variation (pre & post) monsoon study in Shingba Rhododendron sanctuary to Shiv mandir sampling path, North Sikkim.

RAPID BIODIVERSITY SURVEY

Pre-monsoon was conducted in April and post-monsoon survey was in Oct 2019 at Shingba Rhododendron Sanctuary to Shiv mandir sampling path, North Sikkim. The study area of altitudinal gradients ranges between 3200m to 4000m above sea level provides sub alpine forest types. The study area lies between 27°50'49.3'' N -27°43'53.7'' N latitude and 88°41'26.2''E- 88°44'15.1''E longitude and with an elevation ranging from 3200m to 4000m above sea level. During the survey a total of 32 plots were laid covering 0.32 ha.

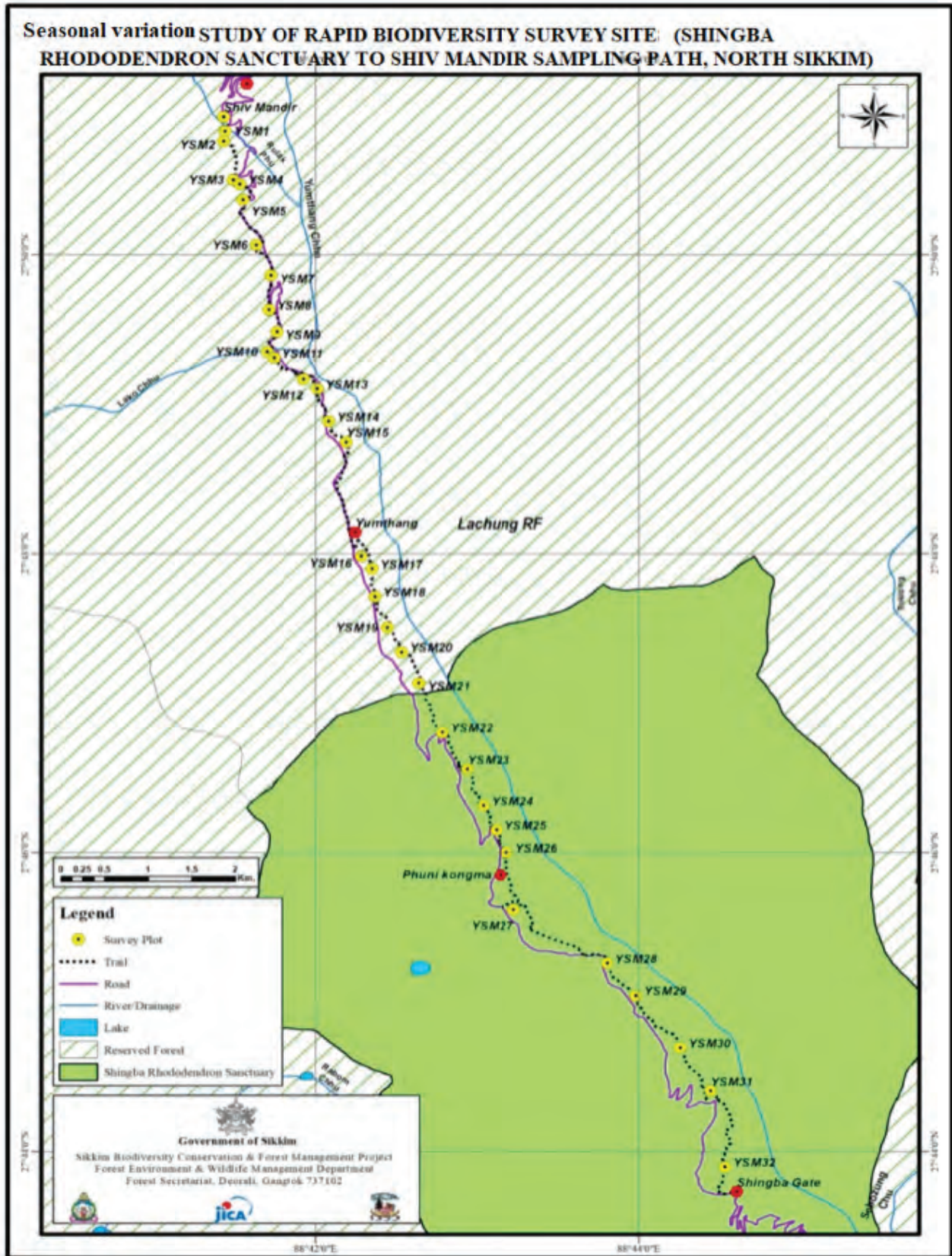


Fig : Showing the rapid biodiversity survey site of Shingba Rhododendron Sanctuary to Shiv Mandir sampling path, in North Sikkim

FINDING AND DISCUSSION

A total of 138 floral species were recorded during pre-monsoon survey period, 104 species (herb, mosses, orchid, climber and ferns) represented the highest number of species. Ericaceae was the dominant family in the sanctuary were recorded in all along the sampling plots.

Plant Density and Frequency

The tree species were recorded cumulatively, viz., adult, sapling and seedling in all the sampling plots. Of the 5 tree species recorded in all the sampling plots, the adult individuals of *Abies densa* (340.63/ha; ± 0.340 SE) recorded the highest density followed by *Betula utilis* (50.00 Ind/ha; ± 1.225 SE) and *Sorbus microphylla* (34.38 Ind/ha; ± 0.250 SE). The lowest density (6.25 Ind/ha each) was recorded for *Larix griffithii* and *Rhododendron arboreum*. Regarding, the highest density of sapling of *Abies densa* (2200 Ind/ha; ± 0.661 SE) followed by *Larix griffithii* (75 Ind/ha; ± 2.000 SE) and *Acer caudatum* (62.5 Ind/ha; ± 0.667 SE) and seedling was recorded for *Abies densa* (43125.0 Ind/ha; ± 0.371 SE) followed by *Betula utilis* (49062 Ind/ha; ± 2.082 SE). Regarding frequency percentage of tree species, the maximum number of occurrences was recorded for *Abies densa* (96.9%) followed by *Sorbus microphylla* and *Betula utilis* (12.5 % each) respectively. For sapling, the maximum number of occurrences was that of *Abies densa* (96.9%) followed by *Acer caudatum* and *Prunus nepalensis* (9.4% each) and *Larix griffithii* and *Sorbus microphylla* (6.3% each) respectively. Whereas, in the seedling category, *Abies densa* (100.0%) followed by *Betula utilis* (9.4%) and *Rhododendron arboreum* and *Sorbus microphylla* (6.3% each) were recorded. The relative frequency of higher tree species was recorded for *Abies densa* followed by *Sorbus microphylla* and *Betula utilis*. *Abies densa* was top most dominant species in all along the sampling path.

In the present study, the higher individual plant density of tree was recorded for *Abies densa* followed by *Betula utilis* and *Sorbus microphylla*. Amongst them, *Betula utilis* was a higher standard error as compared to other species in the sampling plots. That means, the species was not uniformly distributed in all along the sampling. The standard error of balance can provide an uneven evaluation for intervals where the population balance is likely to decline. The statistical measures the accuracy with which a sample distribution represents a population by using standard deviation. The information may also be useful to understand the impact of climate change on regional vegetation and the distribution of species.



Fig: *Rhododendron thomsonii* habitat

IMPORTANCE VALUE INDEX

The importance value index (IVI) is a statistical quantity, which gives an overall picture of the importance of the species in the vegetation community and it also shows the ecological importance of a species in a particular ecosystem. In the present study, the higher importance value index was recorded for *Abies densa* (239.19) followed by *Betula utilis* (21.97) and *Sorbus microphylla* (18.14). The high IVI exhibited by *Abies densa* is largely due to its higher relative frequency, relative density and relative dominance compared to other species. The IVI is also used to prioritize species conservation, with low IVI species requiring a high conservation priority compared to the high IVI species. In the present study, *Rhododendron arboreum* and *Larix griffithii* with low IVI values (6.28 & 6.50) were recorded which means the species are rarely distributed in the forest (**Fig 5**).

Species Diversity, Richness and Evenness

Result pertaining to species diversity showed highest species diversity value of trees (0.76) followed by seedling (0.39) and sapling (0.23). Whereas, the highest species richness was recorded for sapling and seedling (4.81 each) followed tree (4.80) as compared with evenness of tree (0.475) followed by sapling (0.284) and seedling (0.205).

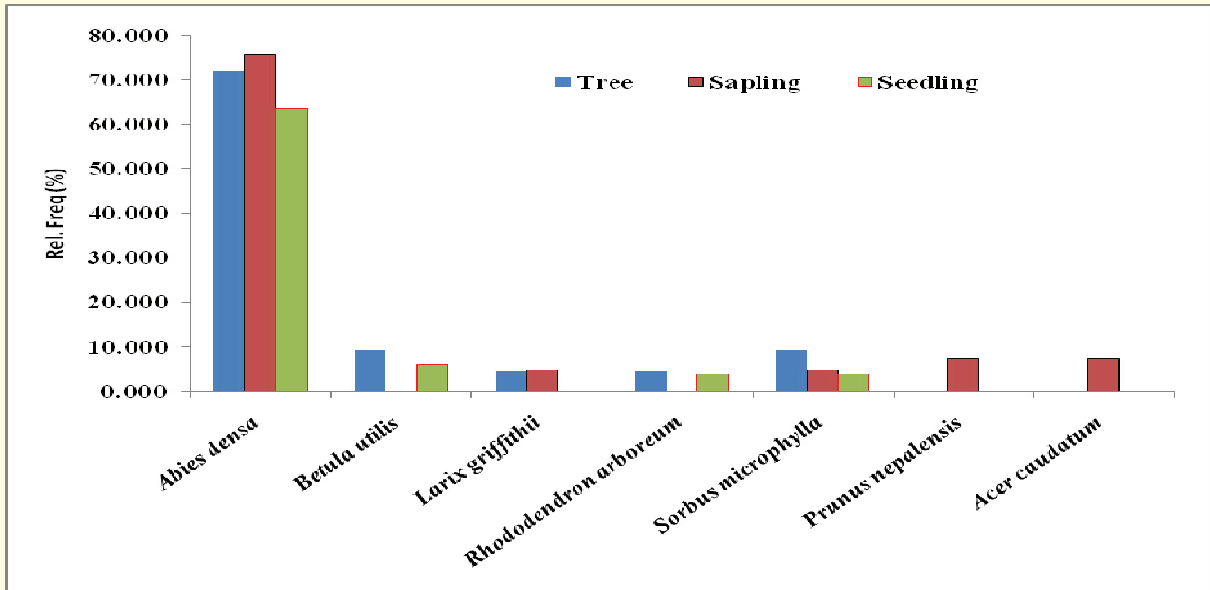


Fig 4: Relative frequency of different categories of tree species in the sampling site

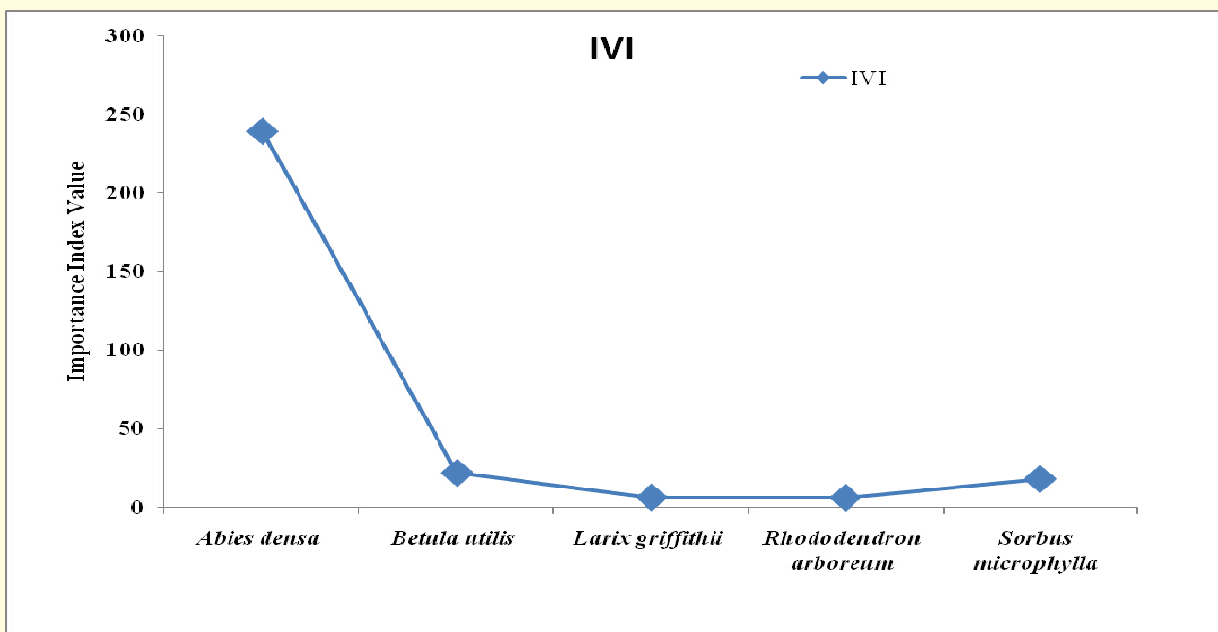


Fig 5: Importance value index of major tree species all along the sampling path

SHRUB AND SCRUB CATEGORY

For percent cover of shrub species, the highest percent cover was recorded for *Rhododendron lepidotum* (50%) followed by *Rhododendron campylocarpum* (47%) and *Rhododendron campanulatum* (38%) respectively **Table 2.**

Table 2: Percent cover and frequency percentage of shrub /shrub lets			
Scientific Name	Family	Cover (%)	Freq %
<i>Berberis</i> sp.	Berberidaceae	8.000	6.250
<i>Berberis sikkimensis</i>	Berberidaceae	10.000	3.125
<i>Lonicera</i> sp.	Caprifoliaceae	10.000	3.125
<i>Enkianthus deflexus</i>	Ericaceae	10.000	3.125
<i>Gaultheria trichophylla</i>	Ericaceae	10.000	6.250
<i>Juniperus indica</i>	Cupressaceae	3.500	6.250
<i>Juniperus recurva</i>	Cupressaceae	35.750	12.500
<i>Lyonia ovalifolia</i>	Ericaceae	40.000	6.250
<i>Rhododendron arboreum</i>	Ericaceae	20.000	6.250
<i>Rhododendron barbatum</i>	Ericaceae	20.000	6.250
<i>Rhododendron campanulatum</i>	Ericaceae	38.381	65.625
<i>Rhododendron campylocarpum</i>	Ericaceae	47.000	31.250
<i>Rhododendron cinnabarinum</i>	Ericaceae	28.000	15.625
<i>Rhododendron decipiens</i>	Ericaceae	28.333	9.375
<i>Rhododendron hodgsonii</i>	Ericaceae	25.000	21.875
<i>Rhododendron lepidotum</i>	Ericaceae	50.000	6.250
<i>Rhododendron niveum</i>	Ericaceae	27.500	6.250
<i>Rhododendron thomsonii</i>	Ericaceae	40.000	15.625
<i>Rhododendron wightii</i>	Ericaceae	15.000	15.625
<i>Ribes</i> sp.	Grossulariaceae	27.500	12.500
<i>Rosa sericea</i>	Rosaceae	26.667	9.375
<i>Salix daltoniana</i>	Salicaceae	36.667	18.750
<i>Salix</i> sp.	Salicaceae	28.889	28.125
<i>Ribes griffithii</i>	Grossulariaceae	4.000	6.250
<i>Viburnum erubescence</i>	Adoxaceae	17.500	12.500

HERB CATEGORY

In the case of herbaceous species, a total of 56 species were recorded from 32 plots, of which, *Primula denticulata* var. *denticulata* and *Eragrostis* sp., had the highest frequency of occurrences (87.50% each) followed by *Anaphalis adnata* (59.38%), *Juncus himalensis* (56.25%), *Arisaema griffithii* (53.13%) respectively. Other species had below 50% frequency of occurrences ranging from 50.00 % to 15.63%. The lowest frequency of occurrences was recorded for *Carex pulchra* (15.63%) followed by *Carex alpine* (18.75%) respectively. *Arisaema griffithii* had the highest percent cover of herb species (15.12%) followed by *Carex pulchra* (11.00%), *Eragrostis* sp. (9.89%) and *Arisaema flavum* (7.14%). Other species had low percent cover ranging from 6.46% to 2.89%.



Photo: Primula denticulata at Yumthang valley, North Sikkim

HIGHLIGHTS OF KEY FINDINGS

PRE-MONSOON

1. A total of 104 herb species were documented.
2. According to Raunkiaer's life form spectrum, the vegetation was dominated by Hemicryptophytes (97%) followed by Phanerophytes (3%). Moreover, the flora was rich with high proportion of herbs and grasses (97%) of the total species.

Over 29 *Rhododendron* species were found in the sanctuary including *Rhododendron glaucophyllum* and *R. lepidotum* have observed early flowering in the sanctuary.

Gyps himalayensis was encountered in the rhododendron forest to feed death yak along with a group of feral dogs. The current global conservation status category of the Himalayan Griffon is Near Threatened by (IUCN 2007).

POST-MONSOON

1. Only 64 herb species were documented, other remaining herb species were dormant (dormancy) during this period.
2. As per the plant life span, maximum species were under perennial life span and other remaining species were annual and biennial life span
3. *Rhododendron glaucophyllum* and *R. lepidotum* have observed early flowering (before the monsoon) and late flowering during the post-monsoon season. This might be the reason of climate change effect.
4. *Gyps himalayensis* was not recorded.

ABOUT THE KEY FINDINGS AND DISCUSSION

Through seasonal variation study concluded that the forest is highly dominant by herb species for being a sub-alpine type. All the herbaceous plant species were inventoried and showed in **Table 1**. Plant life span is most important to check the status of forest because plant survival depends on changing environmental conditions; drought, cold and competition for nutrients are some of the factors that determine the survival of a plant. Moreover, the herbs were dormant (dormancy) during post monsoon season. According to Raunkiaer's life form spectrum, the vegetation was dominated by Hemicryptophytes (97%) followed by Phanerophytes (3%). Hemicryptophytes are especially well adapted in the sub alpine forest because their plant species buds overwinter on the surface of the soil, and are therefore

usually protected by snow cover when the temperate are lower. In some species, the buds are so thickly wrapped in leaves from the previous year that they barely need snow cover.

Shingba Rhododendron sanctuary to Shiv mandir sampling path around 30km, over 29 *rhododendron* species was known to exist in the Lachung valley including Yume-samdong area. A plenty of *rhododendron* species were seen blooming all along the sampling path. *Rhododendron* species are *R. niveum*, *R. glaucophyllum*, *R. ciliatum*, *R. setosum*, *R. campanulatum* subsp. *campanulatum*, *R. campylocarpum*, *R. thomsonii* subsp. *thomsonii*, *R. pendulum*, *R. sikkimense*, *R. fulgens*, *R. cinnabarinum*, *R. wightii*, *R. decipiens*, *R. hodgsonii*, *R. barbatum*, *R. baileyi*, *R. arboreum*, *R. anthopogon* subsp. *anthopogon*, *R. mekongensis*, *R. lepidotum*, *R. triflorum* and *R. camplocarpum* were recorded.

Rhododendron glaucophyllum and *R. lepidotum* have observed early flowering (before the monsoon) and late flowering during the post-monsoon season too. This might be the reason of climate change effect. Because of increased annual temperature which is associated with earlier flowering, increased fall temperature is associated with delayed flowering. These contrasting effects have resulted in opposing changes in flowering time, due to the rapid increased the anthropogenic pressure in the sanctuary.

The two species which is eastern Himalayan endemic in the region such as *Rhododendron wightii* and *Maddenia himalaica* were recorded.

Besides flora, the sanctuary is harbouring many other faunal and avi faunal species. *Gyps himalayensis* was observed feeding on a dead yak at an elevation of 3202m above sea level, 27°43'45.2N and 88°44'28.5E in the rhododendron forest. Since late last year, nearly 300 yaks have died due to starvation during heavy snowfall in Muguthang and Yumthang valley (Shingba Rhododendron Sanctuary), North Sikkim) making the appearance of *G. himalayensis* in the region. As per the literature many vultures especially the Himalayan griffons feed largely on carcasses and carrion. This is one of the important species in the higher region and it can provide service for nutrient redistribution and recycling of ecosystem. That means the making the appearance of *Gyps himalayensis* in Sikkim Himalayan region is good sign for the healthy forest ecosystem.

The sanctuary is known to harbour many of the rare and endangered wildlife species such as Himalayan Red panda, Yellow throated marten, Common leopard and Himalayan black bear. Shingba Rhododendron Sanctuary is also one of the Important Bird Area (IBA) of Sikkim (Islam & Rahmani, 2004) represents a unique mountain system comprising the temperate coniferous forest, tree line and snowline. For the conservation point of view, trapping of

faunal as well avi-faunal species in the forest and poaching should be check regularly. If the proper faunal management is not made on time some of the species may become extinct in Shingba Rhododendron Sanctuary, North Sikkim.



Photo; Gyps himalayensis (Juvenile) was encountered at Shingba Rhododendron Sanctuary, North Sikkim



Greenish Warbler



White Collared Blackbird

Table 1: Comparative study (pre & post monsoon) vegetation of Shingba Rhododendron Sanctuary to Shiv mandir sampling path, North Sikkim

	Species	Family	Habit	Pre-monsoon (April 2019)	Post-monsoon (Oct 2019)	Life-span	Life-form
1	<i>Anaphalis busua</i> (Buch. -Ham. ex D. Don) DC	Asteraceae	Herb	+	+	Perennial	Hemicryptophytes
2	<i>Anaphalis hookeri</i> Clarke ex Hook.f.	Asteraceae	Herb	+	+	Perennial	Hemicryptophytes
3	<i>Anaphalis triplinervis</i>	Asteraceae	Herb	+	+	Perennial	Hemicryptophytes
4	<i>Androsace rotundifolia</i>	Primulaceae	Herb	+	+	Perennial	Hemicryptophytes
5	<i>Arisaema griffithii</i> Schott.	Araceae	Herb	+	-	Perennial	Hemicryptophytes
6	<i>Arisaema nepenthoides</i>	Araceae	Herb	+	-	Perennial	Hemicryptophytes
7	<i>Artemisia myriantha</i> Wall. ex Bess	Asteraceae	Herb	+	+	Perennial	Hemicryptophytes
8	<i>Artemisia vulgaris</i>	Asteraceae	Herb	+	+	Perennial	Hemicryptophytes
9	<i>Aster albescens</i> (DC.) Hand.-Mazz.	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
10	<i>Aster himalaicus</i>	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
11	<i>Astilbe rivularis</i> Buch-Ham.ex D.Don	Saxifragaceae	Herb	+	+	Perennial	Hemicryptophytes
12	<i>Bistorta affinis</i> (D. Don) Greene	Polygonaceae	Herb	+	-	Perennial	Hemicryptophytes
13	<i>Cardamine macrophylla</i> Willdenow	Brassicaceae	Herb	+	-	Perennial	Hemicryptophytes
14	<i>Cardocrinum giganteum</i> (Wall.) Makino	Liliaceae	Herb	+	+	Bulbous Perennial	Phanerophytes
15	<i>Clematis montana</i> Ham. ex DC	Ranunculaceae	Climber	+	+	Perennial	Phanerophytes
16	<i>Clintonia udensis</i> Trautvetter & C. A. Meyer	Liliaceae	Herb	+	-	Perennial	Hemicryptophytes
17	<i>Coriaria terminalis</i> Hemsley	Coriariaceae	Herb	+	+	Perennial	Hemicryptophytes
18	<i>Cremanthodium decaisneti</i> Clarke	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
19	<i>Cremanthodium</i> sp.	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
20	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Herb	+	-	Perennial grass	Hemicryptophytes
21	<i>Delphinium</i> sp.	Ranunculaceae	Herb	+	-	Perennial	Hemicryptophytes
22	<i>Dracocephalum heterophyllum</i>	Lamiaceae	Herb	+	+	Perennial	Hemicryptophytes
23	<i>Hedysarum</i> sp.		Herb	+	+	Perennial	Hemicryptophytes
24	<i>Elsholtzia</i> sp.	Lamiaceae	Herb	+	-	Annual	Hemicryptophytes

25	<i>Elytholzia strobilifera</i>	Lamiaceae	Herb	+	-	Annual	Hemicryptophytes
26	<i>Eragrostis ciliaris</i> (All.) Lut. Ex. Janchen	Poaceae	Herb	+	+	Annual	Hemicryptophytes
27	<i>Euphorbia sikkimensis</i> Boissier	Euphorbiaceae	Herb	+	-	Perennial	Hemicryptophytes
28	<i>Euphorbia wallichii</i> J. Hooker	Euphorbiaceae	Herb	+	+	Perennial	Hemicryptophytes
29	<i>Fragaria nubicola</i> Lindley ex. Lacaita	Rosaceae	Herb	+	+	Perennial	Hemicryptophytes
30	<i>Gentiana ornata</i> (Wallich ex G. Don) Grisebach	Gentianaceae	Herb	+	+	Perennial	Hemicryptophytes
31	<i>Gentiana pedicellata</i>	Gentianaceae	Herb	+	-	Annual	Hemicryptophytes
32	<i>Geranium nepalense</i> Sweet	Geraniaceae	Herb	+	+	Perennial	Hemicryptophytes
33	<i>Hackelia uncinata</i> (Royle ex Benth)	Boraginaceae	Herb	+	+	Perennial	Hemicryptophytes
34	<i>Hemiphragma heterophyllum</i> Wallich	Scrophulariaceae	Herb	+	+	Perennial	Hemicryptophytes
35	<i>Heracleum nepalense</i> D. Don	Apiaceae	Herb	+	-	Biennial	Hemicryptophytes
36	<i>Hypericum elodeoides</i> Choisy	Clusiaceae	Herb	+	+	Perennial	Hemicryptophytes
37	<i>Impatiens</i> sp.	Balsaminaceae	Herb	+	-	Annual	Hemicryptophytes
38	<i>Juncus benghalensis</i> Kunth	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
39	<i>Juncus clarkei</i> Buchen	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
40	<i>Juncus concinnus</i> D. Don	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
41	<i>Juncus himalensis</i> Klotzsch	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
42	<i>Juncus sikkimensis</i> Hook.f.	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
43	<i>Juncus thomsonii</i>	Juncaceae	Herb	+	+	Perennial	Hemicryptophytes
44	<i>Kobresia</i> sp.	Cyperaceae	Herb	+	+	Perennial sedges	Hemicryptophytes
45	<i>Kobresia uncinoides</i> (Boott.) Clarke	Cyperaceae	Herb	+	+	Perennial sedges	Hemicryptophytes
46	<i>Lactucabraceata</i> Hook.f.&Thoms	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
47	<i>Lycopodium</i> sp.	Lycopodiaceae	Herb	+	+	Perennial	Hemicryptophytes
48	<i>Mazus dentatus</i> Wallich ex Benth	Scrophulariaceae	Herb	+	-	Mat forming perennial	Hemicryptophytes
49	<i>Meconopsis paniculata</i> Prain	Papaveraceae	Herb	+	+	Robust perennial	Hemicryptophytes
50	<i>Meconopsis simplicifolia</i> (D. Don) Walp	Papaveraceae	Herb	+	+	Perennial	Hemicryptophytes
51	<i>Myricaria rosea</i> Smith	Tamaricaceae	Herb	+	+	Perennial	Hemicryptophytes
52	<i>Oberonia</i> sp.	Orchidaceae	Herb	+	+	Perennial	Hemicryptophytes

53	<i>Oxalis corniculata</i>	Oxalidaceae	Herb	+	-	Annual	Hemicryptophytes
54	<i>Oxalis</i> sp.	Oxalidaceae	Herb	+	-	Annual	Hemicryptophytes
55	<i>Oxyria digyna</i>	Polygonaceae	Herb	+	+	Perennial	Hemicryptophytes
56	<i>Packera aurea</i>	Asteraceae	Herb	+	-	Perennial	Hemicryptophytes
57	<i>Panax bipinnatifidus</i> Seem.	Araliaceae	Herb	+	+	Perennial	Hemicryptophytes
58	<i>Panax pseudo-ginseng</i>	Araliaceae	Herb	+	+	Perennial	Hemicryptophytes
59	<i>Paris polyphylla</i> Smith	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
60	<i>Parochetus communis</i>	Fabaceae	Herb	+	+	Perennial	Hemicryptophytes
61	<i>Pedicularis elwesii</i> Hook. f.	Scrophulariaceae	Herb	+	-	Perennial	Hemicryptophytes
62	<i>Pedicularis rhinanthoides</i> Schrenk	Orobanchaceae	Herb	+	-	Perennial	Hemicryptophytes
63	<i>Pedicularis roylei</i> var. <i>speciosa</i> (Prain)	Orobanchaceae	Herb	+	-	Perennial	Hemicryptophytes
64	<i>Pedicularis siphonantha</i>	Orobanchaceae	Herb	+	-	Perennial	Hemicryptophytes
65	<i>Persicaria runcinata</i>	Polygonaceae	Herb	+	+	Perennial	Hemicryptophytes
66	<i>Persicaria capitata</i> (Buch-Ham. ex D. Don)	Polygonaceae	Herb	+	+	Perennial	Hemicryptophytes
67	<i>Phlomis</i> sp.	Lamiaceae	Herb	+	+	Perennial	Hemicryptophytes
68	<i>Pleione hookeriana</i> (Lindl) Rollisson	Orchidaceae	Orchid	+	-	Pseudobulb annual	Phanerophytes
69	<i>Poa himalayana</i> Nees ex Steud	Lentibulariaceae	Herb	+	+	Perennial	Hemicryptophytes
70	<i>Poa</i> sp.	Poaceae	Herb	+	+	Perennial	Hemicryptophytes
71	<i>Polygonatum cathartii</i> Baker	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
72	<i>Polygonatum chirrifolium</i> (Wallich) Royale	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
73	<i>Polygonatum hookeri</i> Baker	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
74	<i>Polygonatum pratii</i>	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
75	<i>Polygonatum verticillatum</i> (Linn.) Allioni	Liliaceae	Herb	+	+	Perennial	Hemicryptophytes
76	<i>Polygonum molle</i> D. Don	Polygonaceae	Herb	+	+	Perennial	Hemicryptophytes
77	<i>Potentilla cuneata</i>	Rosaceae	Herb	+	-	Perennial	Hemicryptophytes
78	<i>Potentilla fruticosa</i> var. <i>pumila</i> J.D. Hool	Rosaceae	Herb	+	+	Perennial	Hemicryptophytes
79	<i>Potentilla peduncularis</i> D. Don	Rosaceae	Herb	+	+	Perennial	Hemicryptophytes
80	<i>Primula calderiana</i> I.B Balfour & Cooper	Primulaceae	Herb	+	+	Perennial	Hemicryptophytes
81	<i>Primula denticulata</i> Smith	Primulaceae	Herb	+	+	Perennial	Hemicryptophytes

82	<i>Primula denticulata</i> var. <i>alba</i> Smith	Primulaceae	Herb	+	+	+	Perennial	Hemipterophytes
83	<i>Ranunculus hirtellus</i>	Ranunculaceae	Herb	+	+	-	Perennial	Hemipterophytes
84	<i>Ranunculus</i> sp.	Ranunculaceae	Herb	+	+	-	Perennial	Hemipterophytes
85	<i>Rheum acuminatum</i> J. D. Hooker & Thomson	Polygonaceae	Herb	+	+	-	Perennial	Hemipterophytes
86	<i>Roscoea alpine</i> Royle	Zingiberaceae	Herb	+	+	-	Perennial	Hemipterophytes
87	<i>Rubus</i> sp.	Rosaceae	Herb	+	+	+	Perennial	Hemipterophytes
88	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Herb	+	+	+	Perennial	Hemipterophytes
89	<i>Selinum tenuifolium</i> Wallich	Apiaceae	Herb	+	+	-	Perennial	Hemipterophytes
90	<i>Senecio albopurpureus</i> Kitam.	Asteraceae	Herb	+	+	+	Perennial	Hemipterophytes
91	<i>Sinopodophyllum hexandrum</i>	Berberidaceae	Herb	+	+	-	Perennial	Hemipterophytes
92	<i>Smilacina oleracea</i> (Baker) Hook.f.	Smilacaceae	Herb	+	+	+	Perennial	Hemipterophytes
93	<i>Sphagnum squarrosum</i>	Sphagnaceae	Mosses	+	+	+	Perennial	Phanerophytes
94	<i>Spilanthes</i> sp.	Asteraceae	Herb	+	+	-	Perennial	Hemipterophytes
95	<i>Stellaria</i> sp.	Caryophyllaceae	Herb	+	+	-	Perennial	Hemipterophytes
96	<i>Streptopus simplex</i> D. Don	Liliaceae	Herb	+	+	+	Perennial	Hemipterophytes
97	<i>Swertia</i> sp.	Gentianaceae	Herb	+	+	+	Perennial	Hemipterophytes
98	<i>Trillidium govanianum</i>	Liliaceae	Herb	+	+	-	Perennial	Hemipterophytes
99	<i>Triosetum himalayanum</i>	Caprifoliaceae	Herb	+	+	-	Perennial	Hemipterophytes
100	<i>Usnea himalayana</i>	Parmeliaceae	Mosses	+	+	+	Perennial	Phanerophytes
101	<i>Veronica serpyllifolia</i> L.	Plantaginaceae	Herb	+	+	-	Perennial	Hemipterophytes
102	<i>Veronica</i> sp.	Scrophulariaceae	Herb	+	+	-	Annual	Hemipterophytes
103	<i>Viola biflora</i>	Violaceae	Herb	+	+	+	Perennial	Hemipterophytes
104	<i>Viola sikkimensis</i> W. Becker	Violaceae	Herb	+	+	+	Perennial	Hemipterophytes

Note: + indicates Present, - indicates dormant



Overview of Yakchey in post-monsoon season



Overview of Yakchey in pre-monsoon season

POST MONSOON SURVEY OF BIODIVERSITY OF BARSEY RHODODENDRON SANCTUARY, WEST SIKKIM

Sabita Dahal & Meena Tamang



STUDY AREA

A field trip for conducting post monsoon observation of biodiversity of Barsey Rhododendron Sanctuary were conducted during October 2019 in the previously surveyed area ranging from 2200m (Hillay) to 3610m (Phoktey Dara) - Chewabhyanjang (3119) sampling path which is represented by Figure 1. The forest type of the area is represented by Temperate Rhododendron Mixed Forest, Temperate Coniferous forest, Subalpine and alpine forest. The slope angle of the area ranged between stiff (70 degree) to mild (25 degree) slope and is facing towards N, NE, NW, E and S aspect as showed in table 1. The survey were conducted following the quadrat sampling method in case of flora, and trail sampling methods in case of fauna, for the details of the methodology followed the series of reports on Rapid Biodiversity Survey which has already been published from SBFP under Department of Forest and Environment can be referred.

Since, the most predominant taxa in the forest are trees, followed by herbs, shrubs and shrublets, ferns, climbers and epiphytes, forest constitutes the diverse habitat for fauna of the

temperate to alpine belt. The area is highly dominated with *Rhododendron arboreum*, *Rhododendron barbatum*, *Taxus wallachiana*, *Rhododendron falconeri*, *Rhododendron griffithianum*, *Rhododendron hodgsonii*, *Acer campbellii*, *Acer palmatum*, *Lithocarpus pachyphyllus*, *Lyoniao valifolia*, *Magnolia campbellii*, *Magnolia doltsopa*, *Tsuga dumosa*, *Eurya acuminata*, *Symplocos lucida*. The area above Deonigali Dhap, the dominant species were *Rhododendron falconeri*, *Rhododendron barbatum*, *Betula utilis*, *Acer pectinatum* and *Yushania maling*. In the entire area of Deonigali Dhap (2700-2900m) *Sinarundinaria macrophylla* (Deonigalo) was observed as the highly dominating species, which is the only natural habitat of *Sinarundinaria macrophylla* (Figure 2). Common shrub species recorded from the area are mostly *Rhododendron* such as *R.campanulatum*, *R.dalhousieae*, *R. lindleyi*, *R. lepidotum*, *Rubus ellipticus*, *Rubus niveus*, *Rubus paniculatus*, *Viburnum erubescens*, *Dichroa febrifuga*, *Maesa chisia*, *Oxyspora paniculata* etc. Diversity of the ground covering herbs species in the area recorded high, but in terms of density, in term of the percentage of ground cover, was comparatively less.



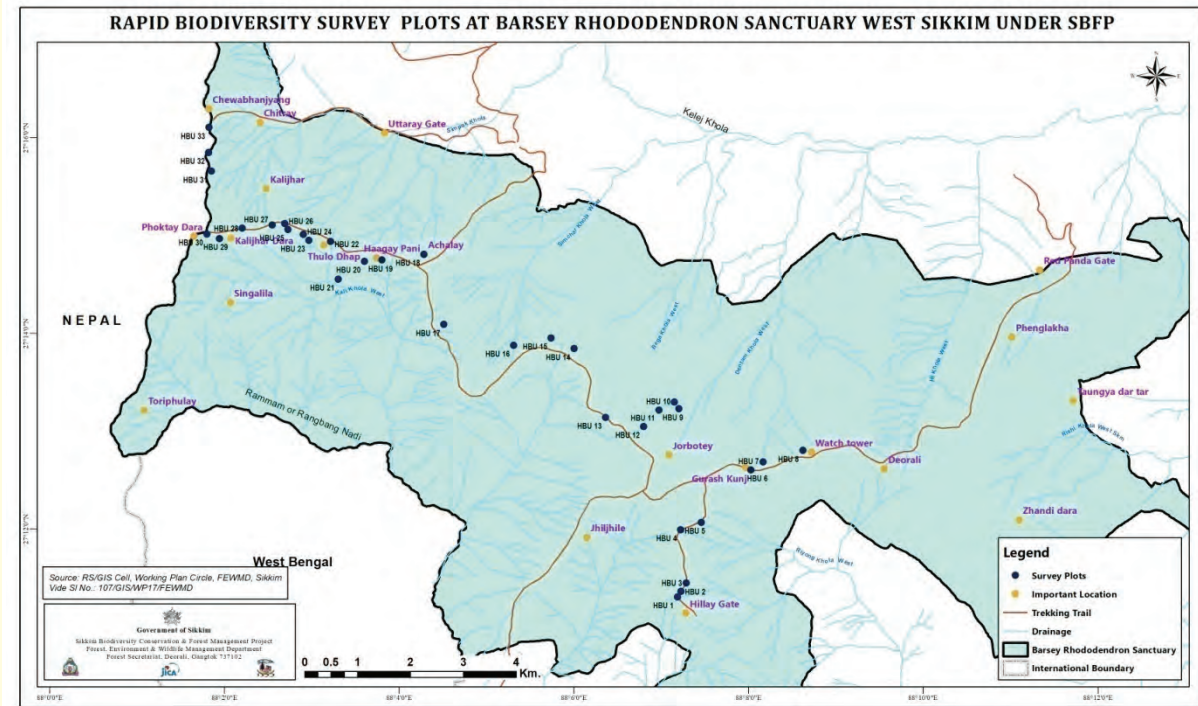


Figure 2: Barsey Rhododendron Sanctuary showing sampling path From Hilay – Phoktay Dara – Chewabhanjyang in West Sikkim.



Table 1: Site characteristics of the survey site along Hillay – Phoktay dara – Chewabhyanjang sampling path at Barsey Rhododendron Sanctuary, West Sikkim.

Site Code	Forest Type	Altitude (m)	GPS Coordinate		Slope Angle	Slope Aspect	Canopy Cover (%)	Location
			Latitude	Longitude				
Plot 1	Mixed temperate	2737	27°11'10.0"	88°07'18.0"	70	N	30	Hilley
Plot 2	Mixed temperate	2774	27°11'18.4"	88°07'14.2"	80	NE	20	Hilley
Plot 3	Mixed temperate	2797	27°11'23.5"	88°07'17.7"	80	NE	10	Hilley
Plot 4	Mixed temperate	2842	27°11'56.09 "	88°07'14.4"	50	E	20	Hilley
Plot 5	Mixed temperate	2811	27°12'20.0"	88°07'28.0"	60	NW	10	Hilley
Plot 6	Mixed temperate	2865	27°12'32.0"	88°07'50.0"	10	E	25	Hilley
Plot 7	Mixed temperate	2822	27°12'17.0"	88°07'26.0"	10	SE	30	Barsey
Plot 8	Mixed temperate	2797	27°12'44.1"	88°08'38.7"	40	NE	15	Barsey
Plot 9	Mixed temperate	2834	27°12'37.0"	88°08'03.0"	70	NE	20	Barsey
Plot 10	Mixed temperate	2845	27°13'10.3"	88°07'13.8"	25	E	45	Barsey
Plot 11	Mixed temperate	2871	27°13'9.7"	88°07'0.1"	40	NE	10	Barsey
Plot 12	Mixed temperate	2826	27°12'59.7"	88°06'49.5"	40	N	10	Lasuney
Plot 13	Mixed temperate	2852.8	27°12'56.0"	88°06'45.0"	35	E	60	Above Lasuney
Plot 14	Mixed temperate	2808	27°13'29.0"	88°06'08.0"	60	SE	0	Below Deonigal oDhaap
Plot 15	Mixed temperate	2787	27°13'55.0"	88°05'32.0"	45	E	60	Deonigal oDhaap
Plot 16	Mixed temperate	2813	27°13'49.0"	88°04'51.0"	10	E	40	Above Deonigal oDhaap

Plot 17	Mixed temperate	2872	27°13'50.2"	88°04'32.9"	mild	NE	10	Above Duck Pokhari
Plot 18	Mixed temperate	2829	27°14'46.0"	88°04'11.0"	mild	NE	0	Achallay
Plot 19	Mixed temperate	2885	27°14'42.0"	88°03'40.0"	30	NE	20	Above Achallay
Plot 20	Mixed temperate	2939.9	27°14'45.0"	88°03'28.0"	15	NE	20	
Plot 21	Mixed temperate	2916	27°14'50.0"	88°03'22.0"	10	NE	0	
Plot 22	Mixed temperate	2877	27°14'50.0"	88°03'06.6"	mild	NE	10	ThuloDhap
Plot 23	Mixed temperate	3002	27°14'55.6"	88°03'0.5"	40	NE	30	Above ThuloDhap
Plot 24	Mixed temperate	3068	27°14'59.7"	88°02'54.2"	30	NE	20	
Plot 25	Mixed temperate	3177	27°15'03.6"	88°02'45.7"	mild	NE	20	
Plot 26	Mixed temperate	3250	27°15'07.8"	88°02'43.2"	60	NE	35	
Plot 27	Mixed temperate	3352	27°15'04.9"	88°02'34.2"	10	NE	0	Chipchipey
Plot 28	Sub-Alpine	3412	27°15'3.5"	88°02'14.8"	90	SW	0	Kalijhar
Plot 29	Sub-Alpine	3509	27°14'57.2"	88°01'59.9"	90	NE	0	Above Kalijhar
Plot 30	Alpine	3610	27°15'10.0"	88°01'50.5"	mild	NE	0	PhokteyDara
Plot 31	Mixed temperate	3251	27°15'38.5"	88°01'53.9"	60	NE	10	
Plot 32	Mixed temperate	3157	27°15'50.10 "	88°01'52.3"	45	E	15	Before Chewabhanjyang
Plot 33	Mixed temperate	3119	27°16'5.8"	88°01'52.16 "	25	S	10	Chewabhanjyang

OUTCOMES

During the survey, a total of 33 plots were laid covering 0.33 ha area (Table 1 & Figure 1). In the existing list of flora of the area 42 species were added, of which 3 species were shrubs and 39 species were herbs which are listed in Table 2: Forest status in terms of the species regeneration appear high during this season.

Table 2: List of species added during post monsoon survey of Barsey Rhododendron Sanctuary

Sl. No	Botanical Name	Habit	Family	Altitudinal range
1.	<i>Aconitum ferox</i> Wall.ex Ser.	Herb	Ranunculaceae	2100-3600
2.	<i>Aletris pauciflora</i> (Klotzsch) Hand.- Mazz.	Herb	Liliaceae	3000-4300
3.	<i>Allium wallichii</i> Kunth	Herb	Amaryllidaceae	2800-4300
4.	<i>Anaphalis contorta</i> D.Don	Herb	Asteraceae	2200-3800
5.	<i>Anaphalis triplinervis</i> (Sims) C.B.Clarke	Herb	Asteraceae	1800-3300
6.	<i>Arisaema erubescens</i> (Wall.) Schott	Herb	Araceae	2300-3000
7.	<i>Arisaema griffithii</i> Schott	Herb	Araceae	2400-3200
8.	<i>Arisaema jacquemontii</i> Schott	Herb	Araceae	2400-3000
9.	<i>Bergenia ciliata</i> (Haw.) Sternb.	Herb	Saxifragaceae	1800-4300
10.	<i>Bergenia purpurascens</i> (Hook. & Thomson) Engler	Herb	Saxifragaceae	2700-4800
11.	<i>Bistorta amplexicaulii</i> (D.Don) Greene	Herb	Polygonaceae	2100-4800
12.	<i>Cynanthus inflatus</i> Hook.f.& Thoms.	Herb	Campanulaceae	1900-4900
13.	<i>Dubyaea hispida</i> Candolle	Herb	Asteraceae	2700-4500
14.	<i>Epilobium wallichianum</i> Haussknecht	Herb	Onagraceae	1800-4100

15.	<i>Erigeron multiradiatus</i> (Lindl.ex DC.) Benth.ex Cl.	Herb	Asteraceae	2300-4600
16.	<i>Erigeron multiradiatus</i> (Lindl.ex DC.) Benth.ex Cl.	Herb	Asteraceae	2300-4600
17.	<i>Fritillaria cirrhosa</i> D. Don	Herb	Liliaceae	3200-4600
18.	<i>Galinsoga parviflora</i> Cavanilles	Herb	Asteraceae	850-3900
19.	<i>Galium</i> sp	Herb	Rubiaceae	
20.	<i>Gentiana algida</i> Pallas	Herb	Gentianaceae	1200-5200
21.	<i>Geranium wallichianum</i> Don ex. Sw.	Herb	Geraniaceae	2900-4000
22.	<i>Halenia elliptica</i> D.Don	Herb	Gentianaceae	700 -4100
23.	<i>Impatiens bicornuta</i> Wall.	Herb	Balsaminaceae	2500-3100
24.	<i>Impatiens racemosa</i> Candolle	Herb	Balsaminaceae	1200-3400
25.	<i>Impatiens radiata</i> Hook.	Herb	Balsaminaceae	2100-3500
26.	<i>Impatiens urticifolia</i> Wallich	Herb	Balsaminaceae	2700-3800
27.	<i>Iris clarkei</i> Baker ex Hook.f.	Herb	Iridaceae	3000-4000
28.	<i>Maharanga emodi</i> (Wallich) A de Candolle	Herb	Boraginaceae	1800-3300
29.	<i>Myricaria rosea</i> W.W.Smith	Herb	Tamaricaceae	2600-4800
30.	<i>Pedicularis longiflora</i> Rudolph	Herb	Scrophulariaceae	2100-5300
31.	<i>Pleurospermum hookeri</i> C.B.Clarke	Herb	Apiaceae	2700-5400
32.	<i>Polygonatum cathcartii</i> Baker	Herb	Polygonaceae	2500-3500
33.	<i>Polygonatum cirrhifolium</i> (Wallich) Royle	Herb	Polygonaceae	1500-3800
34.	<i>Polygonatum verticellatum</i> (L.) All.	Herb	Polygonaceae	1500-3700
35.	<i>Potentilla cuneata</i> Wallich ex Lehm.	Herb	Rosaceae	2400-5500

36.	<i>Satyrium nepalense</i> D.Don	Herb	Orchidaceae	1500-4000
37.	<i>Senecio graciliflorus</i> DC.	Herb	Asteraceae	2400-4000
38.	<i>Senecio raphanifolius</i> Wall.ex DC.	Herb	Asteraceae	2700-4400
39.	<i>Senecio scandens</i> Buch.Ham. ex D. Don	Herb	Asteraceae	1800-3600
40.	<i>Ribes himalense</i> Royle ex Decne.	Shrub	Grossulariaceae	1500-4200
41.	<i>Ribes griffithii</i> Hook.f.& Thomson	Shrub	Grossulariaceae	2600-4200
42.	<i>Rosa sericea</i> Lindley	Shrub	Rosaceae	2100-4500

Photographs of some of the added species from post monsoon survey of Barsey
Rhododendron Sanctuary



Ribes griffithii



Myricaria rosea



Aconitum ferox



Impatiens racemosa

REGENERATION OF SPECIES



CONCLUSION

During post monsoon survey, most of the ground covering species were in flowering, hence, some of the species which were unable to identify in the pre monsoon survey, especially herbs could be identified. The diversity and density of trees, small trees and most of the shrubs recorded same as in pre monsoon survey. Along the upper region of the forest, *Yushania maling* (Malingo) appeared as highly dominant ground covering species both in pre monsoon and post monsoon visits. The population of Rhododendrons were also the same as in pre-monsoon visit. Re-generation of the Rhododendrons and other species appeared comparatively good in the post monsoon survey.

SEASONAL VARIATION STUDY (PRE- AND POST-MONSOON) BIODIVERSITY INVENTORY OF YAKCHEY IN NORTH SIKKIM

-Anjana Pradhan and Dorjee C. Bhutia

INTRODUCTION

Yakchey is located about 7km north of Lachung and stretches upto the border of Shingba Rhododendron Sanctuary in North Sikkim. The entire region of Yakchey falls under Lachung Range with elevation ranging from 2583m asl to 3200m asl and lying between latitude 27°41'27.6"N and longitude 88°44'35.9"E.

The climate of the study area is usually cool throughout the year with considerable amount of rainfall during the monsoon in the month of June – late September. The climate gets warmer between winter and monsoon when there is little or no rainfall at the area. Water is a key factor that regulates the growth and development of plants that favors the proliferation of a myriad of diverse floral species. Climate plays a major role in bringing the changes in vegetation composition and diversity. During the post-monsoon, the forest shows full greenness (mature leaf) which indicates the presence of dense vegetation; the vegetation becomes green and luscious with evergreen plant species highlighting the incoming of autumn. This incoming of autumn brings along the variation in species growth and availability of plants. Pre-monsoon is marked by summer (April – May) and regulates the flowering of rhododendrons in the area and of other plant species. It is also the time for the beginning of leaf flush activity.

The forest is a temperate coniferous to sub-alpine with unique floral diversity dominated with pine and rhododendrons attributing to striking landscape making the region a one-time stop for tourist attraction. The vast region of the forest is also occupied with various species of rhododendrons which is in full bloom at the time of pre monsoon. These species are perennials and some species still bloom towards the end of post monsoon. The State tree, *Rhododendron niveum*, is distributed at Yakchey area upto the lower elevation of Shingba Rhododendron Sanctuary. A great deal of shrubby *R. niveum* is naturally available in the forest as well. The lower elevation of the forest also practices agrofarming which becomes a livelihood for the people of the village.

The aim of the study was to inventorize the seasonally captured herbal species of pre- and post-monsoon seasons. This study was conducted to record the vegetation differences captured between pre- and post-monsoon and to prepare a floristic inventory of Yakchey area from the starting point of Lachung village upto the sanctuary.

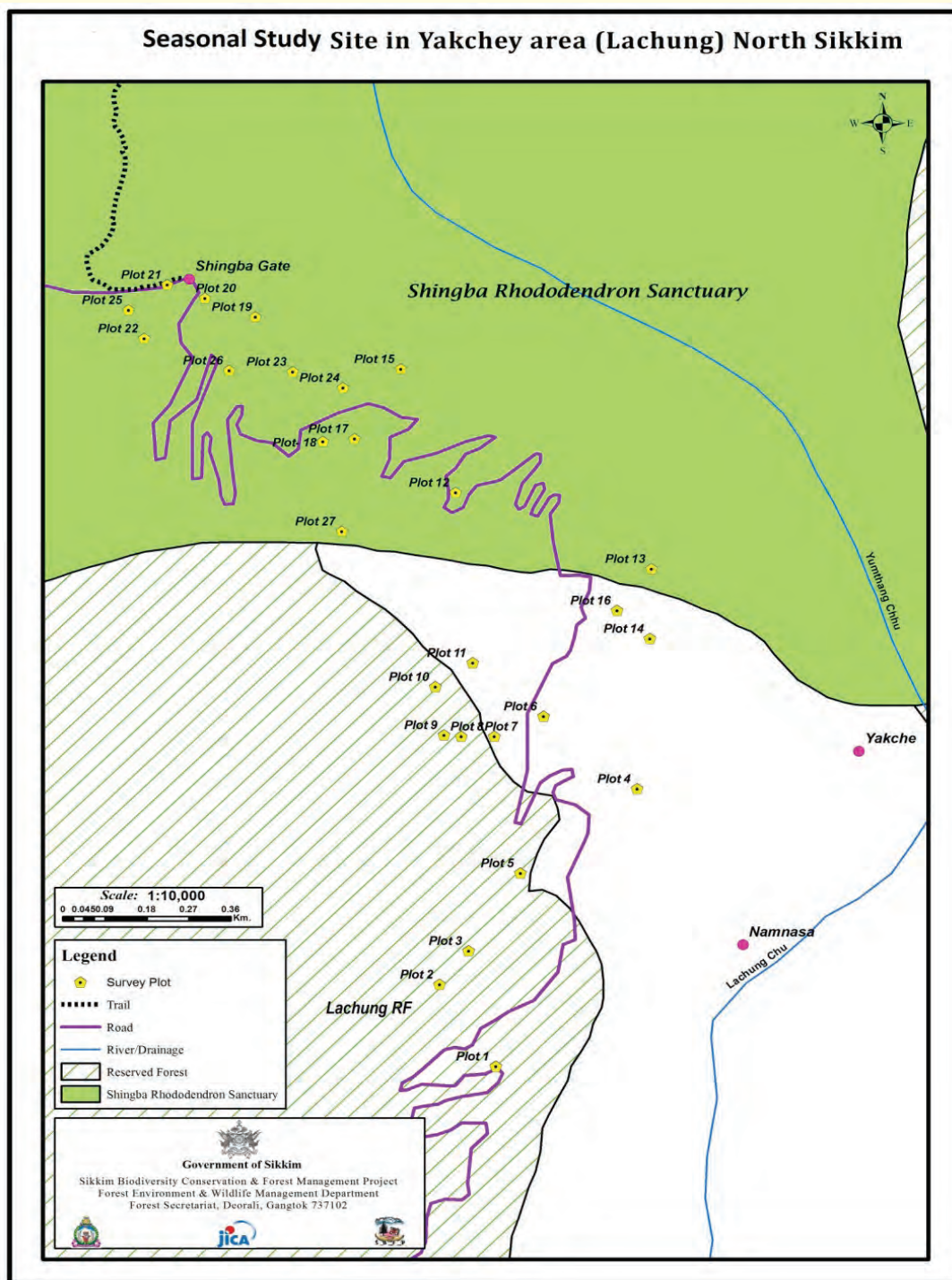
RAPID BIODIVERSITY SURVEY

The survey was carried out in two different seasons i.e. in April – May (pre monsoon) and October – November (post monsoon). To measure the diversity of the forest in the two seasons, quadrats of 1m X 1m were laid along the random sampling path. A total of 27 random sampling plots were laid and geotagged for future reference. The elevation of the study site ranges between 2800m asl and 3200m asl showing aspects of East, North and North-East with slope angle falling between 5 and 45 degree inclination covering an area of 0.27ha. Pre-monsoon study was conducted in May, 2019 and post-monsoon study was carried out in October, 2019.

Table 1: Site characteristics of sampling plots of Yakchey – Shingba Sampling Path

Site	Forest Type	Latitude	Longitude	Elevation (m)
YS 1	Temperate Conifer	27°42'45.0"	88°44'57.3"	2876
YS 2	Temperate Conifer	27°42'51.1"	88°44'53.4"	2931
YS 3	Temperate Conifer	27°42'53.6"	88°44'55.4"	2950
YS 4	Temperate Conifer	27°43'05.7"	88°44'07.1"	2919
YS 5	Temperate Conifer	27°42'59.4"	88°44'59.0"	2937
YS 6	Temperate Conifer	27°43'11.1"	88°44'00.6"	3048
YS 7	Temperate Conifer	27°43'09.6"	88°44'57.2"	3003
YS 8	Temperate Conifer	27°43'09.6"	88°44'54.9"	3016
YS 9	Temperate Conifer	27°43'09.7"	88°44'53.7"	3044
YS 10	Temperate Conifer	27°43'13.3"	88°44'53.1"	3005
YS 11	Temperate Conifer	27°43'15.1"	88°44'55.7"	3012
YS 12	Temperate Conifer	27°43'27.8"	88°44'54.5"	3046
YS 13	Temperate Conifer	27°43'22.1"	88°44'08.1"	2977
YS 14	Temperate Conifer	27°43'16.9"	88°44'08.0"	2952
YS 15	Temperate Conifer	27°43'37.0"	88°44'50.7"	3099
YS 16	Temperate Conifer	27°43'19.0"	88°44'05.7"	2964
YS 17	Temperate Conifer	27°43'31.8"	88°44'47.5"	3097
YS 18	Sub Alpine Forest	27°43'31.6"	88°44'45.3"	3114
YS 19	Temperate Conifer	27°43'40.9"	88°44'40.6"	3148
YS 20	Temperate Conifer	27°43'42.3"	88°44'37.1"	3202
YS 21	Temperate Conifer	27°43'43.3"	88°44'34.5"	3216
YS 22	Sub Alpine Forest	27°43'39.3"	88°44'32.9"	3222
YS 23	Sub Alpine Forest	27°43'36.8"	88°44'43.2"	3220
YS 24	Sub Alpine Forest	27°43'35.6"	88°44'46.7"	3101
YS 25	Sub Alpine Forest	27°43'41.4"	88°44'31.8"	3116
YS 26	Sub Alpine Forest	27°43'36.9"	88°44'38.8"	3148
YS 27	Sub Alpine Forest	27°43'24.9"	88°44'46.6"	3081

Species were identified and recorded either in the field or with the help of literatures, herbarium of Botanical Survey of India and floral references such as from www.floraofchina.net and www.flowersofindia.net. Help of local villagers were taken to understand the vernacular names of the species. Raunkier's system of classification was used to determine the life forms of the species. Their life span was also determined in order to understand the difference of species in two seasons (**Table 1**).



Map showing the sampling plots of Yakchey area

RESULT AND DISCUSSION

Pre-monsoon study was conducted in May, 2019 marking summer season. During this survey, it was observed that the effect of pre-monsoon favored the flowering of many species as of rhododendrons and other plant species. It is also the time for the beginning of leaf flush activity as was observed during the survey. Post-monsoon study was conducted in October, 2019. The climate was cooler at the time which resulted in the decline of species diversity and abundance due to fall in the favorable conditions that followed post the rains. The vegetation growth and distribution differed from that as observed during the pre-monsoon season as favorable conditions for the growth and propagation of all species may not have prevailed. The phenology (flowering and fruiting) also deferred for different plant species depending on specific species as observed during the survey. This could be due to the factors not being in favor of the flowering season.

During the pre-monsoon season, a total of 140 species was encountered from the sampling area (Table 2). One hundred and ten genera belonging to 67 families of floral species were recorded in the present study of which herb represented the highest number of species with 79 species belonging to 67 genera in 38 families. This was followed by shrub/scrub (30 species, 19 genera in 12 families), trees (23 species, 17 genera in 11 families), ferns and fern-allies (7 species, 7 genera in 6 families) and 1 bamboo species.

A total of 130 species was encountered from the same sampling area in the post-monsoon season (Table 2). Ninety six genera belonging to 64 families of floral species were recorded in the post-monsoon study of which herb showed some variation still representing the highest number of species with 74 belonging to 39 genera in 33 families. There were few shrub species added in this season (34 species, 31 genera in 12 families) followed by trees (23 species, 17 genera in 11 families), ferns and fern-allies (8 species, 7 genera in 7 families) and 1 bamboo species. Ericaceae and Rosaceae were the dominant family representing rhododendrons and potentilla and prunus, respectively, in both the seasons.

Table 2: Distributional comparison of floral species recorded in pre- and post-monsoon seasons

Taxa	Pre monsoon			Post monsoon		
	Species	Genus	Family	Species	Genus	Family
Trees	23	17	11	23	17	11
Shrubs	30	19	12	34	31	12
Herb/Climbers/Epiphytes	79	67	38	64	39	33
Fern & Fern-allies	7	6	5	8	8	7
Bamboo	1	1	1	1	1	1
Total	140	110	67	130	96	64

Altogether, in both the seasons, a total of 98 herb species (79 genera and 41 families) were recorded (Table 3). The flora was rich with a high proportion of herbs contributing about 70% of the total species in both the seasons. Such high dominance of herbs is apparent after monsoon downpours. There was only slight change in the herb species diversity observed during the post-monsoon. This can be interpreted as the species observed during the pre-monsoon season may not have been observed during the post-monsoon season thereby reducing the diversity. Many species must have undergone dormancy during the post-

monsoon season because of adverse growing conditions which is typical of the climate experienced in the region's post-monsoon season. Thus, it is prominent that specific species that emerge in monsoon and pre-monsoon seasons perishes by post-monsoon season and thus are driven by climatic conditions that optimize their successful life cycle. Episodic disturbances in the area also affect vegetation structure, composition and diversity contributing to the absence of species in the affected area.

The dominant life span of the total species in the region is perennials with 96% and only 3% species as annuals in pre-monsoon. While 97% were perennials and 1% was annual in post-monsoon season (Figure 1). Plant lifespan (usually measured in years) is defined as the time period from establishment until no live part remains of the respective individual. Maximum plant lifespan is an indicator of population persistence and is therefore strongly related to land use and climate change.

The presence of maximum

perennials may indicate that the forest holds a healthy ecosystem that has the resistance to withstand environmental stress such as low temperatures, low nutrient availability or exposure to excess moisture after monsoon rains. Only 4 species *Elsholtzia strobilifera*, *Gentiana pedicellata*, *Impatiens* and *Portulaca* species showed annual life span which were recorded in the area. While *Jacobaea* species contained both the life span showing biennial behavior which was recorded in post monsoon.

Plant family Ericaceae(5 genera, 21 spp.) was found predominant with high species richness representing maximum of rhododendrons (13 spp.), *Gaultheria* (4 spp.), *Lyonia ovalifolia*, *Enkiathus deflexus*, and *Vaccinium nummularia*. Maximum number of rhododendron species in the area is prominent as the forest lies in close proximity with the Shingba Rhododendron Sanctuary. This was followed by the families Rosaceae (10 genera, 16 spp.) and Asteraceae (15 spp., 10 genera; Figure 2) which is in agreement with the composition described for temperate coniferous to sub-alpine forest. Although the canopy cover of temperate coniferous zone is dominant with a mixture of conifers belonging to families Cupressaceae and Pinaceae, other trees such as *Acer campbellii*, *Salix* sp., and *Populus jacquemontiana* also formed the dominant taxa of the forest.

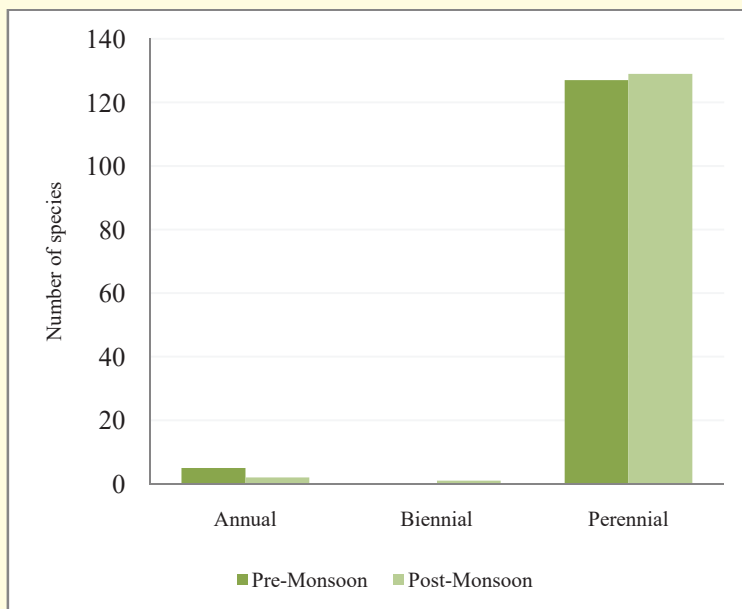


Figure 1: Life span of total species

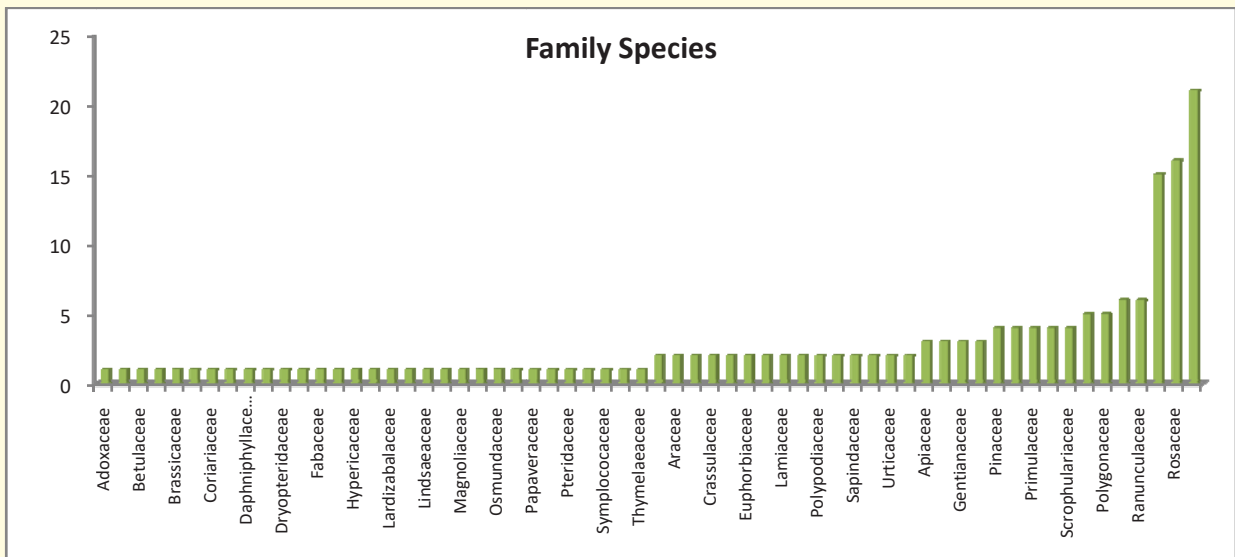


Figure 2: Plant families and species richness of flora of Yakchey forest

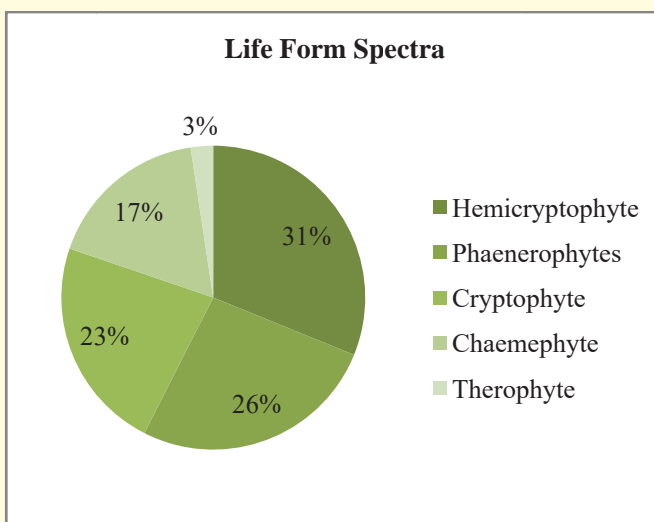


Figure 4: Life form spectra of total species in pre- and post-monsoon season

According to the Raunkier's life form spectrum, the total vegetation of the forest (during pre- and post-monsoon) was dominated by Hemicryptophytes (31%), Phaenerophytes (26%) and Cryptophytes (23%) and Chaemephyte (17%), while Therophyte was poorly represented (Figure 4). The higher Hemicryptophytes represented herbaceous perennial plants which are less compared to the normal spectrum (26%). Such a high representation of Hemicryptophytes in the study area may indicate cold temperate vegetation which supports our study

site being a temperate coniferous to sub-alpine forest. A 26% Phaenerophyte represents the woody trees and shrubs indicating the humid bioclimate of the area. Cryptophytes indicate the presence of rhizomatous plants.

HIGHLIGHTS OF SOME MAJOR FINDINGS

A total of 79 herb species were recorded during the pre-monsoon season while a total of 64 herb species were encountered during the post-monsoon season which is less as compared to the pre-monsoon season. Nevertheless, there was a slight change in the species composition in species level as observed between the two seasons. The herbal composition in the both the seasons showed maximum as compared to other vegetation.

The major change observed in the two seasons was that of the forest canopy cover. During the post-monsoon season, there was an evident sighting of autumn leaf coloration of trees

reflecting the forest canopy with a beautiful wave of colors. Such a view of the tree canopy can also provide an idea of the species present in the forest.



Forest canopy cover in pre-monsoon



Forest canopy cover in post-monsoon

The standing species (tree and shrub) did not show major changes in diversity or dominance between the two seasons (pre- and post-monsoon). While some phenological aspects such as senescence of deciduous trees and shedding of leaves were observed during the post-monsoon season, it was the flowering and fruiting of some other woody species in pre-monsoon season. While maximum rhododendrons were at their flowering stage during pre-monsoon, there was no flowering during the post monsoon except for *Rhododendron glaucophyllum* and

R. lepidotum, whose flowering was still present in post-monsoon. Likewise, there were a maximum number of flowering plants observed in pre monsoon. Fruiting was at its most during the post-monsoon season. Regular seasonal variations such as growth, flowering, fruiting, senescence and shedding of leaves occur over a time period (weeks or months). This concept of plant phenology helps in understanding the effect of seasonal variation on plants.



***Rhododendron glaucophyllum* in its full blooming stage at pre-monsoon season**



***Cardiocrinum giganteum* in (A) Pre-monsoon: favoring the growth of full plant in association with *Arisaema griffithii* and (B) Post-monsoon season: Seed pod**

A few additional shrub species were encountered during the post-monsoon which was because some species at pre-monsoon were unidentified due to their leaf shedding at the time. Species like *Aster albescens* (flowering), *Berberis concinna*, *Cotoneaster frigidus* (fruiting), *Gaultheria semi-infera* (fruiting), *Rubus biflorus* (leaf shed), *R. parviflorus* and *R. pedunculatus* were included in the checklist.

Some herbs had changed their leaf color during the post-monsoon season which was otherwise at their flowering or fruiting stage during the pre-monsoon season. This is possibly due to the change in the climate between the two seasons being warm and getting cooler as the season changes.

In the sampling plots of pre-monsoon season, there was a high diversity of occurrence of some plant species which was completely absent post monsoon. For eg. *Euphorbia sikkimensis*, *Arisaema griffithii*, etc. as shown in Table 3. While *Arisaema griffithii*, a rhizomatous herb, dominated the ground vegetation at regular intervals, this species was absent post monsoon probably due to its dormancy. However, in post monsoon, the ground vegetation was dominated by *Fragaria nubicola* which was present in abundance in both the seasons (Table 3).

The most representative families in number of species were largely the same for both the seasons (pre- and post-monsoon). Most of the species in the environment were native possibly because the study area is a natural forest and has low level of anthropogenic disturbance except for occasional disturbances.



Cotoneaster frigidus in its fruiting stage in post monsoon;

Hippophae salicifolia in its fruiting stage in post monsoon



Berberis asiatica at its early flowering stage in pre monsoon and fruiting stage in post monsoon

Recommendation and conclusion

While multiple factors are important in determining the presence of a particular vegetation type at a given spatial location in a diverse and dynamic landscape, our results show that there is a decline in floral diversity in post-monsoon season though it was only a matter of difference in few numbers as observed through the analysis. It can be concluded that with seasonal and climatic changes, there shows a drastic shift of vegetation which influences the species type and

diversity along with their plant cover type's and species combinations. Hence, the most suitable season for the growth and propagation of many species can be considered as pre-monsoon season in comparison to the post-monsoon season. Further, detailed analysis of the vegetation change of a particular site can be studied to analyze the effect of seasonal and climatic variation.



Flowering of *Senecio scandens* in post monsoon



Flowering of *Aster albescens* in post monsoon

Table 1: Checklist of plant species distributed at Yakchey during pre- and post-monsoon season

	Plant species	Family	Local name	Habit	Life Span	Life form	Pre monsoon	Post monsoon
1	<i>Abies densa</i> Griff.	Pinaceae	Gobre salla	Tree	Evergreen perennial	Phanerophytes	+	+
2	<i>Acer caudatum</i> Wall.	Sapindaceae	Kapasey	Tree	Evergreen perennial	Phanerophytes	+	+
3	<i>Acer campbellii</i> Hook.f. & Thomson ex Hiern	Sapindaceae	Kapasey	Tree	Evergreen perennial	Phanerophytes	+	+
4	<i>Anaphalis contorta</i> (D.Don) Hook.f.	Asteraceae		Herb	Perennial	cryptophyte	-	+
5	<i>Anaphalis margaritacea</i> (L.) Benth. & Hook.f.	Asteraceae		Herb	Perennial	cryptophyte	-	+
6	<i>Anaphalis triplinervis</i> (Sims) Sims ex C.B.Clarke	Asteraceae	Bukiphool	Herb	Perennial	cryptophyte	+	+
7	<i>Androsace rotundifolia</i>	Primulaceae		Herb	Perennial	Hemicryptophyte	+	-
8	<i>Anemone</i> sp.	Ranunculaceae		Herb	Perennial	Hemicryptophyte	+	-
9	<i>Arisaema griffithii</i> Schott	Araceae	Saap ko phool	Herb	Perennial	cryptophyte	+	-
10	<i>Arisaema nepenthoides</i> (Wall.) Mart.	Araceae	Saap ko phool	Herb	Perennial	cryptophyte	+	-
11	<i>Artemisia myriantha</i> Wall.ex Bess	Asteraceae		Herb	Perennial	Hemicryptophyte	-	+
12	<i>Artemisia vulgaris</i> L.	Asteraceae	Titey patey	Herb	Perennial	Hemicryptophyte	+	+
13	<i>Artemisia wallichiana</i>	Asteraceae		Herb	Perennial	Hemicryptophyte	+	+
14	<i>Aster albescens</i> (DC.) Wall. ex Hand.-Mazz.	Asteraceae		Shrub	Perennial	Phanerophytes	-	+
15	<i>Aster himalaicus</i>	Asteraceae		Herb	Perennial	Hemicryptophyte	-	+
16	<i>Astilbe rivularis</i> Buch.-Ham. ex D.Don	Saxifragaceae	Buro okhati	Herb	Perennial	cryptophyte	+	+
17	<i>Berberis asiatica</i> Roxb. ex DC.	Berberidaceae	Chutro	Shrub	Evergreen perennial	Phanerophytes	+	+
18	<i>Berberis concinna</i> Hook.f.	Berberidaceae	Chutro	Shrub	Evergreen perennial	Phanerophytes	-	+
19	<i>Berberis jaeschkeana</i>	Berberidaceae	Jaeschke's Barberry	Shrub	Evergreen perennial	Phanerophytes	+	+
20	<i>Berberis</i> sp.	Berberidaceae	Chutro	Shrub	Evergreen perennial	chaemephyte	+	+
21	<i>Betula utilis</i> D.Don	Betulaceae	Lekh saur	Tree	Deciduous perennial	Phanerophytes	+	+

22	<i>Bistorta affinis</i>	Polygonaceae		Herb	Perennial	Hemicryptophyte	+	+
23	<i>Cardamine macrophylla</i> Willd	Brassicaceae	Mangana saag	Herb	Perennial	Hemicryptophyte	+	+
24	<i>Cardiocrinum giganteum</i> (Wallich) Makino	Liliaceae		Herb	Perennial	Hemicryptophyte	+	+
25	<i>Carex</i> sp.	Cyperaceae	Harkatto	Herb	Perennial	Hemicryptophyte	+	+
26	<i>Centella asiatica</i> Linn.	Apiaceae	Golpatta	Herb	Perennial	Hemicryptophyte	+	+
27	<i>Circium</i> sp.	Asteraceae		Herb	Perennial	Hemicryptophyte	+	-
28	<i>Clematis montana</i> Buch.-Ham. ex DC	Ranunculaceae	Pinasay lahara	Herb	Perennial	chaemephyte	+	+
29	<i>Clintonia udensis</i> Trautv. & Meyer	Liliaceae		Herb	Perennial	cryptophyte	+	-
30	<i>Coriaria terminalis</i> Hemsl.	Coriariaceae		Herb	Perennial	cryptophyte	-	+
31	<i>Cotoneaster frigidus</i> Wall. ex Lindl.	Rosaceae		Shrub	Deciduous perennial	Phanerophytes	-	+
32	<i>Cotoneaster microphyllus</i> Wall. ex Lindl.	Rosaceae	Khareto	Shrub	Evergreen perennial	chaemephyte	+	+
33	<i>Cupressus torulosa</i> D. Don	Cupressaceae	Raj sallo	Tree	Evergreen perennial	Phanerophytes	+	+
34	<i>Cynodon dactylon</i>	Poaceae		Herb	Perennial	cryptophyte	+	-
35	<i>Daphne cannabina</i> Lour. ex. Wall.	Thymelaeaceae	Loktee	Shrub	Evergreen perennial	chaemephyte	+	+
36	<i>Daphniphyllum himalayense</i> (Benth.) Müll.Arg.	Daphniphyllaceae	Lal chandan	Tree	Evergreen perennial	Phanerophytes	+	+
37	<i>Delphinium</i> sp.	Ranunculaceae		Herb	Perennial	Hemicryptophyte	+	-
38	<i>Elsholtzia strobilifera</i> (Benth.) Benth.	Lamiaceae	Ban bawari	Herb	Annual	Therophyte	+	-
39	<i>Enkianthus deflexus</i> (Griffith) Schneider	Ericaceae	Rato angeri	Shrub	Deciduous perennial	Phanerophytes	+	+
40	<i>Eragrostis cilianensis</i> (All.) Janch.	Poaceae	Banso	Herb	Perennial	Hemicryptophyte	+	+
41	<i>Erigeron multiradiatus</i> (Lindl. ex DC.) Benth. & Hook.f.	Asteraceae		Herb	Perennial	cryptophyte	-	+
42	<i>Euphorbia sikkimensis</i> Boiss.	Euphorbiaceae		Herb	Perennial	Hemicryptophyte	+	-
43	<i>Euphorbia wallichii</i> Hook.f	Euphorbiaceae		Herb	Perennial	Hemicryptophyte	+	+
44	<i>Fragaria nubicola</i> (Lindl. ex Hook.f.) Lacaita	Rosaceae	Bhui aiselu	Herb	Perennial	Hemicryptophyte	+	+
45	<i>Galium boreale</i> L. Northern Bedstraw	Rubiaceae		Herb	Perennial	cryptophyte	+	-

46	<i>Gaultheria hookeri</i>	Ericaceae	Dhasingre	Shrub	Evergreen perennial	Phanerophytes	+	+
47	<i>Gaultheria nummularioides</i> D. Don	Ericaceae	Dhasingre	Herb	Perennial	chaemephyte	+	+
48	<i>Gaultheria semi-infera</i> (C.B. Clarke) Aity Shaw	Ericaceae		Shrub	Evergreen perennial	chaemephyte	-	+
49	<i>Gaultheria trichophylla</i>	Ericaceae	Dhasingre	Herb	Perennial	chaemephyte	+	+
50	<i>Gentiana pedicellata</i>	Gentianaceae	Chara ko khutta/Baans Phool/Tauke phool	Herb	Annual	Therophyte	+	-
51	<i>Gentiana</i> sp.	Gentianaceae		Herb	Annual	Therophyte	+	-
52	<i>Geranium nepalense</i>	Geraniaceae		Herb	Perennial	Hemicryptophyte	+	+
53	<i>Hackelia uncinata</i> (Benth.) C.E.C.Fisch.	Boraginaceae		Herb	Perennial	Hemicryptophyte	+	+
54	<i>Halenia elliptica</i> D. Don	Gentianaceae	Tikta	Herb	Perennial	Hemicryptophyte	-	+
55	<i>Hemiphragma heterophyllum</i> Wall.	Plantaginaceae	Nash jhar, Lahare phool, Rato gedi	Herb	Perennial	Hemicryptophyte	+	+
56	<i>Heracleum nepalensis</i> D. Don	Apiaceae	Chimphing	Herb	Perennial	Hemicryptophyte	+	-
57	<i>Himalayacalamus hookerianus</i>	Poaceae	Pareng	Bamboo	Perennial	Phanerophytes	+	+
58	<i>Hippophae salicifolia</i>	Elaeagnaceae	Chuk, Tarwa; Willow-leaved Sea buckthorn	Shrub	Decidious perennial	Phanerophytes	+	+
59	<i>Holboellia latifolia</i> Wallich	Lardizabalaceae	Gulfa	Herb	Perennial	chaemephyte	+	+
60	<i>Hydrocotyle himalaica</i> P.K. Mukh.	Araliaceae	Dhungri jhar	Herb	Perennial	Hemicryptophyte	-	+
61	<i>Hypericum elodeoides</i> Choisy	Hypericaceae	Jibre ghans	Herb	Perennial	Hemicryptophyte	+	+
62	<i>Ilex intricata</i>	Aquifoliaceae		Shrub	Evergreen perennial	chaemephyte	+	+
63	<i>Ilex sikkimensis</i> Kurz	Aquifoliaceae		Shrub	Evergreen perennial	Phanerophytes	+	+
64	<i>Impatiens</i> sp.	Balsaminaceae		Herb	Annual	Hemicryptophyte	+	-
65	<i>Imula hookeri</i> C.B. Clarke	Asteraceae		Herb	Perennial	Hemicryptophyte	-	+
66	<i>Jacobaea</i> sp.	Asteraceae		Herb	Biennial	cryptophyte	-	+
67	<i>Juncus himalensis</i> Klotzsch	Juncaceae		Herb	Perennial	Hemicryptophyte	+	-
68	<i>Juncus thomsonii</i> Buchenau	Juncaceae		Herb	Perennial	Hemicryptophyte	+	-

69	<i>Juniperus recurva</i>	Cupressaceae		Tree	Evergreen perennial	Phanerophytes	+	+
70	<i>Lactuca macrorhiza (Royle) Hook.f.</i>	Asteraceae	Chyate	Herb	Perennial	Hemicryptophyte	-	+
71	<i>Larix griffithii</i> Hook.f.	Pinaceae	Langtang sallo	Tree	Evergreen perennial	Phanerophytes	+	+
72	<i>Lepisorus mehrae</i> Fraser-Jenk	Polypodiaceae	Uniu	Fern	Evergreen	Cryptophyte	+	+
73	<i>Ligularia fischeri</i> (Ledeb.) Turcz.	Asteraceae		Herb	Perennial	Hemicryptophyte	+	+
74	<i>Lonicera obovata</i>	Caprifoliaceae		Shrub	Evergreen perennial	Phanerophytes	+	+
75	<i>Lycopodium japonicum</i> Thunb	Lycopodiaceae	Nagbeli	Fern	Evergreen	Cryptophyte	+	+
76	<i>Lyonia ovalifolia</i> (Wall.) Drude	Ericaceae	Angeri	Tree	Deciduous perennial	Phanerophytes	+	+
77	<i>Lysimachia prolifera</i> Klatt	Primulaceae		Herb	Perennial	Hemicryptophyte	+	+
78	<i>Maddenia himalaica</i> Hook.f. & Thomson	Rosaceae	Himalayan Madden Cherry	Shrub	Deciduous perennial	Phanerophytes	+	+
79	<i>Magnolia globosa</i> Hook.f. & Thomson	Magnoliaceae	Ghogey champ	Tree	Deciduous perennial	Phanerophytes	+	+
80	<i>Mazus dentatus</i> Wallich ex Benth	Scrophulariaceae	Tapre jhar	Herb	Perennial	Hemicryptophyte	+	-
81	<i>Meconopsis paniculata</i> Prain	Papaveraceae		Herb	Perennial	Hemicryptophyte	+	-
82	<i>Myricaria rosea</i> Smith	Tamaricaceae		Herb	Perennial	Hemicryptophyte	+	-
83	<i>Odontosoria chinensis</i> (L.) J. Smith	Lindsaeaceae	Uniu	Fern	Evergreen	Cryptophyte	+	+
84	<i>Osmunda claytoniana</i> L.	Osmundaceae	Uniu	Fern	Evergreen	Cryptophyte	+	+
85	<i>Oxalis corniculata</i> L.	Oxalidaceae	Amilo jhar	Herb	Perennial	Hemicryptophyte	+	+
86	<i>Panax bipinnatifidus</i> Seem	Araliaceae		Herb	Perennial	cryptophyte	+	-
87	<i>Panax pseudoginseng</i> Wall.	Araliaceae	Ginseng	Herb	Perennial	cryptophyte	+	+
88	<i>Paris polyphylla</i> Sm.	Melanthiaceae	Satuwa	Herb	Perennial	cryptophyte	+	+
89	<i>Parochetus communis</i> Buch.-Ham. ex D. Don	Fabaceae		Herb	Perennial	cryptophyte	+	+
90	<i>Pedicularis elwesii</i> Hook.f	Scrophulariaceae		Herb	Perennial	cryptophyte	-	+
91	<i>Pedicularis rhinanthoides</i> Schrenk	Scrophulariaceae		Herb	Perennial	cryptophyte	-	-
92	<i>Pedicularis</i> sp.	Scrophulariaceae		Herb	Perennial	cryptophyte	+	-
93	<i>Persicaria capitata</i> (Buch.-Ham. ex D. Don)	Polygonaceae	Ratnaulo	Herb	Perennial	Hemicryptophyte	+	+

118	<i>Rhododendron barbatum</i> Wall. ex G. Don	Ericaceae	Lal chimal	Tree	perennial	Phanerophytes	+	+
119	<i>Rhododendron camelliflorum</i>	Ericaceae	Chiya phule gurans	Herb	Perennial	Phanerophytes	-	+
120	<i>Rhododendron ciliatum</i> Hook. f.	Ericaceae	Junge chimal	Shrub	Evergreen perennial	chaemephyte	+	+
121	<i>Rhododendron cinnabarinum</i> Hook.f.	Ericaceae	Sanu chimal	Shrub	Evergreen perennial	chaemephyte	+	+
122	<i>Rhododendron glaucophyllum</i> Rehder	Ericaceae	Takma chimal	Shrub	Evergreen perennial	chaemephyte	+	+
123	<i>Rhododendron hodgsonii</i> Hook. f.	Ericaceae	Korlinga	Tree	Evergreen perennial	Phanerophytes	+	+
124	<i>Rhododendron lanatum</i> Hook.f.	Ericaceae	Bhutel chimal	Shrub	Evergreen perennial	chaemephyte	+	+
125	<i>Rhododendron lepidotum</i> Wall. ex G. Don	Ericaceae	Bhale sunpate	Shrub	Evergreen perennial	chaemephyte	+	+
126	<i>Rhododendron niveum</i> Hook.f.	Ericaceae	Hiun pate gurans	Tree	Evergreen perennial	Phanerophytes	+	+
127	<i>Rhododendron niveum</i> Hook.f.	Ericaceae	Huin pate gurans	Shrub	Evergreen perennial	Phanerophytes	+	+
128	<i>Rhododendron pendulum</i>	Ericaceae	Jhundinae chimal	Shrub	Evergreen perennial	chaemephyte	+	+
129	<i>Rhododendron thomsonii</i> Hook.f.	Ericaceae	Dr. thomson ko gurans	Tree	Evergreen perennial	Phanerophytes	+	+
130	<i>Rhododendron triflorum</i> Hook. f.	Ericaceae	Pahenle gurans	Herb	Perennial	Phanerophytes	+	+
131	<i>Ribes alpestre</i> Wall. ex Decne.	Grossulariaceae		Shrub	Deciduous perennial	Phanerophytes	+	+
132	<i>Ribes griffithii</i> Hook. f. & Thomson	Grossulariaceae		Shrub	Deciduous perennial	Phanerophytes	+	+
133	<i>Ribes himalense</i> Royle ex Decne.	Grossulariaceae		Shrub	Deciduous perennial	Phanerophytes	+	+
134	<i>Rosa sericea</i> Wall. ex Lindl.	Rosaceae	Bhote gulaaf	Shrub	Deciduous perennial	Phanerophytes	+	+
135	<i>Rubia manjith</i> Roxb. ex Fleming	Rubiaceae	Majito	Herb	Perennial	Hemicryptophyte	+	+
136	<i>Rubus biflorus</i> Buch.-Ham. ex Sm.	Rosaceae	Aiselu	Shrub	Deciduous perennial	chaemephyte	-	+

137	<i>Rubus parviflorus</i> Nutt.	Rosaceae	Aiselu	Shrub	Decidious perennial	chaemephyte	-	+
138	<i>Rubus pedunculatus</i> D.Don	Rosaceae	Aiselu	Shrub	Perennial	chaemephyte	-	+
139	<i>Rubus</i> sp.	Rosaceae		Shrub	Evergreen Perennial	chaemephyte	+	-
140	<i>Rumex nepalensis</i> Spreng	Polygonaceae	Halhalay	Herb	Perennial	Hemicryptophyte	+	+
141	<i>Salix calyculata</i> Hook.f. ex Anderson	Salicaceae	Bais	Shrub	Decidious perennial	chaemephyte	+	-
142	<i>Salix daltoniana</i>	Salicaceae	Bais	Shrub	Decidious perennial	Phaenrophytes	+	+
143	<i>Salix longiflora</i> Wall. ex Andersson	Salicaceae		Tree	Decidious perennial	Phaenrophytes	+	+
144	<i>Salvia</i> sp.	Labiatae		Herb	Perennial	Hemicryptophyte	-	+
145	<i>Sambucus adnata</i> Wallich ex DC	Sambucaceae		Herb	Perennial	cryptophyte	+	+
146	<i>Saxifraga</i> sp.	Saxifragaceae		Herb	Perennial	chaemephyte	+	+
147	<i>Schisandra grandiflora</i> (Wallich) Hook.f. & Thoms	Berberidaceae	Large-Flowered Magnolia Vine	Herb	Perennial	chaemephyte	+	+
148	<i>Sedum ewersii</i>	Crassulaceae		Herb	Perennial	chaemephyte	+	-
149	<i>Sedum</i> sp.	Crassulaceae		Herb	Perennial	chaemephyte	+	-
150	<i>Selinum wallichianum</i> (DC.) Raizada & H.O. Saxena	Apiaceae		Herb	Perennial	chaemephyte	+	-
151	<i>Senecio scandens</i>	Asteraceae	Paheli lahara	Herb	Perennial climber	cryptophyte	-	+
152	<i>Smilacina oleracea</i> (Baker) Hook.f	Liliaceae		Herb	Perennial	cryptophyte	+	+
153	<i>Sorbus ursina</i> (Wall. ex D.Don) Decne.	Rosaceae	Lek pasi	Tree	Decidious perennial	Phaenrophytes	+	+
154	<i>Spiraea bella</i> Sims	Rosaceae	Seto khareto	Shrub	Decidious perennial	chaemephyte	+	-
155	<i>Stellaria</i> sp	Caryophyllaceae		Herb	Perennial	Hemicryptophyte	+	-
156	<i>Streptopus simplex</i> D.Don	Liliaceae		Herb	Perennial	cryptophyte	+	+
157	<i>Symplocos glomerata</i>	Symplococaceae		Tree	Evergreen perennial	Phaenrophytes	+	+
158	<i>Thalictrum</i> sp.	Ranunculaceae		Herb	Perennial	cryptophyte	+	+
159	<i>Trillidium govanianum</i> D. Don	Liliaceae		Herb	Perennial	cryptophyte	+	-

160	<i>Triosectum himalayanaum</i> Wall	Caprifoliaceae		Herb	Perennial	cryptophyte	+	-
161	<i>Tsuga dumosa</i> (D.Don) Eichler	Pinaceae	Thengre salla	Tree	Evergreen perennial	Phanerophytes	+	+
162	<i>Vaccinium nummularia</i> Hook.f. & Thoms	Ericaceae		Herb	Perennial	chaemephyte	+	+
163	<i>Veronica serpyllifolia</i> L.	Plantaginaceae	Thyme Speedwell	Herb	Perennial	Hemicryptophyte	+	+
164	<i>Viburnum erubescens</i> Wall.	Adoxaceae	Asare	Shrub	Decidious perennial	chaemephyte	+	+
165	<i>Viola biflora</i> L.	Violaceae		Herb	Perennial	Hemicryptophyte	+	+
166	<i>Viola pilosa</i> Blume	Violaceae		Herb	Perennial	Hemicryptophyte	+	-
167	<i>Vittaria</i> sp.	Pteridaceae		Fern	Evergreen	Cryptophyte	+	+

Note: "+" indicates presence; "-" indicates absence/dormant



Sikkim Biodiversity Conservation and Forest Management Project (SBFP)

Forest and Environment Department

Government of Sikkim

2020