

Studies on the Pteridophytic flora of Darjiling Hills.

**Thesis Submitted to the University of North Bengal
For the Award of
Doctor of Philosophy in Botany**

**By
Nayan Thapa**

**Guide
Dr.Dorjay Lama**

**Department of Botany
University of North Bengal
September 2016**

DECLARATION

I declare the thesis entitled "**Studies on the Pteridophytic flora of Darjiling Hills**" has been prepared by me under the guidance of Dr. Dorjay Lama, Associate Professor, Department of Botany, St. Joseph College, P.O North Point, District Darjeeling. I have carried out the work and submitted his Ph.D Thesis as per the New Ordinance

No part of this thesis has formed the basis for the award of any degree or fellowship previously.


Nayan Thapa

Department of Botany,

St. Joseph College,

P.O North Point,

District Darjeeling, West Bengal,

India

Pin code: 734104.

Date:



ST. JOSEPH'S COLLEGE

(Estb. 1927)

P.O. North Point, Darjeeling - 734101

Phone (0354) 2252550, Fax: 0354 2252551

Email: sjc_darj@sify.com

Web: www.sjedarjeeling.edu.in

Dept. of Botany

CERTIFICATE

I certify that Mr. Nayan Thapa has prepared the Thesis entitled “**Studies on the Pteridophytic flora of Darjiling Hills**” for the award of PhD degree of the University of North Bengal under signed as guide.

He has carried out the work at the Department of Botany, St. Joseph College North Point, District Darjeeling, West Bengal, India.

He has carried out the work and submitted his Ph.D Thesis as per the New Ordinance. No part of this thesis has formed the basis for the award of any degree or fellowship previously.

Dr. Dorjay Lama

Associate Professor

Department of Botany

St. Joseph college,

P.O North Point,

District Darjeeling,

West Bengal,

India-734104

*Associate Professor
Department of Botany
St. Joseph's College
North Point, Darjeeling*

ABSTRACT

The present study is based upon extensive survey and field collection over a period of covering years along various altitudinal zones of Darjiling Hills, West Bengal for enumeration, Phyto-sociological analysis and utilization of Pteridophytes. Darjiling Hills, a part of Darjiling district which lies between 26° 27' 05" and 27° 13' 10" N latitudes and between 87° 59' 30" and 88° 53' E longitudes has been covered in the study. The Darjiling hill is a segment of Eastern Himalaya, a part of Indo-Malayan realm and has an area of about 2436.55 km² or 77 % of the total area of the district. The study area ranged in altitudinal variation from 150 m amsl to 3660m amsl covering chiefly 4 climatic zone i.e. tropical, sub-tropical, temperate and sub-alpine. The study was based on the field survey and collection in forest tract, remote villages from 2010 to 2015 to assess the Pteridophytic wealth of the region. Collection, proper identification and enumeration of Pteridophytic flora and their taxonomic placement have been carried out. The family keys been provided and the present study documented 206 species under 70 genera belonging to 26 families. Three families belonging to fern allies have been documented which consist of 5 genera with 17 species, where lycopodiaceae with 3 genera and 8 species have shown the highest diversity (Thapa *et al*, 2015). Polypodiaceae with 13 genera and 40 species showed the highest diversity in the study area.

Taxonomical analysis based upon the classification in terms of the habitat shows the lithophytes accounting 44.11% comprise the largest group followed by the mesophyte 27.13%, epiphyte 26.85 and 2% represented by climbers. The climbers chiefly *Lygodium japonicum*, *Lygodium salicifolium*, *Stenochlaena palustris* occurring in warmer foot hills and *Tricholepidium normale* the sole representative from the cool temperate region has been found. The new record for the region is *Botrychium lunaria* collected from Sandhakphu (Thapa *et al*, 2014; Thapa and Lama, 2016), *Pteris austrosinica* collected from Singla (Thapa & Lama, 2015), *Huperzia ceylanica* collected from Chitrey (Thapa and lama, 2015).

Exotic and adventives species that have naturalized in Darjiling hills are *Adiantum concinnum* and *Pityrogramma calomelanos*. A number of abnormal specimen have been collected during the course of study belonging to different groups that include *Asplenium ensiforme*, *Lepisorus mehra*, *Botrychium lanuginosum*, *Equisteum arvense subsp. diffusum*, *Goniophlebium argutum* (Plate 3.22). In some case the differences exhibited is huge and proper identification required with

minute observation as superficial often tends to be misleading as in *Goniphlebium argutum* which resembled *Goniphlebium metzense* (Thapa and Lama, 2013).

The present study observes that about 90% of the fern flora in Darjiling comprises of Sino –Himalayan and Malesian element. The single species representing the Afro-Arabian connection that may have migrated through Deccan in the foothills is represented by *Aleuritopteris bicolor*. The rarest of species from the study area collected from a single location are *Huperzia ceylanica* and *Asplenium magnificum*. One-time collected species *Pteris barbigera*, *Cyathea contaminans*, *Dipteris wallichii*, *Pteridrys cnemidaria*, *Christopteris tricupsis* could not be collected in the present study as well. This species tend to be rarest in the Indian sub-continent. *Pteris barbigera* is known only from one collection in Darjiling hills after which it could not be seen in the wild neither be collected for 100 years. Large scale deforestation and anthropological interference may have resulted in the disappearance of these rare species. The Phytosociological analysis of Fern and Fern-allies were studied in 4 different forest tract of Darjiling hills ranging from tropical to sub-alpine forest. The raw data collected by ground truth from 80 sample plots in 4 climatic zone recorded a total of 406 species. 53 species of Pteridophytes were recorded, 2 species were tree ferns and 2 species were climbers .The sub-tropical and temperate forest recorded the highest diversity of Pteridophyte i.e. 16 species each. Least diversity of Pteridophyte was recorded in sub-alpine forest.

The utilization of Pteridophyte by people was also studied in the Darjiling hill. The data source includes the primary data obtained during numerous field trips in the forest village, local market (Hatt) were undertaken with questionnaires prepared to interview the village head and local healers.

The survey found that 40 species of fern and fern allies are used by people for different purpose which has been categorized as Medicinal fern, Edible ferns, Cattle bed ferns and ornamental ferns. Study shows that It eleven species are used for medicinal purpose and the young croizer of sixteen species being utilized as vegetable belonging to genera *Diplazium*, *Deparia* and *Cyathea* .Four species of ferns were utilized as cattle bed fern (Sottar) for domesticated animals and nine species of fern find use as ornamental and decorative purposes.

PREFACE

India is a mega biodiversity hot spot region and accounts for more than 7% of vascular plant species. The Pteridophytes belong to the group of vascular cryptogram comprising of fern and fern-allies, represented by 1100 species accounting to 10% of global diversity. Darjiling hills floristically rich account for 19% of the Indian Pteridophyte having 0.1% area of the country. After Mehra (1964) and Hara (1974) the enumeration has been undertaken to assess the ecology with utilization of this alienated group in Darjiling Hills. The present work is an outcome of vigorous ground truth for a period of 5 years in different forest tract, villages and herbaria. Key to the families, genus and species with updated nomenclature, description, photographs and distribution has been provided. Ecological assessment has been carried out with detailed utilization of species by the common people.

This work is an attempt to generate interest among the botanist to work out further this alienated group of vascular cryptogram.

With sense of gratitude, I express my deepest appreciation to my supervisor Dr. Dorjay Lama, Department of Botany, St. Joseph College, Darjeeling, for his esteemed supervision and guidance.

I would like to thank Prof. A.P Das for rendering valuable suggestion and correction during the course of Taxonomic enumeration.

A heartfelt thank to Prof. C.R Fraser-Jenkins who always supported, help and update and made critical suggestion during the treatment of abnormal and difficult specimens.

The study without co-operation of forest department cannot be imagined and I would like to thank Mr. A.Dubey(IFS), Mr. S.K Mollay(IFS), Raju Pradhan, Pawan Prasad and all the staff of Silviculture department for giving me a permission to be a part of MPCA program during which I could visit and carry out restricted collection from these areas.

I would like to thanks officer in charge, Llyod's Botanical garden and Bimal daju for cooperation during my research.

I would thank Prof. P.C Lama and Digbir Tamang for allowing me to study the herbarium deposited in the Dept. Of Botany , Darjeeling Government College.

I would like to thank Kuresong TRA, Barnesbeg Tea estate, Happy valley Tea estate for providing weather data for incorporation in my thesis.

I express my gratitude to my seniors in the Department Dr.Upakar Rai, Dr. Anirudra Gurung, Dr. Manjulla Rai , Mr. Surya Rai and Mr. Rajendra Yonzone for their co-operation and helpful suggestion during the course of study and preparation of the thesis.

Special thanks to the Principal , St. Joseph college for allowing us to carry research and will for registering the department to carry out researches with North Bengal University.

To my juniors namely Abhijeet Chetri, Puran Sarki,Ashis Chetri who were always there with me during my research, often accompanying me for the field trips.

Heartfelt thanks to the people of rural belt in far flung area where I stayed in due course of research who always welcomed me with their smiling faces and gave homely treatment whose support me to achieve this milestone.

Lastly I am indebted to my family Dad, Mum , Brothers ,in-laws who always supported me morally, financially during thin and thick period of my research, without their support and encouragement ,the work would not be possible.

Nayan Thapa,
Dept. of Botany,
St Joseph College,
Darjiling,
Pin -734104

Contents		Page No
Abstract		i-ii
Preface		iii-iv
Chapter I INTRODUCTION		
1.	Introduction	1-2
1.1.	Location	2-3
1.2.	General feature	3
	1.2.1. Topography	3-4
	1.2.2. Geology	4-5
	1.2.3. Soil	5
	1.2.4. River and Drainage	6-7
1.3.	Climate	7-8
	1.3.1. Rainfall	8
	1.3.2. Temperature	8-9
	1.3.3. Relative humidity	11-12
1.4.	Communication Network	12
1.5.	Biological Resource	12
	1.5.1. Flora	13-14
	1.5.2. Fauna	14
1.6.	Past Floristic work	15-16
	1.6.1. Past floristic study on ferns and Fern-allies	16-18
	1.7. Aims and Objective	19
Chapter II MATERIALS AND METHODS		
2.1.	Selection of the Vegetation for Survey and Collection	20-21

2.1.1.	Collection and Preservation of Materials	21
2.1.2.	Field Note Book	22
2.1.3.	Identification	22
2.1.4.	Enumeration and Description	22-23
2.2.	Phytosociological Studies	23
2.2.1.	Location of the Study area	23
2.2.2.	Sampling	23-24
2.2.3.	Phyto-Sociological analysis	25
2.2.3.1.	Density	25
2.2.3.2.	Frequency	25
2.2.3.2.	Abundance	26
2.2.3.4.	Basal Area	26
2.2.3.5.	Importance value Index	27
2.2.4.	Diversity Indices	27
2.2.4.1.	Species Diversity	27
2.2.4.2.	Species richness	28
2.2.4.3.	Concentration of Dominance	28-29
2.2.5.	Local utilization of Fern and their allies	29
Chapter III TAXONOMIC ENUMERATION		
3.	Key to families	30-33

3.1.	Enumeration of Pteridophytic Flora of Darjiling Hills	33-247
3.2.	Result	248-251
3.3.	Discussion	251-253
3.4.	Conclusion	253
3.5.	Summary	253-255

Chapter IV PHYTOSOCIOLOGICAL STUDIES

4.	Introduction	256
4.1.	Result	257-268
4.2.	Discussion	269
4.3.	Conclusion	269
4.4.	Summary	270-271

Chapter V UTILIZATION OF FERN AND FERN ALLIES

5.	Introduction	
5.1.	Utilization of Fern and Fern allies	272-274
5.2.	Result	275-279
5.3.	Discussion	280
5.4.	Conclusion	280-281
5.5.	Summary	281
	Reference	282-290
	Appendices	291-308
	Index	309-312

LIST OF TABLES

3.1. Family, genus and species of Pteridophytic flora.	249-250
4.1. Diversity indices for different forest type in Darjiling hills.	261
5.1. Questionnaires for utilization of ferns in Darjiling hills.	273
5.2. Cattle bed fern (CBH) of Darjiling hills.	275
5.3. Edible fern (EF) of Darjiling hills.	275-277
5.4. Medicinal fern (MF) of Darjiling hills.	277-278
5.5. Ornamental fern (OF) of Darjiling hills.	278-279

LIST OF FIGURE

1.1 Map of Study area.	3
1.2 Average Monthly Rainafall (TRA= Kuresong, HPV= Happpy Valley tea Estate, BBG= Barnesbeg Tea Estate)	9
1.3 Average Monthly Temperature in the Upper Hills of Darjiling (Recorded from Darjiling, Happy Valley Tea Estate)	10
1.4 Average Monthly Temperature in Kuresong (Recorded from TRA,kuresong)	10
1.5 Average Monthly Temperature in lower hill in Darjiling (Recorded from Barnesbeg Tea Estate)	11
1.6 Average Monthly Humidity (TRA= Kuresong, HPV= Happpy Valley Tea Estate, BBG= Barnesbeg Tea Estate)	11
2.1 Sampling design of Phytosociological analysis.	24
3.1: A. <i>Dryopteris serratodentata</i> Beddome (Habit); B. Pinnae; C. Spores 400x; D. Rhizome scales.	204
3.2: A. <i>Loxogramme porcata</i> Price ; B. Portion of frond magnified; C. Spore 400x; D. Rhizome scales.	205
3.3: A. <i>Diplazium succulentum</i> Clarke ; B.Pinnae; C.Spore 400x; D. Scales 20x.	206
3.4: A. <i>Cyathea brunoniana</i> Clarke ; B. Spores 400x; C. Costule scales 40x.	207
3.5: A. <i>Pteris austrosinica</i> (Ching)Ching; B. Spore 400x; C.Ultimate segment, D. Hairs on the Costules, E. Tripartite stipe.	208
3.6: A. <i>Microsorium punctatum</i> (Linnaeus)Copeland ; B. Rhizome scales 40x; C. Spore 400x.	209
3. 7: A. <i>Dennstaedtia apendiculata</i> (Wallich ex Hooker)Smith ; B.Pinnae; C. Hairs 40x; D. Spore 400x.	210
3. 8: A. <i>Pyrrosia mannii</i> (Giesenh)Ching ; B. Stellate hairs 40x; C. Rhizome Scales 40x;D. Spore 400x.	211
3. 9: A. <i>Monachosorum henryi</i> Christ ; B. Pinnae; C. Hairs 40x; D. Spore 400x.	212

3. 10: A. <i>Odontosoria chinensis</i> (Linnaeus)Smith ; B. Pinnae; C. Hairs 40x; D. Spore 400x.	213
3. 11: A. <i>Lindsaea odorata</i> Roxburgh ;B. Pinnae; C. Rhizome scale 40x; D. Spore 400x.	214
3. 12: A. <i>Tectaria polymorpha</i> (Wallich ex Hooker)Copeland (Portion of pinnae); B. Rhizome scales 40x; C. Spore 400x.	215
3.13: A. <i>Lepisorus mehrae</i> Fraser-Jenkins; B. Veins and sori; C. Rhizome scales;D. Spore 400x.	216
3.14:A. <i>Oleandra wallichii</i> (Hooker)Presl; B. Veins and Sori; C. Scales 20x; D.Spore 400x.	217
3.15: A. <i>Leptochilus decurrens</i> Blume subsp. <i>hemionitideus</i> Fraser-Jenkins; B.Veins and sori;C. Scales 20x;Spore 400x.	218
3.16: A. <i>Asplenium phyllitidis</i> D.Don ;B.Veins and sori; C. Scales 20x; D. Spore 400x.	219
3.17: A. <i>Pteris ensiforme</i> N.L Burman; B.Pinnae with sori and veins; C. Scales 20x; spore 400x.	220
3.18: A. <i>Thelypteris lakhimpurensis</i> (Rosenst.)Iwatsuki pinnae; B. Hairs 20x; C. Spore 400x.	221
3.19: A. <i>Deparia petersenii</i> (Kunze) Kato ;B. Portion of Pinnae; C. Scales 40x; Spore 400x.	222
3.20: A. <i>Blechnum orientale</i> Linnaeus; B.Portion of Pinnae; C. Scales 20x; D. spore 400x.	223
3.21:A. <i>Lygodium flexuosum</i> (Linnaeus)Swartz; B.Portion of Pinnae; C. Spores 400x.	224
3.22: A . <i>Botrychium lunaria</i> (Linnaeus) Swartz; B. Fertile sporophore; C. Sterile pinnae showing venation; D. Spores 400x.	225
3.23: Overall scenario of Pteridophytic flora Darjiling hills.	249
3.24: Graph representing Habit & percentage of Species.	251

4.1: Shannon- Weiner Index of species diversity for different forest types in different Strata.	261
4.2: Simpson's Index of concentration of dominance for various forest types in different strata.	262
4.3: Menhinick's Index of species richness for various forest types in different strata.	262
4.4: Dominance-diversity curve for different strata in Tropical Forest.	263
4.5 Dominance-diversity curve for different strata in Sub-Tropical Forest.	263
4.6: Dominance-diversity curve for different strata in Temperate Forest.	264
4.7: Dominance-diversity curve for different strata in Sub-alpine Forest.	264
4.8: Species Distribution of Pteridophytes in Darjiling Hills.	265
4.9: Species distribution of Pteridophytes in different strata.	265
5.1: Utilization of Pteridophyte in Darjiling hills (CBF: Cattle bed ferns; Ef: Edible ferns; MF: Medicinal ferns; OF: Ornamental ferns)	279

LIST OF PLATE

- 3.1. Lycopods of Darjeeling Hills. 226
- 3.2: A. *Selaginella subdiaphana* (Wallich ex Hooker & Greville) Spring; B. Strobilus ; C. Ventral Leaf; D. Ventral Leaf base magnified 100x; E. Median leaf 40x; F. Microsporophyll (Microsporangium) 40x; G. Megasporangium 400x ; H. Megaspore 400x; I. Microspore 400x. 227
- 3.3: A. *Selaginella repanda* (Desvaux ex Poiret) Spring ;B. Stem with leaf; C.Strobilus; D. Ventral leaf;E. Median Leaf; F. Sporophyll; G. Microspore 400x; H. Megaspore 400x. 228
- 3.4: A.*Equisetum arvense* Linnaeus subsp.*diffusum* Fraser-Jenkins; B.Node and internode; C. Spore 100x.D. *Equisetum ramosissimum* Desf.;E. Strobilus;C. Immature spore 100x. 229
- 3.5: A. *Tomophyllum donianum* (D.Don)Fraser-Jenkins;B. Stipe with Hairs; C. Pinnae; D. Pinnae with sori; E. Spore 400x. 230
- 3.6: A. *Dryopsis apiciflora* (Wallich ex Mettineus)Holttum & Edwards; B. Pinnae; C. Lobes with veins 40x; D. Rhizome Scales 40x; E. Spore 400x; F. *Polystichum mehrae* Fraser-Jenkins(Habit). 231
- 3.7: A. *Osmunda claytoniana* Linnaeus subsp *vestita* (Wallich ex Milde) A.Love & D.Love (Habit); B. young croizer;C. Young fronds;D. Pinnae And sori; E & F. *Ophioglossum reticulatum* Linnaeus (Habit and Habitat); G. *Botrychium lanuginosum* Wallich ex Hooker & Greville; H. Forking of Sporophore and Tropophore;I. Spore 100x. 232
- 3.8: A. *Hymenophyllum exsertum* Wallich ex Hooker;B.Hairs 40x;C.Pinnae 20x; D. Sporangium 100x;E. Involucure 40x;F.Spore 100x; G.*Vittaria taeniophylla* Copeland; H.*Woodwardia unigemmata* (Makino)Nakai; I.*Dryopteris woodsii* Hayata. 233
- 3.9: A. *Selliguea griffithiana* (Hooker)Fraser-Jenkins; B.Pinnae; c. Rhizome scales 40x; D. Sporangium 100x; E. Spore 400x; F &G. *Crytomium caryotideum* (Wallich ex Hooker & Greville)C.Presl; H. Pinnae ; I. *Phanerophlebiopsis hookeriana* (C.Presl) Fraser-Jenkins 234

- 3.10: A. *Aleuritopteris formosona* (Hayata)Tagawa;B. Stipe with scales; C.Scales 40x;D.Spore 100x;E. *Aleuritopteris chrysophylla* (Hooker)Ching; F.*Aleuritopteris albomarginata* (C.B Clarke) Ching. 235
- 3.11: A. *Tricholepidium normale* (D.Don)Ching;B. Clinging root; C.Veins and Sori; D. Scales with setae; Spore 100x. 236
- 3.12:A. *Polystichum perscotianum* (Wallich ex Mettenius) T.Moore; B.Scales on Stipe; C.Micro scales on Segment; D.Spore 100x. 237
- 3.13:A. *Thelypteris cana* (Baker)Ching;B.Pinnae; C.Segmets hairy; D. Rachis hairy; E.Sporangium 100x; F. Spore 400x. 238
- 3.14: A. *Pichisermollodes crenato-pinnata* (C.B Clarke) Fraser-Jenkins; B.Stipe; C. Pinnae; D.Scales 40x; E. Spore 100x; F. *Atrthromers lehmannii* (Mettenius)Ching ;G. Rhizome;H. Scales 40x. 239
- 3.15: A. *Diplazium spectabile* (Wallich ex Mettenius)Ching; B. Pinnae; C. Segment 20x;D. Scales 40x; E.Sporangium 100x; F. Spore 400x. 240
- 3.16: A. *Athyrium clarkei* Beddome; B.Rachis with bulbils; C. Segment 20x; D. Scale 20x;E. Spore 400x. 241
- 3.17: A.*Adiantum venustum* D.Don; B. Ultimate segment with sori; C. Scales 20x; D. Sporangium 100x; E.Spore 400x. 242
- 3.18: A. *Nothoperanema squamiseta* (Hooker) Ching;B. Scales on Stipe;C. Scale 20x;D.Segment with Sori; E. Sporangium 100x; F. Spore 400x. 243
- 3.19: A. *Cerosora microphylla* (Hooker) R.M Tryon; B. Segments with Sori; C.Spore 400; D. *Dryopteris splendens* (Hooker) Kuntze; E. Scales; F. Spore 400x. 244
- 3.20:A. *Polypodiodes lachnopus* (Wallich ex Hooker)Ching; b. Rhizome scales; C. Segment with sori;D. Scales 20x; E. Sporangium 100x;F. Spore 400x. 245
- 3.21:A. *Deparia allantodiodes* (Beddome)M.Kato ; B. Pinnae; C. Pinnae with sori; D. Hairs in segment; E. Sori 40x;F. Spore 400x. 246
- 3.22:A. *Asplenium ensiforme* Wallich ex Hooker & Greville ; B. *Goniophlebium argutum* (Wallich ex Hooker) Smith(Close to *G.metzense*); C.*Botrychium Lanuginosum* Wallich ex Hooker et Greville (Close to *B.*

Virginanum); D. Anormal monomorphic frond of *Plagiogyra pycnophylla* (Kunze)Mettenius; E. Abnormal bifurcation in *Loxogramme involuta* M.G Price; F. Abnormal stobilus in *Equisetum arvense* Linnaeus subsp *diffusum* Fraser-Jenkins. 247

4.1: A. Sub-Alpine Forest; B. Temperate Forest; C. Sub-Tropical Forest; D. Tropical Forest. 266

4.2: A. Watch Tower at Neora Valley National Park; B. Biggest Girth *Rhododendron arboreum* Smith in Park;C. Field study; D. Sub-Alpine Vegetation; E. *Polystichum perscotianum* (Wallich e Mettenius)T.Moore; F. Taking GPS reading on field . 267

4.3: A. Collecting Raw data; B. Field survey; C. Tagging for Quadrat study; D. Invasiveness of *Arundinaria sp* in the field; E. Measurement of girth; F. Tropical vegetation. 268

5.1: A. *Cyathea spinulosa* Wallich ex Hooker (croizer); B.*Deparia boryana* (Willdenow.)M.Kato croizer; C.*Tectaria fuscipes* (Wallich ex Beddome) C. Christensen; D.*Huperzia squarosa* (Forster)Trevisan; E. *Davallia fijiensis*; F. *Cyathea brunoniana* C.B Clarke trunks utilized for making pot; G. *Huperzia pulchermia*(Wallich ex Hooker et Greville)Pich.Sermolli;H. *Pteridium revolutum* (Blume)Nakai; I.*Thelypteris procer* (D.Don)Fraser-Jenkins. 274

LIST OF APPENDICES

APPENDIX A:Phytosociological table for the tree layers in different forest in Darjiling hills.

APPENDIX B: Phytosociological table for the Shrub layers in different forest in Darjiling hills.

APPENDIX C: Phytosociological table for Herbaceous layers in different forest in Darjiling hills.

Abbreviation

A	Abundance
amsl	Above mean sea level
CBF	Cattle bed fern
D	Density
E	East
EF	Edible fern
F	Frequency
IVI	Importance value index
MF	Medicinal fern
N	North
OF	Ornamental fern
RA	Relative abundance
RD	Relative density
RDm	Relative dominance
RF	Relative frequency
cm	centimeter
µm	Micron
diamm.	Diameter
DGHC	Darjeeling Gorkh hill council
BA	Basal area
ha	Hectar
Indiv	Individual
SJC	St. Joseph College
LBH	Llyod's Botanical Herbaria

Chapter 1

INTRODUCTION

Introduction

The small township of Darjeeling (Darjiling, after the 1981 census), was laid out by Lord Napier (<http://www.darjeelingnews.net>) of the Royal Engineer and has since been the destination of people from all across the globe. The name Darjiling is believed to have been derived from the two sources i.e. the Corrupted form of Tibetan words ‘Dorje or the celestial spectre or double headed thunderbolt and ‘ling’ meaning the land. Thus it literally means the place of thunderbolt of lamaist religion and from this Sanskrit words ‘durjay ling’, means Shiva of invincible prowess who rule the Himalaya (Rai, 2002; Lama,2004). The evidence of the worship place that stand at the top of Observatory hill, corroborates the source and thus the district came to be know by the name Darjiling.

The present Darjiling district was created during the middle of nineteenth century after the accession of Darjiling and Kalimpong from the two neighboring countries of Sikkim and Bhutan through the treaties. The Sikkim part of Darjiling was annexed by the Nepali forces,who extended the territory up to the west of the river Teesta. However the defeat of nepali warrior at the hands of British force lead to the signing treaty of Sugali on 2nd December 1815 through which Terai and Darjiling part was returned to the British India and eventually, the British restored the region to Raja Chogyal of Sikkim after Signing of the treaty of Titleya on the 10th February, 1817.This piece of land was donated by the Raja of Sikkim and the land gifted to East India Co. in 1835, did not comprise the whole present Darjeeling. It was narrow enclave of about 138 square miles, being about 30 miles long and 6 miles wide (<http://darjeeling.gov.in/darj-hist.html>).Constatnt invasion by the adjoining state of Bhutan plundering of areas of Darjeeling,lead to the deputation of Ashley Eden to negotiate with Bhutan in1863. The British on being openly insulted returned to Darjiling and in the winter of 1864, a military force was dispatched that led to the British capturing the whole Bhutan Duars .On the 10th November 1864, the treaty of Sinchula was signed through which the Bhutan

Duars along with the passes leading into the hills and Kalimpong were ceded to the British.

The Darjeeling district with an area of 1234 sq miles can be said to have assumed its present shape and size in 1866 (<http://darjeeling.gov.in/darj-hist.html>). The district retained its dimension but its administrative placement constantly changed from Rajsahi province to Bhagalpur province (Bhujel,1996;Das,2004). **The Government of India (EXCLUDED AND PARTIALLY EXCLUDED AREAS) ORDER, 1936, No.166** placed the Darjiling district under partially excluded area (<http://www.darjeelingtimes.com/columns/hilman/291-excluded-and-partially-excluded-areas.html>). Its final annexure to the state of West Bengal was automatic incident in 1947. Presently the three hill subdivision is under the Gorkhaland Territorial Administration (GTA) that came into effect on October 2012.

1.1 Location

The Darjiling district lies between 26° 27' 05" and 27° 13' 10" N latitudes and between 87° 59' 30" and 88° 53' E longitudes (O'Malley, 1999). The Darjiling hills is a segment of Eastern Himalaya, a part of Indo-Malayan realm and has an area of about 2436.55 km² or 77 % of the total area of the district. The altitudinal variation ranges from 130 m amsl to 3660 m amsl that present diverse topographical conditions (Das 1995; Acharya & Acharya,2001).Biogeographically the area shares two important zones *viz.* 7B and 8 of Gangetic Plains and the North-East India (Rodger and Panwar,1990).

The District is separated by major rivers ,the Jaldhaka separating Bhutan in the Nort-East and the East; the Teesta and Rangit forming a northen border with the state of Sikkim; the Mechi forming a boundry with Nepal in the East.The hilly tract of Darjiling is contiguous with the Plains of Terai, Duars and maintain the continuity with Purnea district of Bihar on South-West;Nepal on the West; Jalpaiguri District and Bangladesh on the East and The North Dinajpur district of west Bengal to the South. The Darjiling hill comprises of the three sub-division of Darjiling district which is mountainous and a difficult terrain. The present study covers all the hilly tract of Darjiling extending from 180m amsl and including places like Rohini,Sukhna, Singla ,Goak,Gorubathan,Sumbung etc. along the

foothills up to the highest point at Phalut (3660 m amsl) in the north-west and Rachilla Danda (3030 m amsl) towards the north –east.

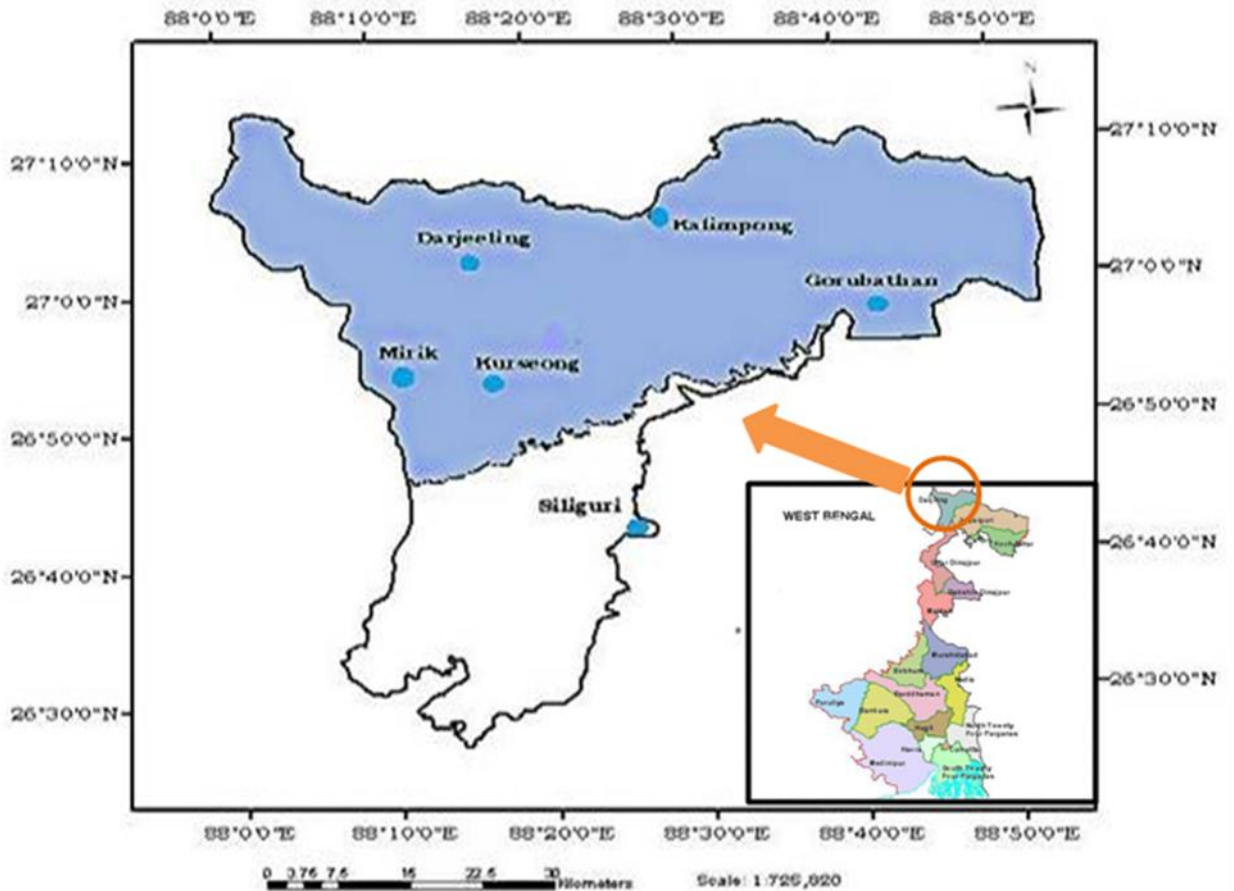


Figure 1.1: Map of the study area.

1.2 General Features

1.2.1 Topography

The three subdivision viz Darjiling,Kuresong and Kalimpong form a hilly tract with elevation towards the northly direction. The highest point of the District i.e. Phalut (3660 m amsl) is an extension of Singalila range that is the continuation of Mt Ghosla of Sikkim. The Ghosla-Phalut ridge enters the Tiger Hill node from where four major ridges radiate out along four directions (Banerjee,1980; Das,

1986; Bhujel 1996) viz, the Darjiling ridge extends towards the north through Jalapahar and descends at Badamtam. The Takdah spur in the East that spreads down to Teesta bazaar through Peshok. The Dow hill ridge form numerous spurs and descends to the plains of Darjiling and Jalpaiguri in the Southern region. The fourth ridge, the longest one traverses along Simana, mirik descends down in Changya-Panigahata in the south-west where it eventually form an contiguous with the plain area of District and with Nepal. The Rechila and Thomsum peaks in Kalimpong sub-divison lie on the eastern ridge and spreads from the Lava to.....

1.2.2 Geology

The geological investigation of Darjiling and Sikkim date as far back as 1854, where Sir Joseph Dalton Hooker in his famous Himalayan journal, reported regional gneissic domes, the overlying bedded sedimentary rocks and crinoidal limestone at the Tso Lhamo lake during his extensive travels. Various other works have studied the geology of this region, notable among them are Wager (1934), Heim and Ganseer (1939), Lahiri and Gangopadhyay (1974), Powde and Shah (1982). The geological formation of Darjiling district consist of different grades of metamorphic rocks in the plains and Terai while the hilly area confined to the south consist of unaltered sedimentary rocks. Very little geological investigation have been carried out except, for the foothills of the eastern Himalaya due to prolonged wet monsoon that mask a great deal of its geological features (Gansser, 1964). Yin (2006), the Proterozoic rock sequences of the Lesser Himalaya in Darjeeling-Sikkim and Arunachal Pradesh are bound by the Main Central Thrust (MCT) in the north and the Main Boundary Thrust (MBT) in the south. The Himalayan range is a result of a series of upheavals in an ancient Tethys sea which had accumulated sediments of different Geological era. The upheaval took place in four successive phase, separated by long interval of time (Rai, 2006). The rocks of Darjiling district has been divided by Mallet into five groups viz Gnesis, Daling series, the Buxa series, Gondwanas and the Tertiary system (O' malley, 1999). One of the most striking feature of Darjiling hill is that the younger formation appear to underlie the older thus, the Tertiary bed ultimately disappear under the Darjeeling gnesis .

The Darjiling hill is comprises of Siwalik and younger deposit of Tertiary age. The foothill comprises of formation called *Damudas*(lower Gondwana) which are coal bearing rocks. The continuity of *Damudas* towards North is succeeded by the *Dalings* that show a sharp thrust contact. The Daling series rest under foliated metamorphic rocks which are partly Igneous and Sedimentary in Origin. This groups of rocks are Globally known as Darjeeling gnesis. The Daling group of rock comprises quartz-chlorite- sericite phyllite, Muscovite-biotite phyllite, slates, Quartzoes phyllite and quartzites of Gourbathan and dolomite, limestone and varigeted phyllite of Buxa formation (Geological Survey of India).

The rock types of the area investigated around Kalimpong comprise of politic, psammitic, carbonaceous and calcareous metasediments belonging to the Darjeeling and Daling series. Three generations of fold structures can be recognized in both the Darjeeling and the Daling rocks (Mukohopadhyay, 1971).

1.2.3 Soil

The soils of Darjeeling Hill area have developed depending upon the underlying geological structure along with fluvial action and their lithological disintegration (<http://www.darjeeling.gov.in/geography.html>). The Darjiling–Sikkim Himalayas enjoy a wide range of physiography, geology and vegetation that have influenced the formation of different kinds of soils (Planning Commission 1981). The texture of the soil varies from loamy to sandy and its depth range from 0 to 120 c.m in different regions. Heavy rainfall in the area results in the leaching of the base from the soil with the pH remaining acidic in range between 5.6 – 6.5. The soli of Darjiling is represented by 5 orders i.e. a. Ultisols, b. Alfisols, c. Mollisols, d. Entisols and e. Inceptols. The lower tropical belt comprises of Ultisols that have a coarse texture and comprises of red to brown coloured soil. As the region ascends towards the sub-tropical zone the Utisols are replaced by Alfisols. The Mollisols make up the sub-temperate forest with steeper slopes. Towards the higher temperate zone the Mollisols are replaced by Ensitols. The Ensitols usually occur at Sub-alpine zone. The weak and unstable geology along with monsoonal type of per humid climate and undulating terrain with diversified landforms are some of the natural processes helping soil degradation in Darjiling and North –Eastern states (Patiram and Bhaduria, 1995). Thus, Dent(1984) regards the Himalaya as the most severely degraded region of the world.

1.2.4 River and Drainage System

Darjiling hill remains traversed by many rivers that ultimately drain towards South. The two biggest glacier fed rivers are the Teesta and Great Rangeet, that have their source of origin at the Zemu glacier located in North Sikkim and Rothong glacier in West Sikkim respectively. Teesta enters the district of Darjiling at the point it meets the Great Rangit (Melli) and its major tributaries in Darjiling hills are Reyang, originating from Mahaldiram Reserve Forest (2438m), Peshok and Gail khola constitutes its main tributaries on the right bank. The Great Rangeet is the main tributary of river Teesta and their point of confluence is called as trivani which is in Teesta bazaar. Great Rangeet originating from Rathong glacier in West –Sikkim enters the district of Darjiling on the northern boundry where it recives the Ramam river and Rangu arising from Singalila and Senchel respectively as the right bank tributaries. The other tributaries include little Rangeet originating in Manebhanjang saddle and the Tonglu and the Rungdung khola originating in Jorebonglow Saddle. The Teesta attains a mammoth size and flows through the Darjiling district and enters the plain of North Bengal and joins the Brahmaputra in Bangladesh.

The other important rivers of Darjiling is Mahanadi originating in the Mahaldiram Dime, East of Kurseong . It flows in the South-East direction with Siva khola, right bank tributary. The Jholi khola, the Jogi khola, Gulma khola, Babu khola and Ghoramara khola make up its left bank tributaries. The river Balason arises from the Ghoom saddle and subsequently joins the Mahanadi in the south. The important tributaries of Balason include Pulungdung khola, Rangbang Khola, the Marma khola, Dudhia khola on the right bank and Rinchingtong khola, Rakti

khola, Rohini khola, Jor khola etc on its left bank. The Teesta and Jaldhakha form the western and eastern boundaries of the sub-division of Kalimpong.

Numerous rivers and rivulets originate in this sub-division of Kalimpong chief among which is Lish having its source on the ridge of Pabringtar village. It flows downwards receiving the Amlkhola on the West and Turungkhola on the east. The river descend further Southwards and it is joined by the Phangkhola and Chunkhola near the Bagrakote Colliery and eventually joins the Teesta at the Kalagaiti Tea estate. The lava and Chumang reserve forest are the source of two rivulets that form the river Gish, its main tributaries being Ramthi and Lethi.

The Neora originates from the Rechila Chawk and joins the Thosum chu at the boundary of Thosum and Rechila and eventually joins Teesta. The Relli originates in Khempong reserve forest and runs along the Southern boundary of Saihur reserve forest. The two tributaries are Pala and Lolley khola and move Southward and joins the Rani khola. Murti originating in the Mo block south of Thosum hills flows through the reserve forest and emerging in the Samsing area and eventually joins the river Jaldhaka . The Jaldakha originates in North Sikkim,flows through Bhutan and enters the district at Todey-tangta. Its important tributaries include Chutang chu, Jal Chu, Rongo chu and Ma chu.

1.3 Climate

The meteorological parameters like precipitation, temperature, humidity, sunshine, velocity etc. and its cumulative effect on a locality is called as climate.

The great Himalayan range forms a barrier which separates the northern part of the Asian continent from the Indian subcontinent. The physical features of the subcontinent have a profound influence on the wind systems, which ultimately affect the climate. The Darjiling hills have a wide range of altitudinal variations

ranging from 300m to 3360m above sea level. The climate varies greatly with the variation in the altitude and the configurations of the hills greatly affect air movement, rainfall and temperature. Even within very short distances great climatic contrasts occur. The latitude of the region is located within the subtropical climate regime yet there is varied climate ranging from subtropical to temperate and subalpine type due to the mountainous configuration of the area. Four climatic seasons can be recognized within the region (a) monsoon or rainy Season, (b) autumn, (C) winter, and (d) summer (spring). Spring and summer cannot be differentiated.

1.3.1 Rainfall

The area remains dry during the winters with occasional precipitation in the form of snow. Apart from the winters the area receives rainfall more or less throughout the year. The ascending south west monsoon laden with moisture from the Bay of Bengal account for about 82% of the total rainfall received in the region from June to September. .

The south facing slope of the town Kuresong receives the highest rainfall in the district of Darjiling that exceeds 4000 mm per anum. The north-east retreating winds also contribute around 4%of the total rainfall of the region. The rainfalls recorded from three weather stations in Darjiling Hills have been provided in the Figure 1.2.

1.3.2 Temperature

The temperature is inversely proportional to the altitude of a place in Darjiling hills. The places show marked differences in temperature with the altitudinal difference, where places like Sandhakphu, Rechilla, Phalut has an average temperature of 10⁰ c throughout the year. In contrast the plains like Shukna, Teesta, Mungpong are warm and hot. In higher altitude the mercury hovers around sub-

zero level in winters. Figure 1.3,1.4 and 1.5 shows the detailed month-wise temperature record of Happy Valley Tea Estate, Darjiling (2150m), Tea research association(TRA) Kurseong (1480m) and Barnesbeg Tea Estate, Darjiling (750m) from 2011 to 2014. January is the coldest month and the daily temperature at Darjiling, Sonada and Labha often touches sub-zero level in day, at night it's even chillier.

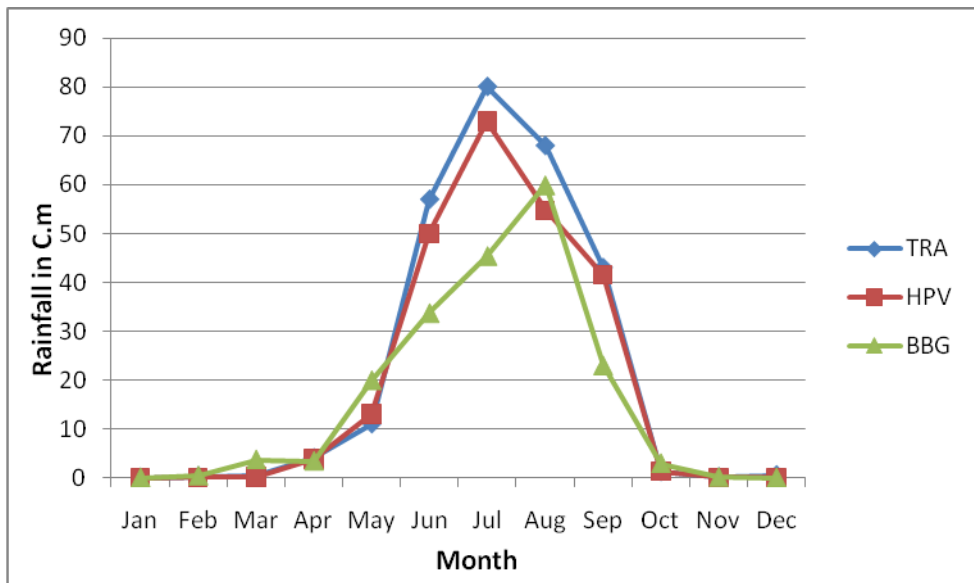


Fig 1.2: Average Monthly Rainafall (TRA= Kuresong, HPV= Happey Valley tea Estate, BBG= Barnesbeg Tea Estate)

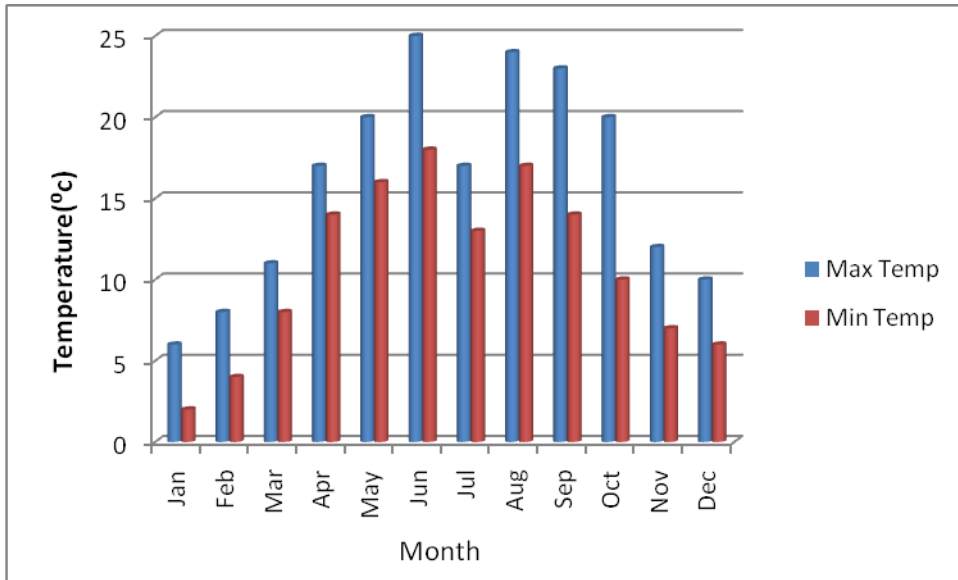


Fig 1.3: Average Monthly Temperature in the Upper Hills of Darjiling (Recorded from Darjiling, Happy Valley Tea Estate)

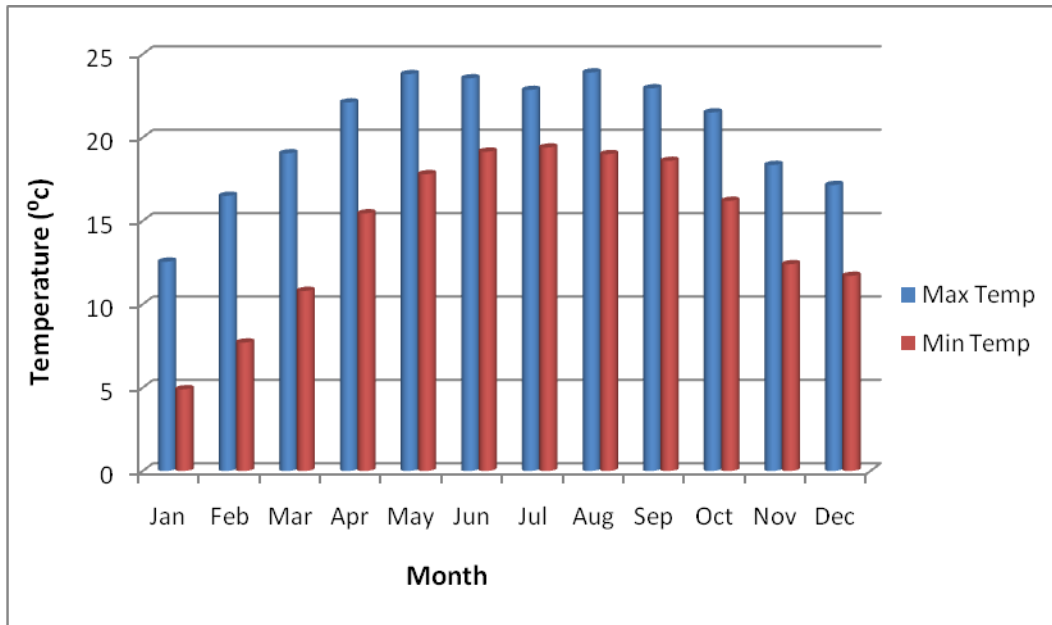


Fig 1.4: Average Monthly Temperature in Kuresong (Recorded from TRA,kuresong)

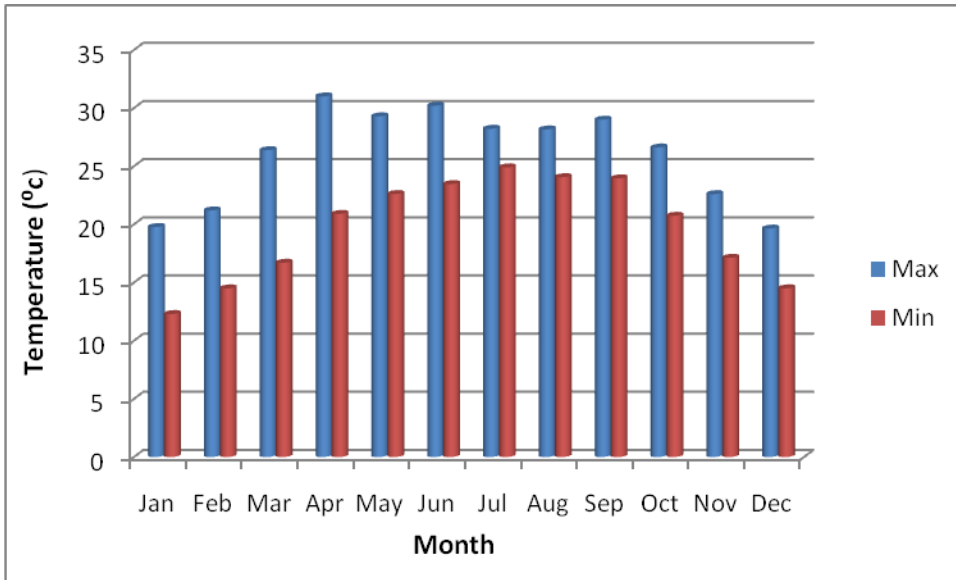


Fig1.5: Average Monthly Temperature in lower hill in Darjiling (Recorded from Barnesbeg Tea Estate)

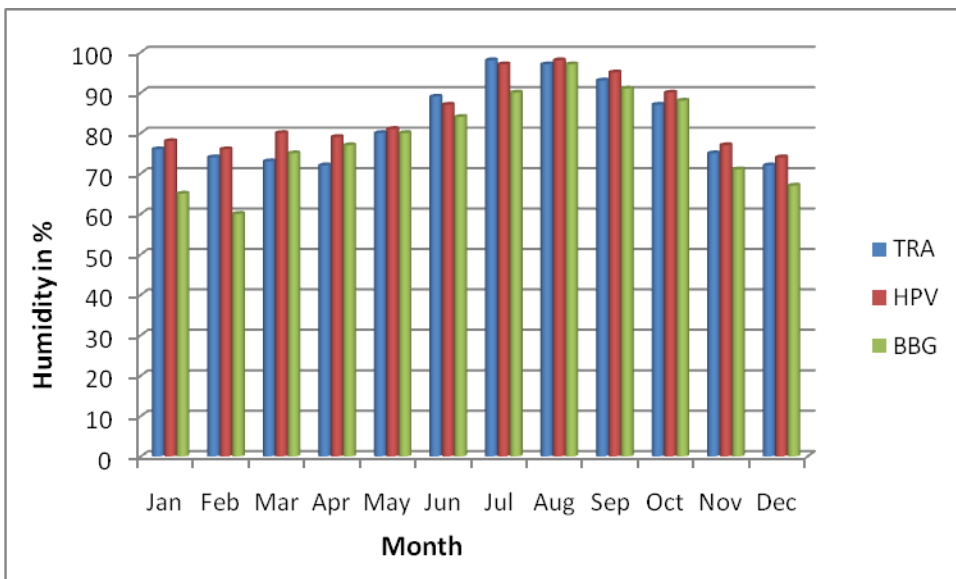


Fig 1.6: Average Monthly Humidity (TRA= Kuresong, HPV= Happy Valley Tea Estate, BBG= Barnesbeg Tea Estate)

1.3.3 Relative Humidity

Relative humidity in Darjiling hills remains comparatively high for most period of the year. March and April remain drier and show lowest relative humidity. The north facing slopes are colder and remain humid throughout the year. The highest

mean value (90 to 93%) occur in Darjiling from June to September (Dash,1947). The Relative humidity for a period of 4 years for three locations in the hill sub divisions of Darjiling have been given in Fig 1.6.

1.4 Communication Network

The topography and the steep ascend of treacherous Darjiling hills and the detail account of difficulties faced by the British during the construction of road has been well discussed by O'Malley (1907). In 1842, a motorable old military road was constructed connecting Darjiling to Siliguri via Pankhabari, Bagawra along the Ghoom ridge. After a gap of 27 years the Present Hill cart road the NH-55 was constructed connecting Darjiling to Siliguri. The NH-31 connects Gangtok to Siliguri that runs parallel to the river Teesta traversing the Darjiling District and Kalimpong sub-division. A number of State highway connect Mirik, Sukhai, Pedong, Bijanbari with the plains. After the formation of DGHC in 1990 and later GTA in 2013, numerous roads have been constructed that interconnect far-flung areas that were once remote and difficult to reach. Programs under Pradhan Mantri Gram Sadhak Yojna have helped Panchayat areas construct new roads providing and improving connectivity of the rural areas.

1.5 Biological Resource

Darjiling hills with an area of 2228.13km², with 4 protected areas viz Singalilla National Park, Neora valley National Park, Senchel wildlife Sancturay, Mahananda wildlife Sanctuary, reserve forest etc is an ideal home for diverse flora and fauna. Phytogeographically, the contiguous Darjiling-Sikkim Himalaya is a part of the Eastern Himalayan Province that in turn is one of the thirteen provinces of the Eastern Asiatic Regional Centre of Endemism (Takhtajan, 1986). Geographically the Darjiling hill is a segment of eastern Himalaya, having diverse ecological niche with diverse species composition.

1.5.1 Flora

Floristically, the Eastern Himalaya is one of the richest regions in the world and is literally considered a *botanist's paradise* and has thus, attracted a large number of plant hunters and botanists during the last three centuries (Don 1821, Das 1995). Phytogeographically it forms a meeting ground of the Indo-Chinese and Indo-Malaysian tropical lowland flora, the Sino- Himalayan east Asiatic flora and the Western Himalayan flora comprising about 9000 spp. with a high percentage of endemic plants (Chatterjee, 1939; Puri *et al*, 1983; Myers, 1988; Wilson ,1992; Das, 1995; Bhujel, 1996). This great floristic diversity is largely attributed to its topography and climatic factors that not only help the local flora to evolve, but also successful migration of plant species from surrounding places like China, Malaysia, Africa and Europe (Das, 1995; 2002). This province along with Khasi Manipur has the richest flora of the Indian subcontinent with the exception of Myanmar (Rao and Murti, 1990). A comprehensive travelogue through the dense and magnificent forest and vegetation of this region is rather difficult to conceive due to the nature of Himalayan terrain and intricacy of the plant cover comparable to almost that of the tropical rainforest in some of the river valleys (Bhattacharya, 1997). The forest of Darjiling and Sikkim himalya has been classified according to the altitude as Lower hill forest, Middle hill forest, Upper hill forest, Alpine and Sikkim alpine (Dash,1947).However later workers has classified vegetation of Darjiling hills into five types (Bhujel,1996).

The region is rich in Plants with Ethnobotanical values,92 species of plant has been documented for their utilization in medicine by the hill folk (Das and Mondal,2003), 421 species of plant has shown therapeutic values from Darjiling hills (Rai,2002),Chettri (2005) gave a current status of ethnomedicinal plants in the Darjiling Himalaya and listed 281 species where 14% of the medicinal plants are in different categories of threat, 256 plants species belonging to 220 genera and 120

families has been documented for ethno biological uses in the Darjiling hills (Yonzone et al, 2011),the study on 15 villages in Darjiling hills for ethnomedicinal plant documented 57 species,38 are herbs,9 are shrubs and 10 are trees (Samuel et al,2013). The important medicinal plants like, *Podophyllum hexandrum*, *Aconitum ferox* , *Pycorhiza sp* etc are lost due to over exploitation. Some timber yielding trees of the region are *Shorea robusta*, Gaertner f., *Tectona grandis* L.f., *Temanilia bellirica* (Gaertner)Roxburgh , *Michellia champaca* Linnaeus., *Cryptomeria japonica* (L.f)D.Don, *Taxus bacata* Linnaeus , *Abies densa* Miller, *Castonopsis spp* ,*Rhododendron spp*.

1.5.2 Fauna

The variation in altitude of the region with contrasting climate and vegetation has lead to the diversity of Fauna in Darjiling Hills. It is a home for *Trilitotriton himalayana*, listed in schedule I of Indian Wildlife conservation. *Ailurus fulgens* and *Panthera tigris* are rare and endangered mammals of the region. Two wild goats are found which are Jamarach's Serow and Brown Himalayan Goral. Wild dogs, Himalayan Black Bear, Mountain Fox wild Boars, Barking Deer's, Porcupine, Clouded Leopard, Bison's are the other important Mammals found in Darjiling Hills.The region is well traversed by fresh water streams and are home to fishes like Indian Trout, Katli, Goonch and Mahseer. The three varieties of Mahseer are found , Golden Himalayan Mahseer, Red finned Mahseer and Copper Mahseer. Darjiling District conatins nearly one quarter of the species of birds found in the Indian empire, Burma and Ceylon (Dash,1947). The avian fauna found in this region are Monal Pheasant, Blood Pheasant, Hwaks, Buzzard, Partridge, Hwaks etc. The invertebrates are exceedingly rich in Darjiling hills where Lepidopterans forms the major chunk.

1.6 Past Floristic Works

The floristically rich Darjiling and Sikkim Himalayas has attracted plant explorers, botanists and researchers since the 18th century (Das 1995; Don 1821). North western Himalayas were first to be scientifically and systematically explored by Thomas Thomson in two attempts since 1840. It was Sir J. D. Hooker in 1848 who, took up the third botanical expedition to the Eastern Himalayas and in doing so became the first ever-botanical explorer of the Eastern Himalayas while writing the Flora of British India as a whole (Burkill, 1965). Darjiling was a part of a Sikkim and in all previous work Darjiling and Sikkim have been considered together. The major contributions include J. D. Hooker (1849-51, 1854, 1855, 1872-1897, 1907); T. Anderson (1832-1870); C. B. Clarke (1876, 1885); H. J. Elwes (1877); George Watt (1881); G. A. Gammie (1893); R. Pantling with Sir George King (1989); Sir George King (1840-1909); Sir W. W. Smith (1911, 1913); C. C. Laccaita (1916); W. J. Buchanan (1916); P. Bruhl (1926); I.H. Burkill (1907, 1965); P. C. Duncan (1935); H. Hara (1963, 1966, 1971); Hara *et al* (1978, 1979, 1982); M. Mizushima (1963); S. Nakao (1964); H. Ohashi (1975); A.J.C. Grierson and D. G. Long (1978, 1979, 1982, 1983, 1984, 1987, 1991) and H. J. Noltie (1993).

On the other hand workers like J. S. Gamble (1875, 1986), A.M. Cowan and J. M. Cowan (1929) have published floras from the Darjiling Himalaya taking the foresters' point of view (Lama, 2004).

Different Indian workers have studied the flora in Darjiling hills which includes D. Chatterjee (1940); S. K. Mukherjee (1940, 1945, 1958); K. P. Biswas (1940, 1967); H. L. Chakraborty (1959); R. S. Rao (1964, 1964b); P.N. Mehra and S.S. Bir (1964); B. D. Sharma and Ghosh (1971); G. S. Yonzon (1976); K. M. Mathew (1981); Sahni (1981); K. K. Tamang and G. S. Yonzon (1982); B. Mathew

(1983); S. S. R. Bennet (1983); A. K. Mukherjee (1983); A. P. Das and R. B. Bhujel (1983); N. C. Muzumdar, B. Krishna and M.C. Biswas (1984); U. C. Pradhan and B. M. Rai (1983-85); A. P. Das and Chanda (1986, 1986a, 1987, 1990); R. B. Bhujel (1984, 1992,); P. C. Lama (1989); R. B. Bhujel *et al* (1994, 1996); T. Rai and L. Rai (1994) A. P. Das (1995, 1995a); A. K. Samanta and A. P. Das (1995, 1996); A.S. Chauhan (1998); D. Lama (2004); U. Rai (2006); R. Yonzon (2011, 2014).

The above list of workers and their floristic studies has contributed a lot for the flora of the region but scrutiny of literature reveals a large tract of natural vegetation mainly forested are yet to be surveyed. The rapidly increasing human population in the region leading to increase in habitational areas leading to steady dwindling forest cover, naturalization of numerous exotics etc. are exerting tremendous pressure on the natural vegetation of this area (Das 1995, 1998) resulting in the loss of many species and leading to many becoming endangered.

1.6.1 Past floristic study on ferns and Fern-allies

India is a mega biodiversity hot spot region and accounts for more than 7% of vascular plant species. The Pteridophytes belong to the group of vascular cryptogram comprising of fern and fern-allies, represented by 1100 species (Fraser-Jenkins, 2012) or 1200 species (Dixit 1984) in India. On the other hand the estimated global diversity of Pteridophyte species ranges between 9000 – 15000 (Smith et al, 2008) or 13,600 (Kramer and Green, 1990). The Indian pteridophyte list will increase as the entire north east having a close proximity with a part of centre of origin and diversification of Asian ferns i.e. Yunnan province of China having maximum concentration of Asian ferns abounds (Ching, 1978; Bir, 1988), has to be thoroughly investigated as they are still virgin forest. It is wise to say that 10% of global Pteridophyte species occur in Indian subcontinent. In India the floristic study dates back to 1883 when Col. R.H. Beddome published “A

Handbook to the ferns of British India, Ceylon and the Malaya Peninsula” and its supplement in 1892 but without Azollaceae, Marsileaceae and Salviniaceae among the fern and fern allies as a whole.

Charles William Webley Hope (1832-1904) was a British pteridologist, collected and studied the ferns of western Himalaya. He published a book entitled “The ferns of North –Western India”(1899-1904).

Charles Baron Clarke (1832 -1906), collected and studied the Ferns of North India and published “A review of the ferns of Northern India” in Trans. Linn. Soc. London II.1 (1880).

Prof. John Firminger Duthie (1845-1922) studied ferns of Kumaon and western Himalaya, published his two works. The “Flora of the upper Gangetic Plain” in the year 1903 and “Catalogue of the Plants of Kumaon” in the year 1918.

Sir Joseph Dalton Hooker (1817-1911), studied the flowering as well fern species in eastern Himalaya from the year 1848 to 1852 and published his findings in “Himalayan Journal” (1855).

Christopher Roy Fraser –Jenkins (b.1948), studied the fern and fern-allies of Nepal, Pakistan and India. His detailed Monographic paper on Indian Sub-continent include the publication of 1977, 1979, 1984, 1985, 1986, 1988, 1991, 1992, 1993, 1997a, 1997b, 2001 and Fraser Jenkins et al (1982 a&b, 1985, 1986, 1996, 1997, 1999). His two books namely; “New species syndrome in Indian Pteridology and the Ferns of Nepal (1997)” and “Taxonomic Revision of Three hundred Indian Subcontinental pteridophytes with a Revised census List-A new picture of Fern Taxonomy and Nomenclature in the Indian Subcontinent (2008). Similarly the paper entitled Rare and Threatened Pteridophyte of Asia 2. Endangered Species of India-the Higher IUCN Categories (2012) throw a light on the status of species in India. The latest publication was Fern and Fern allies of Nepal 1, 2015.

Prof. Hiroshi Hara of Tokyo university organized botanical exploration to Eastern Himalaya from 1960 to 1985 and visited Darjeeling in 1960 with H. Kanai, Gen Murata, Togashi and Takasi Tuyama. The result of five expeditions to Darjeeling

and Nepal From 1960 to 1985 is enumerated in three volumes of Flora of Eastern Himalayas (1971,1975 &1988).

Prof M.kato of Kosikawa Botanical Garden,University of Tokyo wrote a monograph on Asian *Cornopteris* (Kato1979) and *Deparia* (1984) which also included the species from Darjiling and Sikkim himalaya.

Prof . B.K Nayar of Calicut University studied Indian ferns and Some Nepalese species.(Nayar et al,1952,1980).

Dr. R.D Dixit from Botanical survey of India published a book on Indian Pteridophytes, “A census of Indian Pteridophytes “ (1984), Where he enumerated more than 1000 species from Indian Subcontinent,comprising of 67 families and 191 genera. In the year 1992 he published “Selaginellaceae of India”,in which he enumerated 62 species from the political boundry of indain Sub contitnent.Similarly he Published Lycopodiaceae of India in the year 1987 where he enumerated species from indain Sub-continent.

S.Chandra in the year 2000 Published a book “The Ferns of India” which dealt with enumeration,Synonyms and distribution. Similarly in the year 2008 he published a paper in Taiwania entitled “A Summary of the Status of Threatened Pteridophytes of India” where they have said one sixth of the Indian Pteridophytes are critically endangered and 46 species are endemic to India.

In the year 2004 Ghosh *et al*, published a book entitled “The Pteridophytic Flora of Eastern India”, where he presented 810 species and 37 sub species in 179 genera within 60 families.

Later in the year 2010 B.S Kholia published a book entitled” Fern and Fern allies of Sikkim, A pictorial handbook Part-I”, where he presented 149 species of Fern and fern allies. However 50% of the Indian Pteridophytes are found in Sikkim, according to (Chandra et al.,2008) and (Fraser-Jekins,2008).

1.7 Aims and objective of the Present work

1. Taxonomic enumeration and documentation of pteridophyte flora of Darjiling hills with preparation of artificial keys for easy identification.
2. Ecological status of individual species taking into consideration the horizontal and vertical distribution of the different species of pteridophyte in the hills of Darjiling.
3. Creation of database for pteridophytes of Darjiling hill with GPS data for all the species encountered in the study area.
4. Preparation of pteridophyte flora of Darjiling hill and publication to assist the future botanist for their study in pteridophytes.
5. Survey of local uses and economic importance.

CHAPTER - 2

MATERIALS AND METHODS

2.1. Selection of the Vegetation for Survey and Collection

An extensive review of literature was done for the study area prior to the field trip and excursion for documentation and Phyto- sociological study. Different areas of the Darjiling hills comprising of three hill subdivision of Darjiling up to Sukuna having altitudinal range from 300m amsl to 3636m amsl were visited during different seasons for the collection of specimens and all relevant field data. In the Darjeeling subdivision the entire locality from Darjeeling – Lebong – Ging-Badamtam (2100-1900-1700); Lebong – Pattabong (1900-1400m), Rungbul – Dhotrey Moonda Kotee (1950-1600 m) Sonada (2000m), Ghoom - Jorebunglow-Jalapahar - (2300–2350m), Jorebunglow - Rangarung - 3rd Mile- Rungli - Rungloit – Takdah- Bara mangwa (2200-1100m), 3rd mile - Mungpoo (2100-1300), Ghoom - Senchal - Tiger Hill (2300-2400- 500m), Sukhia Pokhri - Maney Bhangyang - Megma (2200-2000-2400m). Megma - Tonglu (2400-3000m), Tonglu – Garibans - Sandakphu (3000-2800-3636m), Sandakphu – Sabargam - Phalut (3636-3300-3700), Sandakphu - Samanden –Kalikhola – Ramam – Srikhola - Rimbick (3636-2400-2400-1900-2200m), Rimbick - Lodhoma (2200-1300m), in the Kurseong subdivision, Dilaram - Kurseong (1700-1650m), Kurseong - St. Mary's - Upper Mamring - Lower Mamring (1650-2000-1700–1300m), Mirik - Manjua (1900-1000m); in the Kalimpong sub-division Lopchu - Peshok - Rayang - Kalimpong (1500-900-300-1350m), Kalimpong – Pedong (1350-1400 m), Kalimpong - Raset (1350-1500), Kalimpong – Labha - Kolbong (1350-1450-2300m); Kafer – Lodaygaon - Munsong (1200-1350-1900m), Latpunchor (1200m and above), Labha - Panmkhasari - Khampong (1450-2400-2000m), Rhenok - Raset (1400-

2500m); Rechela (1400-3160 m), were visited for obtaining data with respect to seasonal, vertical as well as horizontal distribution of the Pteridophytic flora.

2.1.1. Collection and Preservation of Materials

During the field trips the different species of Fern and fern allies along with other plant specimens relevant to the present dissertation were traced on visual observation and representative specimens were collected. The specimens included the entire plant with intact rhizome and the plant considered included those in Sporulating either in the form of spike, sorus or strobilus. In cases where the reproductive structures were not observed, the mature vegetative plant along with their intact rhizome was collected. Special care was taken to collect all relevant data for a given specimen in a field note book and after proper tagging the specimens was pressed in portable herbarium press between the blotting papers. After the completion of field trip the specimen were brought to the laboratory, where the rhizome were cleaned, trimmed, poisoned with 4% Mercuric Chloride solution in rectified alcohol and was transferred to the wooden plant presses. After proper drying the specimens were poisoned by soaking them in 4% Mercuric Chloride solution in rectified spirit, dried again under pressure using blotting papers. The method followed for the preparation of herbarium from the fresh sample was according to Jain and Rao, 1977.

Dried and poisoned specimen were then pasted on standard herbarium sheets, labeled properly and temporarily stored in the Herbarium cabinet in the department of botany, St Joseph College.

2.1.2. Field note Book

The collected specimens were recorded in a Field Note Book noting all that would not be readily visible in pressed dried specimens. The details included the

Gps data, locations, altitude, date of collections, habit, habitat, type and colours of Hairs, Scales, Spines, Mucoration on stipe, rachis, pinnules and rhizome The field notes were transferred to herbarium labels for ready reference. Moreover, data on local utilization were collected with the parts and purpose for which they are used.

2.1.3. Identification

The specimens were primarily examined and identified in the botany department of St Joseph College using the available literature and matching with the herbarium in the Llyod's botanical garden. Identification was confirmed by matching all specimens at the Central National Herbarium, Howrah (Calcutta).

2.1.4. Enumeration and Description

The enumeration of the fern and fern allies of Darjiling hills in the present study has been done following the classification of Smith et al 2006 with slight modification on the family Thelypterideaceae (Fraser-Jenkins,2009). The fern and fern allies have been classified into 4 classes that include 11 orders and 37 families. The correct name followed by basionym and other available synonyms has been provided for each of the species collected and studied. Proper author citation, protologue references and record in floristic and taxonomic work as correct name has been provided. A key to the acronym and abbreviation used to denote various journals and books has been provided at the beginning of the enumeration. Local names whenever available have been provided along with language.

Detailed description of each species has been provided with all the measurements carried out using metric system only. In case of the measurements if not specifically mentioned, the length of the structure is placed first followed by the breadth punctuated by 'x' mark e.g. (6x2 cm denotes that the length = 6cm and the

breadth 2 cm.)

To cite the voucher specimen, the place of collection followed by altitude of the place, local name, local uses, date of collection, the collector's name, name of determinant and field numbers have been provided with the specimens from different places of collections being provided separately. The local distribution of the species given is the data accumulated from the field study. The Global distribution has been reviewed from the past literature and the herbaria visited.

2.2. Phytosociological Studies

The Phytosociological studies were carried out to determine the status of availability, horizontal and vertical distribution and to know the natural associates of the different species of Fern and Fern allies.

2.2.1. Location of the Study area

The study area included all those locations described above in 2.1. The study area was divided into four forest type with respect to climatic zone (Champion and Seth ,1968) which are (1) Tropical Forest (0 -800m (ii) Sub –Tropical Forest (800-1600m) (iii) Temperate forest (1600-3000m) (iv) Sub-alpine forest (3000m and above).

2.2.2. Sampling

A random sampling with nested quadrat was utilized to study the strata of vegetation. Trees and tree saplings above 5 feet in height were classified as trees during the count. The tree and shrub layers were analyzed by quadrat method using

the sizes 20 x 20 m and 5 x 5 m respectively and the herbs were analyzed by 1 x 1 m Quadrat. Basically a nested quadrat was placed having a size of 20 x 20m(for trees) within which 5 x 5 m quadrat was placed for analyzing the shrubs within which 1m x 1m quadrat was placed for the study of herbaceous plant. A total of 20 sampling plots were studied at each forest type with the 5 x 5 m quadrat being inside the 20 x 20 m quadrat (Yadav *et al*, 1991, Nath *et al* 1991). Specimens of the different species were collected tagged and herbarium prepared for identification. The diagrammatic sampling design for Phyto-sociological analysis has been provided in figure 2.1.

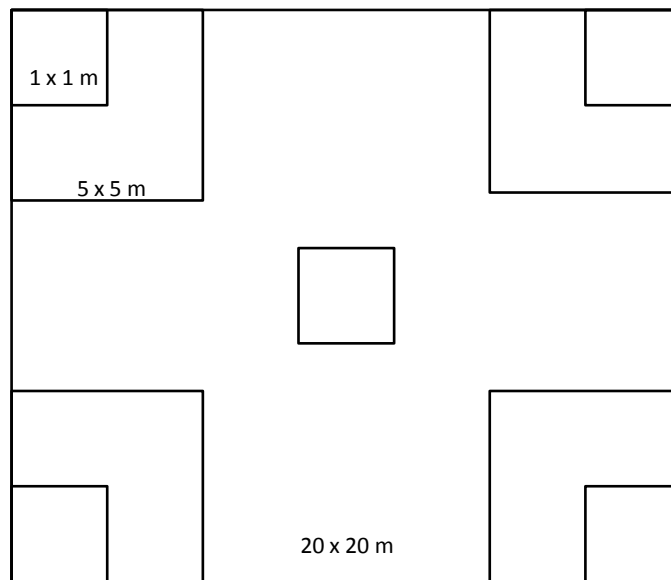


Figure 2.1: Sampling Design for Phytosociological analysis.

2.2.3. Phyto-sociological analysis

The data for each life form were recorded in the study area which were divided into five altitudinal zone and were quantitatively analyzed for Density (D),

Relative density (RD), frequency (F), relative frequency (RF), Abundance (A), relative abundance (RA) etc. The importance value index (IVI) for herbs and shrubs has been calculated through the abundance data according to Samanta and Das (1998). Finally for trees the importance value index (IVI) was calculated according to Philips (1959) and Misra (1969).

2.2.3.1 Density

Density is a numerical strength of a species in relation to a unit area. This parameter gives an idea about the dominance and rarity of a species and is also an indicator of the standing biomass and productivity of the region (Ambashat et al, 1995). The percentage of a species with respect to different species in the unit area is called as Relative density. They are calculated as:

$$\text{Density (D)} = \frac{\text{Total number of individual of a Species}}{\text{Total number of quadrat studied}}$$

$$\text{Relative Density (RD)} = \frac{\text{Density of a Species}}{\text{Sum of the Densities of all the Species}} \times 100$$

2.2.3.2

Frequency is the degree of dispersion in terms of percentage occurrence. In a sampling only the names of the species encountered in the different quadrat are listed. Frequency basically gives us an idea how frequent a species is encountered in the area. The frequency percentage of a species with respect to different species in the unit area is called as Relative Frequency.

$$\text{Frequency (F\%)} = \frac{\text{Number of Quadrat in which species occurred}}{\text{Total number of Quadrat Studied}} \times 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a Species}}{\text{Sum of Frequencies of all Species}} \times 100$$

2.2.3.3 Abundance

Abundance is the total number of individual of a species in a sampling area. It basically gives an idea of the occurrence of a species in the Sampling unit. Relative abundance is the percentage ratio between the Abundance of species with that of sum of abundance of all species in the sampling unit.

$$\text{Abundance (A)} = \frac{\text{Number of Individual of a species occurring}}{\text{Total Number of Quadrat Studied}}$$

$$\text{Relative Abundance (A)} = \frac{\text{Abundance of a Species}}{\text{Sum of Abundances of all Species}} \times 100$$

2.2.3.4 Basal area

Basal area implies the area covered by the tree which is basically calculated by taking a measurement at breast height i.e. 1.37m of a tree trunk above the ground. Basal area indicates the weight, size, volume and provides information regarding the proportion of its dominance in the sampling area. Basal area is calculated as;

$$\text{Basal area (BA)} = \frac{(\text{CBH})^2}{4\pi}$$

CBH: Circumference at Breast height.

2.2.3.5 Importance value Index (IVI)

The IVI gives an overall picture of a species and its importance in a community. The importance of a species in a community can be obtained by adding the value of relative density, relative dominance and relative frequency.

The IVI is calculated by the following formula;

$$IVI = RF + RD + RDm (RA)$$

2.2.4 Diversity indices

Diversity indices serve as important surrogates for measuring Biodiversity (Sarkar and Margules, 2003). A diversity index is a quantitative measure that reflects how many different types (such as species) there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types (http://en.wikipedia.org/wiki/Diversity_index). There are numerous indices formulated for diversity study but the commonly followed diversity indices have been adopted.

2.2.4.1 Species Diversity

It is the effective number of different species that are represented in a collection of individuals. Species richness and species evenness are the two components of Species diversity. Shannon- Wiener index (1963), incorporates both the parameter and is one of the most widely used index for measuring species diversity in an ecosystem (Ilorkar and Khatri, 2003). Lower the dominance higher is the diversity.

Shannon –Wiener index (1963)

$$H' = -\sum [n_i/N] \ln(n_i/N)$$

Where 'H' is the index value

'ni' is the number of individual of a species

'N' is the total number of species in the Habitat area.

2.2.4.2 Species Richness

The number of different species represented in a sampling unit or the habitat per unit area is called as Species Richness. Species richness is simply a count of species, and it does not take into account the abundances of the species or their relative abundance distributions (Colwell,2009).Menhinick's index (1964) and has been used to understand the Species richness.

Menhinick's Index (1964)

$$D=S/\sqrt{N}$$

Where 'D' is the index value

'S' is the total number of Species

'N' is the total number of individual of all Species.

2.2.4.3 Concentration of dominance

Simpson index (1949)is used to measure the degree of concentration of dominance of species which basically gives priority to the Dominant species. It maximum value ranges between 0 -1, which basically relates to the number of chance a particular species that can be encountered in a sampling unit.

Simpson's Index (1949)

$$\lambda= \sum pi^2$$

Where 'pi' is the proportional abundance of the ith species.

$$P_i = n_i/N$$

' n_i ' and ' N ' are same as Shanon-Wiener index.

2.2.5 Local utilization of Fern and their allies

Surveys were also conducted for the documentation of local use of the fern and fern allies in the Study area. During field trips and excursion the primary data for this purpose were collected through questionnaires and interviews with local people. The knowledge's of elderly people and local medicinal practitioner were thoroughly examined in the way of conversation for utilization of fern Species. At the same time different herbal medicinal man as well as healers comprising Bijuwa, Phedengba etc. Were interviewed for their traditional knowledge and utilization of fern Species . Local market was usually visited at a the time of Hatt (villagers sell their product once in a week) for knowing and listing the fern Species utilized for the domestic consumption . Local nursery and Flower shops were visited to determine the use of ferns as ornamentals. Even local drink and their production was surveyed, examined and documented. Lastly, previous literature was surveyed for darjiling hills to understand the utilization of fern species which proved to be a secondary source.

Chapter 3

TAXONOMIC ENUMERATION

3.1 Key to Families

- 1a. Sporangia solitary in axils of simple or once-forked leaves....2
- 2a. Spores of two kinds: large megaspores and much smaller microspores; vegetative shoots often dorsiventral with leaves in 4 ranks, 2 median, with smaller leaves, and 2 lateral, less often uniform and spirally arranged**Selaginellaceae**
- 2b. Spores of one kind, always very small; vegetative shoots usually with leaves uniform and spirally arranged, rarely lateral branches obviously flattened but then leaves not in 2 ranks3
- 3a. stem hollow, sheathed with peltate sporangiophore.....**Equisetaceae**
- 3b. Stem solid, sheath absent without peltate sporangiophore.....**Lycopodiaceae**
- 1b. Sporangia several to very many together borne directly on surface of fronds or frond axes or on specialized sporophores borne on frond or in achlorophyllous strobili, sometimes enclosed within sporocarp or indusium....4
- 4a. Fronds 3-dimensional, divided near base (or middle) into a fertile terminal “panicle” or “spike” and a sterile segment (simple, pinnatifid, or ternate), usually fleshy, vernation usually nodding; caudex subterranean, short, usually erect , apex surrounded by a sheath **Ophioglossaceae**
- 4b. Fronds and caudex not as above, vernation circinate, rarely hooked; apex not sheathed.....5
- 5a. Fronds vine like with a twining rachis**Lygodiaceae**
- 5b. Fronds not vine like, sometimes scrambling but never with a twining rachis...6
- 6a. Fronds membranous, 1 cell thick, or rarely with 2–4 cell layers without intercellular spaces and stomata; sporangia borne on an extended veinlet (receptacle); indusia tubular or 2-lipped, borne on tips or upper margins of segments**Hymenophyllaceae**

- 6b. Fronds herbaceous to leathery, several cells thick with intercellular spaces and stomata; sporangia not borne on extended veinlets.....7
- 7a. Ferns with an erect trunk like rhizome, with large compound fronds in a crown at apex.....8
- 8a. Fertile pinnae without visible lamina; sporangia in dense clusters directly on rachis and rachillae, not covered by indusium or modified lamina**Osmundaceae**
- 8b. Fertile pinnae with distinct lamina; sporangia in orbicular or linear sori or along veins and eventually acrostichoid.....9
- 9a. Stem usually over 8 cm in diam.; sori orbicular or linear along veins and eventually acrostichoid...10
- 10a. Sori discrete, orbicular, medial, with cuplike or scale like indusia or exindusiate **Cyatheaceae**
- 10b. Sori linear along veins and eventually acrostichoid **Marattiaceae**
- 9b. Stem usually less than 8 cm in diam.; sori linear... 11
- 11a. Sori parallel to lateral veinlets or costules, indusia often double **Woodsiaceae**
- 11b. Sori parallel to costa, indusia not double**Blechnaceae**
- 7b. Ferns with rhizome short, creeping or climbing, sometimes massive but then prostrate or hardly longer than wide, never tree like.....12
- 12a. Fronds pseudo dichotomously branched, with a dormant bud in axils of regularly dichotomous forks; ultimate branches pinnate or bipinnatifid **Gleicheniaceae**
- 12b. Fronds simple, pinnatifid, palmate, or pedate, never with buds in axils of branch forks(ignore budlike bulbils along costa or rachis, not associated with branching).....13
- 13a. Fronds simple, uni-pinnate, pinnatifid, rarely pedate.....24
- 13b. Fronds compound14

- 14a. Ferns with long rhizomes and widely spaced fronds**Dryopteridaceae**
14b. Terrestrial ferns with stout erect rhizomes and clustered fronds.....15
- 15a. Stipe with enlarged base; rachis with cushion like or long and Horn like
aerophores at bases of pinnae **Plagiogyriaceae**
- 15b. Stipe without enlarged base; rachis without aerophores.....16
- 16a. Sporangia acrostichoid, uniformly covering abaxial side of lamina
..... **Elaphoglossaceae**
- 16b. Sporangia discrete, in definite sori or ceonosori.....17
- 17a. Fronds with perennating bulbils.....**Aspleniaceae**
17b. Fronds without perennating bulbils.....18
- 18a. Stolon with tubers.....**Nephrolepidaceae**
18b. Stolon without tubers.....19
- 19a.Sori linear to reniform and frond glabrous.....25
19b. Sori globose and fronds hairy.....22
- 20a. Plants grass like.....**Vittariaceae**
20b.Plants not grass like.....21
- 21a. Ulitimate segments rhomboid.....**Davalliaceae**
21b. Ultimate segments oblong to linear.....**Pteridaceae**
- 22a. Plants with costal aeroles..... **Thelypterideaceae**
22b.Plants without costal aeroles.....23
- 23a. Lamina simple.....**Oleandraceae**
23b.Lamina pinnate to pinnatifid.....**Dennstaedtiaceae**
- 24a.Stipe and lamina with red hairs.....**Grammitidaceae**
24b. Stipe and lamina without red hairs.....25
- 25a. Sori exindusiate.....**Polypodiaceae**

25b. Sori double indusiate.....**Lindsaeaceae**

3.1.1 Enumeration of Pteridophytic Flora of Darjiling Hills.

Lycopodiaceae P. Beauvois *ex* Mirbel in Lamarck & Mirbel, Hist.Nat.Veg. 4: 293. 1802. (Plate 3.1)

- 1. Sporangia organized in a strobilus2
- + Sporangia occurring freely i.e. does not produce strobilus
Huperzia
- 2. Sporophytic plants erect *Lycopodiella*
- + Sporophytic plants scrambling *Lycopodium*

Huperzia Bernham, Schrad. J. Bot. 1800(2): 126. 1801.

- 1 Plants usually epiphytic 2
- + Plants usually terrestrial 3
- 2 Leaves linear and scaly.....4
- + Leaves ovate-lanceolate and glossy.....*Huperzia. hamiltonii*
- 3 Leaf margin entire.....5
- + Leaf margin serrate.....*Huperzia. serrata*
- 4 Sporangia arise in the axil of sporophylls*Huperzia. squarrosa*
- + Sporangia arise throughout the length of the stem in the axil of microphylls.....*Huperzia. pulcherrima*
- 5 Leaves reflexed, green, 0.5 - 1.5 × 0.1 - .4 cm.....*Huperzia. heteriana*
- + Leaves ascending, greenish to brownish, 0.4 - 1 × 0.1 - 0. Cm*Huperzia. ceylanica*

LYCOPODIUM Linnaeus, Sp. Pl. 2: 1100. 1753.

Lycopodium japonicum Thunberg. Fl. Jap. 341. 1784; Dixit, Cens. Indian Pterid. 9. 1984; Thapa, Pterid. Nepal 24. 2002; Ghosh, Pterid. Fl. East. Ind. I: 86. 2004; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 519. 2008.

Lycopodium pseudoclavatum Ching, Acta Bot. Yunnan. 4(3): 222. 1982.

Herbaceous with creeping Runner, forked, green; lateral branches erect, up to 30 cm tall, 0.5 – 1 cm in diameter, multiple times dichotomously branched; Leaves microphyllous, spirally arranged, dense, angled upward, linear-lanceolate, 0.4 – 0.6 × 0.2 – 0.4 cm, herbaceous, midrib indistinct, base cuneate, sessile, margin entire, apex acuminate; Strobili 3 – 4 on a peduncle, pedicels erect with varying length, 2 – 5 × 0.2 – 0.4 cm, Strobili cylindrical, 3 – 8 × 0.4 – 0.7 cm; Sporophyll broadly ovate, 2 – 3 × ca. 3 mm, papery, apex acute, with long aristate tip; Sporangia slightly exposed, Spores 30 – 35 µm, tetrahedral, creamish in colour.

Exsiccatae: West Bengal, Darjiling hills, Third mile, 12.08.2011, *Nayan Thapa & Dorjay Lama*, 026A (SJCBH), 026B (LBH), 27° 00'31.7" N and 88°17' 37.4" E, alt. 2154 ± 15 m.

Local Distribution: Third mile, Sukhia, Tonglu, Lava, Chimney.

Global Distribution: Bhutan, Cambodia, China, India, Japan, Laos, Myanmar, Nepal, Vietnam.

LYCOPODIELLA Holub, Preslia 36: 22. 1964.

Lycopodiella cernua (Linnaeus) Pich. Sermolli, Webbia **23**: 166 .1968; Thapa, Pterid. Nepal 24. 2002; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pterid. With Rev. Cen. List 519. 2008.

Lycopodium cernuum Linnaeus, Sp. Pl. **2**: 1103. 1753.

Lycopodium clavatum sensu Clarke, Trans. Linn. Soc. Ser. II. Bot. 1: 592. 1880.

Lycopodium cernuum Linnaeus var. *sikkimense* (O.F. Mull) H.S. Kung, Acta Phytotax. Sin. **18** (2): 239. 1980.

Herbaceous with creeping runner, forked, creamish; Stem erect, 30-60 c.m in height, Ca. 0.5 -1c.m in diameter, dichotomously branched; Leaf microphyllous, spirally arranged, monomorphic, lanceolate, midrib indistinct, margin entire, base cuneate, decurrent, sessile, apex acuminate, 0.2-0.4 × 0.8-1cm; Strobili solitary, 1-1.4 × 0.4-0.6 cm, drooping, stalked, pedicels 0.2-1 × 0.1-1.2 cm; Sporophylls different from trophophylls, subulate to lanceolate, imbricate, margin membranous and irregularly toothed, apex acute; Sporangia yellow, reniform; Spores 25-32 µm, tetrahedral, yellowish in colour.

Exsiccatae: West Bengal, Darjiling hills, Lebong, 15.08.2011, *Nayan Thapa & Dorjay Lama*, 048A (SJCBH), 048B(LBH), 27°04'13.5'' N and 088°16'59.7'' E, alt .1550 ± 11.5 m

Local Distribution: Rungdung, Dhotrey, lebong, Jamuna.

Global Distribution: Bhutan, China, India, Nepal.

HUPERZIA Bernhardi in *Shrad. J. Bot.* 1800(2): 126. 1801.

(Thunberg) Trevisan, *Atti. Soc. Ital. Sci. Nat.* **17**: 248. 1875; Dixit, *Cens. Indian Pterid.* 7. 1984; Thapa, *Pterid. Nepal* 23. 2002; Ghosh, *Pterid. Fl. East. Ind. I*: 51. 2004; Fraser-Jenkins, *Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List* 519. 2008.

Lycopodium serratum Thunberg in Murray, *Fl. Jap.* 341, t.38. 1784.

Urostachys serratus (Thunberg) Herter, *Bot. Arch.* **3**: 13. 1923.

Herbaceous, rooted at base, isodichotomous branching, terrestrial; stem erect, 5 – 25 cm, 0.1 – 0.4 cm in diameter, 2 – 3 times dichotomously branched, bulbils at the tip; leaves sparse, right angles to the stem, lustrous, elliptic, contracted toward base, straight, 1 – 2.5 × 0.4 – 0.6 cm, thinly leathery, both surfaces glabrous, midrib conspicuously raised, base cuneate, decurrent, petiolate, margin irregularly toothed, apex acuminate; Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform to kidney shaped; ca. 0.4 – 0.8 × 0.2 – 0.4 cm. Spores 22 – 32 µm, tetrahedral, yellowish.

Exsiccatae: West Bengal, Darjiling hills, Lebong, 15.08.2011, *Nayan Thapa & Dorjay Lama*, 049A (SJCBH), 049B (LBH), 27°04'13.5'' N and 088°16'59.7'' E, alt .1550 ± 11.5 m

Global Distribution: Australia, Bhutan, Cambodia, China, India, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Philippines, Russia, Sri Lanka, Thailand, Vietnam.

Local Distribution: Lebong, Jalapahar, Lava, Takdah, Third mile.

Huperzia herteriana (Kümmerle) T. Sen & U. Sen, Fern Gaz. **11** (6): 415, f.1a-j. 1978; Dixit, Cens. Indian Pterid. 7.1984; Thapa, Pterid. Nepal 22. 2002; Ghosh, Pterid. Fl. East. Ind. I: 58 – 59.2004; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 518. 2008.

Lycopodium herterianum Kümmerle, Magyar Bot. Lap. **26**: 99. 1928.

Lycopodium sikkimense Herter, Bot. Jahrb.**43**: 42. 1909.

Urostachys sikkimensis (Herter) Herter ex Nessel, Lycopod.: 52, t.7, f.1. 1939.

Urostachys herterianus (Kümmerle) Herter, Ind, Lycopod.: 64. 1949.

Herbaceous, terrestrial, rooting at base, isodichotomous branching; erect, ascending, 4-12 × 0.2- 0.4 cm in diameter, 2-4 times dichotomously branched, ultimate end with bulbils; Leaves dense, reflexed, lustrous, oblanceolate, falcate, 0.6-1.2 × 0.1-0.3 cm, leathery, midrib indistinct, base cuneate, decurrent, sessile, margin straight, upper portion with small teeth, apex acute; Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, Ca. 0.3-0.6 × 0.1-0.3 cm, reniform yellowish; Spores 25-30 µm, tetrahedral, pitted, creamish-yellow in colour.

Exsiccatae : West Bengal, Darjiling hills, Chitrey, 10.08.2011, *Nayan Thapa & Dorjay Lama*, 055A (SJCBH), 055B(LBH), 26°59'23'' N and 088°06'57.2'' E, alt. 2232±15 m

Global distribution: Bhutan, China, India, Nepal.

Local Distribution: Chitrey, Tonglu, Senchel, Rachela, Jalapahar.

Huperzia ceylanica (Spring) Trevisan, Atti. Soc. Ital. Sci. Nat. 17: 248. 1875; Dixit., Lycopod. India 44. 1987; Fraser-Jenkins., Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 518. 2008.

Lycopodium ceylanicum Spring, Mem. Acad. Sci. Belg. 15(1): 37. 1843; 24(2): 16. 1850; Bak. Handb. Fern allies 11.1887.

Huperzia ceylanica (Spring) Rothmaler, Feddes Repert. 54(1): 59. 1944 (Superfl).

Herbaceous, rooting at base, growing on exposed rocky surfaces; terrestrial, erect, 7-16 × 0.3- 0.6 cm, 1-4 times dichotomous branching, Leaves 8 whorled, green to pale green, ascending in the upper half, reflexed at the basal part, thin, lingulate, Ca. 0.8-1 × 0.2-0.4 cm, sparsely serrate at apex, midrib distinct; Sporophyll homomorphic with trophophylls, sporangia borne on the axil of leaves at the upper

half, short apical part with only vegetative leaves; Sporangium Ca. $0.4-0.6 \times 0.2-0.3$ c.m, reniform, yellowish in colour ; Spores $35-40 \mu\text{m}$, tetrahedral, pitted, pale in colour.

Exsiccatae: West Bengal, Darjiling hills, Chitrey, 10.08.2011, *Nayan Thapa & Dorjay Lama*, 160A (SJCBH), 160B(LBH), $26^{\circ}59'23''$ N and $88^{\circ}06'57.2''$ E, alt. 2232 ± 15 m.

Global Distribution: India, Java, Srilanka.

Local Distribution: Chitrey, Jalapahar, Tonglu.

Huperzia squarrosa (Froster) Trevisan, Atti Soc. Ital. Sci. Nat. **17**: 247 (1875); Dixit, A cens. of Indian Pterid. 8.1984 ; Dixit, Lycopod. of India 65.1987; Thapa, Pterid. of Nepal 23.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 519.2008.

Lycopodium squarrosum Froster, Fl. Ins. Austr. Prodr.: 86 (1786).

Lycopodium verticillatum Willdenow, Sp. Pl. **5**: 48 (1810).

Lycopodium hookeri Wallich ex Hooker & Greville, Ic. Fil. **2**: t. 185 (1829).

Phlegmariurus squarrosus (Froster) A. Löve & D. Löve, Taxon **26** (2-3): 324 (1977).

Urostachys squarrosus (Froster) Herter, Bot. Arch. **3**: 14 (1923), Ind. Lycopod.: 83 (1949).

Plant epiphytic, Stems caespitose, branches pendulous, 1 – 8 times forked, $25-75 \times 0.2-0.5$ cm; Trophophylls lustrous, lanceolate, attached at right angles, $0.5-2 \times 0.2-0.4$ cm, leathery, midrib distinct, base cuneate, decurrent, margin entire, apex acute; Strobili terminal on branches Sporophylls densely arranged, ovate-lanceolate, $0.6-1.2 \times ca. 0.2$ cm, margin entire, apex acute; Sporangia yellowish, reniform, vertically bisected; Spores $28-35 \mu\text{m}$, tetrahedral, greenish-white in colour.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10.09.2012, *Nayan Thapa & Dorjay Lama*, 075A (SJCBH), 075B(LBH), $27^{\circ}02'12''$ N and $88^{\circ}20'1.3''$ E, alt. 1050 ± 15 m

Global Distribution: Bhutan, Cambodia, China, India, Laos, Madagascar, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand.

Local Distribution: Mangwa, Teesta valley, Makaibari, Pandam.

Huperzia hamiltonii(Sprengel) Trevisn, Atti Soc. Ital. Sci. Nat., 248,1875; Dixit, A cens. of Ind. Pterid.7.1984 ; Dixit, Lycopod.of India, 48,1987; Thapa, Pterid. of Nepal 22.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List 518.2008.

Lycopodium hamiltonii Sprengel in Linnaeus, Syst. Veg. **5**: 492 (1828);

Lycopodium obtusifolium Hameed ex D.Don, Prodr. Fl. Nepal.: 18 (1825), *non* Sw. (1806).

Lycopodium aloifolium Wallich ex Hooker & Greville, Ic. Fil.: t.233 (1831).

Lycopodium empetrifolium Dalzell, Hooker J. Bot. (1852).

Phlegmariurus hamiltonii (Sprengel) A.Löve & D.Löve, Taxon **26** (2-3): 324 (1977).

Urostachys hamitonii (Spring) Herter ex Nessel, Lycopod.: 68 (1939), Ind. Lycopod.: 63 (1949).

Plants epiphytic, pendulous, 8 -10 × 0. 2-0.4 cm, forked dichotomously; Trophophylls slightly angled upward, slightly oblong, 1-1.5 × 0.3-0.5 c.m, base cuneate, decurrent, lustrous, leathery, midrib distinct, margin entire, apex obtuse; Sporophyll like vegetative leaves, sporangia on the axil of sporophyll in the upper half, Sporangia Ca. 0.6-1 × 0.2-0.4 cm, reniform, vertically bisected yellowish;Spores 28-32 µm,tetrahedral, pitted, pale in colour.

Exsiccatae : West Bengal,Darjiling hills, Singamari,02.07.2011, *Nayan Thapa & Dorjay Lama, 010A (SJCBH), 010B(LBH), 267°03'15.1'' N and 088°14'23.1''E, alt.1950±12m*

Global Distribution: Bhutan, China, India, N Myanmar, Nepal.

Local Distribution: Singamari, Senchel, Lava, Chimney.

Huperzia pulcherrima (Wallich ex Hooker & Greville) Pich. Sermolli, Webbia 25 (1): 219-297 (1970); Dixit, A census of Indian Pteridop. 8.1984 ; Dixit, Lycopod. of India 60.1987; Thapa,Pterid. of Nepal 23.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List 519.2008.

Lycopodium pulcherrimum Wallich ex Hooker. & Greville, Ic. Fil.: t.38 (1827)
Lycopodium setaceum Hameed ex D.Don, Prodr. Fl. Nepal.: 18 (1825)
Lycopodium setaceum Hameed ex D.Don var. *pulcherrimum* (Wallich ex Hooker & Greville) C.B.Clarke, Trans. Linn. Spc. Lond. II Bot.1: 590 (1880).
Lycopodium taiwanense C.M.Kuo, Taiwania **30**: 51 (1985); Tsai & Shieh, Fl. Taiwan ed.2 **1**:43 (1994).
Phlegmariurus pulcherrimus (Wallich ex Hooker & Greville) A.Löve & D. Löve, Taxon **26** (2-3):324 (1977).
Urostachys pulcherrimus (Wallich ex Hooker & Greville) Herter, Ind. Lycopod.: 77 (1949).

Plants epiphytic, 10-50 × 0.8- 1.4 c.m, pendulous, 2-4 times forked; Leaves linear, 0.8-1.2 × 0.2-0.5 cm, erecto patent, margins wavy, involute, slightly decurrent at base, midrib indistinct, yellowish-green in colour; Sporophyll like vegetative leaf, fertile from the middle to the apex, Sporangia in the axil of sporophyll, Ca.0.3 × 0.6-0.1-0.3 cm, kidney shaped, yellowish in colour; Spores 28-30µm, tetrahedral, pitted, yellowish in colour.

Exciccatae : West Bengal, Darjiling hills, Rungdung, 05.07.2011, *Nayan Thapa & Dorjay Lama*, 012A (SJCBH), 012B(LBH), 27°01'16'' N and 088°16'24.5'' E, Alt.1455±13.1m

Global Distribution: Sri lanka, Bhutan, Nepal, India.

Local Distribution: Rungdung, Mungpoo, Mangwa, Balason, Barnesbeg.

Selaginellaceae Willkorm in Anleit. Stud. Bot.2:163.1854.

Selaginella P. Beauvois, Prodr. Aethéogam. 101. 1805.

1. Strobilus 0.5-1.2 × 0.2-0.4 cm.....2
- + Strobilus 0.3-0.5 × 0.1-0.2 cm..... *Selaginella chrysocaulos*
2. Branches 2-3 pairs..... *Selaginella subdiaphana*
- + Branches 4-6 pairs.....3
3. Sporophyll isomorphic.....4
- + Sporopyll dimorphic.....6
4. Lateral leaf 0.4 × 0.3 cm..... *Selaginella vaginata*
- + Lateral leaf 0.3 × 0.1 cm.....5

5. Microspore spherical, 35×50µm.....*Selaginella repanda*
 +. Microspore 30× 20µm.....*Selaginella pulvinata*
 6. Megaspore globose, 350-370µm.....*Selaginella bisulcata*
 +. Megaspore ovoid, 290× 310µm.....*Selaginella monospora*

Selaginella bisulcata Spring, Mem. Acad. Sci. Beig. 24(2):259.1850; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 100.1965; Dixit, A cen. of Indian Pterid. 11.1984; Thapa, Pterid. of Nepal 25.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 520.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:60.2015.

Plant herbaceous, lithophytic, creeping; rhizophore arising from upper $\frac{3}{4}$ th of stem; plants 20-60 cm, light green; stem stramineous to castaneous, glabrous; branches alternate, 6 pairs, distant, 4-6 cm; leaf dimorphic, lateral leaf oblong, dentate, acute, 0.5× 0.2 cm, median leaf lanceolate, dentate, aristate, 0.3×0.1 cm; strobilus quadrangular, 0.5-1× 0.2-0.4 cm; sporophyll dimorphic, larger sporophyll oblong, dentate, acute, 0.4× 0.2, smaller sporophyll lanceolate, dentate, acute, 0.2× 0.1 cm; megaspore globose, smooth, brown, 350-370µm; microspore tetrahedral, warty, grayish-brown, 20×28µm.

Exsiccatae: West Bengal, Darjilinghills, Lebong, 27/05/13, Nayan Thapa, 039A (SJC BH), 039B (LBH), N27°04' 15.05'' and E088°216' 56.7'', Alt: 1859m±11.

Global Distribution: Bhutan, china, India, Nepal.

Local distribution: Lebong, Meghaa, Allubari,

Selaginella chrysocaulos (Hooker & Greville) Spring, Bull. Acad. Roy. Sci. Bruxelles. 10: 232. 1843; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 100.1965; Dixit, A cen. of Indian Pterid. 12.1984; Thapa, Pterid. of Nepal 25.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List. 521.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:62.2015.

Lycopodium chrysocaulos Hooker et Greville in Hooker Bot. Misc. 2: 401. 1831.

Selaginella hypnoides Sprong, Mem. Acad. Sci. Belg. 24(2):101.1850.

Plants herbaceous, lithophytic, terrestrial; rhizophore arising at base, pale, 4-6 cm; root with tubers; plants 10-20 cm, yellowish-green; stem stramineous, 4-5 cm; branches 5-8 pairs, alternate; leaf dimorphic, ascending, ventral leaf ovate, oblique, margin dentate, apex acute, 0.5 × 0.3 cm, dorsal leaf ovate-lanceolate, margin dentate, apex aristate, 0.5 × 0.1 cm; srobili quadrangular, short, 0.3-0.5 × 0.1 cm; sporophyll dimorphic, megasporophyll oblong, base oblique, margin dentate, obtuse, 0.4 × 0.2 cm, microsporophyll ovate-lanceolate, margin dentate, acuminate, 0.4 × 0.1 cm; megaspore dark-brown, perisporate, 300-310 μm; microspore tetrahedral, spinose to tuberculate, orange, 45-50 μm.

Exsiccatae: West Bengal, Darjiling hills, Third mile, 04/05/11, Nayan Thapa, 02A (SJCBH), 02B (LBH), N27°00'31.5'' and E088°17'37.7'', Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Nepal, Pakistan, Vietnam.

Local distribution: Third mile, Chatakpur.

Selaginella monospora Spring, Mém. Acad. Roy. Sci. Belgique. 24: 135. 1850; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 101.1965; Dixit, A cen. of Indian Pterid. 14.1984; Thapa, Pterid. Of Nepal 27.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 62.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 522.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 73.2015.

Selaginella gorvalensis Spring, Mem. Acad. Sci. Belg. 24(2):286.1850.

Selaginella pulmosa var *monospora* (Spring) Baker, Journ. Bot. 21:145.1883.

Plants herbaceous, lithophytic, creeping; rhizophore arising from lower 1/2 of stem, pale, 6-7 cm; plants 10-80 cm, stem pale to stramineous; branches pinnately compound; leaf dimorphic, pinkish-green, ascending, ventral leaf ovate, base

oblique, margin dentate, apex acute, 0.4 × 0.2 cm, median leaf ovate, margin denticulate, apex aristate, 0.4 × 0.1 cm; strobilus quadrangular, short, 0.5-1 × 0.1-0.2 cm; sporophyll dimorphic, megasporophyll oblong, margin dentate, acute, 0.3 × 0.2 cm, microsporophyll ovate-lanceolate, dentate, acute, 0.2 × 0.1 cm; megaspore ovoid, dark-brown, tuberculate, 290 × 310 μm; microspore spherical, minutely tuberculate, orange, 29 × 37 μm.

Exsiccatae: West Bengal, Darjilinghills, Thirdu mile, 01/10/11, *Nayan Thapa*, 074A (SJCBH), 074B (LBH), N27°00'31.5'' and E088°17'37.7'', Alt: 2154m ± 15.

Global distribution: Bhutan, India, Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Thirdu mile, Lebong, Senchel.

Selaginella pulvinata (Hooker et Greville) Maxim., Acad. Imp. Sci. Petersb. 9:335. 1857; Dixit, A cen. of Indian Pterid. 16.1984; Thapa, Pterid. Of Nepal 28.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 523.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 78.2015.

Lycopodium pulvinatum Hooker & Greville in Hooker Bot. Misc. 2:381.1831.

Plants coriaceous, lithophytic, terrestrial, erect; rhizophore absent, rooting at base; plants 15-30 cm, dark green; stem purplish to stramineous, hard, rough; branches 4-6 pairs, alternate; leaf dimorphic, ascending, ventral leaf ovate-oblong, base rounded, margin dentate, acute, 0.3 × 0.1 cm, dorsal leaf ovate, margin dentate, apex aristate, 0.2 × 0.1 cm; strobilus quadrangular, short, 0.5-0.9 × 0.1 cm; sporophyll isomorphic, ovate, margin dentate, apex acuminate, 0.2 × 0.1 cm; megaspore orange, tuberculate, orbicular, 250-270 μm; microspore tetrahedral, minutely spinose, orange, 20 × 30 μm

Exsiccatae: West Bengal, Darjilinghills, Lebong, 18/07/11, *Nayan Thapa*, 121A (SJCBH), 121B (LBH), N27°04'12.05'' and E088°216'49.7'', Alt: 1456m ± 9.

Global distribution: Bangladesh, Bhutan, China, India, Nepal, Vietnam.

Local distribution: Rungdung, Rambhi.

Selaginella repanda (Desvaux ex Poiret) Spring in Gaudichaud, Voy. Bonite, Bot. 1: 329. 1844; Dixit , A cen. of Indian Pterid.16.1984; Thapa, Pterid. Of Nepal 29.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 523.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:80.2015. (Plate:3.3)

Lycopodium repandum Desvaux ex Poiret in Lamarck, Encycl., Suppl. 3: 558.

Plants herbaceous, lithophytic, sub-erect; rhizophore arising from base of the stem; plants, 10-30 cm, pale ; branches arising from base, 4-6 pairs ,alternate;leaf dimorphic, ventral leaf ascending, ovate, base auriculate, ciliated throughout , acroscopic half,0.2× 0.1 cm, dorsal leaf ovate, dentate-ciliate, acuminate, 0.15× 0.1 cm; strobilus rounded,0.5-0.7× 0.1-0.3 cm; sporophyll isomorphic, ovate, ciliate, acuminate, 0.1×0.1 cm; megaspore ovoid to globose, brown,260-290µm; microspore spherical to tetrahedral, spinouse, red,35×50µm.

Exsiccatae : West Bengal,Darjiling hills,Kuresong,13/12/11, *Nayan Thapa & DorjayLama,099A(SJCBH), 099B (LBH),N26°53'03.4''and E088°17'1.1''*,Alt: 1498m±10.1.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Dowhill, Kuresong.

Selaginella subdiaphana (Wallich ex Hooker & Greville) Spring,Bull.Acad.Roy. Sci.Brux. 10:232.1843; Mehra &Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 101.1965; Dixit , A cen. of Indian Pterid.17.1984; Thapa, Pterid. Of Nepal 29.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 523.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:80.2015.

(Plate:3.2)

Lycopodium subdiaphanum wallich ex Hooker & Greville,Hook .Bot.Misc. 2:401. 1831.

Plants herbaceous, lithophytic, light-green, terrestrial, erect; rhizophore arising from lower ¼, pale, 2-4 cm; plants 10-25 cm, light green; branches alternate, 2-3 pairs; leaf dimorphic , ventral leaf ascending, ovate-lanceolate,acroscopic base

auriculate , ciliated at base, dentate at upper half, apex acute, 0.2× 0.1 cm, dorsal leaf ovate, base rounded, serrulate, acuminate, 0.1× 0.1 cm; strobilus quadrangular, 0.5-1.2× 0.1-0.2 cm; sporophyll dimorphic, megasporophyll ovate, acute, 0.1×0.1 cm, microsporophyll ovate, aristate, ciliate. 0.1× 0.05 cm; megaspore brown , warty, spherical, 250-270µm; microspore orange-red, tetrahedral to spherical, 33-37µm.

Exsiccatae : West Bengal, Darjiling hills, Makaibari, 13/12/11, *Nayan Thapa & Dorjay Lama*, 100A(SJCBH), 100B (LBH), N26°33'03.4'' and E088°16'1.1'', Alt: 1151m±11.1.

Global distribution: Bhutan, China, Nepal, India.

Local distribution: Rohini.

Selaginella vaginata Spring, Mem. Acad. Belg. 24(2):87.1850; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 100.1965; Dixit, A cen. of Indian Pterid. 17.1984; Thapa, Pterid. Of Nepal 30.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 523.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:85.2015.

Selaginell imbricate Scott. Journ. Agr. Hort. Soc. India 1:270.1868.

Plants herbaceous, lithophytic, creeping, prostrate; rhizophore arising throughout the stem; stem 5-20 cm, slender, stramineous; branches alternate, branching from the base, 3-5 pairs; leaf dimorphic, lateral leaf perpendicular to the stem, straight, ovate-oblong, ciliate at base, dentate at margin, apex sub acute, 0.4× 0.3 cm, dorsal leaf ovate, dentate, acuminate, 0.3× 0.2 cm; strobilus quadrangular, 0.3-0.6× 0.1-0.3 cm; sporophyll isomorphic, oblong-lanceolate, dentate, sub acute, 0.2× 0.1 cm; megaspore circular to ovoid, dark brown , smooth, 230-260µm; microspore spherical , scarlet, 30-45µm.

Exsiccatae : West Bengal, Darjiling hills, Makaibari, 13/12/11, *Nayan Thapa & Dorjay Lama*, 101A(SJCBH), 101B(LBH), N26°33'02.4'' and E088°16'10.1'', Alt: 1131m±11.1.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Makaibari, Tukvar.

Equisetaceae Richard ex A.p. Candolle in Lamarck et A.P. de Candolle, Fl.Franc.ed 3,2:580.1805.

Linnaeus, Sp. Pl.:1061.1753.

1 Plant less than 3 feet in height, Strobilus stalked...*Equisetum arvense* subsp.*diffusum*

+ Plant more than 3 feet in height, strobilus sessile...*Equisetum ramosissimum*

Equisetum arvense Linnaeus subsp.**diffusum** Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:87.2015.

Equisetum arvense ,Don, Prodr. Fl. Nepal.: 19 .1825.

(Plate:3.4.A,B,C)

Plants lithophytic, terrestrial, erect, herbaceous with perennial underground rhizome; rhizome erect, shining, brown; aerial stems annual, monomorphic, 10-70 cm tall, 0.1-0.4 cm in diam., branched; internodes 1.5-6 cm; Main stem axis with 4-10-ridged; each side of ridge raised and forming edges reaching lower sheath teeth; sheath teeth long, narrow, grayish green in lower portion, blackish brown .in upper portion, with a deep groove going through back of sheath; sheath teeth 5-10, blackish brown, 0.4-0.7 × 0.1-0.4 cm, lanceolate, leathery, caudate at apex, persistent; Lateral branches slender, rigid, 4-8-ridged; sheath teeth 4-6, greyish green, deltoid, leathery, persistent; Strobilus terete, 1-7 × .4-.6 cm, apex blunt; stalk prolonged when mature , 1-1.3 cm. Sporangioophores Ca.0.5-0.6 cm apart, whorled, 7-8, peltate, stalk, 1-.2 cm long; Sporangia 7-9 whorled, dehiscing longitudinally, light brown, ovoid, 300 × 250 μm; Spores spherical, chlorophyllous, 34 -42 μm , with hygroscopic elaters.

Global Distribution: Bhutan, India, Japan, Kashmir, Myanmar, Nepal, Pakistan, Vietnam, China.

Local Distribution: Third mile, Lebong, Singamari, Lava, Algaraha, Deer park.

Exsciccatae : West Bengal, Darjiling hills, Lebong, 15/08/2011, Nayan Thapa & Dorjay Lama, 045A(SJCBH), 045B(LBH), N27°04'13.5'' and E088°16'59.7'', Alt : 1550m ± 11.5

Equisetum ramosissimum Desf., Fl. Atlant. **2**: 398 1800; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 99, 1965; Dixit, A Cen. of Indian Pterid. 198. 1984; Thapa, Pterid. Of Nepal 31. 2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 38-39. 2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 80, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 523. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 89. 2015.

(Plate: 3.4.D,E,F)

Equisetum ramosissimum Desf. subsp. *debile* (Roxb. ex Vaucher) Hauke, Amer. Fern J. **52**: 33 (1962); Dixit: 20 (1984).

Equisetum debile Roxb. ex Vaucher, Mém. Soc. Phys. Hist. Nat. Genève **1**: 387 (1822).

Equisetum ramosissimum Desf. Subsp. *incanum* (Vaucher) Pignatti, Glorn. Bot. Ital. **116** (1-2): 93 (1982 publ. 1983).

Equisetum x wallichianum C.N. Page, Fern Gaz. **11** (1): 25-47 (1974 publ. 1972)

Hippochaete debilis (Roxb. ex Vaucher) Holub, Preslia **44** (2): 122-130 (1972)

Hippochaete ramosissima (Desf.) Börner subsp. *debilis* (Roxb. ex Vaucher) A. Löve & D. Löve, Taxon **26**: 325 (1977)

Plants perennial creeping to erect, medium sized herbs; Rhizome erect, ascending, blackish brown; aerial stem perennial, monomorphic, green, 20-180 × 0.3-0.9 cm tall, lower portion of main stem often branched, tufted; internodes 2-10.5 cm; young whorled branches conspicuous; main stem 5-10-ridged, ridges arc-shaped

abaxially, sheath tubes narrow, up to 1 cm, lower portion grayish green, upper portion usually grayish brown; sheath teeth 5-20, greyish white, membranous, persistent. Lateral branches hard, terete, 5-12-ridged; ridge; sheath teeth 5-10, upper portion brown, lanceolate, leathery but membranous at margin, usually persistent; Strobilus sessile, terminal on branch, 0.5-2.5 cm × 0.4-0.7 cm, oblong, apiculate. Spores spherical, chlorophyllous, 90-120µm, with strap to form elaters.

Global Distribution: Nepal, Myanmar, Thailand, China, Taiwan, India.

Local Distribution: Rungdung, Balason, Mangwa, Kalijhora.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 05/07/2011, Nayan Thapa & Dorjay Lama, 011A (SJCBH), 011B(LBH), N27°01'16'' and E088°16'24.5'', Alt: 1455±13.1m

Ophioglossaceae (Br.) Agardh, Aphor. Bot. 8: 113, 1822.

- | | |
|--|--|
| 1. | Lamina |
| simple, 1.5-7 × 1.2-3 cm..... | Ophioglossum |
| + Lamina pinnate, 4-30 × 2-24 cm..... | Botrychium |
| Botrychium Swartz, J. Bot. (Schrader). 1800(2): 8, 110. 1801. | |
| 1. Plant less than 10 cm in height..... | <i>Botrychium dussenii</i> |
| + Plant more than 10 cm in height..... | 2 |
| 2. Common stalk 1- 4 cm in length..... | 3 |
| + Common Stalk more than 5 cm in length..... | 4 |
| 3. Ultimate pinnule acute..... | <i>Botrychium ternatum</i> |
| + Ultimate pinnule rounded..... | <i>Botrychium multifidum</i>
<i>subsp. robustum</i> |
| 4. Fertile spike arising above the second pinnae..... | <i>Botrychium langunisoum</i> . |

+ Fertile spike arising below the sterile lamina..... *Botrychium daucifolium*.

Botrychium daucifolium Wallich *ex* Hooker & Grev, Ic, Fil.: t.161 1829; Beddome, Handb. Ferns Brit. India (with Supl), 469, 1892; Dixit, A Cen. of Indian Pterid 21 .1984; Thapa, Pterid. Of Nepal 32. 2002;Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 526.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:92.2015.

Sceptridium daucifolium (Wallich *ex* Hooker & Greville) Lylon, Bot. Gaz. **40**: 457 (1905); Ghosh,The Pterid. Flo. Of East.Ind,I, 38-39,2004.

Botrychium subcarnosum Wallich *ex* Hooker & Grev, Hooker Bot. Misc. **3**: 222 (1883).

Botrychium subcarnosum Wall, List no. 49 (1829), *nom. nud.*

Plant lithophytic, terrestrial, erect; rhizomes erect, cylindrical, bearing fleshy roots; Frond 27–50 cm; stipe, 12–20 × 0.3–0.5 cm, greenish, fleshy, hairy; Sterile lamina glabrous, tripinnatifid, subpentagonal, 15–30 × 16–24 cm, herbaceous; pinnae 6–7 pairs, alternate, shortly stalked; basal pinnae largest, triangular, 7–12 × 4–8 cm; Pinnules 4 or 5 pairs, narrowly ovate to broadly lanceolate, lower basal pinnule largest, up to 2–3 × 1–1.5 cm, ultimate segments sharply serrate, apex acute, rachis and costae with sparse, white, long hairs; Sporophore arising from the middle of common stipe, as long as sterile lamina, with stalk 14–16 cm, bi-tripinnate, with long soft hairs; Sporangia globose, shortly stalked, 0.5–1 cm in diam.; Spore yellowish, Spherical, smooth, 30–35 μm.

Exsiccatae : West Bengal, Darjiling hills, Mirik, 12/07/1, *Nayan Thapa & Dorjay Lama*, 023A (SJCBH), 023 B(LBH), N26°54'1.23" and E088°10' 2.31" Alt : 1436m ± 15

Global Distribution: Bhutan, India, Indonesia (Sumatra), Myanmar, Nepal,

Philippines, Sri Lanka, Vietnam.

Local Distribution: Mirik, Mungpoo, Mangwa, Relli.

Botrychium lunaria (Linnaeus) Swartz, Schrad. J. Bot. 1800 (2): 110 .1801;
Bedd., Handb. Ferns Brit. India (with Supl), 469, f. 293, 1883.

Osmunda lunaria L, Sp. Pl. **2**: 1004 (1753).

Botrychium dusenii Alston, Lilloa 30:107.1960.

Plant small, terrestrial, erect; rhizomes short, erect; 5–15 cm tall; Common stipe greenish, cylindrical, 4–12 × 0.2–0.3 cm, hollow; Sterile lamina pinnate, sessile, oblong, 3–8 × 1.5–2.5 cm, fleshy, leathery, glabrous, apex rounded or blunt; pinnae 4–6 pairs, approximate, opposite, flabellate (fan-shaped), lunate, 1–1.5 × 0.2–0.4 cm, shortly stalked to almost sessile, margin entire, veins free, flabellately forked, glabrous; Sporophore with stalk 4–7 cm, glabrous, panicle 2- 3-pinnate, 3–6 × 1.5–2 cm; sporangia sessile, large, 0.5–1 cm in diam.; Spores spherical, yellowish, surface verrucose, 20–25 μm.

Exsiccatae : West Bengal, Darjiling hills, Sandhakphu, 24/06/2013, *Nayan Thapa & Dorjay Lama*, 142A(SJCBH), 014252(LBH), N27°07'41.4' and E087°59'29.5', Alt : 3521 m ± 11.

Global Distribution: Asia, Australia, Europe, North America, Pacific islands.

Local distribution: Sandhakphu, Phalut

Botrychium multifidum (Gmel) Rupr subsp. **robustum** Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:159.2015.

Osmunda multifida Gmel, Nov. Comm. Acad. Sci. Pterid. **12**:517, t.11 .1768.

Sceptridium multifidum (Gmel) Nishida ex Tagawa, J. Jap. Bot. **33**: 200 .1958.

Sceptridium robustum (Rupr.) Lyon, Bot. Gaz. **40**: 458 .1905;

Plants lithophytic, terrestrial; rhizomes erect, cylindrical; Fronds 35–40 cm tall; Sterile lamina stalk 2–7 × 0.5–1 cm, fleshy; lamina bi- or tripinnatifid, dull green, pentagonal, 6–11 × 7–11 cm; pinnae 4–6 pairs, sub-opposite, lower ones stalked; basal pinnae largest, ovate to triangular, 4–6 × 2.5–4.5 cm, bipinnate to tripinnatifid;

pinnules 3 - 4 pairs, narrowly oblong - lanceolate, lower basal pinnule longest, 2.5–4 × 1.5–2 cm; ultimate segments oblong, margin dentate; costae and costules beneath sparsely lanuginose, lateral veins obscure; Sporophore arising from middle or lower part of common stipe, with longer stalk, 10–25 cm, bi-tripinnate, sporangia ellipsoid-globose, in ultimate branches of panicle; Spore creamish, spherical - ellipsoidal, 28–33 μm.

Exsiccatae : West Bengal, Darjiling hills, Gayribas, Date 13/07/13, *Nayan Thapa & Dorjay Lama, 174 A (SJCBH), 174 B (LBH)*, N27°03'31.7'' and E088°01'25'', Alt: 2501 m ± 15

Global Distribution: Japan, Korea, Russia, India, Nepal, Bhutan.

Local Distribution: Gayribas, Alubari, Phalut.

Botrychium ternatum (Thunberg) Swartz, *Scrad. J. Bot.* **1800** (2), 111. 1801; Beddome, *Handb. Ferns Brit. India* (with Supl), 110. 1892; Dixit, *A Cen. of Indian Pterid.* 22. 1984; Thapa, *Pterid. of Nepal* 33. 2002; Fraser-Jenkins, *Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List* 526. 2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and fern-allies of Nepal I*: 198. 2015.

Osmunda ternate Thunberg, *Fl. Jap.*: 329, t. 32. 1784.

Sceptridium ternatum (Thunberg) Lyon, *Bot. Gaz.* **40**, 458. 1905.

Plants terrestrial, lithophytic, erect, small; rhizomes erect, short, annually producing single frond; 15–25 cm; Sterile lamina stalk 5–12 × 0.2–0.4 cm; ternate, dull green, sub pentagonal, 5–10 × 8–12 cm, herbaceous, glabrous, apex acute; pinnae sub-deltoid, basal ones stalked; segments broadly elliptic, sparsely crenate, apex acute; veins pinnate, free; Sporophore arising 2–4 cm above base of common stipe, 3 pinnate, stalk 12–25 cm; sporangia globose, 0.5–0.7 cm; Spore yellowish, tetrahedral, 33 × 30 μm.

Exsiccatae : West Bengal, Darjiling hills, Mungpoo, 02/08/13, *Nayan Thapa & Dorjay Lama, 190A (SJCBH), 190B (LBH)*, N27°00'27'' and E088°17'33'',

Alt: 1950 ± 12.

Global Distribution: India, Japan, Korea, Nepal, and Vietnam, China.

Local distribution: Mungpoo, Kafer, Deer Park.

Botrychium lanuginosum Wallich ex Hooker & Greville ,Ic.Fil.:1, t.29. 1831; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 102.1965; Thapa, Pterid. of Nepal 32.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 526.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:93.2015.

Botrychium lanuginosum Wallich ex Hooker & Greville *var nepalensis* (Nishida) N.C . Nair & R.D .Dixit, J.Bomb.Nat.Hist.Soc.78(3):447.1981.

Botrypus lanuginosum (Wallich ex Hooker & Greville) Holub *var. nepalensis* (Nishida) S.R. Ghosh, J.Econ. Taxon. BOt.5(1):246.1984.

(Plate 3.7:G,H,I)

Plant terrestrial, medium sized; rhizomes short , erect; Stipes stramineous , 12–30 × 0.3 –0.6 cm, fleshy, hairy; hair white, long, 0.5-1 cm; Sterile lamina 3-4 pinnate, deltoid to sub-pentagonal, 14–45 × 5–25 cm, thin, herbaceous, pubescent; Pinnae 5–8 pairs, alternate, long stalked, 2–6 cm apart, lowest pair largest, 7–20 × 5–10 cm; Pinnules 6–10 pairs, alternate, stalked, basiscopic pinnules larger than acroscopic ones, basal pinnule largest; ultimate lobes acute ; veins free, simple or forked; Sporophore with stalk 2–10 cm, 3 pinnate, hairy, arising between the lowest two pairs of pinnae of sterile lamina; Sporangia globose, brown ,in two rows, on ultimate branches of panicles; Spore, yellowish to pale green, spherical to tetrahedral, 34 × 30 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/11, *Nayan Thapa & Dorjay Lama 024A(SJCBH), 024B(LBH), N27°00'31.7'' and E088°17'37.4''*, Alt: 2154 ± 15.

Global Distribution: Sri Lanka, Bhutan, India, Indonesia, Nepal, Philippines, Sri Lanka, Taiwan.

Local Distribution: Mangwa, Chitrey, Pandam, Alu Bari, Makaibari, Third Mile

Ophioglossum Linnaeus, Sp. Pl. 2: 1062. 1753.

Ophioglossum reticulatum Linnaeus, Sp. Pl. 2: 1063 (1753); Beddome, Ferns Sout. India 23, t.70 .1863; Thapa, Pterid. of Nepal 34.2002; Ghosh., The Pter. Flo. Of East. Ind. I :154.2004; Fraser-Jenkins., Tax. Revi. Of Three Hundred Ind.

Subcon. Pterid. With a revi. Cen. List 527.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:104.2015.

Ophioglossum cordifolium Roxburgh in Griffith, Calc. J. Nat. Hist. 4: 475 .1844.

(Plate 3.7:E,F)

Plants perennial, herbaceous, 10–15 cm tall; rhizomes erect, slender, bearing thick fleshy roots; aerial portion annual, sterile leaf 1-2 per plant, cordate-lanceolate, medially wider, narrower apex, apex acute, margin entire, costa not very prominent; Leaves silvery green-green in color, 1.5-7 × 1.2-3 cm, sessile, peduncle sheathed; stipe cylindrical, 4.2-6 × 0.1-0.2 cm wide; veins reticulate, anastomosing, branched with included veinlets; Fertile segment arising from the base of sterile blade, vertical at right angle to lamina; Peduncle green, rounded in shape, 4.0-6 × 0.1-0.3, bearing 1.7-2.7 × 0.2-0.4 cm broad spike; Sporangia laterally paired, 19-42 per spike; Spores spherical to tetrahedral, 35×30µm, pale-yellowish, trilete, tuberculate.

Exsiccatae : West Bengal, Darjiling hills, Mungpoo, 02/08/13, *Nayan Thapa & Dorjay Lama*, 191A(SJCBH), 191B(LBH), N27°00'27'' and E088°17'33'', Alt: 1950±12.

Global Distribution: Korea, Africa, Madagascar, South America, India, Nepal, Bhutan.

Local distribution: Mungpoo, Shrubbery Park, Murdahatti, Sanchel.

Marattiaceae Bercht & Presl, Prirozen-Rostl. 1:270.1820.

Angiopteris Hoffmann, Commentat. Soc. Regiae Sci. Gott. 12(Cl. Phys.): 29. 1796.

Angiopteris helferiana Presl, Suppl. Tent. Pterid. 22. 1845; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 25.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal 1:105 .2015.

Plants lithophyte, terrestrial, erect; caudex stout, erect; Frond bi-pinnate, 200-300 × 50-70 cm; stipe 50-120 cm, green, glabrous; lamina ovate-lanceolate, shining

green, 150- 180 × 60-90 cm; pinnae base swollen, articulated, alternate, lanceolate, 30-45 × 20-30 cm; pinnules alternate, 15-20 pairs, lanceolate, margin serrate, acuminate, 10-15 × 2-3 cm; veins distinct, forked, false vein present; sori inframarginal, along the veins, brown; sporangium globose, brown, 200-210 μm; spore globose, smooth, brown, 24-27 μm.

Exciccatae : West Bengal, Darjiling hills, Mangwa, 03/04/12, *Nayan Thapa & Dorjay Lama*, 113A(SJCBH), 113B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: Bhutan, India, Myanmar, Nepal.

Local distribution: Mangwa, Takdah, Mungpoo

Osmundaceae Martinov, Tekhno-Bot. Slovar. 445. 1820.

Osmunda Linnaeus, Sp. Pl. 2: 1063. 1753.

Osmunda claytoniana Linnaeus subsp. **vestita** (Wallich ex Milde) Löve & Löve, Taxon **26** (2-3): 324 .1977; Thapa, Pterid. of Nepal 35.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 528.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:110.2015.

Osmunda claytoniana Linnaeus var. *vestita* Wallich ex Milde, Monogr. Gen. Osmund.: 102 (1868),

Osmunda claytoniana Linnaeus, Sp. Pl. **2**: 1066 1753; Beddom., Handb. Ferns Brit. India (with Supl), 469, f. 293. 1883; Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 104 .1964.

Osmunda claytoniana Linnaeus subsp. *pilosa* (Wallich ex Hooker & Greville) Fraser-Jenkins, Pakistan Syst. **5** (1-2): 85-120 .1992.

(Plate 3.7:A,B,C,D)

Plant terrestrial, perennial, herbaceous; rhizome ascending, short; aerial portion annual, fronds sub-dimorphic stipe stramineous, shorter than lamina, 10-15 × 0.4-0.8 cm, pubescent; lamina lanceolate, pinnate, 30-40 × 10-20 cm, round to obtuse; pinnae 15-30 pairs, fertile pinnae 5-7 pairs, in lower middle portion of lamina; sterile pinnae linear-lanceolate, 10-15 × 2-3 cm; ultimate segments entire, naked at margin, or with grayish white to grayish brown hairs when young, apex rounded; fertile pinnae ca. 1/3 length of sterile ones, 0.4-0.6 cm wide, covered throughout with sporangia, globose, 310-325µm, greenish turning blackish brown; Spores dark green, elliptic, tuberculate, 40-45µm

Exsiccatae : West Bengal, Darjiling hills, Meghma, 22/07/13, *Nayan Thapa & Dorjay Lama*, 173A(SJCBH), 173B(LBH), N27°01'30'' and E088°05'47.2'', Alt: 2901m±12.

Global Distribution: Korea, India, Nepal, Bhutan, Russia, North America.

Local distribution: Meghma, Tiger hill, Ghoom, Alu bari.

Plagiogyriaceae Bower, Ann. Bot. 40:484.1926.

Plagiogyria (Kunze) Mettenius, Abh. Senckenberg. Naturf. Ges. 2: 265. 1858.

Plagiogyria pycnophylla (Kunze) Mettenius, Farngatt. II: 272. 1858; Beddome, Handb. Ferns Brit. India (with Suppl.) 129. 1892; Dixit, A Cen. Of Indian Pterid. 27. 1984; Thapa, Pterid. of Nepal 35. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 529. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 112. 2015

Lomaria pycnophylla Kunze, Bot. Zeit. (Berlin) 6: 143. 1848

Plagiogyria communis Ching, Acta Phytotax. Sin. 7: 122, 147, t.35, f.2. 1958.

Plant terrestrial, herbaceous; rhizome erect, hard; Stipes 10-30 cm in sterile fronds, 10-40 cm in fertile fronds, stipes and rachis glabrous to hairy; aerophores elongate, hornlike, apex blunt; Sterile lamina pinnate, 20-80 × 6-45 cm, with an pinna like apical segment; rachis abaxially flattened; pinnae 20-30 pairs; proximal pinnae sessile to shortly stalked, base truncate to rounded; middle pinnae sessile, lower 2-4 pairs of pinnae reduced, veins simple or sometimes 1-forked; Fertile lamina pinnate, narrow, linear with revolute margins, 10-45 × 4-16 cm; sori covering complete under surface of fertile pinnae; sporangium globose, 210-250µm; spores tetrahedral, smooth, trilete, 27-35µm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/11, *Nayan Thapa & Dorjay Lama*, 017A (SJCBH), 017B(LBH), N27°00'31.7'' and E088°17'37.4'', Alt : 2154m ± 15.

Global distribution: Bhutan, N India, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Philippines.

Local Distribution: Third mile, Senchel, Chimney, Lava, Alubari, Meghma, Gayribas.

Lygodiaceae C.Presl, Suppl. Tent. Pterid. 98. 1845.

Lygodium Swartz, J. Bot. (Schrader) 1800(2): 7, 106. 1801 (nom. cons.).

1. Fertile segment contracted than sterile segment.....*Lygodium japonicum*
+. Fertile segment of the same size as sterile segment.....*Lygodium flexuosum*

Lygodium flexuosum (Linnaeus) Swartz, Schrad. J. Bot. **1800** (2): 106 (1801); Beddome, Handb. Ferns Brit. India (with Suppl.), 457, t. 283. 1892; Dixit, A Cen. Of Indian Pterid. 60. 1984; Mehra, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 104. 1964; Thapa, Pterid. of Nepal 60. 2002; Ghosh, The Pterid. Flo. Of East. Ind I: 221. 2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Indian Subcon. Pterid. With a rev. Cen. List 530. 2008.

Ophioglossum flexuosum L, Sp. Pl. **2**: 1663 (1753).

Plant terrestrial, twining climber; rhizome shortly creeping, densely covered with roots; fronds 200-350 × 20-40 cm with several pairs of primary rachis terminating in a dormant apex, ca. 0.3 cm and primary rachis branched into pair of secondary rachis branch, 5-12 cm, Secondary rachis branched, branch pinna, palmatiset, finger like lobes, palmately 3-7-lobed, proximal lobe longest 3-7 × 1-3 cm, lateral lobes smaller, 1-3 × 0.5- 1.5 cm, base of pinna cordate, margins serrate; sporophores 0.3-0.5 × 0.1-0.3 cm; sporangium globose, 360-380 μm; spores tetrahedral, trilete, light brown, 35-43 μm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 23/05/2013, *Nayan Thapa & Dorjay Lama*, 131A (SJCBH), 131B(LBH), N27° 04'35 and E088° 25'26'', Alt : 366m ± 19.6

Global distribution: Nepal, Philippines, Sri Lanka, Thailand, Vietnam; Australia, Bhutan, India, Japan, Malaysia.

Local distribution: Teesta, Majitar, Singla, Glenburn.

Lygodium japonicum(Thunberg in Murray) Swartz, Schrad. J. Bot. **1800** (2): 106. 1801; Beddome, Handb.Ferns Brit. India(with Suppl.) 457 .1892; Mehra, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 104.1964;Dixit, A Cen. Of Indian Pterid. 60.984; Thapa, Pterid. of Nepal 60.2002; Ghosh,The Pterid. Flo. Of East.Ind I: 221,2004; Fraser-Jenkins,Tax. Revi. Of Three Hundred Indian Subcon. Pterid. With a revi. Cen. List, 530,2008.

Ophioglossum japonicum Thunb. in A.Murray. Linnaeus Syst. Veg. ed.14: 926 (1784).

(Figure 3.21: A to C)

Plant terrestrial, climber; rhizome creeping, dichotomously branched, clothed with dark brown hairs; Fronds 200-250× 20-40 cm, rachis ca. 0.2cm,dorsal surface pubescent; sterile fronds tri-pinnate, fertile fronds quadripinnate;primary rachis 0.6-0.8 × 0.1-0.3 cm, pubescent; secondary branches 10-25 × 0.1-0.3 cm; articulation of rachis absent; lamina pubescent, midvein and veins pubescent below; ultimate pinnules auricled, deltoid lanceolate; sporophores 0.7-1× 0.1-0.3 cm,brownish; sporangia 4-7 solitary,globose,300-400µm; spores tetrahedral, light brown,colliculate,96-100µm.

Exsiccatae : West Bengal,Darjiling hills, Teesta,07/08/2013, *Nayan Thapa & Dorjay Lama, 192A (SJCBH), 192B(LBH), N27°03'35and E088°25'10''*,Alt :354m ± 14

Global Distribution: Vietnam ,Japan ,Bhutan, India, Indonesia ,Korea , Nepal, Philippines, Sri Lanka; tropical Australia, North America.

Local Distribution: Teesta,Majitar,Singla,Gourbathan.

Gleicheniaceae Presl, Rel.Haenk 1(1):70.1825.

1. Plant stragglng ,fronds 200-500 cm in height..... **Diplopterygium**

+ Plants scrambler, fronds around 100 cm in height.....**Dicranopteris**

Dicranopteris Bernahardi, Schrad. Neu.J.Bot.1(2):38.1905.

1. Dichotomy and apical buds pubescent.....*Dicranopteris lanigera*

+ Dichotomy and apical buds glabrous.....2

2. Presence of deflexed segment at each dichotomous branching
.....*Dicranopteris splendida*

+ Presence of deflexed pinna at each dichotomous
branching.....*Dicranopteris taiwanensis*

Dicranopteris splendida (Hand-Mazz.) Tagawa, Acta Phytotax. Geobot. 8: 164. 1939; Thapa, Pterid. of Nepal 36.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 532.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:128 .2015.

Gleichenia splendida Hand.-Mazz, Akad. Anz. Akad. Wein **19**: 81 .1924.

Dicranopteris ampla Ching & Chiu in Ching & Wang, Acta Phytotax. Sin.**8**: 161 .1959.

Plants terrestrial, scrambler, upto 70- 100 cm tall; rhizome creeping, pubescent, hairs brown, ca. 0.3 cm; Stipe brown, cylindrical, 20– 30 × 0.2-0.4 cm, glabrous; rachis 1-3 times dichotomously branched, apical bud ovate, glabrous; rachis brown, smooth, glabrous; each dichotomy of a rachis bears a deflexed segment, linear-lanceolate, 3-7 × 0.8- 1 cm, ultimate pinnae linear-lanceolate, 15–35 × 5–10 cm, apex attenuate; segment 30–45 on each side, lanceolate, 3-4 × 0.8-1 cm, margin entire, apex obtuse; lamina papery, glaucous abaxially, dark green adaxially, glabrous; costae prominent; veins free, forked; Sori dark brown, scattered; sporangia globose, 200-220 µm; spores hyaline, spherical, 33-37µm.

Exsiccatae : West Bengal, Darjiling hills, Dhotrey, 30/06/13, Nayan Thapa & Dorjay Lama, 145A (SJCBH), 145B(LBH), N26⁰ 59' 12.9 and E088⁰ 14' 46.7'', Alt : 1872m ± 12

Global distribution: Myanmar, Thailand, Nepal, India.

Local Distribution: Sukhia, Pasupathi fatak, Takdah.

Dicranopteris taiwanensis Ching & Chui. in Chien & Chun, Fl. Reip. Pop. Sin. **2**: 346 (1959); Thapa, Pterid. Of Nepal 36.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 532.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:128.2015.

Dicranopteris linearis var. *montana* Holttum, Reinw. **4**: 276 .1957.

Plant terrestrial, scrambler, up to 90-100 cm tall; rhizomes creeping, 0.3-0.6 cm in diam.; Stipe dark brown, 30-40 × 0.2-0.4 cm, glabrous; rachis 2 or more times dichotomously branched; apical buds ovate, small; rachis with a first pair of deflexed lateral pinnae at each dichotomy, broadly lanceolate, 7-9 × 3-4 cm, base and apex attenuate; second pair smaller, 3-5 × 0.5-1.5 cm; ultimate pinnae oblong-lanceolate, 15-25 × 4-7 cm, base attenuate, apex acuminate; segments 25-30 on each side, linear-lanceolate, 3-3.5 × 0.4-0.6 cm, margin entire, apex obtuse, papery, glabrous; costae prominent on both surface, veins forked, free; Sori brown, spherical, arranged in single line on each side of the costule; sporangia globose, golden-brown, 180-190 µm, spores light brown, spherical, 29-32 µm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 11/07/11, *Nayan Thapa & Dorjay Lama, 16A (SJCBH), 16B(LBH), N27°04'13.5'' and E088°15'59.7.7''*, Alt :1659m ± 11.5

Global distribution: China, Taiwan, Nepal, India, Bhutan.

Local distribution: Lebong, Third Mile, Algarah, Payow, Dilaram.

Dicranopteris lanigera (D. Don) Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 35.2008; ; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:125.2015.

Gleichenia lanigera D. Don, *Prodr. Flor. Nepal.*:17.1824.

Plant terrestrial, scrambler, 80-90 cm tall; rhizomes creeping, 0.3-0.6 cm in diam.; Stipe stramineous, 25-35 × 0.2-0.4 cm, glabrous; rachis 2 or more times dichotomously branched; apical buds ovate, small, pubescent; rachis with a first pair of pinnae at each dichotomy, lanceolate, 5-7 × 1.5-3 cm, base and apex attenuate, apex acuminate; segments 25-33 on each side, linear-lanceolate, 1-1.5 × 0.2-0.4 cm, margin entire, apex obtuse, papery, glabrous; costae prominent on both surface, veins forked, free; Sori brown, spherical, arranged in single line on each side of the costule; sporangia globose, golden-brown, 140-160 μm, spores light brown, spherical, 26-28 μm.

Exsiccatae : West Bengal, Darjiling hills, Rohini, 03/04/12, *Nayan Thapa & Dorjay Lama*, 108A (SJCBH), 108B(LBH), N26°54'10.5'' and E088°20'33.5'', Alt : 850m ± 11.5

Global distribution: China, Taiwan, Nepal, India, Bhutan.

Local distribution: Lebung, Third Mile, Algarah, Payow, Dilaram.

Diplopterygium (Diels) Nakai, Bull. Natl. Sci. Mus., Tokyo. 29: 47. 1950.

Diplopterygium giganteum (Wallich ex Hooker & Bauer) Nakai, Bull. Natl. Sci. Mus., Tokyo. 29: 50. 1950; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 130. 2015.

Gleichenia gigantea Wallich ex Hooker & Bauer, Gen. Fil. t. 39. 1840.

Dicranopteris gigantea Ching, Fl. Reipubl. Popularis Sin. 2: 346. 1959.

Diplopterygium giganteum (Wallich ex Hooker & Bauer) Nakai, Bull. Natn. Sci. Mus. Tokyo 29: 50. 1950.

Plants terrestrial, straggling, 300-350 cm tall; Rhizomes thin, long creeping. Stipes dark brown, smooth, cylindrical, 100-150 × 0.3-0.9 cm, branches to produce two primary rachis and axillary bud, further dichotomous branching for 2 - 3 times; axillary buds ovate, ca 0.2 cm, covered with dense brown hairs; rachis branches

100-150 × 0.2-0.4 cm, bi-pinnatifid, lateral pinnae 23-30 pairs, 25-30 × 1.5-3 cm; ultimate segment, 0.7-1.5 × 0.4-1 cm, oblong-lanceolate, obtuse, hairy on undersurface, veins once forked; sori in single line on each side of costule, medial region, naked with 2-5 sporangia, sporangia globose, golden-brown, 190-200 μm; spore tetrahedral, smooth, grayish, 16-20 μm.

Exsiccatae : West Bengal, Darjiling hills, Chatakpur, 20/10/11, *Nayan Thapa & Dorjay Lama*, 082A (SJCBH), 082B (LBH), N27° 00'35'' and E088°17'15'', Alt : 2121m ± 13.5

Global distribution: Nepal, Bhutan, China, Myanmar, Vietnam, Thailand.

Local distribution: Takdah, Lava, Lebong, Kuresong, Sonada, Algarah.

Hymenophyllaceae Link, Handb. Z. Erken. d. Gewachse 3:36.1833.

1. Sori tubular, 0.6-0.8 × 0.2 cm..... **Trichomanes**

+. Sori bi-valved, 0.3-0.4 × 0.1-0.2 cm..... **Hymenophyllum**

Trichomanes Linnaeus, Sp. Pl. 2: 1097. 1753 (*nom. cons.*).

Trichomanes auriculatum Blume, Enum. Pl. Javae 2:225.1828; Copel. In Philip. Journ. Sci. 5(2).1933; Ghosh, The Pterid. Flo. Of East. Ind. 1:245.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 552.2008.

Trichomanes disactum J. Smith in J. Bot. 3:417.1841.

Lacostea auriculata (Bl.) Prantl, Hymen. 50.1875.

Plants lithophytic; rhizome long, creeping, hairy; hairs blackish-brown, Ca. 0.3 cm long, septate, tip blunt; fronds monomorphic, 24-35 × 6-8 cm, bi-pinnate, oblong-lanceolate; stipe 1.5-2 cm, green, winged, hairy; lamina green, 22-30 × 6-8 cm; pinnae 2-4 × 1-2 cm, staked, widest at base, oblique, cuneate, acute, toothed; veins distinct, forked; sori tubular, receptacle protruding, 0.6-0.8 × 0.2 cm; sporangium sessile, globose, 300-310 μm; spore tetrahedral, smooth, hyaline, 30-40 μm.

Exsiccatae : West Bengal,Darjiling hills, Lebong ,13/09/13, *Nayan Thapa & Dorjay Lama*, 198A(SJCBH), 198B (LBH),N27°04'13.4''and E088°16'59.2'',Alt: 1659m±11.1.

Global Distribution:Bhutan, Cambodia, China,India, Japan, Laos, Myanmar, Nepal, Thailand; Pacific islands .

Local Distribution: Singamari,Lebong ,Ging.

Hymenophyllum Smith, Mém. Acad. Roy. Sci. (Turin) 5: 418, t. 9. 1793.

- 1. Pinnae 6-10 pairs 2
- + Pinnae 4-6 pairs..... *Hymenophyllum tenellum*
- 2. Fronds 5-15 × 2-4 cm *Hymenophyllum exertum*
- + Fronds 16-20 × 4-8 cm*Hymenophyllum badium*

Hymenophyllum badium Hooker & Greville, Ic. Fil.: t. 76, 1828; Beddome, Ferns Brit. Ind. t. 282, 1868; Thapa, Pterid. Of Nepal 58, 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 551, 2008.

Hymenophyllum javanicum Spring var. *badium* (Hooker & Greville) Clarke, Trans. Linn. Soc. Lond. II Bot. 1: 438, 1880.

Mecodium badium (Hooker & Greville) Copel., Philip. J. Sci. 67, 23, 1938.

Plants epiphytic to lithophytic; rhizome creeping, wide, hairy; hairs articulate, brown, Ca. 0.1 cm in diameter; fronds monomorphic, oblong-lanceolate, pinnate, 16-20 × 4-8 cm; stipe 4-6 cm, castaneous; lamina 9-15 × 4-8 cm, pinnae alternate, sessile, 6-8 pairs, 2-4 × 1-2 cm, acuminate, ovate-lanceolate; pinnules 2-5, oblique, sessile, truncate, 0.8-1 × 0.1-0.3 cm, costules winged, crisped; veins distinct, simple, one in each lobe; sori terminal, bivalved, reniform, 0.3 × 0.1 cm; sporangium globose, hyaline, 460-610 μm; spore tetrahedral, hyaline, spinose, 56-66 μm.

Exsiccatae : West Bengal,Darjiling hills, Lebong ,17/09/13, *Nayan Thapa & Dorjay Lama*, 210A(SJCBH), 210B (LBH),N27°04'13.4''and E088°16'59.2'',Alt: 1659m±11.1.

Local Distribution: Lebong,Third mile,chatakpur,alubari

Global distribution: Bhutan, India, Japan, Malaysia, Nepal, Sri Lanka, Vietnam.

Hymenophyllum exsertum Wallich *ex* Hooker, Sp. Fil. 1: 109, t.38a .1844; Beddome, Ferns S.Ind.9,1863; Clarke, Trans.Linn. Soc.ser.2. Bot. 1:438. 1880; Thapa, Pteridophytes of Nepal 58.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 551,2008.

Mecodium exsertum (Wallich *ex* Hooker) Copel., Philip. J. Sci. **67**: 23 .1938.

Hymenophyllum densum WallichCat.n.170.1828.

(Plate 3.8: A to F)

Plants epiphytic to lithophytic; rhizome creeping,long,hairy;hairs 1-3 celled, brown; fronds monomorphic, distant on rhizome,5-15 × 2-4 cm; stipe brown, hairy,wingless,1-2 cm; lamina bipinnate, oblong ,green, membranous; pinnae 6-10 pairs, sessile,ovate-oblong,4-13 × 2-4 cm, decurrent, obtuse; veins distinct, dichotomously branched; sori towards apex of lamina, bi-valved, entire; receptacle small, not protruding, 0.4× 0.2 cm; sporangium, greenish, globose, 250-300µm; spore hyaline-greenish, reniform, papillose, 100×40µm.

Exsiccatae : West Bengal,Darjiling hills, Third mile,01/10/11, *Nayan Thapa & Dorjay Lama*, 075A(SJCBH), 075B (LBH),N27°00'31.4''and E088°17'37.2'',Alt: 2154m±15.2

Global Distribution: Bhutan, Cambodia, India, Laos, Malaysia, Thailand, Vietnam.

Local Distribution:Third milee, Chaudafera,chimney, tonglu.

Hymenophyllum tenellum D.Don.Nepal,Prod.Fl.Nepal.:12,1825; Morton in Contrib. U.S.Nation.Herb.38(6),1973; Fraser-Jenkins.,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 552,2008.

Hymenophyllum polyanthus (Swartz)Sw.,Schrad.J.Bot.(2).1800.

Trichomanes polyanthus Swartz,Prodr.Fl.Ind.Occ.:137.1788.

Plants epiphytic to lithophytic; rhizome thin, creeping, hairy; hairs articulate, brownish; fronds pinnate, 14-18 × 2-4 cm; stipe slender,brown,winged,4-6 cm; lamina 10-12 × 2-4 cm, lanceolate, dark green; pinnae 4-6 pairs,alternate,basal one largest, sessile, oblong, entire, acute, costae prominent, hairy on both surface, 2-4 × 1-1.5 cm; sori bi-valved, toward the apex of lamina, valves entire, 0.3× 0.1 cm, receptacle small, inserted; sporangium globose, hyaline, 460-600µm,spore lunar, -green, papillose, 56-60× 64-70µm.

Exsiccatae : West Bengal,Darjiling hills, Lebong ,17/09/13, *Nayan Thapa & Dorjay Lama*, 207A(SJCBH), 207B (LBH),N27°04'13.4''and E088°16'59.2'',Alt: 1659m±11.1.

Global distribution:Bhutan,China,India,Nepal,Thailand, Taiwan.

Local Distribution: Lebong,Mungpoo.

Cyatheaceae Kaulf, Wesen Farrenkr. 119. 1827.

Cyathea Smith, Mém. Acad. Roy. Sci. (Turin) 5: 416. 1793.

- 1. Scales present on costules, 0.4× 0.3 cm..... *Cyathea brunoniana*
- + Scales absent on costules, glabrous..... *Cyathea spinulosa*

Cyathea spinulosa Wallich ex Hooker, Sp. Fil. 1: 25. 1844; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 124.1965; Dixit , A Cen. of Indian Pterid. 94 .1984; Thapa, Pterid. of Nepal 60.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 557.2008; Fraser-Jenkis, Kandel & Pariyar, Fern & fern Allies of Nepal I:157.2015.

Alsophila spinulosa (Wallich ex Hooker) R. M. Tryon, Contr. Gray Herb. 200: 32. 1970.

Hemitelia decipens (Scott ex Bedd.) Scott in Trans.Linn.Soc.Bot.30:33.t.14,1874.

Plant terrestrial ;trunk 200 - 250 × 25-40 cm, spiny, paleaceous; spine hook shaped, 1-1.5 × 0.2-0.5 cm; palea basifixed, linear , toothed,brown,2-3 × 0.2-0.4 cm;frond 90-160 × 100-130 cm,ovate lanceolate, forming a crown, pinnate ;stipe 30-50 × 2-3 cm,spiney,spines 0.8-1 × 0.1-0.3 cm,purplish; lamina oblong, 40-50 × 14-18 cm; pinnules 16-19 pairs, base cuneate ,sessile, basal pinnules shorter, middle ones lanceolate, 6-10 × 1-3 cm, acuminate , caudate; segments 18-20 pairs, ascending, basal segments shorter,1-2 × 0.6-0.8 c, dentate, scaly abaxially, apex acute; venation distinct, pinnate; sori globose ,brown, indusium half cup shaped;sporangium globose, golden brown,300-310 μm; spore trilete, light brown,43 -47 × 48-50 μm.

Exsiccatae : West Bengal,Darjiling hills, Mirik,18/11/11, *Nayan Thapa & Dorjay Lama*, 098A(SJCBH), 098B (LBH),N26° and E088° 08'30.9'',Alt: 1970m±12.8.

Global distribution: Bangladesh, Bhutan, India, china, Japan, Myanmar, Nepal, Sri Lanka, Thailand.

Local Distribution: Mirik, Dhotrey.

Cyathea brunoniana C.B.Clarke, Trans. Linn. Soc. Lond. II Bot. **1**: 430 .1880; Fraser-Jenkis, Kandel & Pariyar, Fern & fern Allies of Nepal I:149.2015.

Alsophila brunoniana Wallich ex Hooker, Sp. Fil. 1: 52. 1844.

Cyathea chinensis Copel, Philip. J. Sci. 3: 355 .1909; Holttum, Kew Bull. **19**: 466 .1965.

Amphicosmia brunoniana sensu Beddome, handb. Ferns Brit. India: 10 .1883.

(Figure 3.4: A to C)

Plant terrestrial, trunk 250-300 × 40-50cm tall, muricate, castaneous, smooth; fronds pinnate, 100-120 × 130-150 cm, ovate-lanceolate, forming a crown; Stipe purplish, finely warty, muricated; scales pale-brown,oblong-lanceolate,2-3× 0.6-1 cm; lamina oblong, 40-60 × 14-16 cm; pinnules 16-24 pairs, base broad ,sessile, basal pinnules shorter, middle ones lanceolate, 6-12 × 1-4 cm, acuminate , caudate;

segments 18-20 pairs, ascending, basal segments shorter, 1-3 × 0.6-1 cm, dentate, scaly abaxially, bullate, 0.4 × 0.3 cm, hairy, apex acute; venation distinct, pinnate; sori globose, brown, indusium half cup shaped; sporangium globose, golden brown, 210-230 μm; spore trilete, tetrahedral, light brown, 43-50 × 48-52 μm.

Exsiccatae : West Bengal, Darjiling hills, GPO, 27/10/11, *Nayan Thapa & Dorjay Lama*, 097A(SJCBH), 097B (LBH), N26°42'10.2'' and E088°20'30.9'',

Alt: 1970m ± 12.8.

Global Distribution: Bangladesh, China, India, Myanmar, Nepal, Vietnam.

Local Distribution: Takdah, Mangwa, Silari Busty, Dowhill, Gpo.

Dennstaedtiaceae Lotsy, Vortr. Bot. Stammesgesch. 2: 655. 1909.

1. Plants with Perenating bulbils.....**Monosaccharum**
+. Plants without Perennating bulbils.....2
2. Fronds more than 200 cm in height**Pteridium**
+. Fronds less than 200 cm in height.....3
3. Stipe 40-60 cm.....**Microlepia**
+. Stipe 10-40 cm.....4
4. Spore spherical, 35-50 μm..... **Dennstaedtia**
+. Spore bilateral, 43 × 24 μm.....**Hypolepis**

Dennstaedtia Bernhardt, J. Bot. (Schrader). 1800(2): 124. 1801.

1. Fronds bi-pinnate, 30-100 × 10-20 cm..... *Dennstaedtia appendiculata*
2. Fronds tri-pinnate, 30-70 × 10-30 cm..... *Dennstaedtia scabra*

Dennstaedtia appendiculata (Wallich ex Hooker) Smith, Hist. Fil.: 265 (1875); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 116, 1965; Dixit, A Cen. of Indian Pterid. 95, 1984; Thapa, Pterid. of Nepal 80, 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 557, 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159, 2015.

Dicksonia appendiculata Wallich ex Hooker, Sp. Fil. 1:79 (1844).

Emodiopteris appendiculata (Wallich ex Hooker) Ching & Wu in Ching, Acta Phytotax. Sin. 16(4):21 (1978).

(Figure 3.7:A to D)

Plants lithophytic, terrestrial, erect, rhizome thick, erect, fronds bipinnate, herbaceous, 30-100 × 10-20 cm; stipe brown, pubescent, 10-20 cm; lamina lanceolate, finely dissected, 20-80 × 10-20 cm; pinnae 20-30 pairs, opposite, lanceolate, 5-10 × 1-2 cm, basal 3-4 pinnae reduced, 3-6 × 1-2 cm; pinnules 10-20 pairs, opposite, oblong, deeply lobed, acute, pubescent, .5-1 × 0.2-0.4 cm; sori terminal, marginal, indusiate, indusia bivalve; sporangium spherical, brown, 250-300 μm; spore spherical, tuberculate, dark brown, 35-40 μm.

Exsiccatae: West Bengal, Darjilinghills, Lebong, 18/07/11, *Nayan Thapa, 032A (SJCB)*, *032B (LBH)*, N27°04'13.5'' and E088°16'59.7'', Alt: 1659m ± 11.5.

Global distribution: Bhutan, china, india, Nepal, Taiwan

Local Distribution: Third mile, Singamari, Lebong.

Dennstaedtia scabra (Wallich ex Hooker) Moore, Ind. Fil.: 307 (1861); Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 116. 1965; Dixit, A Cen. of Indian Pterid. 95. 1984; Thapa, Pterid. of Nepal 80. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 557. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 161. 2015.

Dicksonia scabra Wallich ex Hooker, Sp. Fil. 1:80 (1844)

Dennstaedtia deltoidea Bedd., Ferns south. India: t. 258 (1863)

Plants lithophytic, terrestrial, erect, rhizome thin, wide, creeping, hairy; fronds tri-pinnate, sub-coriaceous, 30-70 × 10-30 cm; stipe brown, pubescent, 10-20 cm; lamina deltoid, finely dissected, 20-50 × 10-30 cm; pinnae petiolated, 4-7 pairs, alternate, lanceolate, 5-15 × 2-4 cm, basal pinnae largest, 10 × 4 cm; pinnules petiolated, 8-10, pairs, alternate, oblong, deeply lobed, acute, pubescent, 3-5 × 1-2 cm; segments 8-

10 pairs, alternate, sessile, oblong, toothed; sori terminal, marginal, cup shaped indusia; sporangium spherical, brown, 270-300µm; spore spherical, tuberculate, light brown, 45-50µm.

Exsiccatae: West Bengal, Darjiling hills, Third mile, 22/09/11, *Nayan Thapa*, 057A (SJCBH), 057B (LBH), N27°00'31.5'' and E088°17'37.7'', Alt: 2154m±15.
Global Distribution: Bhutan, Burma, China, India, Nepal, Japan, Taiwan.

Local distribution: Third mile, Takdah, Mungpoo, Twelve mile.

Hypolepis Bernhardt, *Neues J. Bot.* 1(2): 34. 1805.

Hypolepis polypodioides (Blume) Hooker, *Sp. Fil.* 2: 64. 1852; Thapa, *Pterid. of Nepal* 80.2002; Fraser-Jenkins, *Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List* 558.2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and fern-allies of Nepal I*: 163.2015.

Cheilanthes polypodioides Blume, *Enum. Pl. Javae* 2: 139. 1828.

Plants lithophytic, terrestrial, erect; rhizome creeping, long, hairy; hairs brown, 0.1-0.2 cm; fronds tri-pinnate, 40-100× 8-26 cm; stipe distant, stramineous, 20-40 cm; lamina deltate-lanceolate, pubescent, pale jointed hairs, 20-60× 8-26 cm; pinnae alternate, basal pair opposite, 10-20 pairs, stalked, oblong-lanceolate, acuminate, 4-13× 2-5 cm; pinnules 20 pairs, alternate, sub-sessile, oblong, deeply lobed, apex rounded, 1-4× 0.4-1.5 cm; ultimate segments opposite, 10 pairs, oblong, entire, apex rounded, 0.2-0.7× 0.1-0.3 cm; sori marginal, circular, brown; sporangium ovoid, dark brown, 300× 253µm; spore bilateral, spinulose, brown, 43× 24µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, *Nayan Thapa & Dorjay Lama*, 150A (SJCBH), 150B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam.

Local distribution: Mangawa, Singla, Gourbathan

Microlepia Presl, Tent. Pterid. 124-125. 1836.

1. Pinnae 16-20 pairs.....*Microlepia speluncae*
- +. Pinnae 10-15 pairs.....*Microlepia rhomboidea*

Microlepia speluncae (Linnaeus)Moore, Ind.Fil.:93(1857); Mehra & Bir , Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 117.1965; Dixit , A Cens. of Indian Pterid. 96.1984; Thapa, Pterid. of Nepal 82.2002; Ghosh, Pterid. Fl. East. Ind. I: 436. 2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:264.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 560.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:178.2015

Polypodium speluncae Linnaeus, Sp.Pl.2:1093(1753)

Davallia villosa Don, Prodr. Fl. Nepal.:10(1825).

Plants lithophytic, terrestrial, erect; rhizome thick, horizontal; Frond tripinnate, 100-200 × 40-50 cm; stipe stramineous, 40-60 cm, pubescent, grey hairs; lamina green, ovate-oblong, 60-140 × 40-50 cm, pubescent; pinnae 16-20 pairs, alternate, 8-10 cm apart, stalked, lanceolate, largest pinnae 18-25 × 6-8 cm, acuminate; pinnules 16-20 pairs, stalked, alternate, lanceolate, 3-4 × 1.5-2 cm; segments 10 pairs, alternate, sessile, oblong, crenate, apex mucronate, basal acroscopic segment largest, 1.5 × 1 cm; sori orbicular, marginal, in sinus, indurated, hairy; sporangium globose, brown, 250-230 μm; spore tetrahedral, hyaline, smooth, 33-35 μm.

Exsiccatae: West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa & Dorjay Lama*, 126A (SJCBH), 126B (LBH), N27°04'40.4'' and E088°25'18.5'',

Alt: 649m ± 14.

Global distribution: Africa, Bhutan, Cambodia, India, Indonesia, Japan, Laos, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution: Singla, Badamtam.

Microlepia rhomboidea (Wallich ex Kunze) Prantl, Arbeiten Königl. Bot. Gart. Breslau. 1: 31. 1892; Ghosh, Pterid. Fl. East. Ind. I: 436. 2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:262.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List. 560.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:175.2015.

Davallia rhomboidea Wallich ex Kunze, Bot. Zeitung (Berlin) 8: 158. 1850.

Davallia polypodides var *rhomboidea* (Wallich ex Kunze) Clarke in Trans. Linn. Soc. London Ser. II. Bot 1:448.1880

Plants lithophytic, terrestrial, erect; rhizome wide, creeping; Frond tripinnate, 100-180 × 20-30 cm; stipe stramineous, 20-60 cm, pubescent; lamina green, ovate, 80-150 × 20-30 cm, pubescent; pinnae 10-15 pairs, alternate, 4-8 cm apart, stalked, lanceolate, largest pinnae 10-15 × 4-6 cm, acuminate; pinnules 14-20 pairs, stalked, alternate, oblong-lanceolate, 3-4 × 1.5-2 cm; segments 6-8 pairs, alternate, sessile, oblong, crenate, apex mucronate, basal acroscopic segment largest, 2 × 1 cm; sori orbicular, marginal, in sinus, induratae, hairy; sporangium globose, hyaline, 278-298 μm; spore tetrahedral, hyaline, smooth, 30-32 μm.

Exsiccatae: West Bengal, Darjiling hills, Lebung, 15/08/11, *Nayan Thapa & Dorjay Lama*, 050A (SJCBH), 050B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1649m ± 11.

Global distribution: Bhutan, China, India, Indonesia, Myanmar, Nepal, Philippines, Vietnam.

Local distribution: Lebung.

Monachosorum Kunze, Bot. Zeitung 6: 119–120. 1848.

Monachosorum henryi Christ in Bull. Herb. Boiss. 6: 869. 1898; H. Ito in Fl. East. Himalayas 1: 463. 1966; Dixit, A Cen. of Indian Pterid. 97. 1984; Thapa, Pterid. of Nepal 79. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 561. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 184. 2015.

Phegopteris subdigitata Sensu Bedd., Handb. Ferns Brit. India: 295. 1883.

Monochosorum subdigittum auct. pl.; dixit, Cens. Indian Pterid.: 97. 1984.

(Figure 3.9: A to D)

Plants lithophytic, terrestrial, erect; rhizome thin, long, creeping, hairy; fronds quadripinnate, 50-100 × 20-40 cm; stipe tufted, 10-20 cm, stramineous, hairy; Lamina deltoid, coriaceous, green, finely dissected, adaxially hairy, hairs multicellular, brown; pinnae 3-8 pairs, alternate, petiolated, lanceolate, acuminate, 10-20 × 6-8 cm, basal pair largest, rachis with bulbils; pinnules alternate 7-11 pairs, petiolated, 1-2 × 0.5-1 cm, ovate-lanceolate; segment alternate, 3-5 pairs, petiolated, 0.3-0.5 × 0.1-0.2 cm, rhomboid, cuneate, margins dentate; sori round, median, subterminal, exindusiate; sporangium globose, golden-brown, 320-3700 μm; spore tetrahedral, hyaline, tuberculated, 38-44 μm.

Exsiccatae: West Bengal, Darjiling hills, Gayribas, 25/10/11, Nayan Thapa & Dorjay Lama, 084A (SJCBH), 084B (LBH), N27°03'20.5'' and E88°01'23.4'',
Alt: 2656 m ± 15.

Global distribution: Bhutan, China, Nepal, India, Taiwan.

Local distribution: Gayribas, alubari, Chaudafera.

Pteridium Gleditsch ex Scopoli, Fl. Carniol. 169. 1760.

Pteridium revolutum (Blume) Nakai, Bot. Mag. (Tokyo). 39: 109. 1925; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 118. 1965; Dixit, A Cens. of Indian Pterid. 98. 1984; Thapa, Pterid. of Nepal 83. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 562. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 185. 2015.

Pteris aquilina sensu Clarke: 468. 1880

Plants terrestrial, erect; rhizome long, creeping, hairy; hairs multicellular, 0.3 × 0.1 cm; fronds tri-pinnate, 100-300 × 40-100 cm; stipe stramineous, hairy at base 40-100 cm; lamina deltate, coriaceous, abaxially pubescent, 60-200 × 40-100 cm; pinnae opposite, 4-6 pair, sessile, lanceolate, basal pair largest, 30-100 × 20-40; pinnules

opposite, 15-20 pairs, sessile, lanceolate, acuminate, 10-20 × 3-4 cm, basal pinnule smallest, 5 × 2 cm; segments opposite, 15-20 pairs, linear, margin infolded, acute, 1.5-2 × 0.3-0.5 cm; veins distinct, forked; sori marginal, linear, indusiate, brown; sporangium ovoid, brown, 200 × 160 μm, spore ovoid, spinulose, pale, 20-25 μm.

Exsiccatae : West Bengal, Darjiling hills, Rohini, 03/04/12, Nayan Thapa & Dorjay Lama, 109A (SJCBH), 109B (LBH), N26°54'10.5'' and E088°20'33.5'', Alt : 850m ± 11.5

Global distribution: Bangladesh, Bhutan, China, India, Nepal, Taiwan.

Local distribution: Rohini, Lebong, Badamtam.

Lindsaeaceae Presl ex Schomb., Reis. Brit.-Guiana 3: 883, 1048. 1849.

1. Frond uni-pinnate 10-35 × 2-3 cm..... **Lindsaea**

+ Fronds Quadri-pinnate..... 25-65 × 8-20 cm..... **Odontosoria**

Lindsaea Dryander ex Smith, Mém. Acad. Roy. Sci. (Turin). 5: 413. 1793.

1. Pinnae 15-22 pairs..... *Lindsaea odorata*

+ Pinnae 25-30 pairs..... *Lindsaea himalaica*

Lindsaea himalaica Kramer in Grad. Bull. Singapore 26: 43. f. 3. 1972; Dixit & Ghosh in Proc. Indian Acad. Sci. 92(3): 249. f. 25, 26. 1983; Singh & Panigrahi, Ferns and fern allies of Arunachal Pradesh I: 359. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 562. 2008.

Plants lithophytic, terrestrial; rhizome short, creeping, scaly; scales 0.2-0.6 × 0.1-0.2 cm, lanceolate, entire, acuminate, brown; fronds pinnate, 10-35 × 2-3 cm; stipe castaneous, distant, 2-10 cm; lamina herbaceous, linear-lanceolate, green, 8-25 × 2.3-4.2 cm; pinnae 25-30 pairs, rhomboid, dimidiate, cuneate, margin shallowly lobed, distinct, obtuse, 1.1-2.1 × 0.5-0.8 cm; veins distinct free; sori intra-marginal, oblong, indusiate; sporangium globose, brown, 130-143 μm; spore reniform, smooth, dark brown, 45-50 × 41-44 μm.

Exsiccatae: West Bengal, Darjilinghills, Lebung, 26/10/11, *Nayan Thapa*, 096A (SJCBH), 096B (LBH), N27°04'13.5'' and E088°16'59.4'', Alt: 1659m±11.5.
Global distribution: Bhutan, India.
Local distribution: Lebung, Mungpoo, Algarah.

Lindsaea odorata Roxburgh in Griff., Calc. J. Nat. Hist. 4: 511 (1844); Dixit, A Cen. Of Indian Pterid. 100. 1984; Thapa, Pterid. of Nepal 84. 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 360. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 563. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 193. 2015.

Lindsaea odorata Roxburgh var *darjeelingensis* T. Sen & U. Sen, Amer. Fern J. 61: 14, f. 1-8. 1971.

(Figure 3.11: A to D)

Plants lithophytic, terrestrial; rhizome creeping, scaly; scales 0.3-0.6 × 0.1-0.2 cm, lanceolate, entire, acuminate, brown; fronds pinnate, 15-30 × 2-3 cm; stipe stramineous, distant, 2-7 cm; lamina herbaceous, linear-lanceolate, green, 13-23 × 2-4 cm; pinnae 15-22 pairs, rhomboid, dimidiate, cuneate, margin shallowly lobed, obtuse, 1-2 × 0.5-0.8 cm; veins distinct free; sori at margin, oblong, indusiate; sporangium globose, brown, 135-140 μm; spore reniform, smooth, dark brown, 55-60 × 43-47 μm.

Exsiccatae: West Bengal, Darjilinghills, Third mile, 09/07/11, *Nayan Thapa*, 15A (SJCBH), 15B (LBH), N27°00'31.05'' and E088°17'37.4'', Alt: 2154m±15.

Global distribution: Bhutan, China, India, Nepal, Pacific Islands.

Local distribution: Third mile, Singamari, Lava, Chimney.

Odontosoria Fee, Mem. Foug. 5: 325. 1852.

Odontosoria chinensis (Linnaeus) Smith, Bot. Voy. Herald. 10: 430, 1857; Thapa, Pterid. of Nepal 84. 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 365. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon.

Pterid. With a revi. Cen. List 564.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:195.2015.

Trichomanes chinense Linnaeus, Sp. Pl. 2: 1099.1753.

Adiantum chusanum Linnaeus, Sp. Pl. 2: 1095.1753.

(Figure 3.10:A to D)

Plants lithophytic, terrestrial, erect; rhizome short, cylindrical, scaly; scales 0.3-0.5 × 0.1 cm, linear, narrow like hair, 1-2 celled thick; fronds ovate-lanceolate, 25-65 × 8-20 cm; stipe glabrous, lustrous, castaneous, 10-20 cm; lamina quadripinnate, dull-green, finely dissected; pinnae 8-15 pairs, alternate, ovate-lanceolate, basal pair largest, 3-11 × 1-5 cm; pinnules alternate, 3-5 pairs, 2.5-3 × 1-2 cm; ultimate segment truncate, base cuneate; 0.4-0.6 × 0.1-0.2 cm; veins distinct, forked; sori marginal, terminal, cup shaped, indurated; sporangium round, brown, 130-140 μm; spore reniform, brown, smooth, 48-53 × 33-36 μm.

Exciccatae: West Bengal, Darjilinghills, Third mile, 14/09/13, *Nayan Thapa, 199A (SJCBH), 199B (LBH), N27°00'31.05''* and *E088°17'37.4''*, Alt: 2154 m ± 15.

Global distribution: Bangladesh, Bhutan, China, India, Japan, Korea, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution: Third mile, Takdah, Singamari.

Pteridaceae Kirchn, Schul.-Bot. 109. 1831.

- 1. Fronds 20-100 × 10-30 cm.....2
- + Fronds 5-300 × 2-90 cm.....5
- 2. Pinnae with farina, 2-6 × 1-4 cm.....3
- + Pinnae without farina, 8-16 × 2-4 cm.....4
- 3. Pinnules 10-16 pairs.....**Pityogramma**
- + Pinnules 3-4 pairs.....**Aleuritopteris**
- 4. Stipe black, shiny lustrous, 5-10 cm.....**Adiantum**
- + Stipe stramineous to castaneous, dull, 20-30 cm.....**Pteris**

- 5. Stipe 2-4 cm.....**Cerosora**
- + Stipe 10-100 cm.....5
- 6. Spore bilateral, 40-50× 30-40µm.....**Onychium**
- + Spore tetrahedral, 40-50µm.....**Coniogramme**

Adiantum Linnaeus, Sp. Pl. 2: 1094. 1753.

- 1. Plants unipinnate, 20-40 cm in height.....2
- + Plants tripinnate to quadripinnate, 50-90 cm in height.....3
- 2. Ultimate segment with stipe and glabrous.....*Adiantum philiphense subsp philiphense*
- + Ultimate segment sessile and pubescent.....*Adiantum incisum*
- 3. Sori 8-10 in ultimate segment.....*Adiantum concinnum*
- + Sori 1-3 in ultimate segment.....*Adiantum venustum*

Adiantum concinnum Humb. & Bonpl. ex Willd., Sp. Pl., ed. 4 [Willdenow] 5: 451.1810; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 578.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 34.2015.

Adiantum lutescens Moug. ex Fée Mickel, Mémoires sur les Familles des Fougères 5: 119. 1852.

Plants lithophytic; rhizome creeping, long, scaly; scales lanceolate, brown, 0.6-1 × 0.3-0.5 cm, acuminate, entire; fronds ovate-deltate, 50-90 cm, 3 pinnate, yellowish-green, shiny; lamina ovate to deltoid, 20-40 × 5-20 cm; stipe scaly at base, chestnut, glossy, 5-10 cm; pinnae 6-8 pairs, alternate, 3-10 × 1-5 cm; ultimate pinnules stalked, fan shaped, rhomboid, base cuneate, upper margin notched, 1-2 × 0.5-1.8 cm; sori 6-9, reniform, along the upper margin, indusium false; sporangium golden brown, globose, 283-330 μm; spore tetrahedral, brown, 43-47 × 39-41 μm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa & Dorjay Lama*, 129A(SJCBH), 129B (LBH), N27°04'40.4'' and E088°25'18.2'', Alt: 649m ± 14.1.

Global distribution: India, South America.

Local distribution: Ging, Lopchu, Teesta.

Adiantum incisum Forssk., Fl. Aegypt. Arab.: 187 .1775; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 105.1965; Dixit, A Cen. of Indian Pterid. 75 .1984; Thapa, Pterid. of Nepal 62.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 288.2004;

Adiantum caudatum sensu Bedd., Ferns South. India: t.2 (1863), 83, t.44 (1883), non L.

Plants lithophytic; rhizome erect, scaly; scales brown, lanceolate, acuminate, 0.8-1 × 0.2-0.4 cm; fronds pinnate, lanceolate, 10-30 × 2-4.5 cm; stipe chestnut, shining, scaly at base; rachis hairy, ultimate end with rooting buds; pinnae green, lobed at acroscopic side, cuneate, sessile, hairy, 10-20 pairs, alternate; sori 2-4, linear, covered by false indusium, marginal, greyish; sporangium globose, golden-brown, 280-290 μm; spore tetrahedral, brown, 35-40 × 43-46 μm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 18/07/11 *Nayan Thapa & Dorjay Lama*, 030A(SJCBH), 030B(LBH), N27°01'16.4'' and E088°16'24.2'', Alt: 1586m ± 18.3.9.

Global distribution: Bhutan, China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam.

Local Distribution: Rungdung, single, Teesta, peshok, Ging.

Adiantum philippense Linnaeus subsp. **philiphense** Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 578.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 214.2015.

Adiantum lunulatum Burm.f., Fl. India: 235, 1768.

Plants lithophytes; rhizomes erect, scaly; scales brown, lanceolate, margins denticulate, acuminate; 0.5-0.8 × 0.2-0.3 cm; Fronds tufted, 10-50 × 3-8 cm, pinnate, lanceolate; stipe chestnut, shining, lustrous black; pinnae 2-4 × 1.2-1.8 cm, green, alternate, 7-16 pairs, lunulate to reniform, base cuneate, stalked; rachis chestnut coloured, glabrous, shining; veins forked, distinct, reaching the margin; sori 2-5, along the margin, linear, false indusium, entire, brown; sporangium globose, dark brown, 390-410 µm; spore tetrahedral, alveolate, brown, 46-50 × 48-54 µm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 18/07/11 *Nayan Thapa & Dorjay Lama*, 029A (SJCBH), 029B (LBH), N27°01'16.4'' and E088°16'24.2'', Alt: 1586m ± 18.3.

Global distribution: Bhutan, China, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam.

Local Distribution: Rungdung, single, Teesta

Adiantum venustum Don, Prodr. Fl. Nepal, 17, 1825; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 106.1965; Dixit, A Cen. of Indian Pterid. 76.1984; Thapa, Pterid. Of Nepal 62.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 295.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 579.2008; Fraser-Jenk., Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 223.2015.

(Plate 3.17: A to E)

Plants lithophytes; rhizome short, creeping, scaly; scales dense, brown, ovate-lanceolate, margins entire, 0.6-1 × 0.2-0.4cm; Fronds deltate-ovate, shining green, 30-60 × 10-20 cm; stipe chestnut, shining, glabrous, 5-10 cm; lamina 3-4 pinnate, broadly ovate in outline, 10-38 × 10-20cm; pinnae 8-10 pairs, alternate, basal pair largest; pinnules stalked, ovate, cuneate, teeth present, 0.7-1.2 × 0.5-1cm; sori 1-3 in pinnules, notched, black, indusium false, thick, reniform; sporangium globose, brown, 360-380µm; spore tetrahedral, alveolate, light brown, 36-40 × 28-32µm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 04/05/11 *Nayan Thapa & Dorjay Lama*, 010A(SJCBH), 010B (LBH), N27°00'31.7'' and E088°17'37.2'',

Alt: 2154m±15.

Global Distribution: Bhutan, China, India, Myanmar, Nepal.

Local Distribution: Third mile, Senchel, Alubari, Lava.

Aleuritopteris Fée, Mém. Fam. Foug. 5 Gen. Fil.: 153. 1852.

- 1. Plant more than 20 cm in height.....2
- + Plants less than 20 cm in height.....4
- 2. Costa and costules scaly..... *Aleuritopteris albomarginata*
- + Costa and costules glabrous.....3
- 3. Lamina as long as stipe..... *Aleuritopteris bicolor*
- + Lamina half to one third the length of the stipe..... *Aleuritopteris subdimorpha*
- 4. Abaxially lamina with yellow farina..... *Aleuritopteris chrysophylla*
- + Abaxially lamina with white farina..... *Aleuritopteris formosona*

Aleuritopteris albomarginata (Clarke) Ching, Hong Kong Naturalist. 10: 109, 1941; Ghosh, The Pterid. Flo. Of East. Ind., I, 401, 2004 Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List, 564, 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 226. 2015.

Cheilanthes albomarginata Clarke, Trans. Linn. Soc. London, Bot. 1: 456, 1880;

Cheliantes. farinosa (Forsskål) Kaulfuss var. *albomarginata* Bedd. Handb. with suppl. 22, 1892.

(Plate 3.10:F)

Plant lithophytic, herbaceous; rhizomes erect, short, scaly; scales bicolorous, black with pale margins, lanceolate, 0.6-1 × 0.2-0.5 cm; Fronds monomorphic, clustered, 10-40 × 4-10 cm; Stipe chestnut coloured, lustrous, 4-10 × 0.1-0.3 cm, scaly; scales dark brown, bicolorous, conspicuous with lighter margins, lanceolate; Lamina ovate-deltoid, subcoriaceous, bipinnate, basal part of frond tripinnatifid, adaxial surface glabrous, abaxial surface with white-yellow farina, 6-30 × 4-10 cm; pinnae 3-5 pairs, sessile, basal pair of pinnae ovate-deltoid, bipinnatifid, costae with scales abaxially; pinnules 6-8 pairs, basal basispic pinnules larger than adjacent acroscopic ones, 2-3 cm × 0.3-1 cm, lanceolate, pinnatifid; Sori marginal in ultimate segment, interrupted, fimbriate indusia; sporangium globose, brown, 350-370 µm; spore spherical, trilete, dark brown, smooth, 60-64 µm.

Exsiccatae : West Bengal, Darjiling hills, Alubari, 27/05/13, *Nayan Thapa & Dorjay Lama*, 135A(SJCBH), 135B (LBH), N27°00'27.4" and E088°17'29.5", Alt: 2203m±11.

Global distribution: Bhutan, China, India, Nepal, Pakistan.

Local Distribution: Alubari, Senchel, lava, chimney.

Aleuritopteris bicolor (Roxburgh) Fraser-Jenkins in Ind. Fern Gaz. 18(3). 2008; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 565. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 232. 2015.

Pteris bicolor Roxb. in Griff., Calc. J. Nat. Hist. 4: 507. 1844.

Aleuritopteris kathmandunensis Ching & Wu in C.Y. Wu, Acta Bot. Soc. 74: 185. 1995.

Plants lithophytic, terrestrial; rhizome short, erect, Ca. 0.8 cm in diam., fronds 15-45 × 4-12 cm, deltate-ovate, bi-pinnate; stipe 8-16 cm, purplish-brown, scaly; scales bicolorous, dark streak at center with pale margins, linear, 0.2-0.4 × 0.1-0.2 cm; lamina as long as the stipe, 7-29 × 4-12 cm, coriaceous, adaxially green, abaxially with white farina; pinnae 4-8 pairs, sub-opposite, basal pinnae largest, deltate, 2-6 × 1-4 cm, upper pinnae lanceolate; pinnules sessile, lanceolate, deeply lobed, basispic pinnule of basal pinnae pair largest, 1.5-3 × 0.5-1.5 cm; sori marginal, indusiate; sporangium brown, globose, 225-230 µm, spores globose, trilete, pale-brown, 33-37 µm.

Exsiccatae : West Bengal, Darjiling hills, Singla, 23/07/13, *Nayan Thapa & Dorjay Lama*, 182A(SJCBH), 182B (LBH), N27°06'45.8" E088°16'31"; Alt 335±14

Global distribution: Bangladesh, Bhutan, China, India, Nepal, Sri Lanka Myanmar; Thailand, Laos.

Local distribution: Singla, Teesta.

Aleuritopteris chrysophylla (Hooker) Ching, Hong Kong Naturalist. 10: 201. 1941; Ghosh, The Pterid. Flo. Of East. Ind. I: 391. 2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 565. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 236. 2015.

Cheilanthes chrysophylla Hook, Sp. Fil. 113. 1852

Cheilanthes argentea var. *chrysophylla* Hooker Exot. Fern t. 95, f. 1, 6, 7, 8. 1859.

(Plate 3.10:E)

Plants lithophytic, herbaceous, erect; rhizomes erect, short, scaly; scales concolorous, dark brown, linear-lanceolate, 0.2-0.4 × 0.6-0.8 cm; Fronds monomorphic, bi-pinnate, clustered, 5-16 × 3-6 cm; Stipe castaneous, lustrous, 2-6 × 0.1-0.2 cm, sparsely scaly, scales concolorous, dark-brown, linear-lanceolate; lamina ovate-deltoid, 3-10 × 2-5 cm, papery, adaxially glabrous, abaxially golden-yellow, pinnae 3-5 pairs, sub-opposite, sessile, basal pair largest, triangular, pinnatifid; pinnules 3-4 pairs, alternate, lanceolate, deeply lobed; basal basisopic pinnule largest; Sori marginal in ultimate segment, indusial continuous, crenate; sporangium globose, brown, 140-160 μm; spore spherical, trilete, brown, smooth, 40-54 μm.

Exsiccatae : West Bengal, Darjiling hills, Gayribas, 25/10/11, *Nayan Thapa & Dorjay Lama*, 093A (SJCBH), 093B (LBH), N27°02'27.4'' and E088°04'52.5'', Alt: 2503m ± 11

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Gayribas.

Aleuritopteris formosana (Hayata) Tagawa, Acta Phytotax. Geobot. 14: 191. 1952; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With

a revi. Cen. List 565.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:241.2015.

Cheilanthes formosana Hayata, Enum. Pl. Formosa, 612. 1906 .

Cheliantes anceps Blanf. var. *brevifrondis* Khullar & Mehra.Res. Bull.punjab Univ.n.s 23(3-4):189.1972.

(Plate 3.10: A to D)

Plant Lithophytic, herbaceous, erect; rhizomes short, erect, scaly; scales bicolorous, black with pale brown margins, narrowly lanceolate, 0.4-0.8 × 0.2-0.4 cm; Fronds in tufts, clustered, pinnate, 5-20 × 2-8 cm; Stipe chestnut, lustrous, 2-6 cm, scaly, scale bicolorous, lanceolate. Lamina oblong-lanceolate, 3-12 × 3-8 cm, bipinnatifid, papery when dry, abaxially with white farina, adaxially glabrous, bulged; pinnae 4-7 pairs, opposite, basal pair largest, triangular, 1.5-4 × 0.5-1.5 cm, upper pinnae lanceolate, shorter, narrower; pinnules oblong, deeply lobed, 0.5-1.5 × 0.2-0.8 cm; sori marginal, brown, interrupted by false indusia with laciniate margins; sporangium brown, globose, 210-250 μm; spore globose, pale brown, trilete, smooth, 35-45 μm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 18/07/11, *Nayan Thapa & Dorjay Lama*, 031A(SJCBH), 031B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659m ± 11.5.

Global Distribution: Bhutan, China, India, Kashmir, Nepal, Pakistan, Philippines, Thailand.

Local distribution: Lebong, Ging, kuresong.

Aleuritopteris subdimorpha (Clarke & Baker)Fraser-Jenk. in Ind.Fern Gaz.18(3),2008; ; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 566.2008;Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:249.2015.

Cheliantes farinose var sudimorpha Clarke & Bak., J.Linn.Soc.Bot.24:411.1888.

Aleuritopteris longipes Ching et S.K. Wu, Acta Bot. Yunnanica 5(2):165, t.1.f.1-4.1983.

Plants lithophytic, herbaceous; rhizome thick, erect, Ca. 0.8 cm in Diamm.; Fronds 20-55 × 4-12 cm, coriaceous, pentagonal; stipe 15-35 cm, twice the length of lamina, chestnut coloured, lustrous, scaly at base, scales bicolourous, lanceolate, attenuated apices, concolorous, yellowish-red, 0.4-0.8 × 0.2-0.4 cm; lamina short, deltate; 5-20 × 4-16 cm, coriaceous, abaxially with white farina; pinnae 4-8 pairs, sub-opposite, lowest pinnae much longer; lowest basal basiscopic pinnule longest, 3-5 × 0.8-1 cm; ultimate segment deeply lobed, 0.8-1 × 0.2-0.5 cm; sori marginal, indusia sub entire; sporangium globose, golden-brown, 320-330 μm; spores spherical, trilete, pale brown, 38-42 μm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 24/09/11, *Nayan Thapa & Dorjay Lama*, 064A(SJCBH), 064B (LBH), N27°01'16.4'' and E088°16'24.5'', Alt: 1586m ± 18.3

Global distribution: Bhutan, Bangladesh, Myanmar, Thailand, China, Laos, Vietnam.

Local distribution: Rungdung

Cerosora (Baker) Domin, Acta Bot. Bohem. 8: 3. 1929.

Cerosora microphylla (Hooker) Tryon, Amer. Fern J. 76 (4): 185 .1986 ; Thapa, Pterid. of Nepal 63.2002; Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 567.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 259.2015.

Gymnogramme microphylla Hook, Ic. Pl. 10: t.916 .1854.

Grammitis microphylla Bedd, Ferns Brit. India: t.148.1866.

Anogramma microphylla (Hooker) Diels in Engl. & Prantl, Nat. Pfl.-Fam. 1 (4): 259 .1899.

Idiogramma microphylla (Hooker) Ghosh, J. Econ. Taxon. Bot. 4 (3): 982 .1983.

(Plate 3.19: A to C)

Plants lithophytic, herbaceous, erect; rhizome short, scaly; scales blackish, Ca. 0.1 cm in Diam. ; Fronds clustered, tri-pinnate, 5-10 × 2-4 cm; stipe brown, 2-5 × 0.1-0.3 cm, scaly; lamina green, ovate-deltoid, 2-5 × 2-4 cm; Pinnae 5-7 pairs,

basal pair largest, ovate-deltoid, 1– 2 × 0.7–1.2 cm, stalked; Ultimate segments elliptic, base cuneate, margin entire, apex obtuse; veins distinct, sori elliptic, yellowish; sporangium globose, dark brown, 350-400µm; Spore tetrahedral, brown, 45-55µm.

Global Distribution: China, Bhutan, India, Myanmar, Nepal.

Local Distribution: Meghna

Exsiccatae : West Bengal, Darjiling hills, Meghna, 25/10/11 *Nayan Thapa & Dorjay Lama*, 089A(SJCBH), 089B (LBH), N27°00'31.4'' and E088°17'36.2'', Alt: 2153m±11.

Coniogramme Fée, Mém. Fam. Foug. 5 Gen. Fil. 167. 1852, *nom. Cons*

1. Basal pinnae largest, pinnate dentate at margin..... *Coniogramme procera*

+. Basal pinnae smaller, pinnae serrated at margin..... *Coniogramme serrulata*

Coniogramme procera Fée, Mem. Soc. Sci. Nat. Strasbourg **6** (1): 22 .1865; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 111.1965; Dixit, A Cen. of Indian Pterid. 78 .1984; Thapa, Pterid. of Nepal 68.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 408.2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 319.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 568.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 269.2015.

Coniogramme subchordata Copeland, Leaflets Philip. Bot. **3**: 823 .1910.

Grammitis procera Wallich, List no. 3 (1828), *nom. nud.*

Syngramme fraxinea (D. Don) Beddome, Handb. Ferns Brit. India: 386 .1883..

Plants terrestrial, erect; rhizome creeping, thick, 2-4 cm in diam.; Fronds 100-300 × 50-90 cm, tri-pinnate at base, bi-pinnate upwards; stipe 50-100cm, castaneous; pinnae 5-12 pairs, basal pair largest, pinnate, 25-50 × 15-35 cm, lanceolate; segments lanceolate, 5-12 pairs, stalked, truncate, margins dentate, apex caudate;

veins distinct, forked; sori linear, exindusitae; sporangium globose, brownish, 340-360µm; spore tetrahedral, 40-50µm, brown, smooth.

Exsiccatae : West Bengal, Darjiling hills, Meghma, 04/08/11 *Nayan Thapa & Dorjay Lama*, 042A(SJCBH), 042B (LBH), N27°00'23.4'' and E088°03'30.5'', Alt: 2803m±11.

Global distribution: Bhutan, China, India, Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Meghma, Third mile.

Coniogramme serrulata (Blume) Fée, Gen. Fil.: 167, t.14b, f.2 .1850; Dixit, A Cen. of Indian Pterid. 78 .1984; Thapa, Pterid. of Nepal 69.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 408.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 569.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159.2015.

Gymnogramma serrulata Blume, Enum. Pl. Javae 2: 113. 1828.

Coniogramme serra Fée, Mém. Fam. Foug. 5 Gen. Fil. 167, t. 14 B, f. 1. 1852.

Plants terrestrial, erect; rhizome wide, creeping; fronds 45-90 × 15-30 cm, uni-pinnate, basal pinnae bi-pinnate, deltate, ovate, abaxially green, adaxially pubescent, grayish-green; stipe 20-30 cm, stramineous, sclay at base; Pinnae 2- 6 pairs, simple, lanceolate, basal pair pinnate, 10-25 × 2-4.2 cm, base truncate, margins serrate, acuminate, veins forked; Sori linear, exindusiate; sporangium brown, spherical, 350-376µm, spore 40-45µm, tetrahedral, light brown, smooth.

Exsiccatae : West Bengal, Darjiling hills, Mungpoo, 26/10/11 *Nayan Thapa & Dorjay Lama*, 090A(SJCBH), 090B (LBH), N27°00'32.4'' and E088°17'37.5'', Alt: 2148m±9.

Local distribution: Mungpoo, Gorkhey, Chaudafera, Patliyabas.

Global distribution: China, Indonesia, Nepal, Philippines

Onychium Kaulf., Berlin. Jahrb. Pharm. Verbundenen Wiss. 21: 45. 1820.

1. Sori 1.5-2 cm in length with yellow farina *Onychium siliculosum*

+. Sori less than 1 cm in length with white farina... *Onychium vermae*

Onychium vermae Fraser-Jenkins & Khullar in Fraser-Jenkins, Kandel, & Pariyar, *Ferns and fern-allies of Nepal* 1:300 .2015

Plants terrestrial, erect; rhizome long, creeping, scaly; scales brown, brown, 0.8-1 × 0.1-0.3 cm, lanceolate, entire, acuminate; Fronds 10-50 × 6-14 cm, quadripinnate, shining green, coriaceous; stipe 10-18 cm, stramineous; pinnae 4-9 pairs, alternate, basal pinnae tripinnate, deltoid, upper lanceolate; Ultimate segments stalked or sessile, rhomboid, acute, 0.5-1 × 0.2-0.4 cm, veins free; sori elongated, brown, indusiate, 0.4-0.7 cm; sporangium globose, brown, 320-340 μm; spore bilateral, 58 × 40 μm, pale, with irregular marking.

Exsiccatae : West Bengal, Darjiling hills, Chatakpur, 01/10/11 *Nayan Thapa & Dorjay Lama*, 076A(SJCBH), 076B (LBH), N27°00'43.2'' and E088°17'30.2'', Alt: 2253m ± 15.2

Global Distribution: Bhutan, China, India, Indonesia, Japan, Korea, Myanmar, Nepal, Pakistan, Philippines, Thailand, Vietnam.

Local Distribution: Chatakpur, Tonglu, Alubari.

Onychium siliculosum (Desv.) Christ, *Ind. Fil.*: 468 (1906); Itô: 464 (1966); Mehra & Bir, *Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas* 108.1965; Dixit, *A census of Indian Pterid.* 67 .1984; Thapa, *Pterid. of Nepal* 71.2002; Ghosh, *Pterid. Fl. East. Ind. I*: 362.2004; Fraser-Jenkins, *Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List* 570.2008; Fraser-Jenkins, Kandel, & Pariyar, *Ferns and fern-allies of Nepal* 1:297 .2015

Pteris siliculosa Desv., *Berl. Mag.* **5**: 324 .1811.

Plants lithophytic, erect; rhizomes erect, short, scaly; scales dark brown, lanceolate, 0.8-1 × 0.4-0.6 cm; Fronds tripinnate to quadripinnate, 20-80 × 6-26 cm; slightly dimorphic; stipe tufted, 13-40 cm long, scaly at base; Lamina 7-40 × 6-26 cm, sterile lamina dissected finely, fertile lamina less dissected; Pinnae 6-12 pairs, alternate, ascending, lowest pair largest, 6-10 × 3-6 cm; ultimate segments 1-2 × 0.4-1 cm in fertile fronds, sterile pinnule spatulate, 0.8-1.4 × 0.2- 0.6 cm; sori marginal, entire

abaxially, yellowish; sporangium golden brown, 330-356 μ m; spore bilateral, pale, with irregular marking, 50 \times 30 μ m.

Exsiccatae: West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa*, 130A (SJCBH), 130B (LBH), N27°04'40.05'' and E088°25'18.26'', Alt: 366m \pm 9.

Global distribution: Bangladesh, Bhutan, Cambodia, China, India, Laos, Malaysia, Myanmar, Nepal, Thailand, Vietnam.

Local Distribution: Teesta, single, Sevoke, Samsing.

Pityrogramma Link, Handb. Erken. Gewäsche [Link] 3: 19. 1833.

Pityrogramma calomelanos (Linnaeus) Link, Handbuch. 3: 20. 1833; Thapa, Pterid. of Nepal 72.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:328.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 361.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal 1:303 .2015.

Acrostichum calomelanos Linnaeus, Sp. Pl. 2: 1072. 1753.

Gymnogramma calomelanos (Linnaeus) Kaulfuss, Enum. Fil.:76.1824.

Plants terrestrial, erect; rhizome ascending, sub-erect, scaly; scales lanceolate, entire, acuminate, brown, 0.6-0.8 \times 0.1-0.2 cm; fronds monomorphic, bi-pinnate, 40-100 \times 10-20 cm; stipe purplish, shiny, lustrous, 20-40 cm; lamina oblong-lanceolate, acuminate, abaxially with white farina; pinnae 10-12 pairs, alternate, stalked, lanceolate, acuminate, 5-10 \times 1.5-3 cm; pinnules 10-16 pairs, alternate, sessile, lanceolate, margin crenate, acuminate, 1-1.5 \times 0.3-0.5 cm; veins hidden, pinnate; sori scattered abaxially on pinnules, white farinose, exindusiate; sporangium ovoid, dark brown, 400 \times 350 μ m; spore tetrahedral, reticulate, brown 45-50 μ m.

Exsiccatae : West Bengal, Darjiling hills, Singla, 23/07/13, *Nayan Thapa & Dorjay Lama*, 181A (SJCBH), 181B (LBH), N27°06'45.8'' E088°16'31''; Alt 335 \pm 14

Global distribution: China, Cambodia, Laos, Nepal, Vietnam.

Local distribution: Singla, Teesta

Pteris Linnaeus, Sp. Pl. 2: 1073. 1753.

1. Pinnules with costal aeroles....2
- + Pinnules without costal aeroles.....3
2. Fronds pedate more than 1m in height..... 14
- + Fronds pinnate less than 1m in height.....13
3. Fronds dimorphic.....4
- + Fronds monomorphic.....6
4. Pinnae bifid.....5
- + Pinnae simple.....*Pteris venusta*
5. Pinnules present.....*Pteris ensiformis*
- + Pinnules absent..... *Pteris cretica*
6. Fronds tripartiate.....*Pteris longipes*
- + Fronds not tripartiate.....7
7. Costa and costule prominently spinose....8
- + Costa prominently spinose.....9
8. Basal pinnae with 2-4 pinnules on basiscopic side.....*Pteris spinescens*
- + Basal pinnae with single pinnules on basiscopic side.....*Pteris medogensis*
9. Basal pair of pinnae smallest in size.....*Pteris vittata*
- + Basal pair of pinnae largest in size.....10
10. Acroscopic margin of pinnae entire.....*Pteris semipinnata*
- + Acroscopic margin of pinnae lobed.....11
11. Stipe stramineus and rough in texture.....*Pteris scabririgens*
- + Stipe castaneus and smooth in texture.....12

12. Pinnae 10 -18 pairs.....*Pteris aspericaulis*
 +. Pinnae 4-5 pairs.....*Pteris puberula*
13. Costal aerole 0.4 × 0.3 cm.....*Pteris biaurita* subsp. *walkeriana*
 +. Costa aerole 0.4 × 0.1cm..... *Pteris biaurita* subsp. *fornicata*
14. Costules hairy.....*Pteris austrosinica*
 +. Costule glabrous..... *Pteris wallichiana*

Pteris austrosinica (Ching) Ching, Acta Phytotax. Sin. 10: 302. 1965.

Pteris wallichiana J. Agardh var. *austrosinica* Ching, Bull. Dept. Biol. Sun Yatsen Univ. 6:27. 1933.

(Figure 3.5: A to E)

Plants terrestrial, erect, ca. 2 m tall; rhizome erect, short, thick, ca. 2.5 cm in diameter; Fronds clustered, stipe castaneous, up to 1.5 m, ca. 2 cm in diameter, glabrous, broadly grooved adaxially; Rachis chestnut coloured, narrowly grooved adaxially; Lamina usually 3-pinnatipartite, pentagonal-broadly ovate in outline, 90 – 120 × 90 cm, main central branch, 75 – 85 cm, peripheral branches 25 cm wide, stalked (8 – 10 cm), lateral branches smaller, usually again divided; lateral pinnules 14 – 20 pairs, alternate, decumbent, sessile or slightly shortly stalked, basal several pairs slightly shorter, ca. 1.5 cm apart, middle pinnules lanceolate, 15 – 20 × 3 – 4 cm, base broadly cuneate, nearly symmetrical, deeply pectinately divided leaving broadly winged costule, apex shortly linear-caudate; segments 22 – 30 pairs, alternate, sinuses obtuse-acute, 0.3 – 0.55 cm wide, slightly decumbent, falcate-lanceolate, 2-2.5 × ca. 0.3 cm, basally enlarged, apex shortly acuminate, sterile apex obtusely dentate; terminal pinnules similar to median lateral pinnules, stalked (ca. 1 cm); costules straw-colored, glabrous with short spines on both sides of adaxial groove; veins conspicuous, oblique, anastomosing to form a series of narrow areoles along costa, several simple veinlets reaching incision in outer edge of arcuate vein, and veinlet free outward from areole, and basal veinlet of segment 2-forked at base; lamina brown-green, papery when dried, below with brown slender multicellular hairs.

Exsiccates: West Bengal, Darjiling hills, Singla, 24.06.2013, *Nayan Thapa & Dorjay Lama*, 250A (SJCBH),LB-014240.

Global Distribution: China (Guangdong, Guangxi, Jiangxi) and now in India.

Local Distribution: Singla (N27° 06'45.8'' EO88° 16'31''; Altitude 335±14 m)

Pteris biaurita Linnaeus subsp. ***fornicata*** Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 116.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:316.2015.

Campteria biaurita Hooker, Gen. Fil.: t.65A,1841.

Pteris pectinata D.Don, Prodr. Fl. Nepal.: 15, 1825.

Plants terrestrial, erect; rhizome short, erect, scaly; scales bicolorous, dark brown at centre, margins pale, lanceolate, 0.4-0.6 × 0.1-0.2 cm; fronds bipinnate, 50-90 × 10-40 cm; stipe 15-25 cm, stramineous, glabrous; lamina ovate-lanceolate, sub-coriaceous, 20-65 × 10-40 cm; pinnae 5-12 pairs, opposite, basal pinnae forked, lanceolate, sessile, apex acuminate, 5-20 × 2-4 cm, upper pinnae gradually reducing; pinnae lobed, lobes or segments 14-20 pairs, oblong, obtuse; veins prominent, distinct, 16-20 pairs, basal pair anastomosing, forming a costal aerole, costa aerole 0.4 × 0.1 cm; sori in ultimate lobes, linear, along the margins, indusium thick, hyaline; sporangium globose, golden-brown, 130-150 μm; spore tetrahedral, brown, tuberculated, 54-58 μm.

Exsiccatae : West Bengal, Darjiling hills, Singla, 20/04/12, *Nayan Thapa & Dorjay Lama*, 118A (SJCBH), 118B (LBH), N27°06'45.8'' EO88°16'31''; Alt 335±14

Pteris biaurita Linnaeus subsp. ***walkeriana*** Fraser-Jenk. & Dominic Rajkumar; Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 115.200; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:318.2015.

Plants terrestrial, erect; rhizome short, erect, scaly; scales bicolorous, dark brown at centre, margins pale, lanceolate, 0.4-0.6 × 0.1-0.2 cm; fronds bipinnate, 50-90 × 10-40 cm; stipe 15-25 cm, stramineous, glabrous; lamina ovate-lanceolate, sub-coriaceous, 20-65 × 10-40 cm; pinnae 5-12 pairs, opposite, basal pinnae forked, lanceolate, sessile, apex acuminate, 5-20 × 2-4 cm, upper pinnae gradually reducing; pinnae lobed, lobes or segments 14-20 pairs, oblong, obtuse; veins prominent, distinct, 16-20 pairs, basal

pair anastomosing, forming a costal areole, costal areole 0.4 × 0.3 cm; sori in ultimate lobes, linear, along the margins, indusium thick, hyaline; sporangium globose, golden-brown, 330-350 μm; spore tetrahedral, brown, tuberculated, 54-58 μm. Exsiccatae : West Bengal, Darjiling hills, Singla, 20/04/12, *Nayan Thapa & Dorjay Lama*, 119A(SJCBH), 119B (LBH), N27°06'45.8'' E088°16'31''; Alt 335±14

Global Distribution: Bangladesh, Bhutan, China, India, Indonesia, Laos, Malaysia, Nepal, Philippines, Sri Lanka, Thailand.

Local Distribution: Singla, Teesta, sukuna, Samsing.

Pteris wallichiana Agardh, Recens. Spec. Pter. 69. 1839; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 115, 1965; Dixit, A census of Indian Pteridophytes, 76, 1984; Thapa, Pteridophytes of Nepal, 31, 2002; Ghosh, The Pter. Flo. Of East. Ind., I, 357, 2004; Singh & Panigrahi, Ferns and fern allies of Arunachal Pradesh, Vol I, 608, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 574, 2008.

Campteria wallichiana Moore, Ind. Fil., 221, 1861.

Plants lithophytic, terrestrial; rhizome erect, thick, 1-2 cm in diam., scaly; scales ovate-lanceolate, entire, acute, brown, 0.4-0.8 × 0.1-0.2 cm; Fronds pedate, tufted, umbrella like, 120-150 × 50-80 cm; stipe 40-70 cm, glabrous, lustrous, dark brown; Lamina pentagonal, 80-95 × 60-70 cm, 3 partite, middle branch longest; pinnae 15-25 pairs, lobed upto the costa, lanceolate, 25-30 × 3-5 cm; pinnules, 20-27 pairs, alternate, oblong, crenate, acute, 1.5-2 × 0.4-6 cm; veins distinct, once or twice forked, basal pair fused, costal areole present; sori linear, marginal, indusiate; sporangium brown, globose, 320-335 μm; spore tetrahedral, trilete, brown, tuberculate, 46-54 μm. Exsiccatae: West Bengal, Darjiling hills, Third mile, 22/09/11, *Nayan Thapa*, 060A(SJCBH), 060B (LBH), N27°00'31.05'' and E088°17'37.4'', Alt: 2154m±15.

Global distribution: Bhutan, China, India, Indonesia, Japan, Laos, Malaysia, Nepal, Philippines, Thailand, Vietnam

Local distribution: Third mile, lebung, Siingamari.

Pteris cretica Linnaeus, Mant. Pl. 1: 130. 1767; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 113, 1965; Dixit, A census of Indian Pteridophytes, 69, 1984; Thapa, Pteridophytes of Nepal, 73, 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh, Vol II, 572, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 572, 2008.

Pteris nervosa Thunberg, fl. Jap.: 332 (1784); Ching & S.W. Wu in C.Y. Wu, Fl. Xizangica **1**: 68 (1983).

Plants lithophytic, terrestrial, erect; rhizome short, creeping, scaly; scales 0.3-0.5 × c.m, oblong-lanceolate, entire, acuminate, dark brown; Fronds dimorphic, fertile segments narrower than sterile one's, coriaceous, 60-80 × 15-25 cm; stipe 20-60 cm, stramineous, glabrous; lamina deltate, 30-40 × 15-25 cm; pinnae 4-6 pairs, linear, margin entire to toothed, 7.5-12.5 × 2-3 cm, basal pair bifid; veins distinct, forked, parallel; sori linear, marginal, false indusial, brown; sporangium globose, golden brown, 310-315 μm; spore tetrahedral, brown, warty, 44-46 μm.

Exsiccatae: West Bengal, Darjiling hills, Gorkhey, 08/08/11, *Nayan Thapa*, 046A (SJCBH), 046B (LBH), N27°11.40.223 and E088°03.729, Alt: 2463m±3.

Global distribution: Bhutan, Cambodia, China, India, Japan, Laos, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local Distribution: Gorkhey, Ramam

Pteris vittata Linnaeus, Sp. Pl. 2: 1074. 1753; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 112, 1965; Dixit, A census of Indian Pteridophytes, 73, 1984; Thapa, Pteridophytes of Nepal, 76, 2002; Ghosh, The Pter. Flo. Of East. Ind., I, 319, 2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh, Vol II, 605, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 574, 2008.

Pteris longifolia sensu D. Don, Prodr. Fl. Nepal.: 15 (1825).

Pteris vittata L. forma *brevipinna* S. Verma in Mehra, Res. Bull. Punjab Univ. n.s. **12** (1-2): (1961), *nom. nud.*

Plants lithophytic,terrestrial,erect;rhizome short,erect,scaly;scales lanceolate, pale,entire,acuminate,0.8-1 × 0.2-0.4 cm; frond tufted, pinnate, 50-100 × 18-30 cm; stipe 10-20 cm, stramineous, scaly; lamina 40-80 × 18-30 cm, lanceolate, widest at middle, tapering at both ends; pinnae 10-20 pairs, opposite, linear, broadest at base, tapering towards apex, 8-15 × 1-2.5 cm, few basal pair reduced, broad, ovate-lanceolate, 1-3 × 1-2 c.m; veins forked, distinct; sori linear, marginal, indusium entire; sporangium globose, brown, 130-135 μm; spore tetrahedral, hyaline, tuberculated, 48-50 μm.

Exsiccatae: West Bengal, Darjilinghills, Teesta, 23/05/13, *NayanThapa, 124A (SJCBH), 124B (LBH)*, N27°04'40.05'' and E088°25'18.26'', Alt: 366m±9.

Global distribution: Bangladesh, Bhutan, China, India, Nepal.

Local Distribution: Teesta, Singla, Samsing, Sukuna.

Pteris venusta Kunze, Bot. Zeitung (Berlin). 6: 195. 1848; Dixit, A census of Indian Pteridophytes, 73, 1984; Ghosh, The Pter. Flo. Of East. Ind., I, 323, 2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 576, 2008.

Pteris pellucida sensu Bedd. Ferns. South Ind. t. 38, 1863.

Plants lithophytic, terrestrial, erect; rhizome short, erect; fronds dimorphic, simple. 20-30 × 3-4 cm; stipe 4-6 cm, glabrous; sterile lamina oblong-lanceolate, undulate, crenate, acuminate, 20-30 × 3-4 cm; fertile lamina 20-25 × 1.5-3 cm, narrow, elliptic, acuminate, acuation serrated; veins distinct, prominent, once forked; sori marginal, elongated, linear, indusium entire; sporangium globose, brown, 120-130 μm; spore tetrahedral, brown, tuberculated, 45-47 μm.

Exsiccatae: West Bengal, Darjilinghills, Teesta, 23/05/13, *NayanThapa, 132A (SJCBH), 132B (LBH)*, N27°04'40.05'' and E088°25'18.26'', Alt: 366m±9.

Global Distribution: Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, N Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Teesta, Singla, Kalijhora.

Pteris semipinnata Linnaeus, Sp. Pl. 2: 1076. 1753; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 113, 1965; Dixit, A census of Indian Pteridophytes, 72, 1984; Thapa, Pteridophytes of Nepal, 75, 2002; Ghosh, The Pter. Flo. Of East. Ind., I, 342, 2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh, Vol II, 591, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 575, 2008.

Plants lithophytic, terrestrial, erect; rhizome short, creeping, scaly; scales 0.6-0.8 × 0.1-0.2 cm, lanceolate, acuminate, bicoloured, central dark portion with pale margins; frond monomorphic, tufted, 40-60 × 15-24 cm; lamina lanceolate, 30-40 × 15-24 cm; stipe castaneus, glabrous, 10-20 cm; pinnae 4-8 pairs opposite, 12-18 × 5-8 cm, widest at base, sessile, acroscopic margin entire, basispic margin deeply lobed, basal basispic pinnae largest, sterile margin serrate, fertile margin entire; veins distinct, prominent, forked; sori linear, marginal, indurated; sporangium globose, brown, 120-125 μm; spore tetrahedral, brown, tuberculate, 44-48 μm.

Exsiccatae: West Bengal, Darjiling hills, Teesta, 02/02/12, *Nayan Thapa, 106A (SJCBH), 106B (LBH)*, N27°04'40.05'' and E088°25'18.26'', Alt: 366m ± 9.

Global distribution: Bhutan, China, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local Distribution: Teesta, Singla.

Pteris longipes D. Don, Prodr. Fl. Nepal. 15. 1825; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 114, 1965; Dixit, A census of Indian Pteridophytes, 70, 1984; Thapa, Pteridophytes of Nepal, 74, 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 573, 2008.

Plants lithophytic, terrestrial, erect; rhizome short, 1.5-2 cm in diam., scaly; scales, lanceolate, brown, entire, 0.4-0.6 × 0.1-0.2 cm; Fronds monomorphic, tripartite, clustered, 60-100 × 20-50 cm; stipe 20-40 cm, castaneus, scaly at base, glabrous above; lamina herbaceous, dull green, 40-60 × 20-40 cm; pinnae three, one terminal, two lateral opposite pinnae, lanceolate, 30-50 × 10-20 cm; pinnules 14-20 pairs, opposite, lanceolate, apex acuminate, 8-10 × 2-4 cm; segment numerous, 10-25 pairs, linear-oblong, margins toothed, apex mucronate; veins distinct, prominent,

simple; sori linear, marginal, induistae; sporangium globose, brown, 320-330 μm ; spores tetrahedral, brown, tuberculate, 45-48 μm .

Exsiccatae: West Bengal, Darjilinghills, Teesta, 02/02/12, *NayanThapa, 105A* (SJCBH), *105B (LBH)*, N27°04'40.05'' and E088°25'18.26'', Alt: 366m \pm 9.

Global distribution: Bhutan, China, India, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local Distribution: Teesta, Lopchu, Makaibari, rohini

Pteris scabririgens Fraser-Jenkins, Verm & T. G. Walker, Taxon. Revis. Indian Subcontinental Pteridophytes. 111. 2008.

Plants lithophytic, terreterial, erect; rhizome sub-erect, scaly; scales brown, oblong, acuminate, 0.4-0.8 \times 0.2-0.4 cm; fronds monomorphic, pinnate, coriaceous, rigid, 30-60 \times 10-20 cm; stipe 10-20 cm, hard, rough, stramineous; lamina lanceolate, dull green, coriaceous, 20-40 \times 10-20 cm; pinnae 8-10 pairs, alternate, basal pair largest, bipartite on basisopic side, upper pinnae lanceolate, simple, 8-10 \times 3-4 cm; pinules deeply lobed, opposite, 25-30 pairs, lanceolate, entire, acute; veins distinct, prominent, forked; sori linear, marginal, induistae; sporangium round, golden brown, 320-370 μm ; spore tetrahedral, pale-brown, tuberculate, 40-43 μm .

Exsiccatae: West Bengal, Darjilinghills, Lebong, 18/07/11, *NayanThapa, 036A* (SJCBH), *036B (LBH)*, N27°04'13.05'' and E088°216'59.7'', Alt: 1659m \pm 9.

Global distribution: Bhutan, China, India, Nepal.

Local Distribution: Lebong, singamari, lava

Pteris spinescens Presl, Rel. Haenk. 1:56, 1825; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 575, 2008.

Pteris setuloso-costulata Hayata, Icon. Pl. Formosa. 4:241. f. 168, 1914.

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scales lanceolate, margin toothed, acuminate, brown, 0.8-1 \times 0.2-0.4 cm; fronds monomorphic, pinnate, 40-120 \times 30-45 cm; stipe smooth, shining, ebeneous, 10-30 cm; lamina 30-80 \times 30-45 cm, ovate-lanceolate; pinnae 4-9 pairs, alternate, basal pair deltate, forked 2-3

times basiscopically, upper pinnae pair lanceolate, deeply lobed, acuminate, 14-20 × 3.5-4 cm, costa and costule spinose; basal basiscopic pinnule lanceolate, acuminate, 6 × 3 cm; lobes 15-20 pairs, oblong, margin entire, apex round, 1.7-2.2 × 0.5-0.8 cm; sori marginal, linear, indusiate; sporangium globose, golden-brown, 320-330 μm; spore tetrahedral, dark brown, tuberculate, 48-50 μm.

Exsiccatae: West Bengal, Darjilinghills, Teesta, 15/07/11, *Nayan Thapa*, 022A (*SJCBH*), 022B (*LBH*), N27°04'40.05'' and E088°25'18.4'', Alt: 649m ± 15.

Global distribution: Bhutan, India, Nepal, Myanmar, Japan, Taiwan.

Local Distribution: third mile, lebung, lava, chimney

Pteris aspericaulis Wallich ex J. Agardh, Recens. Spec. Pter. 22. 1839; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas, 113, 1965; Dixit, A census of Indian Pteridophytes, 68, 1984; Thapa, Pteridophytes of Nepal, 72, 2002; Ghosh, The Pter. Flo. Of East. Ind., I, 348, 2004; Singh & Panigrahi, Ferns and fern allies of Arunachal Pradesh, Vol II, 565, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 571, 2008.

Pteris quadriaurita Retz. var *aspericaulis* (Wallich ex J. Agardh) Bedd., Handb. Ferns Brit. India: 111 (1883).

Pteris pseudoquadriaurita Khullar, An Illust. Fern Fl. W. Himal. 1: 285 (1994).

Plants lithophytic, terrestrial, erect; rhizome sub-erect, short, scaly; scales lanceolate, entire, brown, acuminate, 0.2-0.6 × 0.1-0.2 cm; fronds monomorphic, pinnate, sub-coriaceous, 40-110 × 12-24 cm; stipe rough, pinkish, stramineous in maturity, 10-40 cm; lamina lanceolate, dull green, 30-70 × 12-24 cm; pinnae 8-16 pairs, alternate, linear-lanceolate, acuminate, basal pair largest, bipartite, 6-12 × 3-5.5 cm; pinnules oblong, opposite, 10-20 pairs, entire, apiculate, 3-5.5 × 0.5-1 cm; seta at junction of costa and costules; veins distinct, prominent, free, forked; sori marginal, linear, indusiate; sporangium globose, brown, 330-375 μm; spore tetrahedral, brown, tuberculate, 42-45 μm.

Exsiccatae: West Bengal, Darjilinghills, Sukhia, 23/09/11, *Nayan Thapa*, 063A (*SJCBH*), 063B (*LBH*), N26°59'49.05'' and E088°09'50.4'', Alt: 2314m ± 15.

Global Distribution: Bhutan, China, India, Nepal, Thailand.

Local Distribution: Sukhia, singamari, lebung.

Pteris puberula Ching, Bull. Fan Mem. Inst. Biol., Bot. 11: 52. 1941; Thapa, Pteridophytes of Nepal, 74, 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List, 575, 2008.

Pteris nepalensis H. Ito in Hara, Fl. East. Himal., 446, t. 26, 1966.

Plants lithophytic, terrestrial, erect; rhizome short, sub-erect, scaly; scales lanceolate, acuminate, entire, brown, 0.4-0.8 × 0.2-0.4 cm; fronds monomorphic, pinnate, sub-coriaceous, 30-80 × 15-30 cm; stipe smooth, lustrous, castaneus, 5-15 cm; pinnae sub-opposite, 3-5 pairs, lanceolate, acuminate, basal pair largest, forked basiscopically, 10-15 × 3-5 cm; pinnules opposite, 10-20 pairs, lanceolate, entire, acute, 1.5-2.5 × 0.8-1.3 cm; veins distinct, prominent, forked; sori marginal, linear, induristae; sporangium globose, brown, 320-390 μm; spore tetrahedral, brown, tuberculate, 40-45 μm.

Exsiccatae: West Bengal, Darjilinghills, Sukhia, 23/09/11, *Nayan Thapa*, 062A (SJCBH), 062B (LBH), N26°59'49.05'' and E088°09'50.4'', Alt: 2314m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Sukhia, gorkhey, Damsong.

Pteris medogensis Ching & S.K. Wu, *Fl. Xizang. 1: 71-72, pl. 16, f. 1-4 1983*; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List, 573, 2008.

Plants lithophytic, terrestrial, erect; rhizome short, cylindrical, scaly; scales ovate-lanceolate, acute, entire, brown, 0.2-0.6 × 0.1-0.2 cm; fronds monomorphic, pinnate, sub-coriaceous, 30-100 × 15-30 cm; stipe smooth, stramineous, 10-30 cm; pinnae alternate, 8-12 pairs, lanceolate, acuminate, basal pair largest, forked basiscopically, 8-15 × 2-4 cm; pinnules opposite, 10-20 pairs, oblong, entire, obtuse, 1.5-2 × 0.8-1 cm; Seta prominent in costa and costules; veins distinct, prominent, forked; sori marginal, linear, induristae; sporangium globose, brown, 300-330 μm; spore tetrahedral, brown, tuberculate, 48-54 μm.

Exsiccatae: West Bengal, Darjilinghills, Chatakpur, 1/10/11, *Nayan Thapa*, 068A (SJCBH), 068B (LBH), N26°00'43.2'' and E088°17'30.2'', Alt: 2253m ± 15.2.

Global distribution: Bhutan, India.

Local distribution: Chatakpur, Damsong, Chimney

Pteris ensiformis N. L. Burman, Fl. Indica. 230. 1768.

(Figure 3.17: A to D)

Plants lithophytic, terrestrial, erect; rhizome ascending, scaly; scale lanceolate, entire, acuminate, brown, 0.4×0.1 cm; fronds dimorphic, sterile frond pinnate, 10-25× 5-10 cm; stipe stramineous, 5-10 cm; pinnae 3 pairs, stalked, alternate, linear, acuminate, 2.5-5× 0.5-0.6 cm, basal pinnae bi-partite; pinnule 2 pairs, opposite, elliptic, serrate, acute, 3.5× 1 cm; fertile fronds pinnate, 10-50× 10-20 cm; pinnae 3 pairs, alternate, linear, acute to acuminate, 5-10× 0.8-1.2 cm, basal pinnae bi-partite; pinnule 2 pair, stalked elliptic, entire, apex rounded, 2-4× 0.7-1.2 cm; veins distinct, forked; sori linear, along margin, indusiate, brown; sporangium globose, dark brown, 370-400µm; spore tetrahedral, tuberculated, brown, 50-53µm.

Exsiccatae: West Bengal, Darjilinghills, Sukhia, 23/09/11, *NayanThapa, 062A (SJCBH), 062B (LBH)*, N26°59'49.05'' and E088°09'50.4'', Alt: 2314m±15.

Global distribution: Bhutan, Cambodia, India, Japan, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

Local distribution: Sukhai, Mungpoo

Pteris medogensis Ching & Wu, Fl. Xizangica 1: 71-72, pl. 16, f. 1-4 71 1983.

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scales lanceolate, margin toothed, acuminate, brown, 1 × 0.3 cm; fronds monomorphic, pinnate, 30-130 × 30-45 cm; stipe smooth, stramineous, 10-30 cm; lamina 20-100 × 30-45 cm, ovate-lanceolate; pinnae 10-14 pairs, alternate, basal pair deltate, forked basiscopically once, upper pinnae pair lanceolate, lobed, acuminate, 14-20 × 3.5-4 cm, costa and costule spinose; basal basiscopic pinnule lanceolate, 6× 3 cm; lobes 15-20 pairs, oblong, margin entire, apex round, 1.7-2.2× 0.5- 0.8 cm; sori marginal, linear, indusiate; sporangium globose, golden-brown, 350-360µm; spore tetrahedral, dark brown, tuberculate, 48-50µm.

Exsiccatae: West Bengal, Darjilinghills, Teesta, 11/10/11, *NayanThapa, 068A (SJCBH), 068B (LBH)*, N27°00'20.05'' and E088°17'33.4'', Alt: 1800m±15.

Global distribution: Bhutan, India.

Local distribution: Mungpoo, Teesta

Vittariaceae Ching, Sunyatsenia 5(4): 210, 232. 1940.

Vittaria J.E.Smith in Mem.Acad.Turin5:413.pl.9.f.5.1793.

1. Fronds more than 20 cm in length.....2
- + Fronds less than 20 cm in length.....3
2. Scales blackish-brown,0.6-0.8× 0.1-0.2 cm in length..... *Vittaria elongata*
- + Scales dark-brown, 0.2-1× 0.1-0.3 cm in length..... *Vittaria flexuosa*
3. Scales dark brown,linear,0.4-0.9 × 0.1-0.2cm in length..... *Vittaria sikkimensis* .
- + Scales light brown,lanceolate, 0.2-0.6 × 0.1-0.3cm in length... *Vittaria taeniophylla*

Vittaria elongata Swartz, Syn. Fil. 109, 302 .1806; Mehra & Bir, Pteridohytic Fl. Of Darjeeling and Sikkim Himalayas.106.1965; Dixit , A Cen. of Indian Pterid. 81 .1984; Thapa, Pterid. of Nepal 78.2002; Ghosh,The Pterid.. Flo. Of East.Ind.I: 301.2004; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh II : 791 . 2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid.. With a rev. Cen. List 580.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:378 .2015

Pteris graminifolia Roxb. in Griff., Calc. J. Nat. Hist. 4: 502, t.33 (1844).

Vittaria elongata var. *angustifolia sensu* Panigrahi, Bull. Bot. Surv. India 2: 314 (1961), *non* Holttum (1954).

Plants epiphytic,pendulous;rhizome creeping,scaly;scales blackish-brown, lanceolate, margin toothed,acuminate,0.6-0.8× 0.1-0.2cm;lamina simple,tufted,50-90× 0.3-0.6 cm,linear,entire,attenuated,green;stipe 1-7cm,glabrous;sori marginal, linear,elongated,within shallow grooves;sporangium globose,brown,290-300 µm;spore bilateral,reniform,pale-green,50-64µm.

Exsiccatae:WestBengal,Darjilinghills,sukuna,19/07/11,*NayanThapa,035A (SJCBH),035B (LBH),N26°48'03.5''* and *E088°22'09.7''*,Alt: 265m±15

Global distribution: Bhutan, China, India, Philippines, Malaysia, Vietnam.

Local distribution: Sukuna, Singla, Samsing.

Vittaria flexuosa Fée, Mem. Fan Foug.: 16 .1852; Mehra & Bir, Pteridohytic Fl. Of Darjeeling and Sikkim Himalayas 107.1965; Dixit , A Cen. of Indian Pterid. 82 .1984; Thapa, Pterid. of Nepal 78.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 306.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 580.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 379 .2015

Vittaria lineata sensu Bedd., Handb. Ferns Brit. India: 406 (1883)

Vittaria himalayensis sensu Itô: 500 (1966), *p.p.*, *non* Ching.

Plants epiphytic, pendulous; rhizome short, creeping, scaly; scales linear, entire, acuminate, dark-brown, 0.2-1 × 0.1-0.3 cm; lamina simple, tufted, 20-40 × 0.2-0.4 cm, linear, entire, attenuated, green; stipe 1-4 cm, glabrous; sori sub-marginal, linear, elongated, within shallow furrows, indusiate; sporangium globose, brown, 250-310 µm; spore reniform, smooth, pale, 55-57 × 30-37 µm.

Exsiccatae: West Bengal, Darjilinghills, Gayribas, 20/07/11, *Nayan Thapa, 040A (SJCBH), 040B (LBH)*, N27°03'20.5'' and E088°01'23.4'', Alt: 2656m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Gayribas, Senchel, Lava.

Vittaria sikkimensis Kuhn, Linnaea **36**: 66 (1869); Mehra & Bir, Pteridohytic Fl. Of Darjeeling and Sikkim Himalayas 106.1965; Dixit , A Cen. of Indian Pterid. 82 .1984; Thapa, Pterid. of Nepal 79.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 303. 2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 581.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 384 .2015

Vittaria minor Bedd., Ferns Brit. India: t.58 (1865), *non* Fée (1852).

Plant epiphytic, pendent; rhizome short, creeping, scaly; scales linear-linear, entire, acuminate, dark brown, 0.4-0.8 × 0.1-0.2 cm; lamina simple, clustered on rhizome, attenuated, entire, acute, costa raised adaxially, 5-15 × 0.2-0.63 cm; stipe small, glabrous, 0.3-0.4 cm; sori superficial, sub-marginal, linear, indusiate; sporangium globose, brown, 310-320 μm; spore reniform, bilateral, greenish, 32-37 μm.

Exsiccatae : West Bengal, Darjiling hills, Mungpoo, 26/10/11 *Nayan Thapa & Dorjay Lama*, 091A(SJCBH), 091B (LBH), N27°00'32.4'' and E088°16'37.5'', Alt: 1545m±9.

Global distribution: Bhutan, Nepal, India.

Local distribution: Mungpoo, Rungdung

Vittaria taeniophylla Copeland, Philip. J. Sci. 1 Suppl. II: 157 (1906); Dixit, A Cen. of Indian Pterid. 82 .1984; Thapa, Pterid. of Nepal 79.2002; Ghosh, The Pterid.. Flo. Of East. Ind. I: 308.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 581.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 385 .2015

Vittaria revoluta Don, Prodr. Fl. Nepal.: 15 (1825).

(Plate 3.8:G)

Plant epiphytic, pendent; rhizome short, creeping, scaly; scales lanceolate, entire, acute, brown, 0.4-0.6 × 0.1-0.3 cm; lamina simple, clustered on rhizome, attenuated, entire, acute, costa raised adaxially, 5-15 × 0.4-0.6 cm; stipe small, glabrous, 0.3-0.6 cm; sori superficial, sub-marginal, linear, indusiate; sporangium globose, brown, 260-270 μm; spore reniform, bilateral, pale, 45-55 μm.

Global distribution: Bhutan, China, India, Nepal, Philippines.

Local distribution: Kayakatta, gayribas, Alubari

Exsiccatae: West Bengal, Darjiling hills, kayakatta, 11/09/11, *Nayan Thapa*, 056A (SJCBH), 056B (LBH), N27°03'34.5'' and E088°01'28.4'', Alt: 2818m±15.

Aspleniaceae Newman, Hist. Brit. Ferns 6. 1840.

Asplenium Linnaeus, Sp. Pl. 2: 1078. 1753

1. Fronds simple.....2
- + Fronds Pinnate to pinatipartite.....3
2. Lamina 14-33 × 1-3 cm.....*Asplenium ensiforme*
- + Lamina 20-60 × 4-6 cm.....*Asplenium phyllitidis*
3. Costa with scales.....*Asplenium magnificum*
- + Costa without Scales.....4
4. Stipe length more than 6 cm.....5
- + Stipe length less than 6cm.....*Asplenium lacinatum*
5. Pinnae 10-12 pairs.....*Asplenium amoenum*
- + Pinnae 16-40 pairs..... 6
6. Perennating bud presnt on rachis.....*Asplenium yoshinagae* subsp *indicum*
- + Perennating bud absent on rachis..... *Asplenium cheilosorum*

Asplenium cheilosorum Kunze ex Mett.,Abh.Senck.Naturf.Ges.3:177,t.5,f.12-13.1859; Mehra & Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 157.1965; Dixit , A Cen. of Indian Pterid.116.1984; Thapa, Pterid. of Nepal 85.2002; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh I:95.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 583.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:159.2015.

Asplenium heterocarpum Wallich ex Hooker,Sp.Fil.3:132,t.175.1860.

Plant lithophytic, pendent; rhizome thin, long ,creeping, scaly; scales lanceolate, entire, acuminate,brown,0.4-0.6× 0.1-0.2 cm; fronds uni-pinnate, membranaceous, green ,30-45× 4-6 cm; stipe chesnut coloured,shining,6-10 cm; lamina linear-lanceolate,25-35× 4-6 cm; pinnae alternate, 20-40 pairs, stalked, dimidiate,upper

margin deeply lobed, lower margin entire, 2-3 × 0.8-1.2 cm; veins distinct, forked; sori oblong, elongated, confined to lobes, indusiate, brown; sporangium globose, dark brown, 370-380µm; spore reniform, perisporate, brown, 50-54µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, *Nayan Thapa & Dorjay Lama*, 145A(SJCBH), 145B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: Bhutan, China, India, Nepal, Japan, Taiwan.

Local distribution: Mangwa, Takdah.

Asplenium ensiforme Wallich ex Hooker & Greville, Ic. Fil. 1: t. 71 (1828); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 156, 1965; Dixit, A Cen. of Indian Pterid. 117, 1984; Thapa, Pterid. of Nepal, 85, 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 98, 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 584, 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159, 2015.

Plants epiphytic, pendent; rhizome erect, scaly; scales black, ovate-lanceolate, entire, acuminate, 0.8-1 × 0.1-0.3 cm; frond simple, oblanceolate, 15-35 × 1-3 cm; stipe small, winged, 1-2 cm; lamina lanceolate, coriaceous, entire, attenuated at both ends, 14-33 × 1-3 cm; veins forked, obscure; sori linear, oblique, 0.5-1 cm, indusium toothed, brown; sporangium globose, golden-brown, 150-160µm; spore reniform, perispore folded, brown, 45-53µm.

Exsiccatae : West Bengal, Darjiling hills, Lamadhura, 04/08/11, *Nayan Thapa & Dorjay Lama*, 043A(SJCBH), 043B (LBH), N27°00'23.4'' and E088°05'30.5'', Alt: 2803m±21.1.

Global Distribution: Bhutan, China, India, Nepal, Myanmar, Thailand, Taiwan.

Local Distribution: Lamadhura, Third mile, Singamari, Lava, Chimney.

Asplenium laciniatum Don, Prod. Fl. Nepal, 8, 1825; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 157, 1965; Dixit, A Cen. of Indian Pterid. 119. 1984; Thapa, Pterid. of Nepal 86.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 585.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159.2015.

Asplenium varians Wallich ex Hooker & Greville, Ic. Fil.: t. 172, 1829.

Plants lithophyte on rocks, pendent; rhizome short, erect, scaly; scales lanceolate, entire, acuminate, 0.6-0.8 × 0.2-0.4 cm; fronds bipinnate, herbaceous, green; stipe stramineous, scaly, 2-5 cm; lamina bipinnate, linear-lanceolate, attenuated, apex acuminate, 10-23 × 3-5 cm; pinnae alternate, 10-20 pairs, stalked, rhomboid, 1.5-3 × 1.2-2 cm; ultimate segment oblong-elliptic, stalked fan shaped, lobed, acute, 1.5 × 1.2 cm; veins distinct, forked; sori linear, indusia entire; sporangium brown, globose, 140-150 μm; spore reniform, brown, minutely spinose, 43-47 μm.

Exsiccatae : West Bengal, Darjiling hills, Kuresong, 13/12/11, *Nayan Thapa & Dorjay Lama*, 103A (SJCBH), 103B (LBH), N26°53'03.4'' and E088°17'1.1'', Alt: 1498m ± 10.1.

Global Distribution: Bhutan, China, India, Nepal, Taiwan.

Local Distribution: Kuresong, Third mile, Damsong

Asplenium normale Don, Prodr. Fl. Nepal.: 7 (1825); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 156, 1965; Dixit, A Cen. of Indian Pterid. 120. 1984; Thapa, Pterid. of Nepal 87.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 114.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 586.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159.2015.

Plants lithophytic on rocks, pendent; rhizome erect, densely scaly; scales lanceolate, entire, acuminate, blackish-brown, 0.4-0.8 × 0.2-0.3 cm; Fronds unipinnate, tufted, 10-40 × 2-4 cm; stipe 6-8 cm, castaneous, grooved on dorsal surface, glabrous,

scaly at base; lamina linear-lanceolate, subcoriaceous, greenish, 8-32 × 2.5-4 cm; pinnae 20-30 pairs, alternate, 1.5-2 × 0.4-0.7 cm, sessile, rectangular, margin crenate, obtuse, acroscopic side auricled; rachis with buds; sori oblique, median, 0.2-0.3 cm, indusium elliptic, brown; sporangium globose, brown, 147-157 μm, spore reniform, perispore broad, brown, 43-47 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 09/07/11, *Nayan Thapa & Dorjay Lama*, 014A(SJCBH), 014B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m±15.

Global Distribution: Bhutan, China, India, Nepal, Malaya, Hong kong, Taiwan.

Local Distribution: Mungpoo road, Damsong

Asplenium phyllitidis Don, Prodr. Fl. Nepal.: 7(1825); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 114, 1965; Dixit, A Cen. of Indian Pterid. 69. 1984; Thapa, Pterid. of Nepal. 73, 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II: 569. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 572. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 159. 2015.

Thamnopteris nidus (Linnaeus) Presl var *phyllitidis* (Don) Bedd., Handb. Ferns Brit. India: 139(1883).

(Figure 3.16: A to D)

Plants epiphytic to lithophytic, erect; rhizome short, erect, scaly; scales ovate-lanceolate, laciniated, acuminate, brown, 0.6-1.2 × 0.3-0.5 cm; fronds simple, tufted, forming nest, 20-60 × 4-6 cm; stipe woody, stout, 1-4 cm; lamina linear-lanceolate, glabrous, entire, attenuated, caudate, cartilaginous; veins prominent, visible, forked; sori linear, oblique, indusia entire, membranous; sporangium globose, brown, 145-153 μm, spore reniform, spinulose, brown, 47-53 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 04/05/11, *Nayan Thapa & Dorjay Lama*, 008A(SJCBH), 008B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m±15.

Global distribution: Bhutan, China, India, Japan, Nepal, Vietnam.

Local distribution: Rungdung, Third mile.

Asplenium magnificum (Ching) Bir, Fraser-Jenkins & Lovis, Fern Gaz. 13: 61. 1985; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 586.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:445.2015.

Ceterachopsis magnifica Ching, Bull. Fan Mem. Inst. Biol., Bot. 11: 56. 1941.

Plants lithophytic, attached on rocks in streams; rhizome erect, short, scaly; scales ovate, entire, acute, brown, 0.2-0.6 × 0.1-0.4 cm; fronds pinnatifid, herbaceous, 10-20 × 3-4 cm; stipe brown, 2-3 cm, brown, scaly; lamina elliptic, attenuated, obtuse, 8-16 × 3-4 cm; segments alternate, 8-12 pairs, oblong, hyaline, sinuate, basal pair smallest, 0.5 × 0.5 cm; upper one's 2 × 1.3 cm; veins obscure; sori 3-4 pairs/segment, linear to elliptic, 0.3-0.6 cm, indusium elliptic, brown; sporangium globose, brown, 163-173 μm; spore reniform, reticulate, brown, 47-53 μm.

Exsiccatae : West Bengal, Darjiling hills, meghma, 11/07/13, *Nayan Thapa & Dorjay Lama*, 161A(SJCBH), 161B (LBH), N27°01'55.4'' and E088°04'44.5'', Alt: 2674m ± 11.3

Global distribution: China, India, Nepal.

Local distribution: Meghma, Gorkhey.

Asplenium yoshinagae Makino subsp. **indicum** (Sledge) Fraser-Jenkins, Pak. Sys. 5:85-120.1992; Thapa, Pterid. of Nepal 89.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 589. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:159.2015.

Asplenium planicaule Wallich ex Mett., Asplen. Tonkin: 157, 1859.

Asplenium indicum Sledge, Bull. Brit. Mus. Nat. Hist. 3:264, 1965.

Plants epiphytic, pendent; rhizome erect, scaly; scale lanceolate, entire, acuminate, dark-brown, 0.4-0.8 × 0.2-0.3 cm; frond uni-pinnate, coriaceous, 20-50 × 4-6 cm; stipe 10-20 cm, stramineous, scaly; lamina lanceolate, apex acute, 15-30 × 4-6 cm; pinnae alternate, 16-20 pairs, stalked, asymmetrical, ovate, lobed, auricled on acroscopic side, cuneate, acute, 2-3 × 0.8-1.4 cm; veins distinct, forked; sori linear, indusiate; sporangium globose, brown, 140-150 μm; spore reniform, smooth, brown, 40-45 μm.

Exsiccatae : West Bengal,Darjiling hills,Chatakpur,01/10/11, *Nayan Thapa & Dorjay Lama*, 067A(SJCBH), 067B (LBH),N27°00'28.4''and E088°17'37.25'', Alt: 2174m±15.2.

Global distribution: Bhutan,China,India, Japan, Vietnam.

Local Distribution: Chatakpur,Third mile,Singamari,Lava.

Asplenium amoenum Presl ex Mett., *Uber Einige Farngattungen* VI:175.1859; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 582.2008;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:19.2015.

Hymenasplenium obliquissimum (Hayata) Sugimoto, Keys Herb Pl. Jap. Pterid. 356-406, 1966.

Plants epiphytic,pendent;rhizome long, creeping,scaly,scales ovate,entire, acute, brown; fronds uni-pinnate,distant on rhizome, 10-25 × 3-4 cm;stipe 4-7 cm, castaneous,glabrous;lamina green,lanceolate,6-18× 3-4 cm,glabrous;pinnae staked, alternate,10-12 pairs,base asymmetrical,acroscopic side truncate, ,basiscopic side straight,acroscopic margin crenate,apex acute,1.4-1.8× 0.4-0.6 cm;veins prominent,forked;sori linear,indusiate,entire;sporangium globose, brown,134-144µm;spore reniform,smooth,pale-brown,35-43 µm.

Exsiccatae : West Bengal,Darjiling hills, Third mile,01/10/11, *Nayan Thapa & Dorjay Lama*, 070A(SJCBH), 070B (LBH),N27°00'31.4''and E088°17'37.2'',Alt: 2154m±15.2

Global Distribution:China,India, Indonesia, Japan, Vietnam.

Local Distribution: Third mile,Gorkhey,rechala.

Thelypterideaceae Ching ex Pichi-Sermolli in *Webbia* 24:709.1970

Thelypteris Schmidel, *Icon. Pl.*, ed. Keller. 3, 45. 18 Oct 1763, nom. cons.,

1. Fronds uni-pinnate to bipinnate, 20-180×10-30 cm.....2

+. Fronds tripinnate, 100-250× 40-60 cm.....*Thelypteris ornata*

2. Pinnae deeply lobed with segments3

- + Pinnae dentate or serrate, segment absent.....8
- 3. Basal basiscopic pinnules/segment larger than acroscopic segment.....4
- + Basal basiscopic segment equal to acroscopic segment.....5
- 4. Basiscopic pinnules 2.5-4 × 0.5-0.8cm.....*Thelypteris aurita*
- + Basiscopic pinnules 1 × .5cm.....*Thelypteris pyrrhorhachis*
- 5. Segments entire, Lanceolate.....6
- + Segments lobed, oblong.....*Thelypteris flaccida*
- 6. Pinnae pairs more than 15 cm.....*Thelypteris cana*
- + Pinnae pair less than 15 cm.....7
- 7. Terminal pinnae larger than lateral pinnae, 11 × 2.5 cm.....*Thelypteris ornatipes*
- + Terminal pinnae smaller than lateral pinnae, 5 × 2.7 cm.....*Thelypteris procera*
- 8. Basal pinnae auricled at basiscopic side.....*Thelypteris lakhimpurensis*
- + Basal pinnae without auricle.....9
- 9. Largest pinnae pair, 20-30 × 2-4 cm.....*Thelypteris arida*
- + Largest pinnae pair, 20-40 × 3.5-5 cm.....*Thelypteris nudata*

Thelypteris lakhimpurensis (Rosenst.) Iwatsuki, Mem. Coll. Sci. Univ. Kyoto (Bot.) 3:194 (1965); Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 597.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Pronephrium lakhimpurensis (Rosenst.) Holttum, Blumea 20:110.1972.

Dryopteris lakhimpurensis Rosenst., Med. Rijks Herb. 31:7.1917.

(Figure 3.18: A to C)

Plants lithophytic, terrestrial, erect; rhizome short, creeping, scaly; scales ovate, margin hairy, brown, 0.4-0.6 × 0.1-0.2 cm; fronds pinnate, papery, 80-110 × 30-40 cm; stipe castaneous, 30-45;

lamina oblong-lanceolate, 50-70 × 30-40cm; pinnae opposite, 3-5 pairs, sub-sessile, lanceolate, cuneate, acuminate, crenate, terminal pair largest, 15-20 × 4-7cm, basal pair auricled at basiscopic side; veins distinct, united; sori round, median, indusiate, in two row, between the prominent veinlet; sporangium round, brown, 353-373µm; spore reniform, brown, minutely spinose, 47 × 30µm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa & Dorjay Lama*, 127A(SJCBH), 127B (LBH), N27°04'40.4'' and E088°25'18.2'', Alt: 649m±14.1.

Global distribution: Bangladesh, Bhutan, China, Nepal, India.

Local Distribution: Teesta, Singla, Kalijhora.

Thelypteris arida(Don) Morton, Amer. Fern J. 49:113(1959); Thapa, Pterid. of Nepal 91.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List. 590.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Christella arida(Don) Holttum in Nayar & Kaur, Comp. Bedd. Handb. Ferns Brit. India: 206(1974).

Aspidium aridium Don, Prodr. Fl. Nepal.: 4(1825).

Plants lithophytic, terrestrial, erect; rhizome wide, creeping, scaly; scales ovate-lanceolate, entire, acuminate, brown, 0.4-0.8 × 0.1-0.3cm; fronds pinnate, coriaceous, 100-180 × 20-30 cm; stipe castaneus, 40-90 cm; lamina linear-lanceolate, 60-90 × 30-40 cm, pale green; pinnae sub-opposite, 20-30 pairs, sessile, lanceolate, serrate, acuminate, middle pair largest, 20-30 × 2-4 cm, 2-3 basal pairs gradually reduced, 5-10 × 1-2.5 cm; veins distinct, simple, 10-12 pairs; sori round, median, indusiate; sporangium globose, brown, 267-300µm; spore reniform, perispore folded, brown 51-43µm.

Exsiccatae : West Bengal, Darjiling hills, Singla, 23/07/13, *Nayan Thapa & Dorjay Lama*, 183A(SJCBH), 183B (LBH), N27°06'45.4'' and E088°16'3.1'', Alt: 325m±11.1.

Global Distribution: Bangladesh, Bhutan, China, India, Nepal, Taiwan.

Local Distribution: Singla, Rambi, Teesta, Samsing.

Thelypteris flaccida(Blume)Ching,Bull.Fan Mem.Inst.Biol.(Bot.) 6:336(1936); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 151.1965; Thapa, Pterid. of Nepal 93.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List 592.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Metathelypteris flaccida (Bl.)Ching,Acta Phytotax.Sin.8:306(1963)

Aspidium flaccidiun Bl.,Enum.Pl.Jav.:16(1828)

Plants lithophytic, terrestrial, erect; rhizome short, erect, scaly; scales linear-lanceolate, margins hairy, acuminate, 0.5-0.7 × 0.2-0.3 cm; fronds pinnate, tufted, 30-50 × 10-15 cm; stipe 10-20 cm, stramineous; lamina lanceolate, herbaceous, pubescent, 20-30 × 10-15 cm; pinnae subopposite, 8-10 pairs, lanceolate, acuminate, 2nd pair largest, 5-7.5 × 1.5-3 cm, basal pair smaller, deflexed; pinnules opposite, 8-12 pairs, deeply lobed, oblong, obtuse, entire, hairy; veins hidden, forked; sori median, round, indusiate, indusium reniform, brown; sporangium globose, dark brown, 276-303 μm; spore reniform, perispore folded, light brown, 52 × 36 μm.

Exsiccatae : West Bengal, Darjiling hills, Ghoom, 25/07/13, *Nayan Thapa & Dorjay Lama*, 158A (SJCBH), 158B (LBH), N27°00'13.4'' and E088°24'01.2'', Alt: 2501 m ± 11.1.

Global distribution: Bhutan, China, India, Malaya, Sri Lanka.

Local distribution: Lebung, Lopchu, Makaibari.

Thelypteris aurita (Hooker) Ching in Bull.Fan.Mem.Inst.Biol.6:266,1936;); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 152.1965; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 591.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Gymnogramma aurita Hooker, Icon. Pl. 10: t. 974. 1854

Pseudophegopteris aurita (Hooker) Ching, Acta Phytotax. Sin. 8: 314. 1963.

Plants Lithophytic, terrestrial, erect; rhizome creeping, scaly; scales 0.3-0.9× 0.1-0.3 cm, ovate-lanceolate, acuminate, brown; fronds remote, bipinnatifid, coarse, green, 80-120 × 20-40 cm; stipe castenus, shining, 20-40cm; lamina lanceolate, 60-80 × 20-40 cm; pinnae opposite, 15-20 pairs, linear-lanceolate, 2nd last pair longest, 35-40 × 4-6 cm, basal pair 27-33 × 3.5-5 cm; pinnules deeply lobed, opposite, 13-20 pairs, basal baaiscopic largest, 2.5-4 × 0.5-0.8cm, entire, acute; veins distinct, forked; Sori sub-marginal, elongated, exindusiate; sporangium globose, brown, 333-345 μm, spore reniform, pale, 43×23 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 01/10/11, *Nayan Thapa & Dorjay Lama*, 073A(SJCBH), 073B (LBH), N27°00'31.4'' and E088°17'37.2'', Alt: 2154m±15.2

Global Distribution: Bhutan, China, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, Papua New Guinea, Philippines, Vietnam.

Local Distribution: Third miile, Singamari, Lava.

Thelypteris procera (Don) Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 183.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Nephrodium procerum D. Don, Prodr. Fl. Nepal. 6. 1825.

Plants lithophytic, terrestrial, erect; rhizome creeping, scaly; scales lanceolate, brown, 0.6-1 × 0.3-0.4 cm; frond pinnate, distant, 60-80 × 12-20 cm; stipe 15-30cm, stramineous; lamina lanceolate, pubescent, green, herbaceous, 45-60 × 12-20cm; pinnae alternate, 20-25 pairs, lanceolate, acuminate, middle pair largest, 12-20 × 2-3cm, basal pair gradually decreasing, 8-10 × 1-1.5cm; pinnules deeply lobed, opposite, 10-15 pairs, oblong, entire, acute, pubescent; veins distinct, simple; sori round, submarginal, indusiate, hairy; sporangium globose, golden brown, 345-373 μm; spore reniform, pale, perispore folded, 57×43 μm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 25/07/13, *Nayan Thapa & Dorjay Lama*, 184A(SJCBH), 184B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659m±11.3

Global distribution: Bhutan, China, India, Nepal, Thailand.

Local distribution: Lebong, Ging, Lopchu.

Thelypteris nudata(Roxburgh) Morton,*Contr. U.S. Natl. Herb.* 38(7): 352 , 1974; Thapa, Pterid. of Nepal 95.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 595.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Polypodium nudatum Roxburgh, Calcutta J. Nat. Hist. 4: 491. 1844.

Plants lithophytic, terrestrial, erect ;rhizome creeping, scaly; scales lanceolate, entire, acuminate, 0.4-0.6× 0.1-0.2cm,fronds remote,uni- pinnate,60-100× 20-30cm;stipe castenus, 20-40 cm; lamina oblong-elliptic,coriaceous,40-70 × 20-40cm;pinnae sub-opposite, 6-10 pair, sessile, oblong-linear, crenate, broad cuneate, acuminate, 20-40 × 3.5-5 cm, basal pairs gradually reduced,15-30 ×3-4 cm; veins distinct, prominent; sori median, globose, induistae; sporangium globose, brown ,330-380µm; spore reniform, spinulose,brown, 40×25µm.

Exciccatae : West Bengal,Darjiling hills,Makaibari,13/12/11, *Nayan Thapa & Dorjay Lama*, 102A(SJCBH), 102B (LBH),N26°23'02.4''and E088°16'7.1'',Alt: 945m±11.1.

Global distribution:Bhutan, N India, Indonesia, Myanmar, Nepal, Philippines, Vietnam.

Local Distribution: Teesta,Rambi,Sukuna

Thelypteris cana(Baker)Ching,*Bull.Fan Mem.Inst. Biol.* 6(5): 291 1936; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 591. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Nephrodium canum Baker in Hooker & Baker, *Syn. Fil.* 267. 186.

Pseudocyclosorus canus (Baker) Holttum & Grimes, *Kew Bull.* 34: 509. 1980.

(Plate 3.13: A toF)

Plants lithophytic, terrestrial, erect ;rhizome sub-erect, glabrous; fronds clustered, uni-pinnate, 60-120 -15-25 cm; stipe stramineus,20-40cm;lamina lanceolate,pubescent,dark

green, 40-80 × 15-25 cm; pinnae sub-opposite, sub-sessile, 15-20 pairs, lanceolate, acuminate, 15-25 × 2-4 cm, pubescent, middle pinnae largest, basal pinnae gradually reduced, 7-8 × 1-3.5 cm; veins distinct, forked; sori globose, indusiate, brown, hairy; sporangium globose, brown, 330-400 μm; spore reniform, spinulose, brown, 44 × 27 μm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 18/07/11, *Nayan Thapa & Dorjay Lama*, 033A (SJCBH), 033B (LBH), N27°02'0.4'' and E088°16'15.2'', Alt: 1846 m ± 17.1.

Global distribution: Bhutan, China, India, Nepal.

Local Distribution: Rungdung, Kuresong, Pacheng.

Thelypteris pyrrhorhachis (Kunze) Nayar & Kaur subsp. ***distans*** (Mett.) Fraser.-Jenkins, New Syndrome 213.1997; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 597.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Phegopteris distans Mett., Abh. Senck. Naturf. Ges. (Frankfurt) 2(4): 16. 1858.

Polypodium distans Don, Prodr. Fl. Nepal.: 2. 1825.

Plants lithophytic, terrestrial, erect, rhizome sub-erect, scaly; scales lanceolate, margin hairy, acuminate, 0.6-0.8 × 0.2 cm; fronds pinnate, 100-120 × 20-30 cm; stipe stramineous, pubescent, 30-40 cm; lamina sub-coriaceous, green, pubescent abaxially, 70-80 × 20-30 cm; pinnae sub-opposite, 10-15 pairs, sessile, lanceolate, acuminate, pinnae pair longest at the middle, 30 × 3 cm, lower pair gradually reduced, 10 × 2 cm; segments deeply lobed, 10-20 pairs, opposite, oblong, acute, basal basioscopic segment larger, 1 × .5 cm; veins distinct, forked; sori median, exindusiate; sporangium globose, brown, 243-317 μm; spore reniform, smooth, pale, 38 × 20 μm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 10/01/14, *Nayan Thapa & Dorjay Lama*, 205A (SJCBH), 205B (LBH), N27°04'40.4'' and E088°25'18.2'', Alt: 649 m ± 14.1.

Global distribution: Bhutan, China, India, Nepal, Pakistan, Vietnam.

Local distribution: Teesta, Singla.

Thelypteris ornatipes (Holttum & Grimes) Fraser-Jenkins, New Sp. Syndrome 276.1997; Thapa, Pterid. of Nepal 96.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 596.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Pseudocyclosorus ornatipes Holttum & Grimes, Kew Bull. 34:505.1979.

Plants lithophytic, terrestrial, erect, rhizome sub-erect, scaly; scales ovate, acute, margin hairy, 0.4-0.6 × 0.2-0.3 cm; fronds pinnate, linear-lanceolate, 60-80 × 10-14 cm; stipe stramineous, 15-25 cm; lamina linear-lanceolate, pubescent, green, 45-55 × 10-14 cm; pinnae alternate, 8-10 pairs, sessile, lanceolate, acuminate, Pinnae pair largest at mid-half of lamina, 14 × 2 cm, basal pair gradually reduced; pinnules/segment deeply lobed, lanceolate-elliptic, crenate, acute, 1 × 0.4 cm, basal acroscopic segments larger, basiscopic segment slightly smaller; veins distinct, free, simple; sori median, round, indusiate, reniform; sporangium globose, brown, 270-315 μm; spore reniform, spinulose, brown, 43 × 25 μm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 25/09/13, *Nayan Thapa & Dorjay Lama*, 204A (SJCBH), 204B (LBH), N27°02'0.04'' and E088°16'15.2'', Alt: 1846m ± 17.1.

Global distribution: Bhutan, China, India, Nepal

Local distribution: Rungdung, Balason, Chungthung.

Thelypteris ornata (Wallich ex Beddome) Ching in Bull. Fan Mem. Inst. Biol. Bot. 6.346.1936; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 596.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 21.2015.

Polypodium ornatum Wallich ex Beddome., Ferns South. India: t. 171. 1864.

Phegopteris ornata Wallich ex Smith, Hist. Fil. 233. 1875.

Macrothelypteris ornata (Wallich ex Smith) Ching, Acta Phytotax. Sin. 8: 309. 1963.

Plants lithophytic, terrestrial, erect; rhizome short, erect, scaly; scales linear-lanceolate, margin ciliated, acuminate, light brown, 1-2 × 0.2-0.3 cm; fronds tri-pinnate, 100-250 × 40-60 cm; stipe stramineous, 40-100 cm, scaly; lamina ovate, acuminate, pubescent, 60-150 × 40-60 cm; pinnae sub-opposite, 10-20 pairs, stalked, spreading, oblong-lanceolate, acuminate, 20-30 × 6-10 cm; pinnules sessile, opposite, 20-30 pairs, lanceolate, deeply lobed, acuminate, 3-5 × 1-2

cm; ultimate lobes opposite, 12-15 pairs, sessile, oblong, entire, apex rounded, 0.5-1 × 0.2-0.3 cm; veins pinnate; sori orbicular, small, single per segment, exindusiate, brown; sporangium ovoid, dark brown, 350 × 280 μm; spore bilateral, perisporate, light brown, 50 × 24 μm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 10/07/13, *Nayan Thapa & Dorjay Lama*, 152A(SJCBH), 152B (LBH), N27°04'40.4'' and E088°25'18.2'', Alt: 649m ± 14.1.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Singla.

Blechnaceae (Presl) Copeland, Gen.Fil.:155.1947.

- 1. Plants erect, 30-110 × 15-30 cm.....2
- + Plants climber, 60-200 × 20-30 cm.....**Stenochlaena**
- 2. Pinnae margin entire, 20-35 pairs.....**Blechnum**
- + Pinnae margin serrate, with sharp teeth, 11-25 pairs.....**Woodwardia**

Blechnum Linnaeus, Sp.Pl.2:1077.1753.

Blechnum orientale Linnaeus, Sp. Pl. 2: 1077. 1753; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 160.1965; Dixit, A Cen. of Indian Pterid. 172. 1984; Thapa, Pterid. Of Nepal 143. 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:206.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 584.636; Fraser-Jenk., Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 22.2015.

(Figure 3.20: A to D)

Plants lithophytic, terrestrial, erect; rhizome ascending, sub-erect, scaly; scales lanceolate, entire, acuminate, 0.8-1 × 0.1-0.2 cm; fronds uni-pinnate, attenuated at both ends, 30-110 × 15-30 cm; stipe stramineous, 10-40 cm, scaly; lamina ovate-lanceolate, monomorphic, broadest at middle, 20-70 × 15-30 cm, sub-leathery; pinnae alternate, 20-35 pairs, sessile, lanceolate, base rounded, margin entire, acuminate, 7.5-15 × 2.5-3.5 cm, basal pinnae gradually reduced into auricle; veins distinct, free, parallel; sori in two rows, along midrib, linear, indusiate, brown; sporangium globose, dark-brown, 375-385 μm, spore reniform, perisporate, bluish-brown, 36-48 μm.

Exsiccatae : West Bengal,Darjiling hills, Rohini, 03/04/12,*Nayan Thapa & Dorjay Lama, 111A (SJCBH), 111B(LBH)*, N26°54'10.5''and E088°20'33.5'',Alt :850m ± 11.5

Global distribution: Australia, Bhutan, China, Bangladesh, India, Nepal, Japan.

Local Distribution:Rohini, Teesta, Majitar,singla, Garidhura.

Stenochlaena Smith, J.Bot.4:149.1841.

Stenochlaena palustris (Burman) Beddome, Suppl. Ferns S. Ind. 26. 1876; Mehra &Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 160.1965; Dixit , A Cen. of Indian Pterid. 173.1984; Thapa, Pterid. Of Nepal 143 . 2002 ; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 584.637; Fraser-Jenk., Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 22.2015.

Polypodium palustre N. L. Burman, Fl. Indica, 234. 1768;

Plants creeping climber, rhizome erect, scaly; scales ovate,entire,acute,0.8-1× 0.4-0.5 cm; Fronds distant, dimorphic, uni-pinnate,60-200× 20-30 cm; stipe stramineus, 10-60 cm, glabrous ;lamina oblong, greyish-green, 50-140 × 20-30 cm; sterile pinnae 6-20 pairs, alternate, sub-sessile, broadly lanceolate, leathery, margin serrate, apex acuminate,10-15× 2-4 cm; veins distinct, simple; pinnae sterile, sori absent.

Exsiccatae : West Bengal,Darjiling hills, Rohini, 03/04/12,*Nayan Thapa & Dorjay Lama, 112A (SJCBH), 112B(LBH)*, N26°54'04.5''and E088°20'23.5'',Alt :650m ± 11.5

Global distribution: Cambodia,China, India, Indonesia, Laos, Malaysia, Nepal, Thailand, Vietnam; Australia, Pacific islands.

Local distribution: Teesta, Melli.

Woodwardia Smith in Mem.Acad.Sci.Turin.5:411.t.9(3).1793.

Woodwardia unigemmata(Makino)Nakai,Bot.Mag.Tokyo 39:103.1952 ;Mehra &Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 160.1965; Dixit , A Cen. of Indian Pterid. 173.1984; Thapa, Pterid. Of Nepal 143 . 2002 ; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh I:207.2005; Fraser-

Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 584.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 22.2015.

Woodwardia himalaica Ching & Wu in C.Y Wu, Fl. Xizangica 1:191.1983.

Woodwardia biserrata Presl, Rel. Haenk. 1:53.1825.

(Plate 3.8:H)

Plants lithophytic, terrestrial, erect; rhizome thick, erect, scaly; scales oblong-lanceolate, entire, acuminate, brown, 1-1.5 × 0.4-0.6 cm; fronds bi-pinnate, tufted, 80-120 × 30-40 cm; stipe 20-30 cm, grooved, thick, scaly at base; lamina deltoid-lanceolate, coriaceous, grayish-green, 60-90 × 30-40 cm; rachis with bulbils; pinnae alternate, sub-sessile, 10-20 pairs, deeply lobed, ovate-lanceolate, acuminate, 15-20 × 2-3 cm; lobes 11-25 pairs, sub-opposite, oblong-lanceolate, margins serrulate, with sharp teeth, acute, 4-6 × 1-1.5 cm; veins distinct, anastomosing, costal aerole present, veins free at margin; sori oblong, on either side of costa, along costal aeroles, indusiate, grayish-brown; sporangium globose, greyish-brown, 370-380 μm; spore reniform, perisporate, pale, 60-65 μm.

Exsiccatae : West Bengal, Darjiling hills, Third Mile, 23/09/11, *Nayan Thapa & Dorjay Lama*, 060A(SJCBH), 060B (LBH), N27°00'31.4" and E088°17'37.5", Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Japan, Kashmir, Myanmar, Nepal, Pakistan, Philippines, Vietnam.

Local distribution: Third mile, lebung, Lava.

Woodsiaceae Herter, Revista Sudamer. Bot. 9: 14. 1949.

- 1. Fronds uni-pinnate, 30-40 × 6-8 cm..... **Woodsia**
- + Fronds bi-pinnate to tripinnate, pinnatifid..... 20-300 × 7-100 cm... 2
- 2. Lobes 10-15 pairs..... 3
- + Lobes 2-6 pairs..... **Athyrium**
- 3. Lamina hairy **Deparia**
- + Lamina glabrous..... **Diplazium**

Athyrium Roth, Tent.Fl.Germ.3:58.1799.

1. Frond with perennating bulbils.....*Athyrium clarkei*
- + Fronds without Perennating bulbils.....2
2. Stipe 10-20 cm.....3
- + Stipe 5-10 cm.....*Athyrium pectinatum*.
3. Pinnae 15-20 pairs.....4
- + Pinnae 10-15 pairs.....5
4. Pinnales 10-15 pairs.....*Athyrium distans*
- + Pinnules 5-10 pairs.....*Athyrium flabellatum*
5. Ultimate segment 6 pairs.....*Athyrium fimbriatum*
- + Ultimate segment 4 Pairs.....*Athyrium foliosum*

Athyrium distans (Don)Moore ,Ind.Fil.:125.1859; Thapa, Pterid. of Nepal 100.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 601.2008; Fraser-Jenkins,Kandel & Pariyar, Fern and fern allies of Nepal I:22.2015.

Asplenium distans Don,Prodr.Fl.Nepal.:9.1825.

Athyrium imbricatum Christ,Bull.Acad.Int.Geogr.Bot.Mans 16:123.1906.

Plants terrestrial, erect; rhizome stout, erect, scaly, scales lanceolate, entire, acuminate, brown, 0.8× 0.2 cm; frond bi-pinnate, 40-60× 12-24 cm; stipe stramineous, 10-20 cm; lamina herbaceous , ovate-lanceolate,30-40× 12-24 cm; pinnae alternate,15-20 pairs ,stalked, ascending, lanceolate, acuminate, 6-12× 2-3 cm; pinnules 10-15 pairs, alternate, stalked, oblong, deeply lobed, apex acute,1.5× 0.6 cm; segments 2-4 pairs, opposite, oblong, margin entire, apex acute, 0.4× 0.1 cm; veins hidden; sori oblong,close to costule, indusate, brown; sporangium ovoid, dark brown, 300× 240µm; spore lunar, smooth,hyaline,40× 20µm.

Exsiccatae :WestBengal,Darjiling hills,Third mile,20/10/11, *Nayan Thapa & Dorjay Lama*, 081A(SJCBH), 081B (LBH),N27°00'31.4''and E088°17'37.5'',Alt: 2154m±15.

Global distribution: Bhutan, China, India, Japan, Nepal, Vietnam.

Local distribution: Lepcha jagat, sukhia,pokhriabong.

Athyrium clarkei Beddome, Suppl. Ferns S. Ind. 11. 1876; Dixit , A Cen. of Indian Pterid.126.1984; Thapa, Pterid. of Nepal 99.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List 601.2008;Fraser-Jenkins,Kandel & Pariyar, Fern and fern allies of Nepal I:22.2015.

Asplenium clarkei (Beddome) Atkinson ex Clarke, Trans.Linn.Soc.Lond.II Bot.1:489.1880.

(Plate 3.16: A to E)

Plants terrestrial, erect; rhizome erect, stout, scaly; scale ovate – lanceolate, brown, 0.6× 0.4 cm; frond monomorphic, bi-pinnate, 40-60 × 10-12 cm; stipe stramineous, 6-12 cm, glabrous; lamina linear-lanceolate, broadest at middle, herbaceous, adaxially with setae; rachis with proliferating bulbils; pinnae

15-20 pairs, opposite, sub-sessile, lanceolate, acuminate, 5-6× 2-3 cm; pinnules 8-10 pairs, opposite, oblong, shallowly lobed, margin with pointed apices , apex acute, 1-1.5× 0.5-0.9 cm; veins distinct, forked; sori median, linear, 4-6 pairs per pinnules, indusiate, brown; sporangium ovoid, brown, 350× 200µm; spore lunar, smooth, pale , 45× 25µm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 11/07/13, *Nayan Thapa & Dorjay Lama*, 159A(SJCBH), 159B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m±15.

Global distribution: Bhutan, China, India, Myanmar, Nepal.

Local distribution: Lepchajagat, Third mile, Senchel.

Athyrium pectinatum (Wallich ex Mettenius) Moore, Index Fil. 186. 1860; Mehra & Bir , Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 141.1965; Dixit , A Cen. of Indian Pterid.128.1984; Thapa, Pterid. of Nepal.102,2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 602.2008;Fraser-Jenkins,Kandel & Pariyar, Fern and fern allies of Nepal I:23.2015.

Asplenium pectinatum Wallich ex Mettenius, Abh. Senckenberg. Naturf. Ges. 3: 241. 1859.

Plants lithophytic, terrestrial, erect; rhizome long, creeping, scaly; scales lanceolate, entire, acuminate, brown, 0.8 × 0.2 cm; fronds bi-pinnate, 40-60 × 10-18 cm; stipe stramineous, glabrous, 5-10 cm; lamina oblong-lanceolate, acuminate, herbaceous, finely dissected; pinnae alternate, 10-15 pairs, sessile, ascending, lanceolate, acuminate, 5-9 × 2.5-4 cm; pinnules alternate, 5-10 pairs, sessile, finely dissected, lobed, oblong, acute, 1.2-2 × 0.8-1.2 cm; lobes 6 pairs, ascending, oblong, margin shallowly lobed, apex acute, 0.4-0.6 × 0.2-0.3 cm; veins distinct, simple; sori elliptic, on ultimate lobes, indusiate, brown; sporangium ovoid, dark brown, 300 × 270 μm; spore lunar, perisporate, pale, 45 × 30 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 11/07/13, *Nayan Thapa & Dorjay Lama*, 162A(SJCBH), 162B (LBH), N27°00'31.4" and E88°17'37.5", Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Third mile, Meghma, Gayribas.

Athyrium foliolosum Moore ex Sim, Priced Cat. Ferns. 6: 22. 1859; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 144.1965; Dixit, A Cen. of Indian Pterid. 127.1984; Thapa, Pterid. of Nepal 101.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 602. 2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I: 23.2015.

Asplenium fimbriatum Kunze var. *foliosum* (Moore ex Sim), Clarke, Trans Linn. soc. Lond. II Bot. 1: 495. 1880

Plants terrestrial, erect; rhizome short, erect, scaly; scales linear-lanceolate, entire, apex acuminate, 0.6-0.8 × 0.1-0.2 cm; fronds monomorphic, bi-pinnate, 30-60 × 8-18 cm; stipe 10-20 cm; lamina herbaceous, oblong-lanceolate, acuminate, 20-40 × 10-18 cm; pinnae alternate, 10-15 pairs, stalked, broadly lanceolate, acuminate, 4-9 × 2.5-3 cm, basal pinnae reduced, deflexed, 4 × 2.5 cm; pinnules ovate-oblong, deeply lobed, 1-2 × 0.8-1.1 cm;

lobe 4 pairs, opposite, oblong-lanceolate, 0.6× 0.3 cm; veins distinct, forked; sori large, horse shoe shaped, indusiate, brown; sporangium ovoid, dark brown, 300× 240 µm; spore lunar, smooth, hyaline, 40× 18µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, *Nayan Thapa & Dorjay Lama*, 156A(SJCBH), 156B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: Bhutan, China, India, Myanmar, Nepal.

Local distribution: Mangwa, Third mile, Singamari, Lava, chimney.

Athyrium fimbriatum Hooker ex Moore, Index Fil. 185. 1860; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 144.1965; Dixit, A Cen. of Indian Pterid. 127.1984; Thapa, Pterid. of Nepal 101.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 601. 2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:23.2015.

Asplenium fimbriatum Wallich ex Hooker, Sp. Fil. 3: 234.1860.

Athyrium yaklense (Beddome) Panigrahi & Basu, J. Econ Taxon. Bot. 5:1984.

Plants lithophytic, terrestrial, erect; rhizomes short, ascending, scales lanceolate, entire, acuminate, reddish-brown, 0.6-1× 0.2-0.3 cm; fronds monomorphic, tri-pinnate, 40-80× 18-24 cm; stipe stramineous, 8-16 cm, scaly; lamina oblong, acuminate, coriaceous, shining green, 32-64× 18-24 cm; pinnae alternate, 10-15 pairs, stalked, oblong-lanceolate, acuminate, 9-12× 2-4 cm; pinnules alternate, 15-20 pairs, stalked, oblong-lanceolate, acute, basal acroscopic pinnule larger, 2.5× 1.5 cm; segment alternate, 3-4 pairs, oblong, margin toothed, apex acute, 0.5× 0.3 cm; veins distinct, simple; sori median, horse shoe shaped, indusiate, brown; sporangium ovoid, brown, 310× 230 µm; spore lunar shaped, smooth, brown, 40× 26µm.

Exsiccatae : West Bengal, Darjiling hills, Rohini, 03/04/12, *Nayan Thapa & Dorjay Lama*, 117A (SJCBH), 117B (LBH), N26°54'10.5'' and E088°20'33.5'', Alt :850m ± 11.5

Global distribution: Bhutan, China India, Myanmar, Nepal.

Local Distribution: Rohini, lebung, Sidrabong

Athyrium flabellulatum (Clarke) Tardieu, Asplén. Tonkin. 85. 1932; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 144.1965; Dixit, A Cen. of Indian Pterid. 127.1984; Thapa, Pterid. of Nepal 101.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 601.2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:22. 2015.

Asplenium filix-femina (Linnaeus) Bernhardt var. *flabellulata*. Clarke, Trans. Linn. Soc. London, Bot. 1: 493. 1880

Athyrium tenuifolium Hsieh & Wang in Wu, Fl. Xizangica 1:141.1983.

Plants lithophytic, terrestrial, erect, rhizome short, sub-erect, scaly; scales ovate, entire, acuminate, brown, 0.8 × 0.5 cm; fronds monomorphic, bipinnate, 30-50 × 8-14 cm; stipe stramineous, 10-20 cm; lamina lanceolate, acuminate, broadest at middle, 8-14 × 1.5-3 cm, basal pair gradually reduced, 4 × 1 cm; pinnae alternate, 15-20 pairs, stalked, lanceolate, acuminate, 4-7 × 1.5-3 cm; pinnules sub-opposite, 8-10 pairs, sessile, oblong-ovate, margin crenate, apex mucronate, 0.7-1.5 × 0.4-0.9 cm; veins distinct, forked; sori oblong, median on segments, indusiate, brown; sporangium ovoid, golden-brown, 300 × 250 μm, spore lunar, minutely spinous, brown, 30 × 18 μm.

Exsiccatae: West Bengal, Darjiling hills, Tonglu, 12/07/13, *Nayan Thapa & Dorjay Lama*, 176A (SJCBH), 176B (LBH), N27°02'04.4'' and E088°04'46.5'', Alt: 3050m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Tonglu, Sandhakphu, Phalut, Rechal

Deparia W.J Hooker et R.K Greville, Icon. Fil. Pl. 2: pl. 154. 1829.

1. Fronds tri-pinnate..... *Deparia boryana*

+ Frond uni-pinnate..... 2

2. Pinnae 10-14 pairs..... *Deparia petersenii*

+ Pinnae 16-20 pairs.....*Deparia allantodiodes*

Deparia allantodiodes (Beddome) Kato, J. Fac. sci. Univ. Tokyo III Bot. 13:3 93, f.15.1984; Thapa, Pterid. Of Nepal 107.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 606.2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:24.2015.

Arthyrium allantodiodes Beddome, Ferns Brit. India: t.221.1867.

Lunathyrium sikkimensis Ching Acta Phytotax. Sin. 9(1):72.1964.

(Plate 3.21: A to F)

Plants lithophyte, terrestrial, erect; rhizome creeping, slender, scaly; scales lanceolate, entire, acuminate, brown, 0.6× 0.2 cm; fronds uni-pinnate, pinnatifid, 20-50× 3-10 cm; stipe stramineous, 7-15 cm; lamina ovate-lanceolate, acuminate, herbaceous, pubescent, 13-30× 3-7 cm; pinnae alternate, 16-20 pairs, sessile, deeply lobed to the rachis, lanceolate, acuminate, 1.5-5× 1-1.5 cm, basal pinnae gradually decreasing, smallest, 1.5× 1 cm; lobes alternate, 12-15 pairs, oblong, margin serrated, apex mucronate, .5-0.7× 0.2-0.4 cm; veins distinct, forked; sori median, linear, indusiate, grayish-brown; sporangium ovoid, brown, 380× 260µm; spore bilateral, perisporate, hyaline, 47×30µm.

Exsiccatae : West Bengal, Darjiling hills, Tonglu, 14/07/13, *Nayan Thapa & Dorjay Lama*, 171A(SJCBH), 171B(LBH), N27°02 '04.4'' and E088°04 '46.2'', Alt: 3010m±11.8.

Global distribution: Bhutan, China, India, Japan, Korea.

Local distribution: Tonglu, Sandhakphu, Phalut.

Deparia boryana (Willdenow) Kato, Bot. Mag. (Tokyo). 90: 36. 1977; Thapa, Pterid. of Nepal 107.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 606.2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:25.2015.

Aspidium boryanum Willdenow, Sp. Pl., ed. 4, 5: 285. 1810.

Lastrea boryana (Willdenow) Moore, Ind. Fil.:86.1856.

Nephrodium boryanum (Willdenow) Baker, Syn. Fil.:284.1867.

Plants mesophyte, terrestrial, erect; rhizome horizontal, shortly creeping, scaly; scales lanceolate, entire, acuminate, brown, 0.8× 0.2cm; frond tri-pinnate, sub-coriaceous, 100-200× 60-80 cm; stipe stramineous, 20-60 cm, scaly at base; lamina deltate-ovate, pubescent, herbaceous, green, 80-140× 60-80 cm; pinnae 8-10 pairs alternate, stalked, slightly ascending, oblong-lanceolate, 15-20 × 6-12 cm; pinnules alternate, deeply lobed, sessile, 15-20 pairs, oblong, acuminate, 3-6× 1-1.5 cm; segments alternate, 10-12 pairs, oblong, entire, mucronate, basal pair reduced, 0.5-0.8× 0.2-0.3 cm; veins distinct, forked; sori orbicular, median, indusiate, brown; sporangium ovoid, 300× 240µm; spore reniform to bilateral, perisporate, brown, 40×20µm.

Exsiccatae: West Bengal, Darjilinghills, Third mile, 22/09/11, Nayan Thapa, 058A(SJCBH), 058B (LBH), N27°00'31.5'' and E088°17'37.7'', Alt: 2154m ±15.

Global distribution: Africa, Bhutan, China India, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution: Third mile, lebung, singamari.

Deparia petersenii (Kunze) Kato, Bot. Mag. (Tokyo). 90: 37. 1977; Thapa, Pterid. of Nepal 108.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:137.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 606.2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:25.2015.

Asplenium petersenii Kunze, Analect. Pteridogr. 24. 1837.

Athyriopsis lasiopteris (Kunze) Ching, Acta Phytotax. Sin. 9:65.1964.

(Figure 3.19: A to D)

Plants lithophyte, terrestrial, erect; rhizome creeping, slender, scaly; scales lanceolate, entire, acuminate, brown, 0.6× 0.2 cm; fronds uni-pinnate, pinnatifid, 20-45× 7-14 cm; stipe stramineous, 7-15 cm; lamina ovate-lanceolate, acuminate, herbaceous, pubescent, 13-30× 7-14 cm; pinnae alternate, 10-14 pairs, sessile, deeply lobed to the rachis, lanceolate, acuminate, 3.5-7× 2-3 cm; lobes alternate, 8-10 pairs, oblong, margin crisped, apex mucronate, 1-3× 0.3-0.6 cm, basal lobe reduced, smallest, 1× 0.3; veins distinct, forked; sori median, linear, indusiate, grayish-brown; sporangium

ovoid , brown, 367× 250µm; spore bilateral, perisporate, hyaline-brown, 50× 30µm.

Exsiccatae: West Bengal, Darjilinghills, Third mile, 22/09/11, Nayan Thapa, 059A (SJCBH), 059B (LBH), N27°00'31.5'' and E088°17'37.7'', Alt: 2154 m± 15.

Global distribution: Bhutan, China, India, Japan, Korea.

Local distribution: Third mile, Singamari, Lebong.

Diplazium Swartz, J. Bot. (Schrader) 1800(2): 4, 61. 1801.

1. Frond uni-pinnate, 60-140× 20-30 cm.....2
- + Frond bi-pinnate and pinnatifid, 100-300× 30-100 cm.....3
2. Pinnae 15-20 pairs..... *Diplazium stoliczkae*
- + Pinnae 10-15 pairs..... *Diplazium javanicum*
3. Pinnule 15-30 pairs.....4
- + Pinules 8-12 pairs.....6
4. Stipe 50-100 cm..... *Diplazium himalayense*
- + Stipe 10-20 cm.....5
5. Spore spherical, 40-45µm..... *Diplazium kawakamii*
- + Spore bilateral, 48× 30 µm..... *Diplazium forrestii*
6. Scales margin entire, 0.8 -1.5×.2-0.5.....7
- + Scales margin toothed, 1×0.3..... *Diplazium spectabile*
7. Sporangium 350× 250.....8
- + Sporangium 350× 300.....9
8. Spore lunar, 50× 30µm..... *Diplazium esculentum*
- + Spore bilateral, 64× 50µ..... *Diplazium succulentum*
9. Lobes 0.4× 0.2 cm..... *Diplazium maximum*
- + Lobes, 0.6× 0.4 cm..... *Diplazium sikkimensis*

Diplazium esculentum (Retzius) Swartz, J. Bot. (Schrader). 1801(2): 312. 1803; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 148.1965; Dixit, A Cen. of Indian Pteridophytes, 132,1984; Thapa, Pterid. of Nepal,109,2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:161.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List, 584,2008; Fraser-Jenkins, Kandel & Pariyar, Fern and fern allies of Nepal I:25.2015.

Hemionitis esculenta Retzius, Obs.Bot.6:38.1791.

Asplenium esculenta (Retzius) Presl, Rel. Haenk.1:45.1825.

Plants mesophytic, terrestrial, erect; rhizome long, creeping, scaly; scales lanceolate, entire, acuminate, brown, 0.8× 0.2 cm; fronds bi-pinnate to tri-pinnate, green, 100-200× 30-60 cm; stipe stramineous, 20-40 cm; lamina herbaceous, lanceolate to ovate-deltoid, 80-160× 30-60 cm; pinnae alternate, 12-16 pairs, ascending, stalked, lanceolate, acuminate, 15-30× 7-12 cm; pinnules 8-10 pairs, sub-sessile, alternate, broadly lanceolate, margin shallowly lobed, apex acute, 3.5-6× 2-3 cm; veins distinct, anastomosing; sori linear, indusiate, brown; sporangium ovoid, dark-brown, 350 × 250µm; spore lunar, smooth, light brown, 50× 30µm.

Exciccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, Nayan Thapa & Dorjay Lama, 155A(SJCBH), 155B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: Bhutan, China, India, Nepal, Myanmar, Vietnam.

Local distribution: Mangwa, Singla, Teesta.

Diplazium javanicum (Bl.) Makino, Bot.Mag.Tokyo 20:85.1906; Thapa, Pterid. Of Nepal 110,2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 609. 2008 ; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Diplaziopsis javanica (Bl.) Chr., Ind.Fil.:227.1905.

Plant mesophytic, terrestrial, erect; rhizome thick, erect, scaly; scales lanceolate, entire, acuminate, blackish brown, 1× 0.3 cm; fronds uni-pinnate, 60-140× 20-30 cm; stipe stramineous, 20-40 cm; lamina herbaceous, lanceolate, green, 40-100× 20-30 cm; pinnae 10-15 pairs, alternate, subsessile, oblong lanceolate, margin entire, acuminate, 10-15× 2.5-4 cm; veins distinct forming aeroles; sori elongate, linear, indusiate, brown; sporangium ovoid, dark brown, 370× 270µm; spore lunar, perisporate, brown, 50× 33µm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 17/09/13, *Nayan Thapa & Dorjay Lama*, 201A(SJCBH), 201B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659m±11.5.

Global distribution: Bhutan, India, Nepal.

Local distribution: Lebong.

Diplazium sikkimense (Clarke) Christensen, Contr. U.S. Natl. Herb. 26: 304. 1931; Thapa, Pterid. of Nepal 112.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:183.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 611.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Asplenium sikkimense Clarke, Trans. Linn. Soc. London, Bot. 1: 500. 1880.

Plants mesophytic, terrestrial, erect; rhizome thick, horizontal, scaly; scales oblong, toothed, acuminate, light brown, 0.5-1.5× 0.1-0.4 cm; fronds, bipinnate, 200-300 × 30-40 cm; stipe stramineous, 50-100 cm; lamina coriaceous, glabrous, ovate, 150-200× 30-40 cm; pinnae 10-12 pairs, alternate, subsessile, oblong-lanceolate, acuminate, 15-20× 6-8 cm, costa rough, scabrous; pinnules 10-12 pairs, sub opposite, alternate, sessile, oblong, deeply lobed, apex caudate, 3-4× 1.5-2.5cm; lobes oblong, margin serrate, apex mucronate, 0.6× 0.4 cm; veins distinct, forked; sori oblong, indusiate, brown; sporangium ovoid, dark brown, 350× 300µm; spore spherical, smooth, dark brown, 40-45µm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 30/07/13, *Nayan Thapa & Dorjay Lama*, 188A(SJCBH), 188B (LBH), N27°02'00.4'' and E088°16'15.5'', Alt: 1846m±10.5.

Global distribution: China, India.

Local distribution: Rungdung, Third mile.

Diplazium maximum (D. Don) C. Christensen, Index Filic. 235. 1905; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 147.1965; Thapa, Pterid. of Nepal 113.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List. 609.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Asplenium maximum D. Don, Prodr. Fl. Nepal. 8. 1825.

Plants mesophytic, terrestrial, erect; rhizome thick, horizontal, scaly; scales oblong, toothed, acuminate, light brown, 0.5-1.5 × 0.1-0.4 cm; fronds, bipinnate, 200-300 × 30-40 cm; stipe stramineous, 30-70 cm; lamina herbaceous, glabrous, ovate, 170-230 × 30-40 cm; pinnae 10-12 pairs, alternate, sub sessile, oblong-lanceolate, acuminate, 15-20 × 6-8 cm, costa smooth, glabrous; pinnules 10-12 pairs, sub opposite, alternate, sessile, oblong, deeply lobed, apex caudate, 3-4 × 1.5-2.5 cm; lobes oblong, margin serrate, apex mucronate, 0.4 × 0.2 cm; veins distinct, forked; sori oblong, indusiate, brown; sporangium ovoid, dark brown, 360 × 300 μm; spore lunar to reniform, smooth, perisporate, pale, 47 × 24 μm.

Exsiccatae : West Bengal, Darjiling hills, Takdah, 10/07/13, *Nayan Thapa & Dorjay Lama, 148A (SJCBH), 148B (LBH), N27°02'01.4''* and *E088°20' 52.5''*, Alt: 1865m ± 10.5.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Takdah, Third mile, Singamari, Lebong.

Diplazium succulentum (Clarke) Christensen, Index Filic. 240. 1905; Thapa, Pterid. of Nepal 112.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 611.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Asplenium succulentum Clarke, Trans. Linn. Soc. London, Bot. 1: 502. 1880.

(Figure 3.3: A to D)

Plants mesophytic, terrestrial, erect; rhizome creeping, wide, scaly; scales lanceolate, margin toothed, acuminate, light brown, 1 × 0.3 cm; fronds bipinnate, 200-300 × 30-60 cm; stipe stramineous, 40-60 cm; lamina herbaceous, deltoid, acuminate, 160-240 × 30-60 cm; pinnae 8-10 pairs, alternate, stalked, ascending, oblong-lanceolate, acuminate, 15-30 × 8-16 cm; pinnules alternate, 8-10 pairs, alternate, lower pinnules stalked, oblong-lanceolate, margin deeply lobed, apex acuminate, 8-16 × 4-6 cm; lobes alternate, 8 pairs, oblong, entire, apex round, 1-2 × 0.5-0.8 cm, basiscopic lobes larger, 2.1 × 1 cm; veins distinct, forked; sori linear, median, single per lobe, indusiate, brown; sporangium ovoid, dark brown, 350 × 280 μm; spore bilateral, smooth, pale, 64 × 50 μm.

Exsiccatae: West Bengal, Darjilinghills, Gayribas, 25/10/11, Nayan Thapa, 085A (SJCBH), 085B (LBH), N27°03'20.5'' and E088°01'23.4'', Alt: 2656 m ± 15.

Global distribution: China, India, Nepal.

Local distribution: Gayribas, Senchel

Diplazium stoliczkae Beddome, Suppl. Ferns South India Brit. India: 13, t. 361. 1876; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 145. 1965; Thapa, Pterid. of Nepal 112. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 611. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 25. 2015.

Diplazium hirsutipes (Beddome) Nayar & Kaur, Comp. Bedd. Handb. Ferns Brit. India: 44. 1974.

Diplazium calogramma Christ, Not. Syst. (Paris) 1: 45. 1909.

Plants mesophytic, terrestrial, erect; rhizome erect, robust, scaly; scales linear lanceolate, margin toothed, acuminate, blackish-brown; fronds unipinnate, 40-60 × 10-20 cm; stipe chestnut coloured, 10-20 cm, scaly; lamina lanceolate, green, 30-40 × 10-20 cm; pinnae 15-20 pairs, alternate, sessile, lanceolate, margin deeply lobed, acuminate, 5-10 × 1-1.5 cm; lobes 15-20 pairs, sub-opposite, oblong, entire, apex round, 0.7 × 0.4 cm; veins distinct, forked; sori median, elongate, along the veins, indusiate, brown;

sporangium ovoid, dark brown, 400× 323µm; spore reniform, perisporate, hyaline, 43× 30µm.

Exsiccatae : West Bengal, Darjiling hills, Chatakpur, 14/07/13, *Nayan Thapa & Dorjay Lama*, 178A(SJCBH), 178B (LBH), N27°00'43.4'' and E088°17'30.5'', Alt: 2253m±15.5.

Global distribution: Bhutan, China, India, Myanmar, Nepal, Taiwan.

Local Distribution: Chatakpur, Lebong, Mungpoo.

Diplazium himalayense (Ching) Panigrahi, *Phytologia* 31(3): 254. 1975; Thapa, *Pterid. of Nepal* 113.2002; Fraser-Jenkins, *Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List* 609.2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and fern-allies of Nepal I*:25.2015.

Allantodia himalayense Ching, *Acta Phytotax. Sin.* 9:55.1964.

Diplazium polypodioides Bl. Var *vestita* (Clarke) Iwats., *Univ. Mus. Univ. Tokyo Bull.* 31:319.1988.

Plants mesophyte, terrestrial, erect; rhizome massive, sub erect, scaly; scales lanceolate, entire, acuminate, brown, 0.8-1.2× 0.2-0.4 cm; fronds bipinnate, pinnatifid, coriaceous, 200-300× 50-100 cm; stipe woody, erect, 50-100 cm, densely scaly; lamina green, ovate, 150-200× 50-100 cm; pinnae 25-30 pairs, alternate, stalked, lanceolate, acuminate, 25-50× 8-16 cm; pinnules alternate, 25-35 pairs, sub-sessile, lanceolate, deeply lobed, acuminate, 4-8× 2-4 cm; lobes oblong, margin dentate, apex round, 1-2× 0.5-1 cm; costules scaly; veins distinct, forked; sporangium ovoid, dark brown, 400× 354µm; spore lunar, perisporate, brown, 50× 37 µm.

Exsiccatae: West Bengal, Darjiling hills, Ragarung, 01/10/11, *Nayan Thapa*, 078A(SJCBH), 078B (LBH), N27°00'20.5'' and E088° 07' 23.4'', Alt: 1985m ±11.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Ragarung, Lebong.

Diplazium spectabile (Wallich ex Mettenius) Ching, Lingnan Sci. J. 15: 278. 1936; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 146.1965; Thapa, Pterid. of Nepal 112.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 611.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Asplenium spectabile Wallich ex Mettenius, Abh. Senckenberg. Naturf. Ges. 3: 240 (seors. 196). 1859.

Asplenium multicaudatum var *triste* Clarke, Trans. Linn.Soc.Lond.II Bot.1:502.1880.

(Plate 3.15:A to F)

Plants mesophytic, terrestrial, erect; rhizome long, creeping, scaly; scales lanceolate, margins toothed, acuminate, blackish-brown 0.8-1 × 0.2-0.3cm; fronds bi-pinnate, pinnatifid, coriaceous, 100-150 × 30-40 cm; stipe stramineous, dark brown at base, 20-40 cm; lamina deltoid, acuminate, 80-110 × 30-40 cm; pinnae 10-12 pairs, alternate, stalked, ascending, oblong-lanceolate, acuminate, 15-20 × 6-12 cm; pinnules alternate, 8-10 pairs, sessile, oblong-lanceolate, deeply lobed, acuminate, 3-6 × 1-2 cm; lobes 8-10 pairs, oblong, dentate, apex mucronate, 1 × 0.5cm; veins hidden, forked; sori ovoid, dark brown, 350 × 293 μm; spore reniform, perisporate, smooth, 40 × 27 μm.

Exsiccatae : West Bengal, Darjiling hills, Kuresong, 13/12/11, *Nayan Thapa & Dorjay Lama*, 104A(SJCBH), 104B (LBH), N26°53'03.4'' and E088°17'1.1'', Alt: 1498m ± 10.1.

Global distribution: Bhutan, China India, Nepal.

Local distribution: Lebung, Third mile, Mungpoo.

Diplazium kawakamii Hayata, J. Coll. Sci. Imp. Univ. Tokyo. 30: 435. 1911; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 609.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:25.2015.

Allantodia kawakamii (Hayata) Ching; *A. kingpingensis* Ching, not *A. jinpingensis* W. M. Chu; *Athyrium allanticarpum* Rosenstock; *A. kawakamii* (Hayata) C. Christensen.

Plants mesophytic, terrestrial, erect; rhizome ascending, sub-erect, scaly, scales lanceolate, entire, acuminate, brown, 0.6-1 × 0.2-0.3 cm; fronds monomorphic, bi-pinnate, 40-80 × 10-30 cm; stipe 5-10 cm, stramineous; lamina coriaceous, oblong-lanceolate, dark green, glabrous, 35-70 × 20-30 cm; pinnae alternate, 10 pairs, stalked, ascending, oblong-lanceolate, broadest at base, acuminate, 5-15 × 2-6 cm; pinnules alternate, 15-18 pairs, lanceolate, lobed, acuminate, lobes oblong, entire, apex rounded, 1-1.5 × 0.5-0.7 cm; veins distinct, forked, sori on lobes, linear on veins, indusiate, brown; sporangium ovoid, dark brown, 373 × 284 μm; spore spherical, perisporate, hyaline, 45-50 μm.

Exsiccatae: West Bengal, Darjiling hills, Lebung, 17/09/13, *Nayan Thapa & Dorjay Lama*, 200A (SJCBH), 200B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659 m ± 11.5.

Global distribution: Bhutan, China, India, Nepal, Japan.

Local distribution: Lebung.

Diplazium forrestii (Ching ex Z. R. Wang) Fraser-Jenkins, *Taxon. Revis. Indian Subcontinental Pteridophytes*. 256. 2008; Fraser-Jenkins, Kandel & Pariyar, *Fern and fern allies of Nepal I*: 25. 2015.

Allantodia forrestii Ching ex Z. R. Wang, *Acta Phytotax. Sin.* 32: 82. 1994.

Plants mesophytic, terrestrial, erect; rhizome robust, erect, scaly; scales lanceolate, toothed, entire, acuminate, brown, 1 × 0.2 cm, frond bi-pinnate, pinnatifid, 60-100 × 20-34 cm; stipe stramineous, glabrous, 15-30 cm; lamina ovate, acuminate, herbaceous, 45-70 × 15-30 cm; pinnae alternate, 15-20 pairs, stalked, oblong, acuminate, 10-17 × 5-8 cm; pinnules 15 pairs, alternate, sub-sessile, acroscopic basal pair smallest, lanceolate, lobed to the rachis, acuminate, 2.5-4 × 1-2 cm; lobes 6 pairs, sessile, oblong, crenate, apex rounded, 1.2 × 0.5 cm; veins distinct, forked; sori median, linear, on either side of costule, indusiate, brown; sporangium ovoid, dark brown, 350 × 280 μm; spore bilateral, smooth, pale, 48 × 30 μm.

Exsiccatae : West Bengal,Darjiling hills,Rungdung,30/07/13, *Nayan Thapa & Dorjay Lama, 187A(SJCBH), 187B (LBH),N27°01'16.4''*and *E088°16'24.5''*,Alt: 1586m±8.3.

Global distribution:China, India, Myanmar.

Local distribution: Rungdung,Lebong,

Woodsia elongata Hooker,Sp.Fil.1:62.1844; Thapa, Pterid. of Nepal 108.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 608.2008; Fraser-Jenkins,Kandel & Pariyar, Fern and fern allies of Nepal I:26.2015.

Cheliantopsis elongata Copeland,Univ. Calf.Publ.Bot.12:395.1931.

Plants lithophytic, terrestrial, erect; rhizome creeping, scaly; scales linear, entire, acuminate, brown, 0.6× 0.1 cm; frond monomorphic, uni-pinnate, 30-40× 6-8 cm; stipe, 5-10 cm, chesnut coloured, scaly; pinnae 15-20 pairs, alternate, sessile, pinnatifid, oblong, lobed, apex rounded, pubescent, 3-4× 1.5-2.2 cm, basal pinnae gradually reduced; lobes opposite ,3-6 pairs, oblong, margin entire, apex rounded, pubescent, .7-1.1× 0.4-0.8 cm; veins distinct, simple; sori globose, single per lobes , at vein ending; sporangium globose, brown, 276-285µm, spore spherical. tuberculate, brown, 30-45µm.

Exsiccatae : West Bengal,Darjiling hills,Tonglu,14/07/13, *Nayan Thapa & Dorjay Lama, 171A(SJCBH),171B(LBH),N27°02 '04.4''*and *E088°04'46.2''*,Alt: 3010m±11.8.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Tonglu, Sandhakphu.

Dryopterideaceae Herter, Rev.Sudam.Bot.9:15.1949.

1. Frond monorphic2
- + Fronds monomorphic- dimorphic.....3
2. Lamina uni-pinnate to bipinnate..... 7

- + Lamina tri-pinnate to quadripinnate..... 6
- 3. Costa and costule hairy.....**Tectaria**
- + Costa and costule glabrous.....**Dryopteris**
- 4. Veins distinct, forked.....5
- + Veins distinct, anastomosing6
- 5. Sori restricted to the apices of pinnae.....**Dryopsis**
- + Sori distributed through-out the pinnae.....**Polystichum**
- 6. Pinnae 15-20 pairs..... **Phanerophlebiopsis**
- + Pinnae 3-7 pairs.....**Cyrtomium**
- 7. Stipe purplish,scaly,20-30cm..... 8
- + Stipe stramineus, 10-20 cm..... **Arachniodes**
- 8. Pinnae 10-20 pairs.....**Peranema**
- + Pinnae 8-10 pairs..... **Nothoperanema**

Arachniodes Blume,Enum.Pl.Javae 2:241.1828.

Arachniodes assamica (Kuhn) Ohwi, J. Jap. Bot. 37: 76. 1962; Dixit , A Cens. of Indian Pterid. 147.1984; Thapa, Pterid. of Nepal 116. 2002 ; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 619.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:26 .2015

Aspidium assamicum Kuhn, Linnaea 36: 108. 1869.

Plants lithophytic, terrestrial, erect; rhizome creeping, scaly; scales lanceolate, entire, acuminate,0.6-1.2× 0.2-0.4 cm; fronds tri-pinnate, 40-60× 10-30 cm; stipe stramineus, 10-20 cm; lamina deltoid, acuminate, coriaceous, 30-40× 10-30 cm; pinnae alternate, 6 pairs, stalked,1-2 cm, oblong-lanceolate, acuminate,5-15× 2.5-8cm,lowest pinnae deltoid, forked, bipartite; pinnules 8-10 pairs, sub-opposite, sub-sessile, ascending, rhombic-lanceolate, acroscopic margin serrate , sharply toothed, base cuneate,1.2- 4× 0.6-2 cm; ultimate pinnules inbasal basioscopic pinnae , sub-sessile, ovate,

cuneate, acuminate, 8× 3 cm; veins distinct, forked; sori median, globose, 5-8 pairs per pinnule, indusiate, brown; sporangium ovoid-spherical, dark brown, 300× 280µm; spore bilateral, perisporate, brown, 34× 26µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, *Nayan Thapa & Dorjay Lama*, 147A(SJCBH), 147B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m±10.5.

Global distribution: China, India, Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Mangwa, Takdah, Pokhriabong.

Crytomium Presl, Tent. Pterid.: 84. t. 2. 2f. 19. 1863.

Crytomium caryotideum (Wallich ex Hooker & Greville) C. Presl, Tent. Pterid. 86. 1836; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 129. 1965; Dixit, A census of Indian Pteridophytes 140. 1984; Thapa, Pteridophytes of Nepal 117. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 619. 2008.

Aspidium caryotideum Wallich ex Hooker & Greville, Icon. Filic. 1: t. 69. 1828.

(Plate 3.9:F,G,H)

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scale lanceolate, margin hairy, acuminate, brown, 0.6-0.8× 0.2-0.3 cm; fronds uni-pinnate, oblong-lanceolate, 40-80× 12-20 cm; stipe stramineous, scaly, scales blackish-brown, 10-20 cm; lamina coriaceous, oblong-lanceolate, green, 30-60× 12-20 cm; pinnae alternate, 3-7 pairs, deltate-ovate, base truncate, margin serrate, acroscopic margin with auricle, acuminate, 12-20× 3-5 cm; veins distinct, anastomosing; sori globose, scattered abaxially, indusiate; sporangium globose, 210-215µm; spore reniform, tuberculate, brown, 48-56µm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 15/08/11, *Nayan Thapa & Dorjay Lama*, 051A(SJCBH), 051B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659m±11.3

Global distribution: Bhutan, China, India, Japan, Nepal, Pakistan, Philippines, Vietnam.

Local Distribution: Lebong, Rungdung, Mungpoo

Dryopsis Holttum & Edwards, Kew Bull. 41: 179. 1986.

Dryopsis apiciflora (Wallich ex Mettenius) Holttum & Edwards, *Kew Bull.* 41(1): 189. 1986; Thapa, Pteridophytes of Nepal 118.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 625.2008.

Aspidium apiciflorum Wallich ex Mettenius, Abh. Senckenberg. Naturf. Ges. 2: 338 (seors. 54). 1858.

Dryopteris apiciflora (Wallich ex Mettenius) Kuntze, Revis. Gen. Pl. 2: 812. 1891.

(Plate:3.6)

Plants lithophytic, terrestrial, erect; rhizomes erect, scaly; scales, linear-lanceolate, entire, acute, 0.8-1.2 × 0.1-0.2 cm; fronds uni-pinnate, lanceolate, 30-80 × 10-30 cm; stipe stramineous, 10-30 cm, scaly; lamina coriaceous, green, 20-50 × 10-30 cm; rachis, costa scaly; pinnae opposite, 10-20 pairs, oblong-lanceolate, acuminate, 5-15 × 1.5-2 cm; deeply lobed; segment oblong, entire, obtuse, abaxially glabrous, 1.5-2 × 0.5-0.9 cm; veins distinct, forked; sori globose, restricted to apex, indusiate, brown; sporangium globose, brown, 230-245 μm; spore ellipsoid, minutely spinose, brown, 43-47 μm.

Exsiccatae : West Bengal, Darjiling hills, Meghma, 20/10/11, Nayan Thapa & Dorjay Lama, 083A(SJCBH), 083B(LBH), N27°01' 23.4'' and E088°043' 38.2'', Alt: 2700m ± 15.

Global distribution: Bhutan, China, India, Myanmar, Nepal.

Local distribution: third mile, senchel, lava.

Dryopteris Adanson, Fam. des Pl. 2: 20, 551. 1763.

- 1. Fronds dimorphic.....2
- + Fronds monomorphic.....3

- 2. Pinnules lanceolate, margin notched, 1.5 × 0.5 cm.....*Dryopteris marginata*
- + Pinnules oblong, margin entire, 1 × 0.4 cm.....*Dryopteris cochleata*

- 3. Lamina uni-pinnate, 30-100 × 10-20 cm.....4
- + Lamina bi-pinnate, 10-100 × 5-40 cm.....5

- 4. Pinnae 10-15 pairs.....*Dryopteris atrata*
- + Pinnae 20-30 pairs.....*Dryopteris conjugata*

5. Pinnae 2.5-8 × 1-3cm..... 6
 +. Pinnae 10-20× 3-8 cm.....7
 6. Segment 5-10 pairs.....8
 +. Segment 4-6 pairs.....*Dryopteris serratodentata*
 6. Stipe ebenous,10-20cm.....*Dryopteris splendens*
 +. Stipe stramineus, 10-30 cm.....9
 8. Scales 0.6-0.8× 0.2-0.3cm.....*Dryopteris woodsii*
 +. Scales 0.4-0.6× 0.1-0.2 cm.....*Dryopteris juxtaposita*
 9. Segmnet 6-8 pairs.*Dryopteris subimpressa*
 +. Segemnet 10-20 pairs..... *Dryopteris wallichiana* subsp
nepalensis

Dryopteris juxtaposita Christ, Bull. Acad. Int. Géogr. Bot. 17: 138. 1907; Thapa, Pterid. of Nepal 122. 2002 ; Fraser-Jenkins,Tax. Revi. Of Three Hundreed Ind. Subcon. Pterid. With a revi. Cen. List 616.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:27 .2015

Nephrodium filix-mas var. *normalis* Clarke,Trans.Linn.Soc.Lond.II Bot.1:519,t.68,f.2,1880.

Plants lithophytic, terrestrial ,erect;rhizome thick,erect,scaly;scales lanceolate, entire, acuminate,brown,0.4-0.6× 0.1-0.2 cm; fronds ovate-lanceolate,bipinnate,10-60× 8-16cm;stipe stramineus,5-20 cm,scaly at base;lamina coraiceous,green,5-40× 8-16 cm;pinnae 10-15 pairs,sub opposite,sessile,lanceolate,acuminate, 4-8 × 2-3 cm,deeply lobed, pinnae broadest at middle,basal pinnae gradually decreasing; segements 8-10 pairs,oblong,margim serrate,apex serrated,2-3× 1-2cm;veins distinct, forked; sori globose,sub-marginal,indusiate,brown;sporangium globose,brown,270-275µm;spore reniform,perisporate,brown,45-47µm.

Exsciccatae : West Bengal,Darjiling hills,Third Mile,01/10/11, *Nayan Thapa & Dorjay Lama*, 077A(SJCBH), 077B (LBH),N27°00'31.4''and E088°17'37.5'',Alt: 2154m±15.

Global distribution: Bhutan,China, India, Kashmir, Nepal.

Local Distribution: Third mile, Singamari

Dryopteris marginata (Clarke) Christ, Philipp. J. Sci., C. 2: 212. 1907; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 133.1965; Dixit, A Cens. of Indian Pterid. 151.1984; Thapa, Pterid. of Nepal 123. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 616.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:27. 2015

Nephrodium filix-mas (Linnaeus) Richard var. *marginatum* C. B. Clarke, Trans. Linn. Soc. London, Bot. 1: 521. 1880.

Nephrodium marginatum Hope in Jour. Bombay Nat. Hist. Soc., 14, 740, t.38.1903.

Plants lithophytic, terrestrial, erect; rhizome erect, scaly; scales lanceolate, entire, acuminate, light brown, 0.8-1 × 0.2-0.3 cm; fronds bi-pinnate, dimorphic, fertile fronds narrower, 50-90 × 10-20 cm; stipe stramineous, 30-45 cm in fertile fronds, 5-15 cm in sterile fronds; lamina herbaceous, lanceolate, 20-45 × 10-20 cm; pinnae alternate, 8-12 pairs, sessile, lanceolate, acuminate, 5-10 × 2.5-3.5 cm; sterile pinnules sessile, oblong, serrated, obtuse, 2 × 1 cm; fertile pinnules contracted, lanceolate, margin notched, acute, 1-1.5 × 0.3-0.5 cm; veins distinct, forked; sori sub-marginal, globose, indusiate, brown; sporangium globose, brown, 230-240 μm; spore reniform, perisporate, hyaline, 35-40 μm.

Exsiccatae: West Bengal, Darjiling hills, Lebong, 16/08/11, *Nayan Thapa & Dorjay Lama*, 052A(SJCBH), 052B(LBH), N27°04' 13.4'' and E088°16' 57.5'', Alt: 1648m ± 12.

Global distribution: Bhutan, India, Myanmar, Nepal, Thailand, Vietnam.

Local Distribution: Lebong, Takdah.

Dryopteris wallichiana (Sprengel) Hylander subsp. **nepalensis** Fraser-Jenkins, New Sp. Syndr. Indian Pteridol. 134.1997; Thapa, Pterid. of Nepal 126. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 618.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:28. 2015

Plants lithophytic, terrestrial, erect, rhizome ascending, erect, scaly; scales lanceolate, entire, acuminate, dark brown, 0.6-1 × 0.2-0.3 cm; fronds bi-pinnate, 60-100 × 20-30 cm, stipe stramineous, 10-30 cm, scaly; lamina ovate-lanceolate, green, 50-70 × 20-30 cm; pinnae alternate, 20-30 pairs, sub-sessile, lanceolate, deeply lobed, acuminate, 10-15 × 2.5-3.5 cm; segments 10-20 pairs, oblong, margin cartilaginous, apex round, 1.2-1.7 × 0.5-0.8 cm; veins distinct, forked; sori globose, indusiate, brown; sporangium globose, dark-brown, 310-320 μm; spore reniform, perisporate, brown, 40 × 25 μm.

Exsiccatae : West Bengal, Darjiling hills, Meghma, 11/07/13, *Nayan Thapa & Dorjay Lama*, 166A(SJCBH), 166B(LBH), N27°01'23.4'' and E088°043'38.2'', Alt: 2700m ± 15.

Global distribution : Bhutan, India, Japan, Malaysia, Myanmar, Nepal.

Local distribution: Meghma, Senchel.

Dryopteris woodsiiisora Hayata, Icon. Pl. Formosan. 6: 158. 1916; Thapa, Pterid. of Nepal 126.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 618.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 28. 2015

Dryopteris tenuissima Tagawa, Acta Phytotax. Geobot. Kyoto 1: 308, 1932.

(Plate 3.8: I)

Plants lithophytic, terrestrial, erect; rhizome ascending, erect, scaly; scales ovate, entire, acuminate, 0.6-0.8 × 0.2-0.3 cm; fronds uni-pinnate, 20-45 × 8-15 cm; stipe cataneous, 4-7 cm; lamina ovate-lanceolate, 16-38 × 8-15 cm; pinnae sub-opposite, 10-20 pairs, sub-sessile, deeply lobed, ovate-lanceolate, acuminate, largest at middle, 7.5 × 3 cm, lower pinnae gradually decreasing, 4 × 1.5 cm; segments sub-opposite, 5-10 pairs, oblong, margin toothed, apex round, 1-1.5 × 0.5-0.7 cm; sporangium globose, dark brown, 300-310 μm; spore lunar, grayish, tuberculate, 48-55 μm.

Exsiccatae : West Bengal, Darjiling hills, Third Mile, 23/05/13, *Nayan Thapa & Dorjay Lama*, 123A(SJCBH), 123B(LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Nepal, Thailand.

Local Distribution: Third mile, Singamari, lava.

Dryopteris splendens (Hooker) Kuntze, Revis. Gen. Pl. 3: 813. 1891; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 133.1965; Dixit, A Cens. of Indian Pterid. 154.1984; Thapa, Pterid. of Nepal 125. 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I:290.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 617.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:27.2015

Nephrodium splendens Hooker, Sp. Fil. 4: 126. 1862.

(Plate 3.19: D to F)

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scales linear-lanceolate, entire, acuminate, 0.6-0.8 × 0.1-0.2 cm, brown; fronds bi-pinnate, monomorphic, 50-90 × 20-40 cm; stipe ebenous, 10-20 cm; lamina lanceolate, coriaceous, 40-70 × 20-40 cm; pinnae alternate, sub-sessile, 15-20 pairs, lanceolate, acuminate, 10-20 × 3-4 cm; pinnules sub-opposite, 15-20 pairs, sessile, oblong, margin notched, acroscopic base cuneate, apex mucronate, 1.5-2 × 0.4-0.6 cm; veins distinct, forked; sori median, closed to costules, round, indusiate, brown; sporangium globose, dark brown, 270-275 μm; spore spherical, tuberculate, brown, 40-45 μm.

Exsiccatae : West Bengal, Darjiling hills, Meghna, 11/07/13, *Nayan Thapa & Dorjay Lama*, 165A(SJCBH), 165B(LBH), N27°01'23.4'' and E088°043.2'37.5'', Alt: 2700m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Meghna, Senchel.

Dryopteris atrata (Wallich ex Kunze) Ching, Sinensia. 3: 326. 1933; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 130.1965; Dixit, A Cens. of Indian Pterid. 148.1984; Thapa, Pterid. of Nepal 120.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 614.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:26.2015

Aspidium atratum Wallich ex Kunze, Linnaea 24: 279. 1851.

Dryopteris gambeli (Hope)Chr.,Index Fil.,267,1905

Plants lithophytic,terrestrial,erect;rhizome sub-erect, robust, scaly;scales linear-lanceolate,entire,acuminate, dark brown,0.8-1.5× 0.2-0.3cm; fronds uni-pinnate,ovate-lanceolate,30-60× 10-20cm;stipe greenish,10-20 cm,scaly at base;lamina herbaceous,20-40× 10-20cm;pinnae sub-opposite,10-15 pairs,sessile,base truncate,margin dentate,acuminate,7.5-15× 2-3.5 cm;veins distinct ,forked;sori scattered abaxially,globose,indusiate,brown;sporangium globose,dark-brown,260-270µm;spore reniform,perisporate,brown,40-45µm.

Exsiccatae : West Bengal,Darjiling hills,Damsong,03/01/11, *Nayan Thapa & Dorjay Lama*, 001A(SJCBH), 001B (LBH),N27°08'21.4''and E088°34'47.5'',Alt: 1825m±12.8.

Global distribution:Bhutan,China, India, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

Local distribution: Damsong,Lopchu

Dryopteris cochleata (Buchanan-Hamilton ex D. Don) C. Christensen, Index Filic. 258. 1905; Dixit , A Cens. of Indian Pterid. 150.1984; Thapa, Pterid. of Nepal 121. 2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 615.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:27 .2015

Nephrodium cochleatum Buchanan-Hamilton ex D. Don, Prodr. Fl. Nepal. 6. 1825.

Plants lithophytic,terresterail,erect;rhizome ascending,denely scaly;scales lanceolate,entire,acuminate,light-brown,0.8-1.6× 0.2-0.3 cm;fronds bi-pinnate,dimorphic, fertile fronds narrower,coraiceous, 40-80× 10- 18 cm;stipe stamineus, 20-45 cm in fertile fronds,10-20 cm in sterile fronds; lamina lanceolate, 20-35× 10-18cm;pinnae alternate,10-12 pairs ,stalked,lanceolate,acuminate,5-9× 2-3cm;pinnules oblong,margin serrate, obtuse,basisopic pinnule longer,1-3× 0.3-0.5 cm,fertile pinnules, oblong, entire,narrow,contracted,1× 0.4 cm ; veins distinct, forked; sori globose,

indusiate, dark- brown, in two rows, on either side of costules; sporangium globose, dark brown, 270-280µm; spore reniform, perisporate, pale-brown, 50-55µm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 17/09/13, *Nayan Thapa & Dorjay Lama*, 202A(SJCBH), 202B(LBH), N27°04 '13.4'' and E088°16' 57.5'', Alt: 1648m±12.

Global Distribution: Bangladesh, Bhutan, China India, Indonesia, Myanmar, Nepal, Philippines, Thailand.

Local distribution: Lebong, balasan.

Dryopteris serratodentata (Beddome) Hayata, Icon. Pl. Formosan. 4: 179. 1914; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 131.1965; Dixit, A Cens. of Indian Pterid. 153.1984; Thapa, Pterid. of Nepal 124. 2002 ; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 617.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:27 .2015

Lastrea filix-mas (Linnaeus) Presl var. *serratodentata* Beddome, Suppl. Ferns Brit. Ind. 55. 1892.

Nephrodium serrato-dentatum Hope in Jour. Bombay Nat. Hist. Soc ., 12, 622, t.10, 1899.

(Figure 3.1: A to D)

Plants lithophytic, terrestrial, erect; rhizome ascending, short, scaly; scales ovate-lanceolate, margin serrate, acuminate, brown, 0.6-0.8 × 0.2-0.3 cm; fronds bi-pinnate, coriaceous, 10-40 × 5-10 cm; stipe stramineous, 4-10 cm, scaly; lamina oblong-lanceolate, green, 6-30 × 5-10 cm; pinnae 5-10 pairs, sub-opposite, sessile, deeply lobed, oblong – lanceolate, apex obtuse, 2.5-5 × 1-2.5 cm; lobes 4-6 pairs, oblong, serrated, apex round, 1-2.5 × 0.4-1.3 cm; veins distinct, forked; sori globose, indusiate, brown; sporangium globose, dark-brown, 270-280µm; spore reniform, perisporate, dark brown, 44-47µm.

Exsiccatae : West Bengal, Darjiling hills, Sandhakphu, 21/07/11, *Nayan Thapa & Dorjay Lama*, 038A(SJCBH), 038B(LBH), N27°07 '41.4'' and E088°05'29.5'', Alt: 3521m±11.8.

Global distribution: Bhutan, China, India, Kashmir, Myanmar, Nepal, Pakistan.

Local distribution: Sandhakphu, Phalut

Dryopteris conjugata Ching, Bull. Fan Mem. Inst. Biol., Bot. 11: 63. 1941; Thapa, Pterid. of Nepal 122. 2002 ; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 615.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 27. 2015

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scales ovate-lanceolate, entire, acuminate, brown, 0.8-1.2 × 0.2-0.4 cm; fronds uni-pinnate, monomorphic, 60-100 × 15-30 cm; stipe 10-25 cm, ebenous, scaly, scales linear, dark-brown; lamina lanceolate, acuminate, widest at middle, 50-75 × 15-30 cm; pinnae alternate, 20-30 pairs, sessile, lanceolate, lobed, acuminate, 9-15 × 1.5-2.5 cm, basal pinnae smaller, 7 × 1.5 cm; veins distinct, forked; sori scattered abaxially, globose, indusiate, brown; sporangium globose, dark brown, 320-325 μm; spore reniform, perisporate, pale, 45-53 μm.

Exsiccatae : West Bengal, Darjiling hills, meghma, 11/07/13, *Nayan Thapa & Dorjay Lama*, 163A (SJCBH), 163B (LBH), N27°01'55.4'' and E088°04'44.5'', Alt: 2674m ± 11.3

Global distribution: China, India, Nepal.

Local Distribution: Meghma, Damsong

Dryopteris subimpressa Loyal, Nova Hedwigia. 16(3-4): 467. 1969; Dixit, A Cens. of Indian Pterid. 154. 1984; Thapa, Pterid. of Nepal 125. 2002 ; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 618.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 38. 2015

Dryopteris submarginata Loyal in Mehra, Res Bull. Punjab Univ. n.s. 12(1-2) : 153. 1961, *nom nud*.

Plants lithophytic, terrestrial, erect; rhizome wide, creeping, scaly; scales ovate, entire, acuminate, pale, 0.8 × 0.3 cm; frond bi-pinnate, coriaceous, 60-100 × 20-40 cm; stipe stramineous, 10-30 cm, scaly; lamina deltoid-lanceolate, green, 50-70 × 20-40 cm; pinnae alternate, 10-20 pairs, stalked,

oblong-lanceolate, acuminate, 10-20 × 4-8 cm; pinnules 12-15 pairs, basal pinnules opposite, upper pinnules alternate, sessile, oblong-lanceolate, deeply lobed, acuminate, 2-4 × 1-2 cm; lobes opposite, 6-8 pairs, oblong, margin serrate, apex obtuse, serrate, 0.5-1 × 0.2-0.5 cm; veins distinct, forked; sori orbicular, single per segment, indusiate, brown; sporangium ovoid, dark brown, 300 × 245 μm; spore ellipsoid, perisporate, papillate, brown, 50 × 30 μm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 26/10/11, *Nayan Thapa & Dorjay Lama*, 095A(SJCBH), 095B(LBH), N27°04 '13.4'' and E088°16' 57.5'', Alt: 1648m ± 12.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Lebong, Mangwa.

Nothoperanema (Tagawa) Ching, Acta Phytotax. Sin. 11: 25. 1966.

Nothoperanema squamiseta (Hooker) Ching, Acta Phytotax. Sin. 11(1): 27. 1966; Thapa, Pterid. Of Nepal 128. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a Revi. Cen. List 620. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 28. 2015.

Nephrodium squamisetum Hooker, Sp. Fil. 4: 140, t. 268. 1862.

Dryopteris squamiseta (Hooker) Kuntze, Revis. Gen. Pl. 2: 813. 1891.

Lastrea buchanani Bedd. Handb. Ferns Brit. India: 225. 1883.

(Plate 3.18: A to F)

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly, ovate, entire acuminate, brown, 1.2-1.5 × 0.3-0.4 cm; fronds tripinnate, pubescent, 60-80 × 22-30 cm; stipe purplish, scaly, 20-30 cm; lamina ovate, acuminate, coriaceous, 40-50 × 22-30 cm; pinnae stalked, lanceolate, subopposite, 8-10 pairs, basal pair largest, 22-30 × 6-8 cm; pinnules alternate, sub-sessile, 8-10 pairs, oblong-lanceolate, acute, 3-4 × 1.5-2 cm; ultimate segments sub-opposite, 7-9 pairs, ovate-oblong, base cuneate, apex round, 0.8 × 0.4 cm; veins distinct, forked; sori globose, at vein ending, indusiate, brown; sporangium globose, dark brown, 253-265 μm; spore reniform, spinose, brown, 40 × 25 μm.

Exsiccatae : West Bengal,Darjiling hills,Meghma,11/07/13, *Nayan Thapa & Dorjay Lama*, 167A(SJCBH), 167B (LBH),N27°01'55.4''and E088°04'44.5'',Alt: 2674m±11.3

Global distribution:Bhutan,China, India; Africa, Madagascar.

Local Distribution: Meghma,Dhotrey,Newra.

Peranema D. Don, Prodr. Fl. Nepal. 12. 1825.

1. Fronds tri-pinnate,40-120× 20-40 cm.....2
- + Fronds Quadripinnate, 80-120 ×30-40cm.....*Peranema paleolulata*
2. Stipe scaly,dark brown, 1.8-2 × 0.2-0.4 cm.....*Peranema cyatheoides*
- + Stipe scaly,setose,light brown, 0.6-0.8 × 0.1-0.2 cm...*Peranema aspidioides*

Peranema cyatheoides Don,Prodr.Fl.Nepal.:12,1825; Dixit , A Cen. of Indian Pterid. 146,1984; Thapa, Pterid. of Nepal 128.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 613.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:28 .2015

Sphaeropteris barbata Wallich,Plant.Asiat.Rar.:42,1830.

Plants lithophytic, terrestrial, erect, rhizome erect, short, densely covered with scales ;scales linear-lanceolate, entire, acuminate, dark brown,1.8-2 × 0.2-0.4 cm ;fronds tufted,tri-pinnate,80-120× 30-40cm;stipe purplish, 20-30 cm, scaly, 1.8-2 × 0.2-0.4 cm ; lamina deltate-ovate,coriaceous,60-80× 30-40cm;pinnae alternate,15-20 pairs, ovate-lanceolate, basal pair largest,30 × 8cm;pinnules deeply lobed, lanceolate,3-4 × 1-1.2cm;segment sessile, oblong, obtuse,0.5 × 0.2cm;veins distinct, simple, free; sori stalked, globose, capsulated, hard; sporangium globose, dark brown, 230-245µm;spore globose, smooth, light brown,45-50µm.

Exsiccatae : West Bengal,Darjiling hills,Third mile,04/05/11, *Nayan Thapa & Dorjay Lama*, 009A(SJCBH), 009B (LBH),N27°00'35.4''and E088°17'34.5'',Alt: 2174m±15.3

Global distribution:Bhutan,China,India,Nepal,Pakistan,Taiwan

Local distribution:Third mile,Senchel.

Peranema aspidioides(Blume)Mett.Fil.Lechl.2:33,1850; Dixit , A Cen. of Indian Pterid.146.1984; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 613.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:28 .2015.

Diacalpe aspidioides (Blume)Enum.Pl.Jav.241.1828.

Plants lithophytic, terrestrial, erect, rhizome erect, short, scaly ;scales linear-,entire, acuminate, light brown,0.6-0.8 × 0.1-0.2 cm ;fronds tufted,tripinnate,40-80× 20-30cm;stipe purplish, 10-20 cm, scaly, setose, 0.6-0.8 × 0.1-0.2 cm; lamina ovate,coriaceous,30-60× 20-30cm;pinnae alternate,10-15 pairs, broad lanceolate, basal pair largest,30 ×7 cm; pinnules oblong, deeply lobed,3-3.5× 1.2-1.5 cm; segment sessile,oblong,obtuse,0.5 × 0.2cm;veins distinct, simple, free; sori shortly stalked, globose, capsulated ,hard ; sporangium globose, dark brown,240-250µm;spore globose, smooth,pale,45-50µm.

Exsiccatae : West Bengal, Darjiling hills,Third mile,01/10/11, *Nayan Thapa & Dorjay Lama*, 080A(SJCBH), 080B (LBH),N27°00'35.4''and E088°17'34.5'',Alt: 2174m±15.3

Global distribution: Bhutan,China,India,Nepal,Pakistan,Taiwan

Local distribution: Third mile,Senchel,lava.

Peranema paleolulata(Pich Sermoi)*Fraser-Jenkins*, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 317 . 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:28 .2015

Acophorus paleolulatus Pich Sermoi,*Webbia* 31(1): 252, 1977.

Plant lithophytes, terrestrial, erect, rhizome sub-erect, scaly; scales lanceolate, entire, acuminate, brown, 0.8× 0.2 cm; Fronds quadripinnate, herbaceous,80-120 ×30-40cm, stipe purplish, scabrous, 20-40cm; lamina deltoid, reddish when young, greenish at maturity,60-80× 30-40cm; pinnae opposite,8-10pairs, oblong-lanceolate, acuminate, pinnae base swollen, 15-20× 4-6 cm; pinnules opposite,10-15 pairs, oblong, basioscopic pinnules larger,4-6×1-2 cm; ultimate segments sub-opposite,5-7 pairs, rhomboid, acrosopic base cuneate, apex round,0.5-1× 0.2-0.4 cm; veins distinct, forked; sori median, globose, indusiate; sporangium globose,brown,267-273µm; spore spherical, smooth, brown,40-45µm.

Exsiccatae : West Bengal,Darjiling hills,meghma,11/07/13, *Nayan Thapa & Dorjay Lama*, 164A(SJCBH), 164B (LBH),N27°01'55.4'' and E088°04'44.5'',Alt: 2674m±11.3

Global distribution: Bhutan,China,India, Myanmar, Nepal ,Taiwan.

Local Distribution:Meghma, Gayribas, Thirdmile,Lebong.

Phanerophlebiopsis Ching, Acta Phytotax. Sin. 10: 115. 1965.

Phanerophlebiopsis hookeriana (Presl)Fras.-Jenkins,Himal.Ferns:42,1997; Thapa, Pterid. of Nepal 128.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 620.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:29.2015.

Lastrea hookeriana Presl,Trent.Pterid.:77,1836.

Polystichum hookerianum Chr.,Ind.Fil.:67,1905.

Crytomuim hookerianum (Presl)Chr.,Ind.Fil.Suppl.I:101,1913.

(Plate 3.9:I)

Plants lithophytic,terrestrial,erect,rhizomeshort,erect,scaly;scales lanceolate, acuminate,brown,0.4-0.6× 0.1-0.2 cm;fronds tufted,uni-pinnate,30-70 × 15-20 cm; stipe stramineus,scaly at base, 10-30cm; lamina coriaceous, lanceolate, 20-40× 15-20cm; pinnae alternate, 15-20 pairs, sub-sessile, lanceolate,margin toothed,apex acute,acroscopic base auricled,7.5 × 2cm; sori large,round,scattered, indusiate, brown; sporangium globose,golden-brown,220-230µm;spore reniform, tuberculate, brown,40-44µm.

Exsiccatae : West Bengal,Darjiling hills,Mungpoo,`1/10/11, *Nayan Thapa & Dorjay Lama, 079A(SJCBH), 079B (LBH),N27°00'31.4''*and *E088°17'37.5''*,Alt: 2154m±15.3

Global distribution:Bhutan,China,India,Nepal,Taiwan,Vietnam.

Local Distribution: Mungpoo,Takdah.

Polystichum Roth,Trent.Fl.Germ.3:31,69.1799.

1. Plants terrestrial, 12-100× 2-30 cm.2
- + Plants epiphytic, 5-15× 1-1.5 cm.....11
2. Rachis with perennating bulbils or buds.....3
- + Rachis without perennating bulbils or buds.....
3. Fronds bi-pinnate.....4
- + Fronds uni-pinnate..... *Polystichum lentum*
4. Stipe length 4-20 cm..... *Polystichum miamense*
- + Stipe length 20-60 cm..... *Polystichum scariousum*
5. Pinnae 7.5-15× 2.5-3.2 cm in size.....6
- + Pinnae 1.5-3× 0.5-1.5 cm in size.....7
6. Pinnules 1.5-2× 0.4-0.6 cm in length.... *Polystichum neobelatum*
- + Pinnule 1.2-1.6 × 0.3-0.5 cm in length..... *Polystichum semifertile*
7. Lamina with microscales abaxially..... *Polystichum nepalense*
- + Lamina without microscales.....8
8. Scales bullate1.2-1.5× 0.7-0.9 cm.....*Polystichum mehrae*
9. Scales ovate-lanceolate, 0.6-0.8 × 0.1-0.4cm..... 10

10. Spore grayish-brown, 46-50µm..... *Polystichum prescottianum*
 +. Spore dark brown, 50-55µm.....*Polystichum stenophyllum*
 11. Sporangium ovoid, 310× 230µm..... *Polystichum thomsonii*
 +. Sporangium globose, 300-310µm..... *Polystichum atkinsonii*

Polystichum atkinsonii Beddome, Suppl. Ferns S. Ind. 14. 1876; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 126.1965; Dixit, A cen. of Indian Pterid. 156.1984; Thapa, Pterid. of Nepal 129.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 620.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:29.2015.

Aspidium atkinsonii Clarke, Trans. Linn. Soc. Lond. II Bot. 1:506. 1880.

Polystichum franchetii Christ, Bull. Soc. Fr. 52 Mem. 1:28. 1905.

Polystichum gemmiferum Tagawa, Acta Phytotax. Geobot. 3:31. 1934.

Plants epiphytic, pendent; rhizome erect, short, scaly; scales ovate-lanceolate, entire, acuminate, 0.4-0.6 × 0.1-0.2 cm; fronds uni-pinnate, 5-10 × 1-1.5 cm; stipe stramineous, 1-3 cm, scaly; lamina coriaceous, lanceolate, 4-7 × 1-1.5 cm; pinnae 10-15 pairs, sub-opposite, sub-sessile, ovate-oblong, margins notched, toothed, apex acute, acroscopic base auriculate, 0.6 × 0.4 cm; veins distinct, forked; sori median, on veinlets, indusiate, brown; sporangium globose, dark-brown, 300-310µm; spore spherical, tuberculate, brown, 53-55µm.

Exsiccatae : West Bengal, Darjiling hills, Meghma, 25/10/11, *Nayan Thapa & Dorjay Lama*, 087A(SJCBH), 087B(LBH), N27°01 '23.4' and E088°043' 38.2'', Alt: 2700m±15.

Global distribution: Bhutan, China India, Japan, Nepal.

Local distribution: Meghma, Gayribas, Rechala.

Polystichum lentum (D. Don) T. Moore, Index Fil. 86, 95. 1858; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 126.1965;

Dixit , A cen.of Indian Pterid.158.1984; Thapa, Pterid.of Nepal 131.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 62.,2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:29.2015.

Aspidium lentum D. Don, Prodr. Fl. Nepal. 4. 1825.

Aspidium auriculatum (Linnaeus) Swartz var. *lentum*(D. Don) C. B. Clarke, Trans. Linn. Soc.Lond.II Bot.1:507.1880

Plants lithophytic, terrestrial, erect; rhizome erect, scaly; scales ovate, margin entire, acuminate, brown, 0.6-0.8 × 0.4-0.5 cm ; fronds uni-pinnate 30-50 × 4-6 cm; stipe castaneus, 5-10cm, scaly; lamina linear-lanceolate, leathery, green, with proliferating gemma, 25-40 × 4-6 cm; pinnae alternate, 20-25 pairs, stalked, basal pairs deflexed, rest at right angle to rachis, lanceolate, auricled on acroscopic side, margins serrate, toothed, apex acute, 2-3 × 0.8-1.5 cm; veins distinct, free; sori large, circular, 5-8 pairs per pinnae, indusiate, brown; sporangium, globose, dark brown, 270-280 μm; spore spherical, spinose, brown, 33-39 μm.

Exsiccatae : West Bengal, Darjiling hills, Third Mile, 15/07/11, *Nayan Thapa & Dorjay Lama*, 025A(SJCBH), 025B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Lebung, Singamari, Lava.

Polystichum manmeiense (Christ) Nakaike, Misc. Publ. Nat. Sci. Mus. Tokyo. 141. 1982; Thapa, Pterid. of Nepal 131.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 622.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:29.2015.

Aspidium manmeiense Christ, Bull. Herb. Boissier 6: 965. 1898.

Polystichum nepalense var. *subbipinnatum* Christensen, Contrib. U.S. Natn. Herb. 26: 284. 1931.

Plants lithophytic, terrestrial, erect; rhizome ascending, scaly; scales linear-lanceolate, entire, acuminate, brown, 0.4-0.6 × 0.1-0.2 cm; Fronds bipinnate, 15-50 × 4-8 cm; stipe stramineous, 4-20 cm, scaly; lamina oblong-lanceolate, acuminate, abaxially with micro scales, 11-30 × 4-8 cm; rachis with bulbils; pinnae alternate, 10-15 pairs, stalked, lanceolate, deeply lobed, acute, 2-4 × 1.2-2.3 cm, abaxially scaly; lobes 4-6 pairs, alternate, oblong, margins with sharp teeth, acute, 0.6-0.8 × 0.2-0.4 cm; basal acroscopic lobes largest, lobed to pinnae rachis, ovate, 0.8-1.2 × 0.5-0.6 cm; veins distinct, forked; sori round, on either side of costa, indusiate, brown; sporangium globose, dark brown, 310-320 μm; spore spherical, minutely spinose, brown, 47-53 μm.

Exsiccatae : West Bengal, Darjiling hills, Meghna, 12/07/13, *Nayan Thapa & Dorjay Lama*, 172A(SJCBH), 172B(LBH), N27°01' 23.4'' and E088°043' 38.2'', Alt: 2700m ± 15.

Global distribution: Bhutan, China, India, Nepal, Taiwan.

Local distribution: Meghna, Dhotrey, rechala.

Polystichum mehrae Fraser-Jenkins & Khullar, Indian Fern J. 2(1, 2): 10. 1985; Thapa, Pterid. of Nepal 131. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 622. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 29. 2015.

Plants lithophytic, terrestrial, erect; rhizome sub-erect, scaly; scales bullate, entire, aristate, dark brown, 1.2-1.5 × 0.7-0.9 cm; frond bi-pinnate, 12-30 × 2-4 cm; stipe stramineous, 4-6 cm, scaly; lamina coriaceous, lanceolate, 8-24 × 2-4 cm; pinnae 10-20 pairs, sub-opposite, deeply lobed, sessile, ovate, acuminate, 1-2 × 0.5-1 cm; lobes 1-4 pairs, alternate, ovate, margin entire, apex sharp, acute, 0.2-0.5 × 0.1-0.2 cm, basal acroscopic lobe largest, 0.8 × 0.4 cm; veins distinct, forked; sori spherical, on either side of costules, indusiate,

brown; sporangium globose, dark-brown, 320-325 μm ; spore reniform, tuberculate, brown, 50-54 μm .

Exsiccatae : West Bengal, Darjiling hills, Meghma, 12/07/13, *Nayan Thapa & Dorjay Lama*, 170A(SJCBH), 170B(LBH), N27°01 '23.4'' and E088°043' 38.2'', Alt: 2700m \pm 15.

Global distribution: Bhutan, China, India, Nepal, Pakistan, Taiwan.

Local distribution: Meghma, Gorkhey, Dhotrey.

Polystichum neolobatum Nakai, Bot. Mag. (Tokyo). 39: 118. 1925; Dixit, A Cen. of Indian Pterid. 158. 1984; Thapa, Pterid. of Nepal 132. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 623. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 29. 2015.

Polystichum lobatum var *chinensis* Christ, Nuov. Giorn. Bot. Ital. n.s. 4: 92. 1897.

Polystichum neolobatum var *brevipinnum* Tagawa, Acta Phytotax. Geobot. 9: 92. 1940.

Plants lithophytic, terrestrial, erect; rhizome erect, scaly; scales ovate-lanceolate, entire, acuminate, 0.8-1.5 \times 0.3-0.6 cm; fronds bi-pinnate, 30-60 \times 10-18 cm; stipe stramineous, 10-20 cm, scaly, scales brown; lamina ovate-lanceolate, coriaceous, 20-40 \times 10-18 cm; pinnae alternate, 15-20 pairs, sessile, lanceolate, acute, 5-9 \times 2-3 cm; pinnules alternate, 4-9 pairs, ovate, base cuneate, margin with sharp teeth, acuminate, 1.5-2 \times 0.4-0.6 cm; veins distinct, forked; sori orbicular, on either side of costa, indusiate, brown; sporangium globose, golden-brown, 300-310 μm ; spore globose, spinulose, bluish brown, 37-43 μm .

Exsiccatae : West Bengal, Darjiling hills, Lebong, 17/09/13, *Nayan Thapa & Dorjay Lama*, 203A(SJCBH), 203B(LBH), N27°04 '13.4'' and E088°16' 57.5'', Alt: 1648m \pm 12.

Global distribution: Bhutan, China, India, Japan, Nepal.

Local distribution: Lebung, Mungpoo, Newra Source.

Polystichum prescottianum (Wallich ex Mettenius) T. Moore, Index Fil. 101. 1858; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 127.1965; Dixit, A Cen. of Indian Pterid. 159.1984; Thapa, Pterid. of Nepal 133.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 623.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:29.2015.

Aspidium prescottianum Wallich ex Mettenius, Abh. Senck. Naturf. Ges. 2: 48.1858.

Polystichum castaneum (Clarke) Nayar & Kaur, Comp. Bedd. Handb. Ferns Brit. India. 1974.

(Plate 3.12:A to D)

Plants lithophytic, terrestrial, erect; rhizome ascending, scaly; scales ovate, entire, acute, glossy, brown, 0.6 × 0.4 cm; fronds bi-pinnate 30-40 × 3-5 cm; stipe 5-10 cm, densely scaly; lamina lanceolate, acuminate, shining green, 25-30 × 3-5 cm; pinnae 20-25 pairs, alternate, sessile, ovate, acute, deeply lobed, 2-2.7 × 0.7-0.9 cm; lobes sub-opposite, 4-6 pairs, oblong, margins toothed, acuminate, 0.5 × 0.3 cm, abaxially scaly, micro-scales present; veins distinct, forked; sori orbicular, singly in each lobe, indusiate, brown; sporangium globose, brown, 330-340 μm; spore spherical, tuberculate, grayish-brown, 46-50 μm.

Exsiccatae: West Bengal, Darjiling hills, Tonglu, 14/07/13, *Nayan Thapa & Dorjay Lama, 169A(SJCBH), 169B(LBH), N27°02' 04.4''* and *E088°04' 46.2''*, Alt: 3010m ± 11.8.

Global distribution: Afghanistan, Bhutan, China, India, Nepal.

Local distribution: Tonglu, Sandhakphu, Phalut

Polystichum stenophyllum (Franchet) Christ, Bull. Soc. Bot. France. 52(Mém.1) : 27. 1905; Dixit, A Cen. Of Indian Pterid. 160.1984; Thapa, Pterid. of Nepal 134.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred

Ind. Subcon. Pterid. With a revi. Cen. List 624.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:30.2015.

Aspidium caespitosum Wallich ex Mettenius var. *stenophyllum* Franchet, Pl. David. 2: 155. 1888.

Polystichum stenophyllum var. *abbreviatum* Tagawa, Acta Phytotax. Geobot. 3: 93. 1934.

Plants lithohytes, terrestrial, erect; rhizome ascending, sub-erect, scaly; scales lanceolate, margins ciliate, acuminate, 0.6-0.8 × 0.1-0.2 cm; fronds uni-pinnate, 15-60 × 2-4 cm; stipe stramineous, 5-15 cm, scaly; lamina linear-lanceolate, acuminate, 10-45 × 2-4 cm; rachis scaly, proliferating bulbil present; pinnae alternate, 10-20 pairs, sub-sessile, oblong, base cuneate, auricled at acroscopic side, margin serrulate, apex acute, middle pinnae largest, 2 × 1 cm, basal pinnae gradually smaller, 1.6 × 0.7 cm; veins distinct, forked; sori orbicular, median, on either side of pinnae, indusiate, brown; sporangium globose, brown, 340-350 μm; spore spherical, tuberculate, dark-brown, 50-55 μm.

Exsiccatae : West Bengal, Darjiling hills, Meghna, 12/07/13, *Nayan Thapa & Dorjay Lama*, 168A(SJCBH), 168B(LBH), N27°01'23.4'' and E088°043'38.2'', Alt: 2700m ± 15.

Global distribution: Bhutan, China, India, Japan, Myanmar, Nepal.

Local distribution: Meghna, Dhotrey.

Polystichum semifertile (C. B. Clarke) Ching, Lingnan Sci. J. 15(3): 398. 1936; Dixit, A Cen. of Indian Pterid. 159. 1984; Thapa, Pterid. of Nepal 134. 2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 623. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:30. 2015.

Aspidium aculeatum (Linnaeus) Swartz var. *semifertile* C. B. Clarke, Trans. Linn. Soc. London, Bot. 1: 509. 1880.

Polystichum longipinnulum Nair, Amer. Fern J. 64:15. 1974.

Plants lithophyte, terrestrial, erect; rhizome ascending, scaly; scale linear, entire, acute, brown, 0.6-0.8 × 0.1-0.2 cm, fronds bi-pinnate, 60-100 × 15-30 cm; stipe stramineous, 15-30 cm, smooth; lamina oblong-ovate, coriaceous, 45-70 × 15-30 cm; pinnae alternate, 10-20 pair, sub-sessile, lanceolate, acuminate, basal pinnae largest, 7.5-15 × 2.5-3.2 cm; pinnules alternate, 15-20 pairs, sub-sessile, rhomboid-oblong, margin serrate, cuneate, auricled acroscopically, apex acute, 1.2-1.6 × 0.3-0.5 cm; veins distinct, forked; sori orbicular, large, 4-6 pairs per pinnules, indusiate, brown; sporangium ovoid, dark brown, 250-270 μm; spore spherical, minutely spinose, 43-47 μm.

Exciccatae : West Bengal, Darjiling hills, Third Mile, 01/10/11, *Nayan Thapa & Dorjay Lama*, 069A(SJCBH), 069B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m ± 15.

Global distribution: Bhutan, China, India, Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Third mile, Chatakpur, Senchel.

Polystichum scariosum (Roxburgh) C. V. Morton, Contr. U.S. Natl. Herb. 38: 359. 1974; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 623.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:30.2015.

Polypodium scariosum Roxburgh, Calcutta J. Nat. Hist. 4: 494.

Plants lithophytic, terrestrial, erect; rhizome short, ascending, sub erect, scaly; scales dimorphic, large scales ovate-oblong, entire, acuminate 1.4 × 0.6 cm, smaller scales linear-lanceolate, sub-entire, toothed, acute, brown, 0.6 × 0.1 cm; Fronds bi-pinnate, 60-180 × 16-24 cm; stipe stramineous, 20-60 cm densely scaly; scales similar to rhizome's; lamina coriaceous, greyish-green, oblong-lanceolate, 40-120 × 16-24 cm; rachis with proliferating buds; pinnae alternate, 10-15 pairs, sub-sessile, lanceolate, acuminate, 8-12 × 3-5 cm; pinnules alternate, 15-20 pairs, sessile, dimidiate, rhomboid, base cuneate, margin shallowly lobed, auricled at acroscopic side, apex sharp, acute, 1.5-

2.5× 0.4-0.6 cm; veins distinct, forked; sori scattered along pinnules, orbicular, indusate, brown; sporangium ovoid, 310-320µm; spore spherical, tuberculate, brown; 54-57µm.

Exsiccatae: West Bengal, Darjilinghills, Dhotrey-Balasan, 30/06/13, Nayan Thapa & Dorjay Lama, 144A(SJCBH), 144B(LBH), N26°59'14.4'' and E088°14'34.8'', Alt: 1907m±11.7.

Global distribution: China, India, Japan, Sri Lanka, Thailand, Vietnam.

Local distribution: Dhotrey-balasan, Lebong, Ging.

Polystichum nepalense (Sprengel) C. Christensen, Index Filic. 84. 1905; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 126.1965; Dixit, A Cen. of Indian Pterid. 158.1984; Thapa, Pterid. of Nepal 132.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 623. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 29.2015.

Aspidium nepalense Sprengel, Syst. Veg. 4: 97. 1827.

Aspidium marginatum Wallich ex Mett.; Hope, J. Bomb. Nat. Hist. Soc. 14: 459, t. 17. 1902.

Plants lithophytic, terrestrial, erect; rhizome ascending, sub erect, scaly; scales linear-lanceolate, entire, acuminate, brown, 0.8-1 × 0.1-0.2 cm; frond uni-pinnate, 30-60 × 3-6 cm; stipe stramineous, 10-15 cm, scaly; pinnae contracted at base, lanceolate, acuminate, abaxially with micro scales, 20-45 × 3-6 cm; rachis without proliferating bulbils; pinnae alternate, ascending, 20-25 pairs, sub-sessile, lanceolate, auricled at acroscopic side, base oblique, margin entire, apex acute, 1.5-3 × 1-1.5 cm; veins distinct, forked; sori orbicular, in two rows, on pinnae, indusiate, brown; sporangium ovoid, dark brown, 390-400µm; spore spherical, tuberculate, dark brown, 55-60µm.

Exsciccatae : West Bengal,Darjiling hills,Mangwa,10/07/13, *Nayan Thapa & Dorjay Lama*, 146A(SJCBH), 146B (LBH),N27°03'01.4''and E088° 23'52.5'',Alt: 1267m±10.5.

Global distribution: Bhutan, China, India, Myanmar, Nepal, Philippines, Vietnam.

Local distribution:Mangwa,Takdah.

Polystichum thomsonii (Hooker) Beddome, Ferns Brit. India. 1: t. 126. 1866; Mehra & Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 127.1965; Dixit , A Cen. of Indian Pterid.160.1984; Thapa, Pterid.of Nepal 135.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 624.2008.

Aspidium thomsonii J. D. Hooker, Cent. Ferns, t. 25. 1860.

Dryopteris gracilis(moore ex Beddome) Ching ,Bull.Fan Mem. Inst.Biol. 8:455. 1938.

Plants epiphytic,pendent; rhizome short,erect, scaly; scales lanceolate, entire, acuminate, 0.6× 0.2 cm; fronds uni-pinnate, 8-15 × 1-1.5 cm; stipe 1-2 cm, stramineus, scaly; lamina linear-lanceolate, acuminate, dark green,7-13× 1-1.5cm; pinnae 10-15 pairs, alternate, sub-sessile,broadest at middle, basal pair gradually decreasing , ovate, margin shallowly lobed, apex acute, acroscopic base auriculate, 0.5-0.8× 0.3-0.4 cm; veins distinct, simple; sori median, close to midrib, indusiate, brown; sporangium ovoid, brown, 310×230µm,spore spherical,minutely spinouse, brown, 45-56µm.

Exsciccatae : West Bengal,Darjiling hills, Gayribas,25/10/11, *Nayan Thapa & Dorjay Lama*, 088A(SJCBH), 088B (LBH),N27°03'33.5''and E088°01' 27.9'',Alt: 2532m±12.8.

Global distribution:Afghanistan, Bhutan, China, India, Myanmar, Nepal, Pakistan.

Local distribution: Gayribas ,Rechala.

Tectaria Cavanilles, Ann. Hist. Nat. 1: 115. 1799.

1. Frond unipinnate, 30-80× 10-25cm.....*Tectaria polymorpha*

- + Frond Bipinnate to tripinnate, 20-100× 6-40 cm.....2.
- 2. Fronds monomorphic, 40-100× 10-40cm*Tectaria codnuta*
- + Fronds dimorphic, 20-40× 6-20cm.....*Tectaria fuscipes*

Tectaria fuscipes (Wallich ex Beddome) C. Christensen, Contr. U.S. Natl. Herb. 26: 290. 1931; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 135.1965; Thapa, Pteridophytes of Nepal 136.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II:637.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a rev. Cen. List 626.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:30.2015.

Lastrea fuscipes Moore, Ind. Fil.:82, 1858.

Aspidium fuscipes Wallich ex Beddome, Suppl. Ferns S. Ind. 15. 1876.

Plants lithophytic, erect, terrestrial; rhizome ascending, scaly; scales lanceolate, entire, acuminate, 0.8-1.2× 0.1-0.2cm; fronds dimorphic, deltate, bi-pinnate, 20-40× 6-20; stipe small, scaly, 4-8cm; lamina elliptic, ovate, acuminate, fertile lamina smaller, 20-40× 6-10cm; sterile lamina larger, 20-40× 10-20cm; pinnae opposite, 3-5 pairs, basal pair largest, triangular, acuminate, 6-20× 4-8cm; middle pairs lanceolate, deeply lobed, acuminate, 4-16× 2-5 cm; segment oblong, opposite, 4-8 pairs, margins, mucronate, acute, 1.5-3× .8-1.5cm; veins distinct, reticulate; sori globose, 3-5 pairs in lobes, indusiate, brown; sporangium globose, dark brown, 287-293µm; spore spherical, perisporate, brown, 48-56µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 03/04/12, Nayan Thapa & Dorjay Lama, 114A (SJCBH), 114B (LBH), N27°03'01.4'' and E088° 23' 52.5'', Alt: 1267m±10.5.

Global distribution: Bhutan, China, India, Indonesia, Myanmar, Nepal, Vietnam.

Local Distribution: Mangwa, Takdah, Lopchu.

Tectaria coadunata (J. Smith) C. Christensen, Contr. U.S. Natl. Herb. 26: 331. 1931; Dixit , A census of Indian Pterid.142.1984; Thapa, Pterid. of Nepal 136. 2002 ; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh II:633.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. Lis. 626,2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:30.2015.

Sagenia coadunata Smith in Hooker, J. Bot. 4:184. 1841.

Aspidium coadunatum Wallich ex Hooker & Greville.Ic.Fil.2:202,1831.

Plants lithophytic,terrestrial,erect;rhizome horizontal,scaly;scales lanceolate, entire, acuminate,brown,0.6-0.8× 0.2-0.3cm;fronds tri-pinnate,ovate-deltate,40-100× 10-40cm; stipe stramineous, 10-30cm; lamina ovate, herbaceous,pubescent adaxially ,glabrous abaxially,green,30-70× 10-40cm;pinnae sessile,5-8 pairs, alternate,ovate-lanceolate,deeply lobed,5-20×4-10cm;segments ovate-oblong, crenate,acute,5× 2.5 cm,veins distinct, reticulate;sori reniform,sub-marginal,in two rows,indusiate; sporangium globose,brown,283-293µm;spore reniform,perispore folded,brown,48-54µm.

Exsiccatae : West Bengal,Darjiling hills,Mangwa,03/04/12, *Nayan Thapa & Dorjay Lama, 115A(SJCBH), 115B (LBH),N27°03'01.4''* and *E088°23 '52.5''*,Alt: 1267m±10.5.

Global distribution: Africa, Bhutan, China,India, Laos, Madagascar ,Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

Local Distribution:Mangwa,Mungpoo,Rungdung

Tectaria polymorpha (Wallich ex Hooker) Copeland, Philipp. J. Sci., C. 2: 413. 1907; Mehra & Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 135 .1965; Dixit , A cen. of Indian Pterid.144.1984; Thapa, Pterid. of Nepal 136.2002; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh II: 653.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 627.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:31.2015.

Aspidium polymorphum Wallich ex Hooker, Sp. Fil. 4: 54. 1862.

(Figure 3.12:A to C)

Plants lithophytic,terrestrial,erect;rhizome Sub-erect,scaly;scales linear- ipe lanceolate,margin lacerated, acuminate,brown,0.6-1.2× 0.1-0.2cm;fronds deltate,uni-pinnate,30-80× 10-25cm;stipe stramineus,10-20 cm,scaly;lamina coriaceous,20-60× 10-25cm;pinnae opposite,3-8 pairs,sessile,oblong,base round,margin entire,apex acuminate,10-25× 5-7cm,basal pinnae forked, bipartite; veins distinct,reticulate;sori scatterd,globose,indusiate, brown; sporangium globose, dark-brown,220-230µm;spore spherical, perisporate ,light brown,34-38µm.

Exsiccatae:WestBengal,Darjilinghills,Teesta,02/02/12,*NayanThapa, 105A (SJCBH), 105B (LBH)*,N27°04'40.05''and E088°25'18.26'',Alt: 366m±9.

Global distribution: Bhutan, Cambodia, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, Thailand, Vietnam

Local distribution: Teesta, Rungdung,Mungoo.

Elaphoglossaceae Pichi-Sermolli in *Webbia* 23:209.1968.

1. Frond 10-60× 4-8 cm with perennating bulbils.....**Bolbitis**

+. Frond 10-20× 0.5-1.5 cm without perennating bulbils.....**Ephaloglossum**

Bolbitis Schott, Gen.Fil.:Pl.:13.1835.

1. Veins anastomosing forming 4-6 costal aerole.....*Bolbitis heteroclita*

+. Veins free ,forked without costal aerole.....*Bolbitis appendiculata*

Bolbitis appendiculata (Willdenow) Iwatsuki, Acta Phytotax. Geobot. 18: 48. 1959; Thapa, Pterid. Of Nepal 140.2002; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh I:368.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 346.2008; Fraser-Jenkins,Kandel & Pariyar, Fern and fern allies of Nepal I:32.2015.

Acrostichum appendiculatum Willdenow, Sp. Pl. 5: 114. 1810.

Polybotrya appendiculata (Wenowilld)Smith, Ferns Brit.Foreign:111.1866.

Bolbitis helferiana (Kunze)Iwats.,Acta Phytotax.Geobot.Kyoto 18:48.1959.

Plants lithophytic, terrestrial, erect; rhizome wide, creeping, densely scaly; scales blackish-brown, lanceolate, margin toothed, acute; 0.2-0.4 × 0.1-0.2 cm; frond dimorphic, uni-pinnate, sterile fronds 30-60× 6-8 cm, fertile fronds 10-30× 2-3 cm; stipe stramineous, scaly,5-10 cm in sterile fronds, 5-20 cm in fertile fronds; sterile lamina lanceolate, acuminate,herbaceous,25-50× 6-8 cm, rachis with perennating bulbils; pinnae alternate, 15-20 pairs, sessile, oblong, serrate, apex round,3 × 1 cm; fertile lamina, linear, acuminate,5-10× 2-3 cm; pinnae 10 pairs, alternate, stalked, lanceolate, entire, acute, covered with sori; veins distinct, free,forked; sori acrostichoid, exindustiae, brown; sporangium ovoid, 400× 364µm; spore spherical, perisporate,hyaline to pale, 50-54µm .

Exsiccatae : West Bengal,Darjiling hills, Rohini, 03/04/12,*Nayan Thapa & Dorjay Lama, 110A (SJCBH), 110B(LBH), N26°54'10.5''*and *E088° 20'33.5''*,Alt :850m ± 11.5

Global distribution: Bangladesh, Bhutan, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution:Rohini, Rambh.

Bolbitis heteroclita (Presl) Ching in Christensen, Index Filic., Suppl. 3: 48. 1934; Mehra &Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 136.1965; Dixit , A Cen. of Indian Pterid. 161.1984; Thapa, Pterid. of Nepal 141.2002; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh I:375.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 630.2008 ;Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:32.2015.

Acrostichum heteroclitum Presl, Reliq. Haenk. 1: 15. 1825.

Acrostichum flagelliferum Wallich ex Hooker & Greville,Ic. Fil.: t.23.1827

Plants lithophytes, terrestrial, erect; rhizome wide, creeping, long, scaly; scales lanceolate, entire, acuminate, brown, 0.3-0.8 × 0.1-0.2 cm; fronds dimorphic, fertile frond simple, 10-30 × 4-5 cm; stipe 4-10 cm, rough, dirty brown; sterile frond pinnate, 20-80 × 5-8 cm; stipe 5-20 cm, rough, brown; pinnae 2-4 pairs, opposite, sub-sessile, broadly lanceolate, base cuneate, margin entire, 8-16 × 3-6 cm, terminal pinnae long, acuminate with bulbil, 8-25 × 3-6 cm; veins distinct, anastomosing, forming costal areole; sori acrostichoid, exindusiate, brown; sporangium ovoid, 450 × 370 μm; spore spherical, perisporate, brown, 50-54 μm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/07/13, *Nayan Thapa & Dorjay Lama*, 151A (SJCBH), 151B (LBH), N27°03'01.4'' and E088°23'52.5'', Alt: 1267m ± 10.5.

Global distribution: Bangladesh, China, India, Indonesia, Japan, Myanmar, Nepal, New Guinea, Philippines, Thailand, Vietnam.

Local Distribution: Mangwa, Teesta, Kalijhora.

Elaphoglossum Schott ex J. Sm., J. Bot. (Hooker) 4: 148. 1841, *nom. cons.*

Elaphoglossum stelligerum (Wallich ex Baker in Hooker & Baker) Moore in Sal. Ind. Fil.: 89.1857; Dixit, A Cen. of Indian Pterid. 166.1984; Thapa, Pterid. of Nepal 142.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 632.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I: 32.2015.

Acrostichum stelligerum Wallich ex Baker in Hooker & Baker, Syn. Fil. ed. 2: 521.1874.

Elaphoglossum yunnanense (Baker) Ching, Contrib. U.S. Natn. Herb. 26: 327.1931.

Plants lithophytic, terrestrial, erect; rhizome ascending, erect, scaly; scales linear-lanceolate, margin ciliate, apex acuminate, 0.4-0.6 × 0.1 cm; fronds dimorphic, simple, 10-20 × 0.5-1.5 cm; stipe 3-4 cm in sterile frond, castenous, scaly, 6-9 cm in fertile frond, castenous, scaly; fertile lamina coriaceous, thick, narrower, linear, apex acute, 11 × 0.5 cm; sterile lamina broad, sub-coriaceous, lanceolate, acuminate, 13 × 1.5 cm; veins distinct, forked; sori scattered on fertile lamina, exindusiate, brown; sporangium ovoid, brown, 310-320 μm; spore elliptic, perisporate, brown, 43-47 μm.

Exsiccatae : West Bengal,Darjiling hills,Mangwa,10/07/13, *Nayan Thapa & Dorjay Lama*, 157A(SJCBH), 157B (LBH),N27°03'01.4''and E088° 23' 52.5'',Alt: 1267m±10.5.

Global distribution:Bhutan, China, India, Indonesia, Malaysia, Nepal, Philippines, Vietnam.

Local distribution: Mangwa,Rohini

Nephrolepidaceae Ponce de Leon ex Pich-Sermolii in *Webbia* 29:8.1975.

Nephrolepis cordifolia (Linnaeus) C. Presl, Tent. Pterid. 79. 1836; Mehra & Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 121 .1965; Dixit , A cen. of Indian Pterid.167.1984; Thapa, Pterid. of Nepal 137.2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 629.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:32.2015.

Polypodium cordifolium Linnaeus, Sp. Pl. 2: 1089. 1753.

Aspidium auriculatum (Linnaeus)Swartz in Schrad .J.Bot. 1800(2):31.1801.

Plants lithophytic to epiphytic, erect; rhizome thin, long, creeping, stolons with scaly tubers; scales lanceolate, toothed, acuminate, pale, 0.9× 0.2 cm; fronds monomorphic, uni-pinnate, 50-100× 3-6 cm; stipe scaly,10-20 cm; lamina linear-lanceolate, sub-coriaceous,40-80× 3-6 cm;pinnae 40-100 pairs, lanceolate, margin serrate, apex acute, auricled on acroscopic side, 1.5-3× 0.6-1.3 cm; veins prominent, forked; sori sub-marginal, kidney shaped, indusiate, brown; sporangium ovoid, dark brown, 300× 256µm; spore reniform, smooth, dark brown, 36× 24µm.

Exsiccatae : West Bengal,Darjiling hills,Mangwa,10/07/13, *Nayan Thapa & Dorjay Lama*, 153A(SJCBH), 153B (LBH),N27°03'01.4''and E088° 23' 52.5'',Alt: 1267m±10.5.

Global distribution: Bangladesh, Bhutan, Cambodia, India, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam.

Local distribution: Mangwa, lopchu, Takdah

Oleandraceae (Smith) Ching ex Pichi-Sermolli in *Webbia* 20:745.1965.

Oleandra Cavanilles in *Ann.Hist.Nat.*1(2):115.1799.

1. Frond arises verticillately in groups on a Phyllopodia
.....*Oleandra pistillaris*

+. Fronds arise singly or in group on Phyllopodia but not verticillately
arranged.....*Oleandra wallichii*

Oleandra pistillaris (Swartz)Chr., *Index Fil. Suppl.* III: 132. 1934; Dixit , A Cen, of Indian Pterid. 168.1984; Thapa, Pterid. of Nepal 137. 2002; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pter. With a revi. Cen. List 629.2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and Fern-allies of Nepal I*:33.2015.

Aspidium pistillare Swartz, *Schrad. J. Bot.* 1800(2): 30. 1801; Tagawa & K.Iwats., *Fl. Thailand* 3: 182. 1985.

Oleandra neriiformis auct. non Cav.: *Bedd., Handb. Ferns Brit. India*: 285, f. 146. 1883.

Plants epiphytic, pendent; rhizome wide, creeping, scaly; scales ovate-lanceolate, margin hairy, acuminate, 0.5-0.9 × 0.2-0.4cm; fronds simple, clustered, 10-30 × 2-4cm; stipe 1-3 cm, pubescent; lamina elliptic-oblong, margin entire, apex acuminate, 9-26 × 2-4cm; veins distinct, forked; sori median, on either side of rachis, indusiate, indusium reniform, entire; sporangium reniform, slightly elongated, 257-264µm; spore spherical, brown, perisporate, spinulose, 37-46µm.

Exsiccatae : West Bengal,Darjiling hills,lebong,26/09/11, *Nayan Thapa & Dorjay Lama*, 065A(SJCBH), 065B (LBH),N27°04'13.4''and E 088° 16' 59.5'',Alt: 1659m±11.5.

Global distribution: Bhutan,China,India,Malaya,Nepal,Vietnam.

Local Distribution:Lebong, Rungdung ,Mungpoo,Kuresong,.

Oleandra wallichii(Hooker)Presl,Trent.Pterid:78.1836; Beddome, Handb. ferns Brit.India:287.t.147.1883; ching and S.K. Wu in Fl. Xizangica 1:281.1983; Mehra &Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 121.1965; Dixit , A Cen. of Indian Pterid.167.1984; Thapa, Pterid. of Nepal 137. 2002; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh II:427. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundreed Ind. Subcon. Pterid. With a revi. Cen. List 629. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 33.2015.

Aspidium wallichianum Hooker,Exotic .Fl.1:t.5.1823.

(Figure 3.14 : A to D)

Plants epiphytic, pendent;r hizome wide, creeping, scaly; scales ovate-lanceolate, margin hairy,acuminate,0.5-0.7 × 0.2-0.3cm;fornds simple,1-2 cm apart, 20-40× 3-5cm;stipe 1-3 cm ,pubescent; lamina elliptic-oblong, margin entire, hairy,apex acuminate,17-35× 3-5cm;veins distinct, forked; sori median, on either side of rachis, indusiate, indusium reniform, entire; sporangium reniform, slightly elongated,167-173µm;spore spherical,brown, perisporate,spinulose,44-48µm.

Exsiccatae : West Bengal,Darjiling hills,Third mile,04/05/11, *Nayan Thapa & Dorjay Lama*, 006A(SJCBH), 006B (LBH),N27°00'31.4''and E 088° 17' 37.5'',Alt: 2154m±15.

Global distribution: Bhutan,China,India,Malaya,Nepal,Vietnam.

Local Distribution: Third mile,Singamari,Chimney,Ragarung.

Davalliaceae M. R. Schomb. ex A. B. Frank, Reis. Br.-Guiana [Ri. Schomburgk]. 883. 1848.

- 1. Fronds 15-30 × 6-12 cm2
- + Fronds 30-60 × 10-16 cm **Leucostegia**
- 2. Pinnae 5-10 pairs..... **Davallia**
- + Pinnae 10-15 pairs.....**Katoella**

Davallia Smith, Mém. Acad. Sci. Turin 5: 414. t. 9(6). 1793

Davallia trichomanoides Blume, Enum. Pl. Jav.: 238. 1828; Dixit, A cen. of Indian Pterid. 170. 1984; Thapa, Pterid. of Nepal 139. 2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 234. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List. 634. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 34. 2015.

Leucostegia griffithiana (Hooker) Smith, Hist. Fil.: 84. 1875.

Davallia griffithii (Hooker) Christ in Bull. Boiss. II 4: 616. 1904.

Plants epiphytic, pendent; rhizome wide, creeping, scaly; scales ovate-lanceolate, margin with bristle, acuminate, 0.8-1.2 × 0.2-0.4 cm; frond tripinnate, coriaceous, 18-30 × 6-12 cm; stipe stramineous, 6-10 cm; lamina deltoid, pentagonal, acuminate, 12-20 × 6-12; pinnae alternate, 5-10 pairs, stalked, lanceolate, acute, basal pair largest, 12 × 5 cm; pinnules alternate, 4-6 pairs, stalked, ovate, basal basiscopic pinnule largest, 2.5 × 1.5 cm; segments oblong, crenate, acute, 0.5 × 0.2 cm; veins distinct, forked; sori terminal, indusiate, half cup shaped, brown; sporangium globose, dark-brown, 280-287 μm; spore reniform, spinose, hyaline, 47-52 μm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 15/07/13, *Nayan Thapa & Dorjay Lama*, 180A (SJCBH), 180B (LBH), N27°03'01.5'' and E088°23'52.5'', Alt: 1267 m ± 10.1.

Global distribution: Bhutan, China, India, Japan, Nepal, Taiwan.

Local Distribution: Mangwa, Takdah, Rungdung.

Katoella Fraser-Jenkins, Kandel & Pariyar, *Ferns and Fern-allies of Nepal I*: 33.2015.

Katoella pulchra (Don) Fraser-Jenkins, Kandel & Pariyar, *Ferns and Fern-allies of Nepal I*: 34.2015.

Davallia pulchra Don, *Prodr. Fl. Nepal*. 11. 1825;

Araiostegia pulchra (Don) Copeland, *Philipp. J. Sci.* 34: 241. 1927.

Plants epiphytic, pendent; rhizome wide, creeping, scaly; scales ovate, entire, apex acute, brown, 0.2-0.4 × 0.1-0.2 cm; fronds tri-pinnate, 15-30 × 6-12 cm; stipe stramineous, 4-7 cm, scaly; lamina coriaceous, dull green, lanceolate, acuminate, 11-23 × 6-12 cm; pinnae alternate, 10-15 pairs, stalked, elliptic-triangular, acute, 3-6 × 1.5-3 cm; pinnules alternate, 6-8 pairs, stalked, deeply lobed, oblong-ovate, acute, 1.5-2.1 × 0.6-1.1 cm; segments opposite, 2-3 pairs, lanceolate, entire, acute, 0.3 × 0.1 cm; veins distinct, simple; sori circular, singly in segment's, indusiate, brown; sporangium globose, dark brown, 250-260 μm; spore spherical to reniform, brown, smooth, 30-40 × 20-25 μm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 15/07/13, *Nayan Thapa & Dorjay Lama*, 179A (SJCBH), 179B (LBH), N27°03'01.5'' and E088°23'52.5'', Alt: 1267m ± 10.1.

Global distribution: Bhutan, China, India, Laos, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

Local distribution: Mangwa, Takdah.

Leucostegia C. Presl, *Tent. Pterid.* 94. 1836.

Leucostegia truncata (Don) Fraser-Jenkins, *Taxon. Revis. Indian Subcontin. Pterid.* 348.2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and Fern-allies of Nepal I*: 35.2015.

Leucostegia immersa Presl, *Tent. Pterid.* 95. 1836

Plants epiphytic, pendent; rhizome robust, long, creeping, scaly; scales lanceolate, entire, acuminate, light brown, 0.4-0.6 × 0.2-0.4 cm; fronds tripinnate, 30-60 × 10-16 cm; stipe 10-20, stramineous, glabrous; lamina deltoid, herbaceous, glabrous, green, 20-44 × 3.5-5 cm; pinnae alternate, 4-8 pairs, lanceolate, acuminate, basal pair largest, 16 × 5 cm; pinnules 3-5 pairs alternate, sub-sessile, ovate-lanceolate, 3.5 × 2 cm; ultimate segments /lobes rhomboid, base oblique, margin toothed with blunt apex; veins distinct, forked; sori half cup shaped, in ultimate segments, on acroscopic veinlet, Indusiate, yellowish; sporangium globose, brown, 155-170 μm; spore bilateral, oblong, tuberculated, yellow, 55-63 μm.

Exsiccatae : West Bengal, Darjiling hills, lebong, 18/07/11, *Nayan Thapa & Dorjay Lama*, 034A(SJCBH), 034B (LBH), N27°04'13.4'' and E088°16'59.5'', Alt: 1659m ± 11.5.

Global distribution: Bhutan, Cambodia, China, India, Indonesia, Malaysia, Myanmar, New Guinea, Philippines, Thailand.

Local distribution: Lebong, Third mile, Takdah

Polypodiaceae Bercht. & J. Presl, Delic. Prag. 159. 1822.

- 1. Frond simple , 3-60 × 1 – 9 cm.....2
- + Fronds pinnatifid to pinnate, 30-70 × 10-30 cm....7
- 2. Sori scattered abaxially on lamina.....3
- + Sori on either side of mid-vein.....5
- 3. Lamina 10-40 × 2-4 cm.....4
- + Lamina 20-70 × 3-8 cm.....**Microsorium**
- 4. Spore spherical to lunar, 35-70 × 20-50 μm**Pyrrhosia**
- + Spore bilateral, 25 × 15 μm.....**Tricholepidium**
- 5. Stipe 4-5 cm.....**Selliguea**
- + Stipe absent or 1-2 cm.....6
- 6. Sporangium 250-290 μm.....**Loxogramme**

- + . Sporangium 290-380µm.....**Lepisorus**
- 7. Pinnae 5-20 pairs.....8
- + . Pinnae absent lamina deeply pinnatifid.....10
- 8. Rhizome with whitish bloom.....**Arthromeris**
- + . Rhizome without whitish bloom.....9
- 9. Pinnae stalked..... **Phymatosorus**
- + . Pinnae sessile.....**Goniophlebium**
- 10. Fronds dimorphic.....**Drynaria**
- + . Fronds monomorphic.....11
- 11. Lobes 10-20 pairs.....**Polypodiodes**
- + . Lobes 3-5 pairs.....12
- 12. Stipe winged with laminar segments.....**Leptochilus**
- + . Stipe free without laminar segments.....**Pichisermollodes**

Arthromeris (T. Moore) J. Smith, Hist. Fil. 110. 1875

- 1. Sori scattered in many rows on either side of the costa.....2
- + Sori in one row on either side of the costa.....*Arthromeris wallichiana*
- 2 Fronds 40-60 cm, pinna 3-7 pairs.....*Arthromeris lehmannii*
- + Fronds 20-40 cm, pinna 1-3 pairs.....*Arthromeris himalayensis*

Arthromeris wallichiana (Spreng) Ching, Contrib. Inst. Bot. Natn. Acad. Peiping **2**: 92 .1933; Mehra & Bir , Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 173.1965; Dixit , A cen. of Indian Pterid.35. 1984; Thapa, Pterid. of Nepal 38.2002; Ghosh ,The Pter. Flo. Of East.Ind. I :575.2004; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 534.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium wallichianum Spreng, Linnaeus Syst. Veg. **4**: 53 .1927.

Polypodium juglandifolium Don, Prodr. Fl. Nepal.: 3 .1825.

Pleopeltis juglandifolia Moore, Ind. Fil.: 78 .1857.

Arthromeris wardii (Clarke) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) **4**: 94 .1933.

Polypodium wardii C.B. Clarke. J. Linn. Soc. (Lond.) Bot. **25**: 99, t.43 .1889.

Plants lithophytic to epiphytic; rhizome thick, creeping, scaly throughout; scales golden- brown, lanceolate, 0.1-0.15 × 0.2-0.3 cm; stipe stramineous, 15-30 × 0.2-0.4 cm, glabrous; lamina oblong, 30-50 × 15-25 cm; pinnae usually 6-12 pairs, sub-opposite, sessile, oblique, ovate-lanceolate, 5-12 × 3-5 cm, base obliquely cordate, margin entire, apex acuminate, glabrous; sori large, globose -orbicular, exindusiate, in one row on either side of costa; 1 on each side of costa, medial , solitary between lateral veins; sporangia globose, brown, 310-330 μm, spores brown, round, tuberculate, 27-35 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/11, *Nayan Thapa & Dorjay Lama*, 028A (SJCBH), 028B(LBH), N27°00'31.7'' and E088°17'37.4'', Alt :2154m ± 15

Global Distribution: Bhutan, China, India, Myanmar, Nepal, Vietnam,.

Local Distribution: Third mile, Sukhia, Takdah, Sonada, Lava, Algarah, Deer park.

Arthromeris lehmanni (Mettineus) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 4: 96 . 1933; Mehra & Bir , Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 173.1965; Dixit , A cen. of Indian Pterid. 35 .1984; Thapa, Pterid. of Nepal 38.2002; Ghosh, The Pter. Flo. Of East. Ind. I: 577.2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I :442.2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 534.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium lehmanni Mettineus, Abh. Senck. Naturf. Ges. (Frankfurt) 2: 109 .1857.

Pleopeltis lehmanni (Mettineus) Beddome, Ferns Brit. India: t.260 .1868.

Arthromeris lungtauensis Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 4: 98 .1933.

(Plate 3.14:G To I)

Plant epiphytic to lithophytic; rhizome long, creeping, scaly, covered with whitish bloom; scales brown at center, paler toward margin, 0.4-0.6 × 0.1-0.15 cm, margin minutely toothed, apex long caudate; stipe castaneous, shining, 10-20 × 0.2-0.4 cm, glabrous; rachis castaneous, glabrous; lamina imparipinnate, oblong-ovate in outline, 30-40 × 15-20 cm, green, both surfaces usually glabrous; pinnae usually 3-7 pairs, 7-12 × 1.5-2.7 cm, sub-opposite, sessile, slightly ascending, straight, lanceolate, base rounded, overlapping rachis, margin entire with cartilaginous membrane, ca. 0.15 cm, apex acuminate; terminal pinnae same as lateral pinnae; sori orbicular, exindusiate, irregularly distributed along veinlet, usually in 2-4 rows between costa and margin; sporangia globose, golden to brownish, 310-325 μm, spores spherical, golden brown, tuberculate, 23-26 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/11, *Nayan Thapa & Dorjay Lama*, 027A (SJCBH), 027B(LBH), N27°00'31.7'' and E88°17'37.4'', Alt : 2154m ± 15

Global Distribution: Bhutan, India, Myanmar, Nepal, Philippines, Thailand, Vietnam.

Local Distribution: Third mile, Ramam, Lava.

Arthromeris himalayensis (Hooker) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) **4**: 96.1933; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 173. 1965; Dixit, A Cen. of Indian Pterid. 35.1984; Thapa, Pterido. Of Nepal 38.2002; Ghosh, The Pter. Flo. Of East. Ind. I: 567.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 534.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium himalayense Hooker, Sp. Fil. **5**: 91.1863.

Pleopeltis himalayensis (Hooker) Beddome, Ferns Brit. India: t.318 .1869.

Plant epiphytic; rhizome long, creeping, with whitish bloom, scales ferruginous, linear-lanceolate, margin denticulate; Stipe distant, glabrous, dark stramineous, 8-18 × 0.2-0.6 cm; lamina oblong, 20-40 × 12-22 cm; pinnae 3-5 pairs, opposite, sessile, 6-9 × 2-3.5 cm, oblong lanceolate, acuminate, margin entire with whitish membrane, base rounded; sori large, rounded, exindusiate, scattered in many rows on either side of costa; sporangia globose, golden-brown, 250-287 μm, spore round, brown, minutely tuberculate, 33-35 μm.

Exsiccatae : West Bengal, Darjiling hills, Chatakpur, 1/10/11, *Nayan Thapa & Dorjay Lama, 070A (SJCBH), 070B (LBH)*, N27°00'43.2 and E088°17'30.2, Alt : 2253m ± 15.2

Global Distribution: Bhutan, India, Myanmar, Nepal, Vietnam.

Local Distribution: Chatakpur, Gorkhey, Alu bari, Deer parkely

Drynaria (Bory) J. Smith, J. Bot. (Hooker) **4**: 60. 1841 (*nom. cons.*).

1. Plants more than 50cm in height.....2

+. Plants less than 50 cm in height.....*Drynaria propinqua*

2. Plants pubescent, sori arranged singly between the two parallel veins of pinnae.....*Drynaria mollis*

+ . Plants glabrous, sori 3-5 in a single row between two parallel veins of pinnae*Drynaria coronans*

Drynaria propinqua (Wallich *ex* Mettines) Smith, *apud* Beddome, Ferns Brit. India: t.160 .1866; Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 175.1964; Dixit, A Cen. Of Indian Pterid. 58.1984; Thapa, Pterid. of Nepal 41.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 456. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 535.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium propinquum Wallich *ex* Mettines, Abh. Senck. Naturf. Ges. (Frankfurt) 2: 120, t.2, f.50 .1857.

Plant epiphytic to lithophytic, coriaceous; rhizome creeping, long ,thick, scaly; scales pale, appressed, 0.3-0.6 × 0.1-0.15cm, margin dentate; fronds dimorphic, sterile nest leaves 9-15× 7-10 cm, light brown, hard ,sessile, ovate, thin, pinnatilobed, lobes up to 8 pairs; Foliage leaves ,petiolated, ovate, lanceolate, green, 20-50 × 10-30 cm, pinnatifid; pinna oblong lanceolate, margins crenate to entire , base adnate, apex acute,7-12 × 1-3 cm; sori in single row between midrib and margin, exindusiate, sporangium globose, brown,268-310 μm, spore reniform, tuberculate, light brown, 36-40 × 23-25μm.

Exsiccatae : West Bengal,Darjiling hills, Lebong,20/05/13, *Nayan Thapa & Dorjay Lama, 122A (SJCBH), 122B(LBH), N27°04'13.5'' and E088° 16' 59.7''*,Alt :1550m ± 11.5

Global Distribution: Bhutan, India, Myanmar, Nepal, Thailand, Vietnam,China.

Local Distribution:Lebong, Rungdung,Toongsong,Ging,Dilaram,Payow.

Drynaria mollis Beddome,Ferns Brit. India:t.216.1867; Dixit, A Cen. Of Indian Pterid. 58.1984; Thapa , Pterid. of Nepal 41.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 535.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium rivale Mett.ex Bak.,Syn. Fil. ed.2:368. 1867.

Drynaria tibetica Ching & S.K.Wu, Fl. Xizangica 1:342.1983.

Plant epiphytic, yellowish green, rhizome long, creeping, scaly; scales basifixed, brownish, tufted; fronds dimorphic, sterile nest leaves hairy, sessile, , 7-15 × 3-7 cm, light brown, hard , base cordate, auriculate, pinnatilobed , lobes 8-13 pairs; foliage leaves stalked, stipe 1-10cm, winged; lamina pinnatifid , 20-50 × 7-15 cm, apex not aborted; pinnae 15-20 pairs, spreading, lanceolate, 3-8 × 1.5-2cm, margin entire, densely ciliate, apex acute, scales on abaxial side of costa, veins distinct; Sori in single row between costa and margin, globose, brownish; sporangium globose, golden , 310-330µm; spores reniform, light green, with spines.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 17/08/11, *Nayan Thapa & Dorjay Lama*, 053A (SJCBH), 053B(LBH), N27°03'01.25'' and E088°23'52'', Alt : 1267m ± 10.5

Global Distribution: Bhutan, India, Nepal, China.

Local Distribution: Mungpoo, Takdah, Mangwa.

Drynaria coronans Smith in J. Bot. 4:61.1841; Beddome, Handb. Ferns Brit. India, 341, t. 191.1883; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 535.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 35.2015.

Polypodium coronans Wallich, List n. 288.1828 (nomen nudum).

Pseudodrynaria coronans (Wallich) Ching in Sunyatesenia, 5, 357, 1940.

Aglaomorpha coronans Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 439.2005.

Plants epiphytic, hard, coriaceous, shining green, nest forming; rhizome thick, creeping, making thick bracket around host, covered by golden tomentose scales, basifixed, lanceolate, toothed, acuminate, 2-2.5 × 0.2-0.4 mm ; Fronds monomorphic, 100 -150 × 25-45 cm, elliptic to ob-lanceolate, base broad, dilated, basal portion represent the nest leaf, the upper portion is a normal fertile frond, pinnatifid, lobes oblong, entire, wavy, acuminate, 10-15 × 2-3 cm; sori brown , subglobose to elongated, 6-8, in single row between the

lateral veins, on either side of midrib; sporangium dark brown, globose, 170-180µm; spore reniform, hyaline, minutely spinous, 42-48µm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa & Dorjay Lama*, 128A (SJCBH), 128B(LBH), N27°04'40.2'' and E088°25'18.1'', Alt : 412m ± 11.5

Global Distribution: Bhutan, China, India, Hongkong, Malaya, Nepal, Thailand, Vietnam.

Local Distribution: Teesta, Samsing, Gourbathan, Melli, Singla.

Goniophlebium (Blume) C. Presl, Tent. Pterid. 185. 1836.

Goniophlebium argutum (Wallich *ex* Hooker) Smith in Hook, Gen. Fil.: t.51. 1840; Beddome, Handb. Ferns Brit. India (with Suppl.), 323, t.174. 1865; Thapa, Pterid. of Nepal 41.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 535.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I : 35.2015.

Polypodium argutum Wallich *ex* Hook, Sp. Fil. 5: 32, 1863.

Polypodiastrum argutum (Wallich *ex* Hooker) Ching, Acta Phytotax. Sin. 16 (4): 28, 1978.

Plants epiphytic to lithophytic, pendent; rhizome creeping, 0.3 -0.6 cm in diam., scaly; scales peltate, dark brown, ovate, ciliate at margin, acuminate, 0.6-0.8 × 0.2-0.3 cm; Frond monomorphic, 35-60 × 8-20; lamina, bi-pinnate, lanceolate, herbaceous, green abaxially and adaxially, 29-54 × 8-20 cm; stipe purplish, glabrous, 6-13 cm; pinna 8-18 pairs, linear-lanceolate, 7-14 × 1-3 cm, sessile, margin mucronate, acuminate; veins distinct, anastomosing, a linear row of costal areole, free forked marginal vein; sori on each costal areole, globose, brown, naked; sporangium globose, golden-brown, 260-280µm; spore monoletate, hyaline, smooth, globose, 45-50µm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 04/05/2011, *Nayan Thapa & Dorjay Lama*, 003A (SJCBH), 003B(LBH), N27°00'31.7'' and E088°17'37.5, Alt : 2154m ± 15.3

Global Distribution: Bhutan, NE India, Myanmar, Thailand, Nepal.

Local Distribution: Third mile, Chitrey, Lava, Chimney

Microsorium Link, Hort. Berol. 2: 110. 1833.

1. Fronds larger than 50 cm, sori scattered in the lamina.....2

+ Fronds smaller than 50 cm, sori arranged biserrately in the lamina.....*Microsorium zippelii*

2. Fronds membranaceous, dark green, veins distinct.....*Microsorium membranaceum*

+ Fronds leathery, Light green, veins indistinct.....*Microsorium punctatum*

Microsorium membranaceum (Don) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) **4**: 309 .1933; Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalaya 175.1964; Dixit, A Cen. Of Indian Pterid.46.1984; Thapa, Pterid. of Nepal 47.2002; Ghosh, The Pter. Flo. Of East.Ind. I: 558.2004; Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 543.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

Polypodium membranaceum D.Don, Prodr. Fl. Nepal.: 2 .1825.

Polypodium hymenodes Kunze, Linnaea **23**: 279, 319 (1850), *non* Wallich [List no. 283 (1829), *nom. nud.*]

Colysis membranacea (D.Don) J.Sm., Catl. Cult. Ferns: 11 (1857), *non* C. Presl (1851).

Microsorium hymenodes (Kunze) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) **4**: 301 (1933).

Plant epiphytic to lithophytic, green in colour ,membranaceous; rhizome creeping, thick, 0.2-0.8 cm in diam., covered with brown scales; stipe 1-6 cm long, grooved ,winged; lamina simple,20-60 × 4.5-9 cm, decurrent at base, apex acute, margin entire; veins distinct, reticulate; sori in many rows

,scattered on undersurface, circular, small, exindusiate ; sporangium globose, golden brown,220-250µm;spore reniform, light brown,smooth,45-53 µm.

Exsiccatae : West Bengal,Darjiling hills, Third mile,15/07/11 *Nayan Thapa & Dorjay Lama*, 20A(SJCBH), 20B (LBH),N27°00'31.4''and E088°17'36.2'',Alt: 2153m±11.

Global Distribution: Bhutan, India, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam.

Local Distribution: Third mile, Lebong, Sonada,Tung, Dear park, Lava, Algarah, Payow.

Microsorium punctatum (Linnaeus) Copeland, Univ. Calif. Publ. Bot. **16**: 111 .1929; Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalaya 175.1964;Dixit, A Cen. Of Indian Pterid.47. 1984; Thapa , Pterid. of Nepal 4. 2002; Ghosh,The Pter. Flo. Of East. Ind. I: 562.2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh I: 481.2005; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 543.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

Acrostichum punctatum Linnaeus, Pl.: (1753).

Polypodium punctatum (Linnaeus) Swartz , Schrad. Bot. **1800** (2): 21 (1801)

Pleopeltis punctata Beddome, Suppl. Ferns South. India Brit. India: 22 .1876.

(Figure 3.6:A to C)

Plant epiphytic to lithophytic, subcoriaceous to coriaceous; rhizome wide creeping, sub-cylindrical, 0.4-0.8 cm in diam., scales 0.3 × 0.15 cm ,peltate, ovate-lanceolate, toothed, apex acute, dark brown; stipe small, winged ,3-4cm;lamina simple,30-70 × 10-15 cm, linear –lanceolate, glabrous, base decurrent, margin entire, apex acute to acuminate, veins indistinct; sori whitish, that turn brownish at maturity, globose, scattered in 2-6 irregular rows; sporangia globose, golden yellow,198-235µ,spore pale green, reniform to elliptic,smooth,48-64 ×40-42µm.

Exsiccatae:WestBengal,Darjilinghills,Teesta,07/08/2013,*NayanThapa*,193 A (SJCBH), 193B (LBH),N27°04'40.4''and E088°25'18.1'',Alt: 350m±11.

Global Distribution : India, Indonesia, Malaysia, Myanmar, New Guinea, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution: Teesta,Gourbathan,Jamuney,Singla,Kali Jhora.

Microsorium zippelii(Blume) Ching in Bull.Fan Mem. Inst.Biol.4: 308,1933 ; Holttum , Rev. Fl.Mal.2:176.1955; Mehra & Bir,Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 175.1964; Dixit ,A Cen. Of Indian Pterid. 47.1984; Ghosh ,The Pterid. Flo. Of East.Ind. I: 559.2004; Singh & Panigrahi ,Ferns and fern-allies of Arunachal Pradesh I: 483.2005; Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 543.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

Polypodium zippelii Blume,Fl.Jav.Fil.172,t.80.1829.

Pleopeltis zippelii Moore, Ind. Fil.348.1862.

Polypodium heterocarpum Bedd. Ferns Brit. Ind. t.319.1870.

Polypodium heterocarpum var zippelii Hookeret Bak.Syn.Fil.ed.2:360.1874.

Plants epiphytic to lithophytic; rhizome creeping ,stout, 0.2-0.4cm in diam., scales dark brown,0.4-0.6 × 0.1-0.2 cm, ovate-lanceolate, acuminate; fronds simple, elliptic to lanceolate,20- 50 ×3-8 cm, base decurrent, lateral veins thick, prominent, with 4-7 row of aeroles; stipe 2-5 cm, articulated ,scales dark brown;sori in two row between the lateral veins,superficial, sporangium,globose,golden brown,220 -230µm,spores reniform,hyaline, 52 -60µm.

Exsiccatae: West Bengal, Darjiling hills, Lebong,date, *Nayan Thapa & Dorjay Lama,138 A (SJCBH), 138B(LBH), N27°04'13.5'' and E088°16'59.7''*,Alt :1550m ± 11.5

Global distribution: Malaya,India,Vietnam,Philippines,China.

Local Distribution: Lebong,Rungdung.

Lepisorus (J. Smith) Ching, Bull. Fan Mem. Inst. Biol. 4: 47. 1933.

1. Sori close to margin.....*Lepisorus loriformis*
- + Sori close to midrib.....2
2. Stipe more than 2 cm.....3
- + Stipe less than 2 cm.....*Lepisoru scolopendrium*
3. veins distinct and reaching to the margin.....4
- + Veins hidden.....*Lepisorus contortus*
4. Frond lanceolate, 30-40× 2-2.5 c.m.....*Lepisorus mehra*
- + Frond sickle shaped, 20-30 ×2-4 cm*Lepisorus sublinearis*

Lepisorus contortus (Christ) Ching, Bull.Fan Mem. Inst. Biol. (Bot.) 4: 90.1933; Dixit , A Cen. of Indian Pterid. 40 .1984; Thapa, Pterid. of Nepal 43.2002; Ghosh,The Pterid. Flo. Of East.Ind.I:517.2004; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 537.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 36.2015.

Polypodium lineare Thunb. var. *contortum* Christ, Nuov. Giorn. Bot. Soc. Ital. n.s. 4: 98 ,1897.

Polypodium conturtum (Christ) Christ, Bot. Gaz. (Chicago) 51: 347 ,1911.

Plants epiphytic;rhizome wide,creeping,Ca. 0.2 cm,scaly;scales laneolate, peltate, 0.4-1.9 × 0.1 cm,brown,acute; Fronds 12-29 × 1-1.7 cm, stipe 2-2.5 cm, straminaceous; lamina simple, green,linear to elliptic-lanceolate, attenuate, entire, rachis raised on abaxial side;veins hidden;sori median,on either side of the rachis, round;sporangia globose,brown,130-160µm,spore lunar to bilateral,hyaline,tuberculate, 40-42 × 32-26µm.

Exsciccatae : West Bengal,Darjiling hills, Third mile,04/05/11 *Nayan Thapa & Dorjay Lama*, 007A(SJCBH), 007B (LBH),N27°00'31.4''and E088°17'36.2'',Alt: 2153m±11.

General distribution: Bhutan,China,India,Nepal.

Local Distribution: Third mile, Senchel, Lava,Chimney

Lepisorus loriformis (Wallich *ex* Mett.) Ching, bull. Fan Mem. Inst. Biol. (Bot.) **4**: 81 .1933; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 169.1965; Dixit , A Cen. of Indian Pterid. 41 ,1984; Thapa, Pterid. of Nepal 43.2002; Ghosh.The Pterid. Flo. Of East.Ind. I: 515.2004; Singh & Panigrahi,Ferns and fern-allies of Arunachal Pradesh II:510.2005 ;Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 537.2008; Fraser-Jenkin Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 36.2015.

Polypodium loriforme Wallich *ex* Mett. Abh. Senck. Naturf. Ges. (Frankfurt) **2**: 92, 1857.

Pleopeltis loriformis (Wallich *ex* Mett.) Alston & Borner, Candollea **15**: 208 ,1956.

Plants epiphytic;rhizome short,creeping,Ca. 0.3 cm in diam.scaly;scales ovate-lanceolate,peltate,toothed,brown,0.2-0.4× 0.1 cm;frond simple, 20-70 × 1-1.9 cm; stipe palish green, 2-4cm;lamina green adaxially,glaucous adaxially,linear,sub-coriaceous,acuminate,18-64 ×1-1.9 cm; sori large, globose, brown, exindusiae; sporangium globose,golden brown,300-320µm; spore, bilateral, hyaline, tuberculated, 34-36 × 24-28µm.

Exsciccatae : West Bengal,Darjiling hills, Kayakatta,20/07/11 *Nayan Thapa & Dorjay Lama*, 039A(SJCBH), 039B (LBH),N27°03'34.4''and E088°01'28.2'',Alt: 2818m±130.9.

Global Distribution: Bhutan,China,India,Myanmar,India.

Local distribution: kayakatta,Gayribas,Rachela.

Lepisorus mehrae Fras.- Jenkin New Sp. Syndrome .157-159.1997; Thapa. Pterid. of Nepal 43.2002; Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 537.2008; Fraser-Jenk., Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 37.2015.

Lepisorus kashyapii (Mehra) Mehra in Bir, Res. Bull. Punjab Univ. n.s. **13**: 24.1962.

Lepisorus kashyapii (Mehra) Mehra in Bir var. *major* Bir & Tirkha, Amer. Fern J. **71** (2): 55 .1981.

Lepisorus kashyapii (Mehra) Mehra in Bir var. *minor* Bir & Tirkha, Amer. Fern J. **71**(2): 55 .1981.

Polypodium kashyapii Mehra, Punjab Univ. Publ.: 24 (1939), *nom. nud.*

(Figure 3.13:A to D)

Plants epiphytic;rhizome thick,creeping,Ca.0.8 cm,scaly;scales 0.8-1× 0.2-0.4 cm,lanceolate,acuminate,bicolours,brown;fronds simple,green, 30-37 × 1-3.5 cm;stipe light green,2-2.5 cm;lamina linear-lanceolate, herbaceous,attenuated on both end;veins distinct,reticulate;sori large,globose,on either side of the rachis;sporangia globose,golden-brown,exindusate ,360-380µm;spore monolete,hyaline, bilateral, tuberculate, 45-50 × 35-37 µm.

Exsiccatae : West Bengal,Darjiling hills, Third mile,04/05/11 *Nayan Thapa & Dorjay Lama*, 04A(SJCBH), 04B (LBH),N27°00'31.4''and E088°17'36.2'',Alt: 2153m±11.

Global distribution: Bhutan,China,India,Nepal,Thailand.

Local distribution: Senchel, Mungpoo,Singamari,lava.

Lepisorus scolopendrium (Buchanan-Hamilton ex Don) Mehra & Bir, Res. Bull. Panjab Univ. Sci. n.s. 15: 168. 1964; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 538.2008; Fraser-Jenk., Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 37.2015.

Polypodium scolopendrium Buchanan-Hamilton ex D. Don, Prodr. Fl. Nepal. 1,1825.

Pleopeltis scolopendrium(Don)Alston &Bonner in Candollea,15,207,1956.

Lepisorus excavates (Bory)Ching var.*scolopendrium*(Don)Ching in Bull.Fan.Mem.Inst.Biol.Bot.ser.4,69,1933.

Plants epiphytic,rhizome short,Ca.0.5 cm,scaly;scales bicolorous,dark brown at the center, pale-brown towards margin,lanceolate,toothed,acute,0.5-0.7 × 0.2-0.3 cm;frond simple,35-47 ×2-3 cm,stipec 0.5-1 cm,light green;lamina green ,rachis raised abaxially,elliptic-lanceolate,attenuate,acuminate,34-46 × 2-3 cm;sori globose, brown,exinidistae;sporangium spherical,golden brown, 290-300µm; spore bilateral,reniform,pale,tuberculate,60-65×40-42µm.

Exciccatae : West Bengal,Darjiling hills, Third mile,15/07/11 *Nayan Thapa & Dorjay Lama*, 21A(SJCBH), 21B (LBH),N27°00'31.4''and E 088° 17' 36.2'', Alt: 2153m±11.

Global distribution: Bhutan,China N India, Nepal,Taiwan.

Local Distribution: Third mile, Senchel,Chimney,Ghoom, Algarah

Lepisorus sublinearis (Baker ex Takeda) Ching, Bull.Fan Mem. Inst.Biol .4:78. 1933; Dixit , A Cen. of Indian Pterid. 43 .1984; Thapa, Pterid. of Nepal 45.2002; Ghosh,The Pterid. Flo. Of East.Ind. I: 526. 2004; Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 538.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 36.2015.

Polypodium sublineare Baker ex Takeda, Notes Roy.Bot. Gard. Edinb. 8:276.1915.

Plants epiphytic, sub coriaceous; rhizome creeping, wide,scaly;scales lanceolate,entire, acuminate, brown,0.4-0.8 × 0.1-0.2 cm; frond simple,20-30

×2-4 cm; stipe 1-3 cm, light green; lamina simple, broadly lanceolate, widest at basal half, entire, acuminate, 19-25 × 2-4 cm; sori globose, brown, exinductae; sporangium spherical, golden brown, 330-340 μm; spore bilateral, reniform, pale, tuberculate, 50-55 × 35-42 μm.

Exciccatae : West Bengal, Darjiling hills, Third mile, 01/10/11, *Nayan Thapa & Dorjay Lama*, 071A(SJCBH), 071B (LBH), N27°00'31.4'' and E088°17'37.5'', Alt: 2154m±15.

Global distribution: Bhutan, China, India, Nepal.

Local distribution: Third mile, Mungpoo.

Leptochilus Kaulf., Enum. Filic. 147. 1824.

1. Fronds monomorphic, , 30-70 × 4-30 cm..... 2
+. Fronds dimorphic , 30-50 × 5-10 cm *Leptochilus pedunculatus*
2. Lamina pinnatifid, 30-50 × 20-30 cm..... 3
+. Lamina simple, 10-80 × 4-8 cm..... *Leptochilus decurrens subsp. hemionitideus*.
3. Lamina segment 6-8 pairs..... *Leptochilus ellipticus*
+. Lamina segment 3-5 pairs..... *Leptochilus insignis*.

Leptochilus ellipticus (Thunberg) Nooteboom, Blumea. 42: 283. 1997; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 62.2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal I:38 .2015

Polypodium ellipticum Thunberg, Fl. Jap.: 335. 1784.

Colysis elliptica (Thunberg) Ching in Bull. Fan Mem. Inst. Biol. Bot. 2:333. 1933.

Plants lithophytic, terrestrial, erect; rhizome long, creeping, scaly; scales ovate lanceolate, toothed, acuminate, brown, 0.6 × 0.3 cm; fronds

monomorphic, 40-60 × 20-30 cm; stipe stramineous, glabrous, 10-20 cm; lamina pinnatifid, deeply lobed, ovate, acuminate, 30-40 × 20-30 cm; rachis winged; lamina segment 6-8 pairs, opposite, lanceolate, entire, acuminate, 10-15 × 2.5-3.5 cm; veins distinct, anastomosing; sori coenosori, oblique, linear, between lateral veins, brown; sporangium ovoid to globose, dark brown, 345 × 310 μm; spore reniform, smooth, pale, 42 × 24 μm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 27/05/2013, *Nayan Thapa & Dorjay Lama, 136A (SJCBH), 136B (LBH), N27°01'46.0'' and E088°16'34.5, Alt : 1285m ± 18.3*

Global distribution: Bhutan, China, India, Japan, Korea, Myanmar, Nepal, Philippines, Thailand, Vietnam.

Local distribution: Teesta, Rambi.

Leptochilus insignis (Blume) Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 62.2008; Fraser-Jenkins, Kandel, & Pariyar., Ferns and fern-allies of Nepal 1 :38. 2015.

Plants lithophytic, terrestrial, erect; rhizome short, creeping, scaly; scales lanceolate, toothed, acuminate, brown, 0.9 × 0.2 cm; fronds pinnatifid, monomorphic, 40-60 × 20-30 cm; stipe stramineous, winged, glabrous, 5-10 cm; lamina ovate – sub triangular, membranaceous, adaxially pubescent, 35-50 × 20-30 cm; rachis winged, 0.5-1 cm; lamina segment 3-5 pairs, opposite, ascending, oblong-lanceolate, entire, acuminate, 10-15 × 4-5 cm; veins prominent, distinct, reticulate; sori oblique, linear, exindusiate; sporangium ovoid, brown, 376 × 311 μm; spore spherical, tuberculate, pale, 45-50 μm.

Exsiccatae : West Bengal, Darjiling hills, Takdah, 10/07/13, *Nayan Thapa & Dorjay Lama, 149A (SJCBH), 149B (LBH), N27°02'01.4'' and E088°20'52.5'', Alt: 1865m ± 10.5.*

Global distribution: Bhutan, China, India, Japan.

Local distribution: Takdah, Kuresong.

Leptochilus pedunculatus (Hooker & Greville) Fraser-Jenkins, Taxon. Revis. Indian Subcontinental Pteridophytes 62. 2008; Fraser-Jenkins, Kandel, & Pariyar., Ferns and fern-allies of Nepal 1 :38. 2015.

Ceterach pedunculatum Hooker & Greville, Icon. Filic. 1: t. 5. 1827.

Colysis pedunculata (Hooker et Greville) Ching in Bull.Fan Mem. Inst. Biol. 4 : 321.1933

Plants lithophytic, terrestrial, erect; rhizome wide, creeping, scaly; scales ovate-lanceolate, margin toothed, acuminate, brown, 0.3-0.4× 0.1-0.2cm; frond dimorphic, distant, sterile frond simple, 30-50× 5-10 cm; stipe dark brown,scaly; 10-20 cm; sterile lamina ovate-oblong, entire, acuminate, 20-30× 5-10 cm;veins distinct, anastomosing forming costal areole; fertile frond simple, 60-80× 4-5 cm; stipe dark brown, 50-60 cm;lamina ovate-lanceolate,entire, acuminate,10-20× 4-5 cm; sori elongated,linear ,oblique to the rachis,between the rows of lateral veins, brown; sporangium ovoid, dark brown, 367× 310µm; spore reniform, minutely spinous, pale-brown, 52× 28µm.

Exciccatae : West Bengal,Darjiling hills,Mangwa,10/07/13, *Nayan Thapa & Dorjay Lama, 154A(SJCBH), 154B (LBH),N27°03'01.4''*and *E088°23'52.5''*,Alt: 1267m±10.5.

Global distribution: China,India, Indonesia, Thailand, Vietnam.

Local distribution: Mangwa,Mungpoo

Leptochilus decurrens Blume subsp. **hemionitideus**Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 63.2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal 1 :37. 2015.

Colysis decurrens (Blume) Panigrahi, Abstr. & Souv. Nation. Symp. Curr. Trends. Pterid.1991:13.1991 (*comb .inval.*)

(Figure 3.15: A to D)

Plants lithophytic, terrestrial, erect; rhizome long, creeping, scaly; scales lanceolate, entire, acuminate, 0.4× 0.1 cm; fronds monomorphic, simple, 10-80× 4-8 cm; stipe 2-4 cm, winged; lamina oblong lanceolate, glabrous, papery, base cuneate, margin entire, apex acuminate; veins distinct, reticulate forming areoles; sori elongate to round, between lateral viens, brown; spore reniform, smooth, pale, 50× 28µm.

Exsiccatae : West Bengal,Darjiling hills,Rungdung,30/07/13, *Nayan Thapa & Dorjay Lama*, 186A(SJCBH), 186B (LBH),N27°02'00.4''and E088°16'15.5'',Alt: 1846m±10.5.

Global distribution:Bhutan, India, Japan, Nepal, Thailand.

Local distribution: Rungdung.

Loxogramme (Blume) C. Presl, Tent. Pterid. 214-215, pl. 9, f. 8. 1836.

1. Plants less than 20 cm in height.....*Loxogramme chinensis*
- + Plant more than 20 cm in height.....2
2. The cell of the scale longer than its width.....*Loxogramme porcata*
- + The cells of the scale as long as its width.....*Loxogramme involuta*

Loxogramme involuta (D.Don) C.Presl, Tent. Pterid.: 215 .1836; Beddome, Ferns Brit. India ,393, f.228. 1883; Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 160.1964;Dixit , A Cen. Of Indian Pterid. 33.1984; Thapa, Pterid. of Nepal 46.2002; Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 541. 2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

Grammitis involuta D.Don, Prodr. Fl. Nepal.: 14 .1825.

Gymnogramme involuta (D.Don) Hooker, Sp. Fil.: 5: 155 .1864.

Loxogramme mussooriensis R.D. Dixit & S. Das, Indian Fern J. 11 (1-2):60 .1995.

Plant epiphytic, thick coriaceous, green; rhizome erect, short, scaly , scales ovate , brown with white –transparent hellow, 0.4 –0.6 × 0.1-0.2 cm,

acuminate; fronds in apical tuft, monomorphic; stipe indistinct, short; lamina simple, lanceolate, glabrous, attenuated at base, abaxially paler, adaxially deep green, 27-40 × 3-4 cm, apex caudate-acuminate, mid-vein raised abaxially, usually flat adaxially, straw-colored or pale green, veins hidden; sori linear, 3-4 × 0.1-0.2 cm, oblique, well spaced, between midvein to frond margin, superficial, exindusiate, sporangium globose, golden-brown, 250-265 μm, spore reniform, minutely tuberculate, light green, 40-45 μm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/2011, *Nayan Thapa & Dorjay Lama, 018A (SJCBH), 018B(LBH)*, N27°00'30.5'' and E088°17'40.2'', Alt : 2130m ± 11.5

Global Distribution: India, Nepal, China, Thailand, Vietnam.

Local Distribution: Third mile, Toongsong, Singamari, Lava.

Loxogramme porcata Price, Amer. Fern J. **80** (1): 4-8 . 1990; Thapa, Pterid. of Nepal 47.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 541.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

(Figure 3.2: A to D)

Plant epiphytic, thick coriaceous, green; rhizome erect, short, scaly, scales ovate, brown, 0.6 – 0.8 × 0.1-0.3 cm, acuminate; fronds in apical tuft, monomorphic; stipe indistinct, short; lamina simple, lanceolate, glabrous, attenuated at base, abaxially paler, adaxially deep green, 30-50 × 3-6 cm, apex caudate-acuminate, midvein raised adaxially, usually flat abaxially, straw-colored or pale green, veins hidden; sori linear, 3-4.5 × 0.1-0.3 cm, oblique, well spaced, between mid-vein to frond margin, superficial, exindusiate; sporangium globose, brown, 270-280 μm, spore reniform to lunar, light green, minutely spinous, 43-47 μm.

Exsiccatae : West Bengal, Darjiling hills, Rohini, 03/04/2012, *Nayan Thapa & Dorjay Lama, 107A (SJCBH), 107B(LBH)*, N26°54'10.5'' and E088° 20' 33.2'', Alt : 850m ± 11

Global Distribution: Bhutan, China, India, Myanmar, Nepal, N Thailand.

Local Distribution: Rohini, Pankhabari, Jamunay.

Loxogramme chinensis Ching in Sinensia, 1,13. 1829 ; Mehra & Bir, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 160.1964; Dixit, A Cen. Of Indian Pterid.33. 1984; Thapa , Pterid. Of Nepal 47.2002; Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 541.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 39.2015.

Loxogramme lanceolata sensu Bedd.,Handb Ferns Brit.India,392.1833.

Plant epiphytic, coriaceous, dark green; rhizome creeping, 0. 1-0.2 cm in diam., densely scaly , scales pale brown , lanceolate, 0.5-0.7 × 0.1-0.2 cm, margin sub-entire; Fronds closely spaced , monomorphic; stipe short, pale green, narrowly winged; lamina simple,dark green, linear-lanceolate, 5-14× 0.5-2 cm, glabrous, base decurrent, margin slightly undulate , apex acute; costa raised on both surfaces, veins hidden; sori linear, oblique, subparallel to costa, superficial, exindusiate; sporangium globose, golden brown, 250-290µm; spore reniform to lunar, light green,spinous,35-40 µm.

Exciccatae : West Bengal,Darjiling hills, Toongsong,05/07/2011, *Nayan Thapa & Dorjay Lama, 013A (SJCBH), 013B(LBH), N27°54'2.5'' and E088°16'57.2''*,Alt :1623m ± 15.2

Global Distribution: Bhutan,China, India, Myanmar, Nepal, Thailand, Vietnam.

Local Distribution: Toongsong, Senchel,Chitrey,Lava.

Phymatosorus Pich.Sermolli, Webbia 28: 457. 1973.

Phymatosorus cuspidatus (Don) Pich.Sermolli subsp. **cuspidatus** Fraser-Jenkins ,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 529. 2008 ; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 40.2015.

Polypodium cuspidatum D.Don, Prodr. Fl. Nepal.: 2.1825.

Polypodium lucidum Roxb. in Griff., Calc. J. Nat. Hist. **4**: 486.1844.

Phymatodes cuspidata (D.Don) J.Sm., Catl. Cult. Ferns: 10 .1857.

Polypodium leiorhizum Wallich ex Mett., Fil. Hort. Lips.: 37, t.25, f.7 .1856.

Pleopeltis leiorhiza (Wallich ex Mett.) T.Moore, Ind. Fil.: 346.1862.

Microsorium lucidum (Roxb. in Griff.) Copel., Gen. Fil.: 196 .1947.

Microsorium cuspidatum (D.Don) Tagawa in Hara, Fl. East. Himal.: 495 .1966.

Phymatosorus lucidus (Roxb. in Griff.) Pich.Serm., Webbia **28**: 459 .1973.

Plants lithophytic, terrestrial, erect; rhizome thick, creeping, Ca.0.8 cm, scaly; scales bullet, broad, almost circular, adpressed, Ca. 0.6 cm; frond pinnate, 40-100 ×20-30 cm, shining green, coriaceous, glabrous;stipe articulated, glabrous, grooved dorsally, castanecous, 20-40 cm; lamina 50-70 × 20-30 cm; lateral pinnae 8-24 pairs, opposite, linear-lanceolate, stalked, 8-22× 2.5-3.1 cm, entire ,acuminate; veins distinct, anastomosing; sori globose, large, exindusiate; sporangium globose, golden-brown,350-360µm; spore bilateral,hyaline,reniform,smooth,50-54 × 30-34µm.

Exsiccatae : West Bengal,Darjiling hills, Rungdung,20/05/13, *Nayan Thapa & Dorjay Lama*, 120A(SJCBH), 120B (LBH),N27°02'00.4''and E088°16'15.2'',Alt: 1846m±17.1.

Global Distribution: Bhutan,China, India,Nepal.

Local Distribution: Singla,Teesta, Peshok,Kalijhora

Pichisermollodes Fraser-Jenkins, Indian Fern J. 26(1-2): 122. 2010.

1. Plants less than 20 cm in height.....4
- +. Plants more than 20 cm in height.....2

2. Abaxial surface of pinna glaucous to white, pinna 6-8 × 2-3 cm.....3
- + . Abaxial surface of pinna light green, 4-12 × 1-2 cm...*Pichisermollodes stewartii*
3. Pinna broad, lanceolate, minutely serrated.....*Pichisermollodes ebenipis*
- + Pinna narrow, wavyly-crenate..... *Pichisermollodes crenatopinnata*
4. Lamina hairy, margins entire.....*Pichisermollodes erythrocarpa*
- + Lamina glabrous, margin with spines.....*Pichisermollodes malacodan*

Pichisermollodes ebenipis (Hooker) Fraser-Jenkin, Indian Fern J. 26(1-2): 122 .2009; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 40.2015.

Polypodium ebenipes Hooker, Sp. Fil. 5:88 .1863.

Pleopeltis ebenipes (Hooker) Bedd., Ferns Brit. India: t.138 .1866.

Phymatodes ebenipes (Hooker) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 4: 86 .1933.

Crypsinus ebenipes (Hooker) Copel., Gen. Fil.: 206 .1947.

Crypsinus nepalensis Nakaike, Bull. Natn. Sci. Mus. (Bot.) Tokyo 13 (3): 89-105 .1978.

Selliguea ebenipes (Hooker) S. Lindsay, Edinburgh J. Bot. 66: 356. 2009.

Plants epiphytic to lithophytic, rhizome creeping, 0.3-0.5 cm in diam., scales dark brown, ovate-lanceolate, ca. 0.5cm, apex acute. Fronds monomorphic, 20-35 × 10-18 cm, palmatifid, deltate, adaxial surface green, abaxial surface

glaucous;Stipe 5-10 cm,scaly at base,purple ;rachis winged, lateral lobes 5-10 pairs,lanceolate,margins serrulate,apices acuminate basal pair deflexed;veins reticulate,prominent,Sori brown,orbicular, exindusiate,on either side of costa;Sporangium brownish,180-200µm;Spores greenish,lunar shaped,tuberculate,42-46×22-26µm.

Exciccatae : West Bengal,Darjiling hills,Third mile,22/09/2011, *Nayan Thapa & Dorjay Lama, 061A (SJCBH), 061B(LBH), N27°00'31.7'' and E088°17'37.4''*,Alt :2154m ± 15

Global Distribution:India,Nepal,Thailand,China

Local Distribution: Senchel,Lava,Chimney,Third Mile.

Pichisermollodes stewartii (Beddome) Fras-Jenkin, Indian Fern J. 26(1–2): 122 .2009; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 41.2015.

Pleopeltis stewartii Beddome, Ferns Brit. India: t.204 ,1867.

Polypodium stewartii (Beddome) C.B.Clarke, Trans. Linn.Soc.Lond. II Bot 1: 563 .1880.

Polypodium cyrtolobum J.Sm. ex C.B.Clarke; Trans. Linn. Soc. Lond. II Bot 1: 563, t.83 .1880.

Pleopeltis malacodon (Hooker) Beddome var *majus* (Hooker) Beddome, Handb Ferns Brit. India: 363 .1883.

Phymatodes stewartii (Beddome) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 4: 81-87.1933.

Crypsinus stewartii (Beddome) Copeland, Gen. Fil.: 206 .1947.

Phymatopteris stewartii (Bedd.) Pich.Sermolli, Webbia 28: 464.1973 .

Plants epiphytic to lithophytic;Rhizome creeping,0.4 -0. in diamm.,covered with bloom of scales;Fronds monomorphic,17-28 ×10-16 cm ,pinnately parted;lateral lobes 10-15 × 1-3 cm,upwardly directed, adnate, serrulate, acuminate, veins reticualte, prominent, rachis winged;stipe 3-8 cm, articulated, glabrous;Sori globose,medial,on either side of rachis, brown,

exinduisate;Sporangium globose, golden-brown, 270-300 µm; Spores greenish,lunar shaped,spinose,45-50× 20-30µm.

Exsiccatae : West Bengal,Darjiling hills,Tonglu,05/08/2011, *Nayan Thapa & Dorjay Lama, 037A (SJCBH), 037B(LBH), N27°02'04.2''* and *E088°04'46.4''*,Alt :3050m ± 15

Global distribution:Bhutan,China,India,Nepal.

Local Distribution: Tonglu,Gayribas,Ramita.

Pichisermollodes crenato-pinnata (C.B. Clarke) Fraser-Jenkin, Indian Fern J. 26(1–2): 122 .2009.

Polypodium crenatopinnatum C. B. Clarke, J. Linn. Soc., Bot. 25: 99 t.42.1889.

Phymatopteris crenato-pinnata (Clarke)Pic.ser..Webbiba,28:461.1973.
(Plate 3.14:A to F)

Plants lithophytic,erect;rhizome ca. 0.2cm in diam., scaly; scales black - brownish, 15 cm;Stipe purplish, 5-10 cm, glabrous; lamina bipinnate,divided almost to midrib, deltoid-ovate in outline, 5-20 × 5-10 cm, base truncate; Lateral lobes 3-5pairs, 5-10 × 0.5-1.2 cm, base distinctly contracted, decurrent , margin irregularly incised or lobed, , apex acute ; Sori orbicular, medial ,brown,on either side of rachis;Sporangium globe,brown, 180-250µm;Spores lunar, light green,35-40 × 20-25µm,tuberculate.

Exsiccatae : West Bengal,Darjiling hills,Maneybhanj,05/08/2011, *Nayan Thapa & Dorjay Lama, 041A (SJCBH), 041B(LBH), N27°02'02.7''* and *E088°04'42.4''*, Alt :2154m ± 15

Global distribution: Bhutan,China,India,Nepal.

Local Distribution: Maneybhanj.

Pichisermollodes malacodon (Hooker) Fraser-Jenkin, Indian Fern J. 26(1–2): 122. 2009; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 40.2015.

Polypodium malacodon Hooker, Sp. Fil. 5: 87,1863.

Pleopeltis malacodon (Hooker) Beddome, Handb Ferns Brit. India : 363 .1883.

Phymatodes malacodon (Hooker) Ching, Bull. Fan Mem. Inst. Biol. (Bot.) **4**: 83 .1933.

Crypsinus malacodon (Hooker) Copeland, Gen. Fil.: 206 .1947.

Phymatopteris malacodon (Hooker) Pich.Sermolli, Webbia **28**: 463 .1973.

Phymatopsis cartilagineoserratus Ching & S.K.Wu in C.Y.Wu, Fl. Xizangica **1**:323 .1983.

Crypsinus cartilagineoserratus (Ching & S.K.Wu) Nakaike, Bull. Natn. Sci. Mus. (Bot.) Tokyo **13** (3).1987.

Selliguea malacodon (Hooker) S. G. Lu, Hovenkamp & M. G. Gilbert [comb. nov.]

Plants lithophytic,erect;rhizome ca. 0.2cm in diam., densely scaly; scales golden-brown, lanceolate, ca. 0.2cm, margin toothed, acuminate; Fronds monomorphic,10-15× 5-7 cm; stipe stramineous, 4-6 cm, glabrous; lamina pinnatisect, 8-12 × 4- 8 cm, base sub- cordate, margin serrulate, with sharply pointed teeth;Lateral lobes 1-3 pairs, lowest pair slightly deflexed, 4-6 × 1.5-2 cm, apex acute;veins distinct,reticulate;Sori orbicular,brown, medial ,on either side of costa;sporangium globose,brown,250-300µm;spore greenish, lunar,smooth,35-40× 20-25µm.

Exsiccatae : West Bengal,Darjiling hills,Sandhakphu,06/08/2011, *Nayan Thapa & Dorjay Lama, 044A (SJCBH), 044B(LBH), N27°07'41.2''* and *E087°59'29.4''*,Alt :3520m ± 11.8

Pichisermollodes erythrocarpa (Mettenius ex Kuhn) Fraser-Jenkins, Indian Fern J. 26(1-2): 122 ,2009; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 40.2015.

Polypodium erythrocarpum Mettenius ex Kuhn, Linnaea 36: 135. 1869.

Plants epiphytic to lithophytic, erect; Rhizome Ca.0.2cm in diam., covered with whitish bloom of scales; scales dark brown, lanceolate, ciliate, acuminate ; Fronds monomorphic,10-15×4-6cm; Stipe stminaceous, 2-6 cm, pubescent; Lamina green, pinnate , 6--9 × 4-6 cm, cordate at base;Pinna 4-6 pairs, lanceolate, 3-4.5 × 0.8-1.5 cm, , margin crenate-serrate , ciliate, apex acute; lateral veins distinct,; Sori orbicular, close to costa,on either side of costa,brown;Sporangium golden-brown,globose,240-260µm;spore greenish, lunar,spinose,35-40 × 25-28µm.

Exsiccatae : West Bengal,Darjiling hills,Sandhakphu,02/09/2013, *Nayan Thapa & Dorjay Lama, 194A (SJCBH), 194B(LBH), N27°07'41.2'' and E087°59'29.4''*,Alt :3520m ± 11.8

Global distribution:Bhutan,China,Indai,Nepal

Local Distribution: Phalut,Sabargram,Sandhakphu.

Polypodiodes Ching, Acta Phytotax. Sin. 16(4): 26. 1978.

1. Plant 40-65 × 8-25 cm, pinnae incised or serrated2
- + Plant 20-50 × 10-20 cm, pinnae densely double serrate3
2. Scales brown, segments 1.5-2 cm wide..... *Polypodiodes amonea*
- + Scales black, segment 0.5-1cm wide..... *Polypodiodes lachnopus*
3. Scales brown,denticulate,0.6-0.8 × 0.2-0.4 cm.....*Polypodiodes hendersonii*
- + Scales black, entire, 0.7-1 cm × 0.5- 0.8 cm.....*Polypodiodes subamonea*

Polypodiodes amoena (Wallich *ex* Mettenius) Ching, Acta Phytotax. Sin. **16** (4): 27 .1978; Dixit, A Cen. Of Ind. Pterid.51.1984; Thapa, Pterid.of Nepal 52.2002; Ghosh,The Pter. Flo. Of East.Ind. I: 590.2004 Fraser-Jenkins,Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen.

List 545.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 41.2015.

Goniophlebium amoenum (Wallich ex Mettenius) Bedd., Ferns Brit. India: t.5 .1865.

Polypodium amoenum Wallich ex Mett., Abh. Senck. Naturf. Ges. (Frankfurt) **2**: 80 .1857.

Polypodium amoenum Wallich ex Mett. forma *pilosum* C.B.Clarke, Trans. Linn. Soc. Lond. II Bot **1**: 417 .1880.

Plants epiphytic to lithophytic, rhizome creeping, 0.5-0.7 cm in diam., scaly; scales dark-brown, ovate-lanceolate, 0.6 × 0.6 cm, acuminate, denticulate; frond pinnate, 40-65 × 20-25 cm, ovate-lanceolate, thick; stipe castaneous, 10-20 cm; pinna or segment, 20-30 pairs, oblong lanceolate, 10-13 × 1.5-2 cm, margins serrated, acuminate, basal pair deflexed; veins distinct, unisertae areoles along costa; sori round, brown on either side of costa, along the areoles; sporangium globose, golden-brown, 260-280 μm, paraphysis stalked, umbrella shaped, brown; spore light brown, monolete, smooth, reniform, 50-55 × 24-30 μm.

Exsiccatae : West Bengal, Darjiling hills, Lebong, 28/07/13, *Nayan Thapa & Dorjay Lama*, 185A (SJCBH), 185B (LBH), N27°04'13.4'' and E088°16'59.2'', Alt: 1659m ± 11.1.

Global distribution: Bhutan, China, India, Nepal, Myanmar, Thailand, Taiwan.

Local distribution: Lebong, Singamari

Polypodiodes hendersonii (Beddome) Fraser-Jenkins, New Sp. Syndr. Indian Pteridol. 202. 1997; Thapa, Pterid. of Nepal 53.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen.

List 545.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 42.2015.

Goniophlebium hendersonii Bedd., Suppl. Ferns South. India Brit. India: 21, t.384.1876.

Polypodiodes atkinsonii (C.Chr.) Ching, Acta Phytotax. Sin **16** (4): 27 .1978.

Plants epiphytic to lithophytic; rhizome creeping, Ca.0.4-0.6 cm in diam., scaly; scales linear lanceolate, black, dented, acuminate; fronds pinnate, papery, remote on rhizome, 20-35 × 10-15 cm; stipe stramineous, 8-10 cm; lateral pinnae 20-25 pairs, 5-8 × 1-1.5 cm, lobes ascending, lanceolate, serrate, acuminate, lowest segment deflexed; veins distinct, forming a linear costal aerole, along the costa; sori round, brown, each in costal aerole along either side of costa; sporangium golden-brown, globose, 350-370 μm, spore bilateral, monolet, hyaline, smooth, 35-40 × 26-30 μm.

Exsiccatae : West Bengal, Darjiling hills, Jalapahar, 27/05/13, *Nayan Thapa & Dorjay Lama*, 134A(SJCBH), 134B (LBH), N27°00'25.2'' and E088°16'27.2'', Alt: 2235m ± 11.1.

Global Distribution: China, India, Nepal.

Local Distribution: Jalapahar, Garg world, Chaudafera.

Polypodiodes lachnopus (Wallich *ex* Hooker) Ching, Acta Phytotax. Sin. **16** (40): 27 .1978; Dixit, A Cen. Of Indian Pterid. 52.1984; Thapa, Pterid. of Nepal 53.2002; Ghosh, The Pter. Flo. Of East. Ind. I: 589.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 543.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 43.2015.

Goniophlebium lachnopus (Wallich *ex* Hooker) Bedd., Handb. Ferns Brit. India: 319 .1833.

Polypodium lachnopus Wallich *ex* Hooker, Ic. Pl.: t.592 .1854.

Polypodium lachnopus Wallich *ex* Hooker, Hooker's Icon. Pl. t. 952.1854.

(Plate 3.20: A to F)

Plants epiphytic to lithophytic; rhizome long, creeping, Ca. 0.5 cm in diam., scaly; scales black, ovate-lanceolate, margin ciliated, acuminate; fronds pinnate, lanceolate, papery, 35-60 × 20-25 cm; stipe stramineous, 5-9 cm; pinna lobes lanceolate, 35-40 pairs, 3-7 × 0.5-1 cm, lanceolate, margin serrated, acute, lobes ascending, basal two pairs deflexed, short; veins distinct, forming a single row of costal aerole; sori orbicular, brown, each included within costal aerole; sporangium brown, globular, 200-240 μm; spore hyaline, lunar, smooth, 35-38 × 28-30 μm.

Exsiccatae : West Bengal, Darjiling hills, Singamari, 13/09/13, *Nayan Thapa & Dorjay Lama*, 196A (SJCBH), 196B (LBH), N27° 1.02' 2.3'' and E88° 15' 1.2'', Alt: 1969m ± 12.1.

Global Distribution: Bhutan, China, India, Nepal.

Local Distribution: Singamari, third mile, sonada.

Polypodiodes subamoena (Clarke) Ching, Acta Phytotax. Sin. **16** (4): 27 .1978; Dixit, A Cen. Of Indian Pterid. 52.1984; Thapa, Pterid. of Nepal 54.2002; Ghosh, The Pteridophytic Flo. Of East. Ind. I: 591.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 543.2008.

Goniophlebium subamoenum (Clarke) Bedd., Handb. Ferns Brit. India: 317. 1883.

Polypodium subamoenum Clarke, Trans. Linn. Soc. Lond. II Bot. **1**: 550, t. 82, f. 2 .1880.

Plants epiphytic to lithophytic; rhizome creeping, wide, scaly; scales brown, subulate, clathrate, denticulate, acuminate, 0.7-1 × 0.5-0.8 cm; fronds monomorphic, papery, lanceolate, remote on rhizome, 20-50 × 10-20 cm; stipe stramineous, 8-15 cm; pinnae lobes 10-20 pairs, lanceolate, 5-10 × 1.5-2.5 cm, acuminate, margin double serrate, ascending, basal two pairs short, deflexed; veins distinct, forming a serial row of costal aerole; sorus

orbicular, brown; each inside a costal areole; sporangia elliptic-elongated, brown, 230-240×80-90µm; spore light green, smooth, bilateral-lunar shaped, monolete, 33-40 × 26-28µm.

Exsiccatae : West Bengal, Darjiling hills, Singamari, 13/09/13, *Nayan Thapa & Dorjay Lama*, 197A(SJCBH), 197B (LBH), N27°1.02'2.3'' and E088°15' 1.2'', Alt: 1969m ±12.1.

Global Distribution: Bhutan, China, India, Nepal.

Local Distribution: Sinagmari, lava, Chimney

Pyrrrosia Mirbel, Hist. Nat. Vég. (Lam. & Mirbel) 3: 471; 5: 91. 1802

1. Plants less than 10 cm in height.....*Pyrrrosia lanceolata*
- + Plants more than 20 cm in height.....2
2. Stipe length more than 5 cm.....3
- + Stipe length less than 3cm.....4
3. Lamina lanceolate, 10-20 cm *Pyrrrosia nuda*
- + Lamina ovate to oblong5
4. Lamina ovate, 15-30 × 6-10 cm..... *Pyrrrosia lingua*
- + Lamina oblong, 30-50 × 6-12 cm..... *Pyrrrosia costata*
5. Rhizome short, decumbent, 2-3 cm..... *Pyrrrosia mannii*
- + Rhizome long creeping, 6-10 cm..... *Pyrrrosia porosa*

Pyrrrosia costata (C.Presl ex Beddome) Tagawa & K.Iwats, Acta Phytotax. Geobot. Kyoto 22:100.1967; Dixit, A Cen. of Indian Pterid. 53, 1984 Thapa, Pterid. of Nepal 54.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 463.2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II: 539.2005

;Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 546. 2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I :42 2015.

Niphobolus costatus C.Presl ex Bedd, Ferns Brit. India: t.120, 1868.

Niphobolus beddomeana Giesenh, Farng. Niphobolus: 101, 1901.

Pyrrosia beddomeana (Giesenh) Ching, Bull. Chin. Bot. Soc. 1:68, 1935.

Plants lithophytic to epiphytic; rhizome short, creeping, Ca. 0.4 cm in diam., scaly; scales basifixed, entire, lanceolate, brown, acuminate, 0.5-0.8 × 0.2-0.4 cm; Fronds monomorphic, 18-62 × 5-8 cm, oblong-lanceolate; lamina green, glabrous adaxially, dimorphic hairs abaxially, decurrent, apex caudate; stipe 1-4 c.m, winged, scaly; sori circular, brown, intermingled with stellate hairs; sporangium globose, brown, 220-230 µm; spore bilateral to lunar shaped, grayish-yellow, smooth, 60-63 × 42-46 µm.

Exsiccatae : West Bengal, Darjiling hills, Rungdung, 27/05/2013, *Nayan Thapa & Dorjay Lama, 141A (SJCBH), 141B (LBH), N27°01'16.0'' and E088°16'24.5, Alt : 1585m ± 18.3*

Global Distribution: Bhutan, China, India, Myanmar, Nepal, Thailand, Vietnam.

Local Distribution: Rungdung, Barnesbeg, Peshok, Makaibari

Pyrrosia lingua (Thunberg) Farwell, Amer. Midl. Naturalist. 12: 302. 1931; Ching, Bull. Chinese Bot. Soc. 1:60. 1935; Dixit, A Cen. of Indian Pterid. 54. 1984; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II: 540. 2005; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 546. 2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I :42 2015.

Acrostichum lingua Thunberg Syst. Veg, ed. 14, 928. 1784.

Niphobolus lingua Giesenh Niphobolus 156, 1901.

Plants lithophytic to epiphytic; Rhizome wide creeping, 0.3-0.5 cm in diam., scaly; scales brown, lanceolate, entire, acuminate, 0.6-0.8 × Ca. 0.2 cm; Fronds mono-morphic, 10-30 × 3-6 c.m; lamina simple, elliptic, green adaxially, abaxially with stellate hairs, 6-23 × 3-6 c.m; stipe stramineous, 4-7 c.m; sori globose, compact, covered by lobose, golden-brown, 200-220 µm; spore reniform, greenish, tuberculated, 65 × 44 µm.

Exsiccatae : West Bengal,Darjiling hills,Pandam,22/09/2011, *Nayan Thapa & Dorjay Lama,054A(SJCBH),054B(LBH)*, N27°03'31.7''and E088° 16' 30.2.4'', Alt :1720m ± 15.2

Global Distribution: China, India, Japan, Korea, Myanmar, Vietnam .

Local Distribution: Pandam,Lebong, Takdah.

Pyrrrosia lanceolata (Linnaeus) Farwell, Amer. Midl. Nat. **12**: 245 ,1931; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 161.1965; Dixit, A Cen. Of Indian Pterid 54.1984; Thapa, Pterid. of Nepal 54.20 02; Ghosh, The Pterid. Flo. Of East. Ind. I: 463.2004; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II:539.2005 ; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 547.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I :42. 2015.

Acrostichum lanceolatum L, Sp. Pl, **2**, 1067.1753.

Polypodium adnascens Sw, Syn. Fil.: 25, 222 .1806.

Niphobolus adnascens (Sw.) Kaulf, Enum. Fil.: 124 .1824.

Pyrrrosia adnascens (Sw.) Ching, Bull. Chin. Bot. Soc. **1**, 45 .1935.

Plants epiphytic to lithophytic; Rhizome thin, long creeping, Ca.0.2 c.m in diam, sclay; scales brown, lanceolate, acuminate, ciliate ,0.3-0.7 × 0.1-0.2 cm; Fronds monomorphic, ,5-12 × 0.4-1.2 cm; lamina simple, green adaxially , abaxially with stellate hairs , 6-13 × 0.4-1.2 cm, base attenuate, decurrent, obtuse; Sori sunken, covered with stellate hairs; Sporangia globose, dark brown, 200-245 µm; spore greenish, lunar, spinose, 35-45 × 24-27 µm.

Exsiccatae : West Bengal,Darjiling hills,Teesta,23/05/13, *Nayan Thapa & Dorjay Lama, 054A (SJCBH), 054B(LBH)*, N27°04'40.2'' and E088°16' 25.18.1'', Alt :649m ± 14.2

Global Distribution: Bangladesh, Bhutan, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Sri Lanka, Thailand, Vietnam.

Local distribution: Peshok, Teesta, Singla, Sukuna.

Pyrrosia mannii (Giesenh) Ching, Bull. Chin. Bot. Soc. **1**: 55 (1935); Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 163.1965; Dixit, A Cen. Of Indian Pterid. 55.1984; Thapa, Pterid. of Nepal 55.2002; Ghosh, The Pterid. Flo. Of East. Ind. I : 467.2004; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 547.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I :42. 2015.

Niphobolus mannii Giesenh, Farng. Niphobolus: 107 ,1901.

Niphobolus fissus sensu Beddome: 330 f.179 (1883), *p.p, non* Bl.

Polypodium fissum sensu Clarke: 554 (1880); Hope: 88 (1903), *non* Bak., 1867.

Niphobolus mannii Giesenhagen, Niphobolus, 107. 1901.

(Figure 3.8: A to D)

Plants epiphytic, pendent; Rhizome short, decumbent; 0.2-0.4 cm in diam, scaly; scales lanceolate, brown, acuminate; Fronds monomorphic, 10-30 × 1.5-3 cm; lamina simple, lanceolate, green, adaxially with stellate hairs, brown abaxially with stellate hairs; Sori superficial, round, red; sporangium globose, brown, 180-240 μm; spore lunar, light brown, lunar to ovoid, 65-70 × 46-50 μm.

Exsiccatae : West Bengal, Darjiling hills, Lebong ,27/05/13, *Nayan Thapa & Dorjay Lama, 137A(SJCBH), 137B(LBH), N27°04'13.5''* and *E088°16'25.1'59.7''*, Alt :1649m ± 14.2

Global Distribution: Bhutan, India, Myanmar, Nepal, Thailand

Local Distribution: Rungdung, Takdah, Lebong.

Pyrrosia nuda (Giesenh) Ching, Bull. Chin. Bot. Soc. **1**: 70 .1935; Mehra & Bir, Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 162.1965; Dixit, A Cen. Of Indian Pterid. 55.1984; Thapa, Pterid. of Nepal 55.2002; Ghosh, The Pterid. Flo. Of East. Ind. I: 461.2004; Fraser-Jenkins, Tax. Revi.

Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 547.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I : 42.2015.

Niphobolus nudus Giesenh, Farngr. Niphobolus: 149 .1901.

Plants epiphyte to lithophytics; rhizome long creeping, 0.1-0.3 cm in diam., scaly; scales brown, lanceolate, acuminate; fronds monomorphic, 10-30 × 1.8-2.5 cm; lamina simple, adaxially green, abaxially with minute stellate hairs, 3-25 × 1.8-2.5 cm; stipe pale-green, 1-5 cm; Sori dark brown, globose, 300-310 μm; spore spherical, smooth, pale, 30-40 μm.

Exsiccatae : West Bengal, Darjiling hills, Teesta, 23/05/13, *Nayan Thapa & Dorjay Lama*, 133A (SJCBH), 133 (LBH), N27°04'40.2'' and E088°16' 25.1' 8.1'', Alt : 649m ± 14.2

Global Distribution: Bhutan, N India, Myanmar, Nepal .

Local distribution: Peshok view Point, Teesta, Kalijhora, Sukuna.

Pyrrrosia porosa (Presl) Hovenkamp, Blumea **30**: 208 .1984; Thapa, Pterid. of Nepal 55.2002; Singh & Panigrahi, Ferns and fern-allies of Arunachal Pradesh II: 547.2005 Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 547.2008; Fraser-Jenkins, Kandel, & Pariyar, Ferns and fern-allies of Nepal I : 42.2015.

Niphobolus porosus C.Presl, Tent. Pterid.: 202 .1836.

Niphobolus mollis Kunze, Bot. Zeit. **6**: 121.1848.

Pyrrrosia mollis (Kunze) Ching, Bull. Chin. Bot. Soc. **1**: 53 .1935.

Pyrrrosia penengiana (Hooker) Holttum, Rev. Fl. Mal. **2**: 146, f.62 ,1955.

Pyrrrosia stictica (Kunze) Holttum, Novit. Bot. **1968**: 30 ,1969.

Plants epiphytic to lithophytic, pendent; rhizome lanceolate, thin, long, creeping, Ca. 0.1-0.3 cm in diam., scaly; scales, lanceolate, smooth, 0.1-0.6 × 0.1-0.2 cm, base entire, acuminate; Frond monomorphic, 10-25 × 1.5-2.7 cm; lamina simple, linear, decurrent, adaxially green, glabrous, abaxially with monomorphic stellate hair; stipe winged; sori globose with stellate hair,

brown, exindusiate; sporangium brown, globose, 210-230µm, spore spherical, smooth, green, 50-60µm.

Exsiccatae : West Bengal, Darjiling hills, Mangwa, 10/09/13, *Nayan Thapa & Dorjay Lama, 195A (SJCBH), 195(LBH)*, N27°03'01.1'' and E088°16'23'52.0'', Alt : 1267m ± 10.5

Global Distribution: Bhutan, India, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam.

Local Distribution: Mangwa, Takdah, Mungpoo, Kalimpong.

Selliguea Bory, Dict. Class. Hist. Nat. 6: 587. 1824.

Selliguea griffithiana (Hooker) Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a rev. Cen. List 47.2008; Fraser-Jenkin, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 43.2015.

Polypodium griffithianum Hooker, Hooker's Icon. Pl. 10: t. 951. 1854,

Phmatodes griffithiana (Hooker) Ching in Contrib. Inst. Bot. nat. Acad. Peiping 2, 71.1933; ; Mehra, Pteridophytic Fl. of Darjeeling and Sikkim Himalayas 170. 1964.

Phymatopteris griffithiana (Hook) Pich. Serm., Webbia 28:462, 1973; Thapa, Pterid. Of Nepal 50.2002.

(Plate 3.9: A to D)

Plants lithophytic to epiphytic, rhizome long, creeping, 0.3-0.4 cm in diam., densely scaly, scales dark brown, lanceolate, margin entire, apex acuminate; Fronds monomorphic; stipe stramineous, 4-10 cm; lamina simple, green, ovate-lanceolate, 5-23 × 3-6 cm, margin entire, cartilaginous, glabrous, cuneate at base, apex acute to acuminate; veins distinct, reticulate; sori globose, brown, large, in single row between midrib and margin, exindusiate; sporangium dark brown, globose, 300-320µm; spores brown, reniform, minutely spinous, 40 × 25µm.

Exsiccatae : West Bengal, Darjiling hills, Third mile, 15/07/11, *Nayan Thapa 019A (SJCBH), 019B(LBH)*, N27°00'31.2'' and E088°17'37.4'', Alt : 2154m ± 11.5

Global Distribution: Bhutan,China, India, Myanmar, Nepal, Thailand, Vietnam.

Local Distribution: Third mile,Chatakpur,Kafer,Chimney.

Tricholepidium Ching, Acta Phytotax. Geobot. 29: 41. 1978.

Tricholepidium normale (Don) Ching, Acta Phytotax. Geobot. 29: 43. 1978; Mehra & Bir ,Pteridophytic Fl. Of Darjeeling and Sikkim Himalayas 118.1965; Dixit , A Cens. of Indian Pterid.98.1984; Thapa, Pterid. of Nepal 83.2002; Fraser-Jenkins, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 562. 2008; Fraser-Jenkins, Kandel & Pariyar,Ferns and fern-allies of Nepal I:185.2015.

Polypodium normale Don, Prodr. Fl. Nepal. 1. 1825.

(Plate 3.11:A to E)

Plants epiphytic, pendent; rhizome long, creeping, scaly; scales lanceolate, bristle at base, entire, acuminate, 0.8× 0.2 cm; fronds simple, monomorphic, 10-40× 2-4 cm, sessile; lamina lanceolate, margin undulate, acuminate, herbaceous, green, abaxially scaly, 10-24× 2-4 cm; veins distinct, anastomosing, aeroles 2-5 on either side of midrib; sori scattered, superficial, spherical, exindusiate, whitish –brownish ; sporangium ovoid, dark brown, 300× 250µm; spore bilateral, smooth, green, 25× 15µm.

Exsiccatae : West Bengal,Darjiling hills,Third mile,30/06/13, *Nayan Thapa & Dorjay Lama,143A(SJCBH),143B(LBH),N27°00'31.2''* and *E088°17'37.4''*,Alt :2154m ± 11.5

Global distribution: Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Thailand, Vietnam.

Local distribution: Third mile, lebong, lava

Grammitidaceae Newman, Hist. Brit. Ferns 7. 1840.

Tomophyllum (E. Fourn.) Parris, Gard. Bull. Singapore 58(2): 245. 2007.

Tomophyllum donianum (Sprengel) Fraser-Jenkins & Parris, Tax. Revi. Of Three Hundred Ind. Subcon. Pterid. With a revi. Cen. List 75.636; Fraser-Jenkins, Kandel & Pariyar, Ferns and Fern-allies of Nepal I: 43.2015. (Plate:3.5)

Polypodium donianum Sprengel, Syst. Veg. 4: 54. 1827.

Plant epiphytic, rhizome short, erect, hairy; hairs reddish-brown, simple, Ca. 0.1 cm in diam.; fronds uni-pinnate, hairy, green, 7-16 × 1-2 cm; stipe glabrous upto 1 cm; lamina 6-15 × 1-2 cm, oblong-lanceolate, hairy on adaxial and abaxial side; segments or lobes adnate, oblique, margin irregularly lobed, obtuse, 1 × 0.5 cm; sori round, brown, exindusiate; sporangium globose, golden-brown, 300-310 μm; spore tetrahedral, smooth, 35-40 μm.

Exsiccatae : West Bengal, Darjiling hills, Gayribas, 25/10/11, *Nayan Thapa & Dorjay Lama*, 086A(SJCBH), 086B(LBH), N27°03'33.5'' and E088°01'27.9'', Alt: 2532m ± 12.8.

Global distribution: Bhutan, China, India, Nepal.

Local Distribution: Gayribas, Sanchel

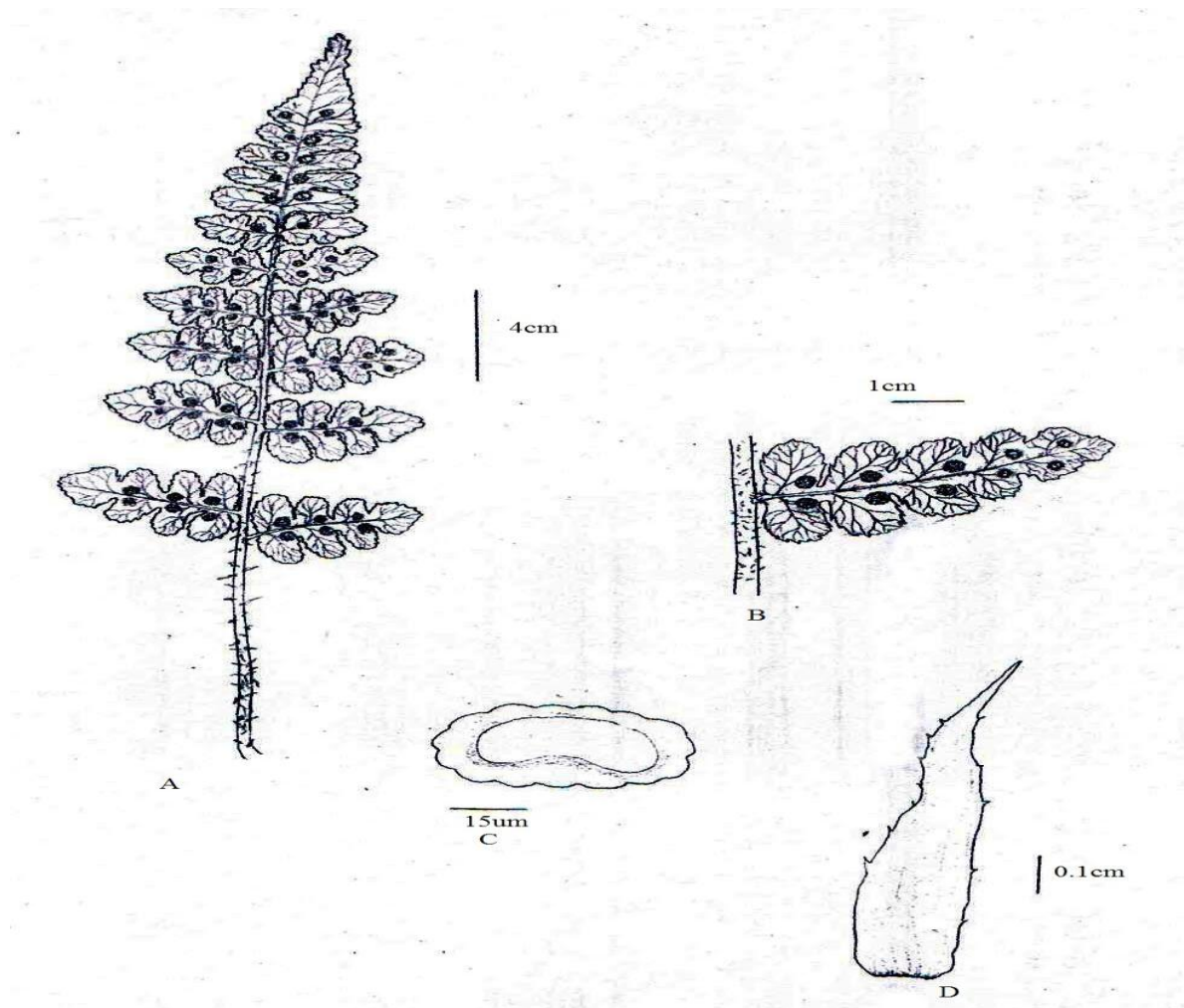


Figure 3.1: A. *Dryopteris serratodentata* Beddome ; B. Pinnae; C. Spores 400x; D. Rhizome scales.

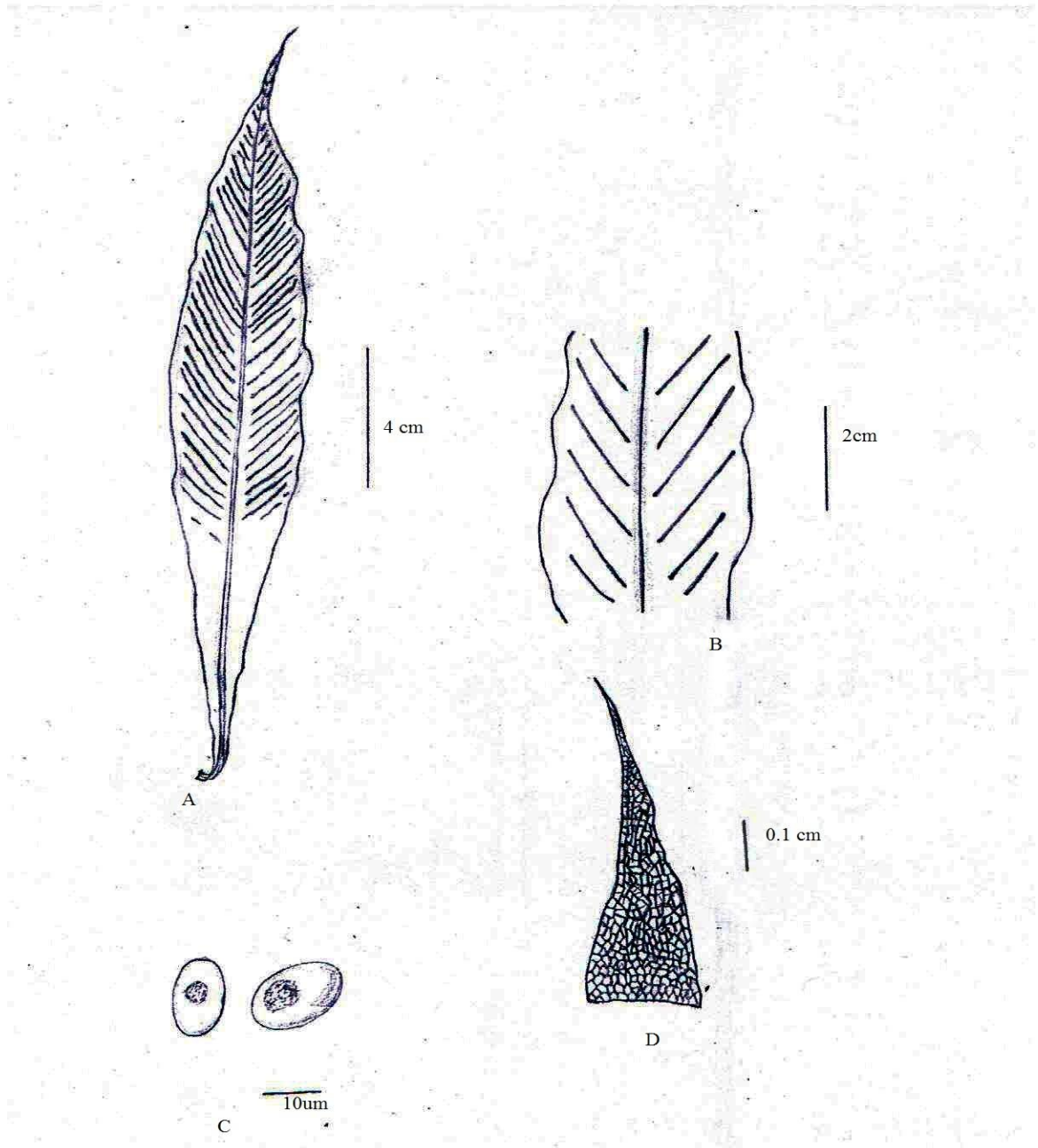


Figure 3.2: A. *Loxogramme porcata* Price ; B. Portion of frond magnified; C. Spore 400x; D. Rhizome scales.

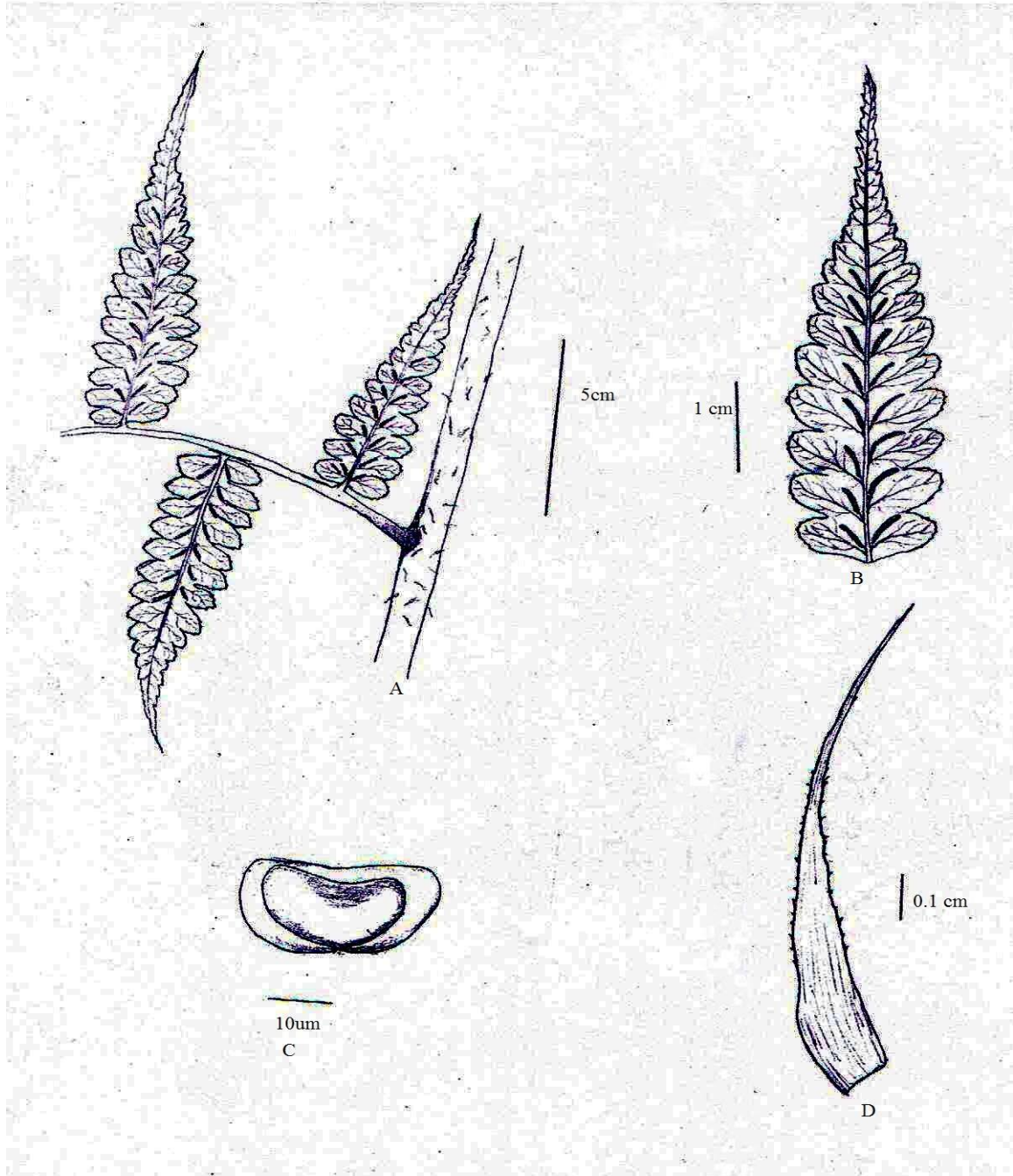


Figure 3.3: A. *Diplazium succulentum* Clarke ; B.Pinnae; C.Spore 400x; D. Scales 20x.

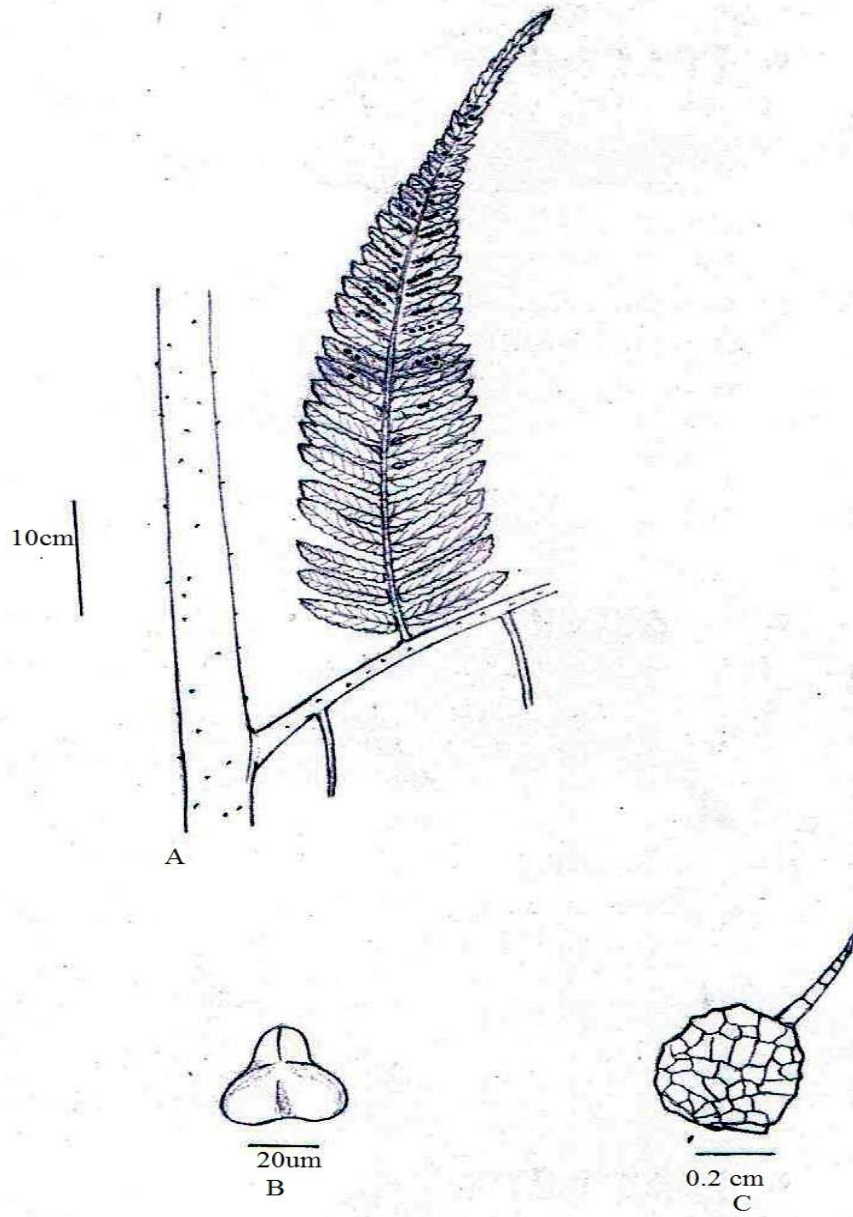


Figure 3.4: A. *Cyathea brunoniana* Clarke ; B. Spores 400x; C. Costule scales

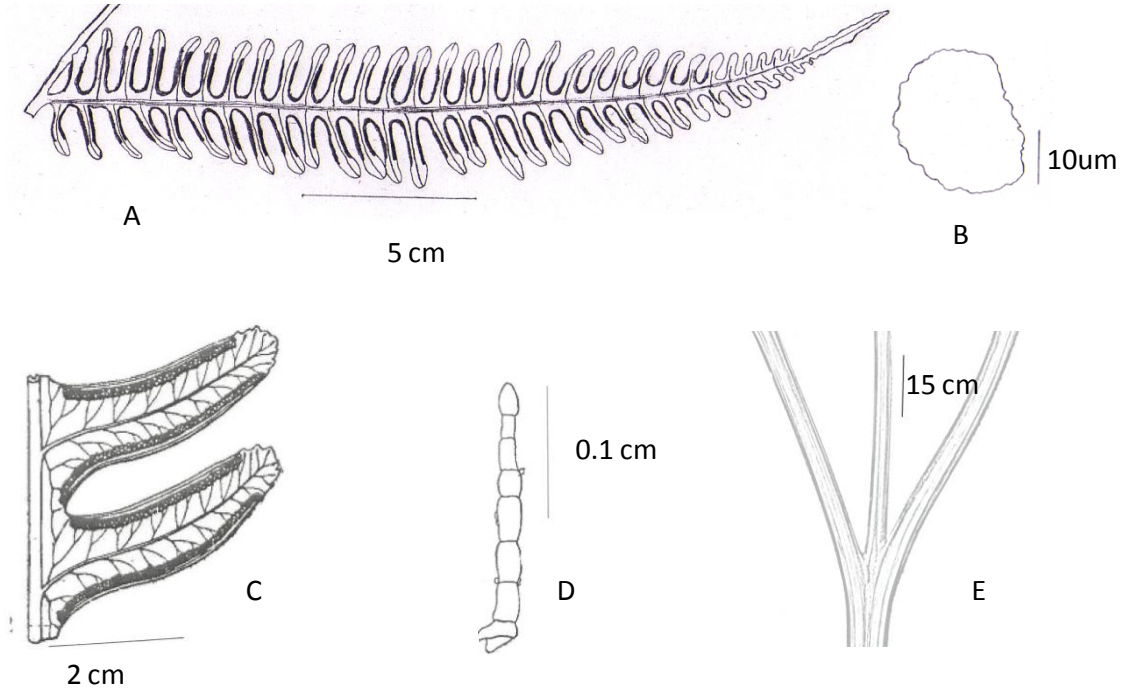


Figure 3.5: A. *Pteris austrosinica* (Ching) Ching; B. Spore 400x; C. Ultimate segment, D. Hairs on the Costules, E. Tripartite stipe .

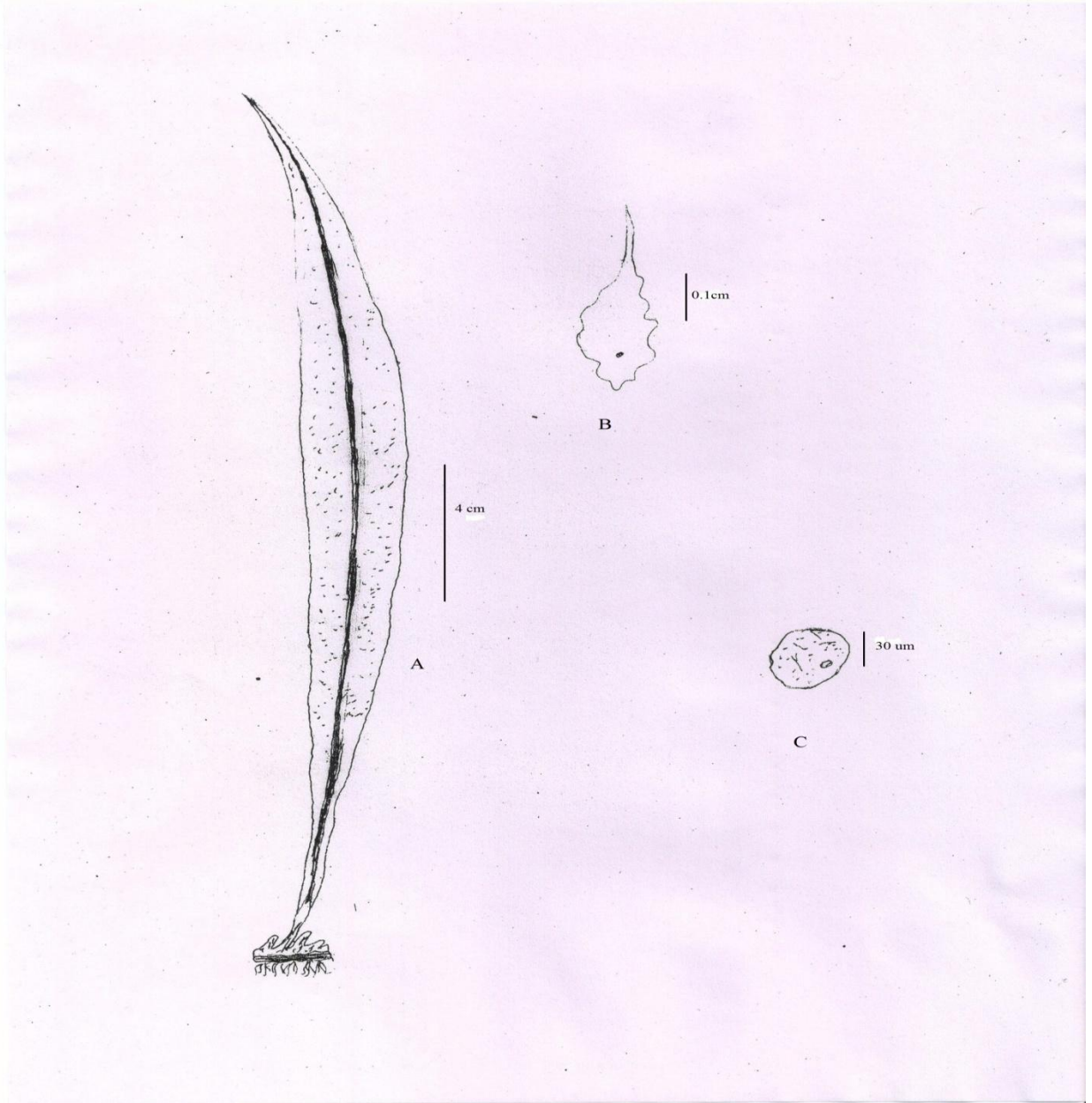


Figure 3.6: A. *Microsorium punctatum*(Linnaeus)Copeland ; B. Rhizome scales 40x; C. Spore 400x.

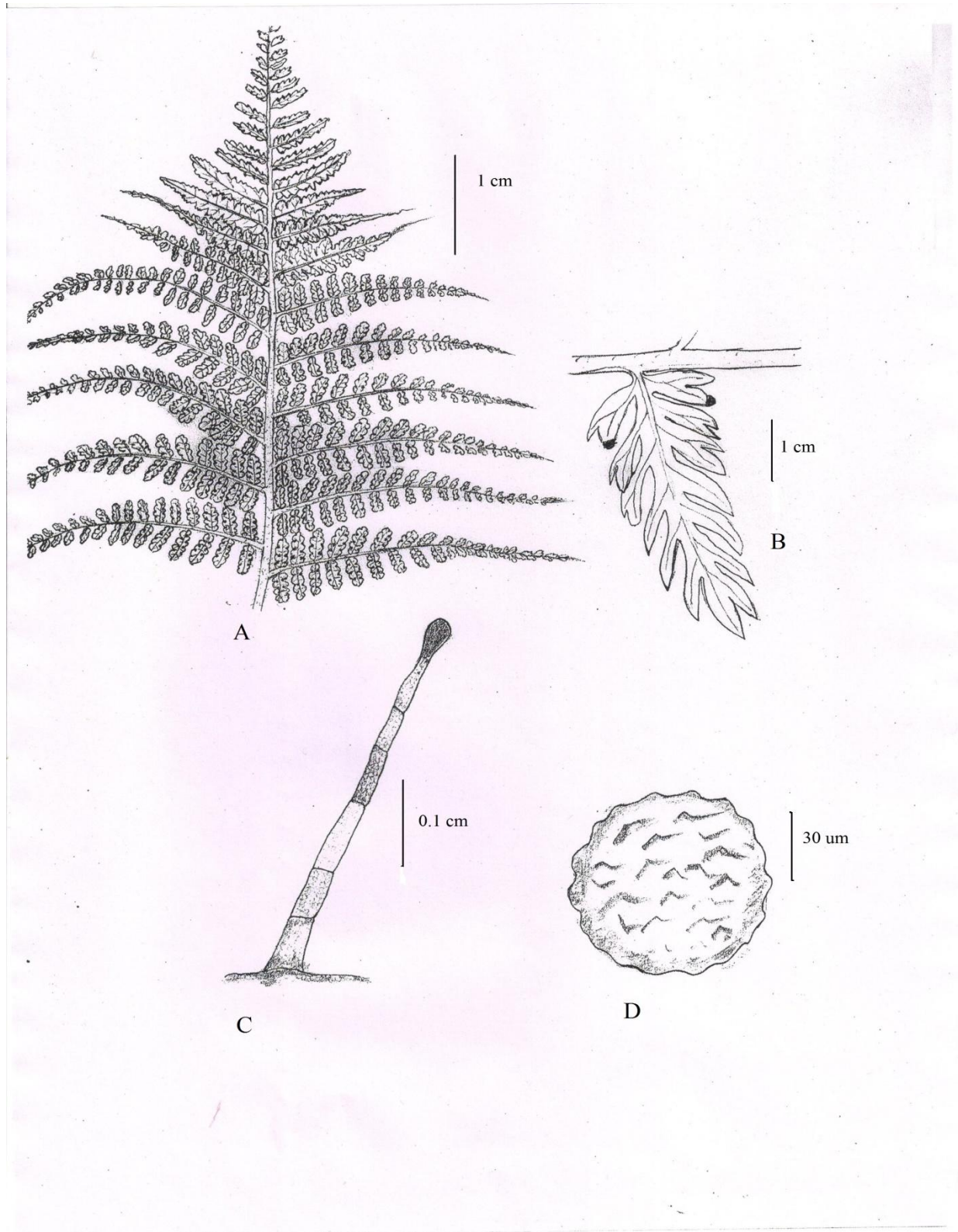


Figure 3. 7: A.*Dennstaedtia apendiculata*(Wallich ex Hooker) Smith ;
B.Pinnae; **C.** Hairs 40x; **D.** Spore 400x

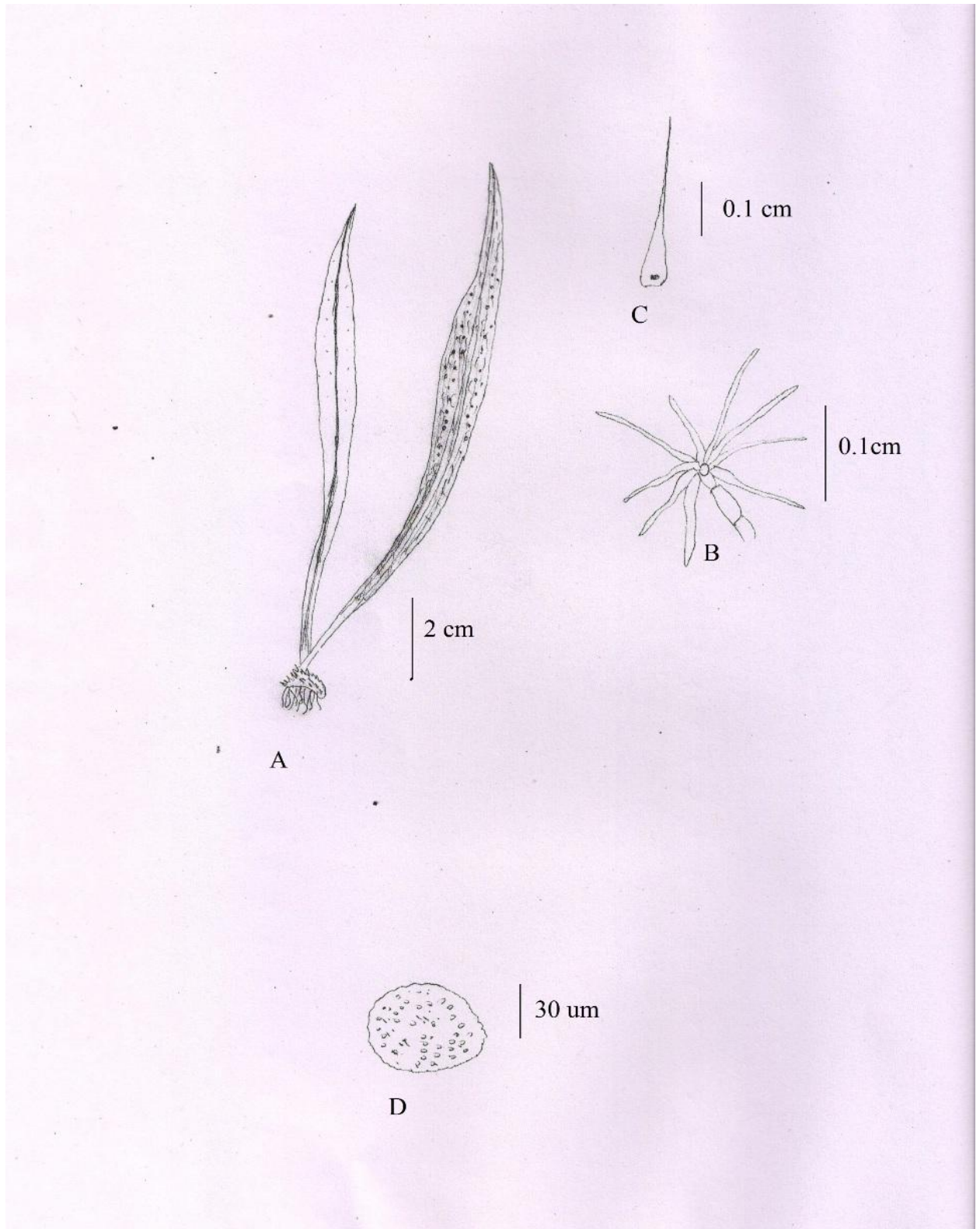


Figure 3. 8: A. *Pyrrhosia mannii* (Giesenh)Ching;B. Stellate hairs 40x;
C. Rhizome Scales 40x;D. Spore 400x.

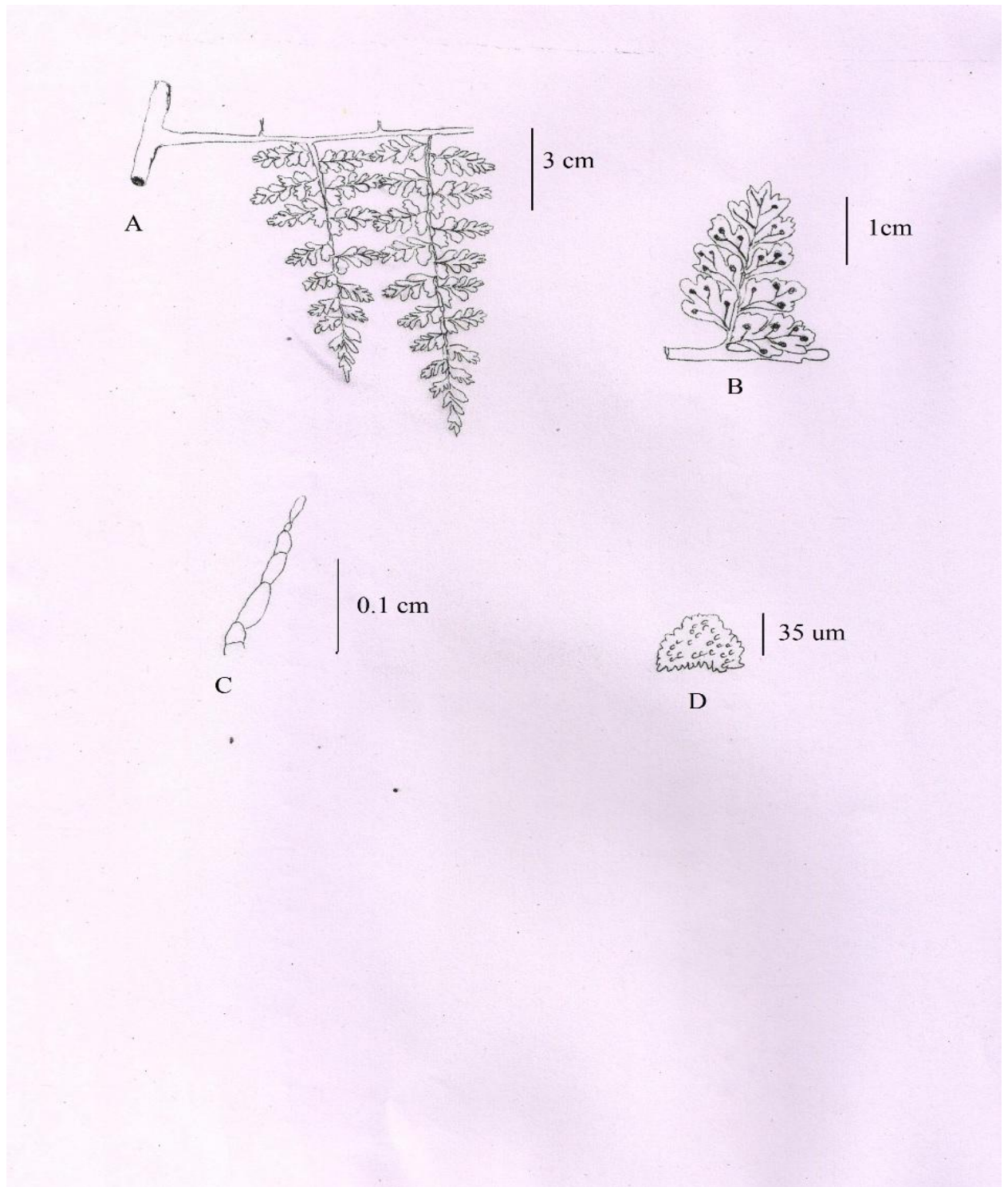


Figure 3. 9: A. *Monachosorum henryi* Christ ; B. Pinnae; C. Hairs 40x; D. Spore 400x.

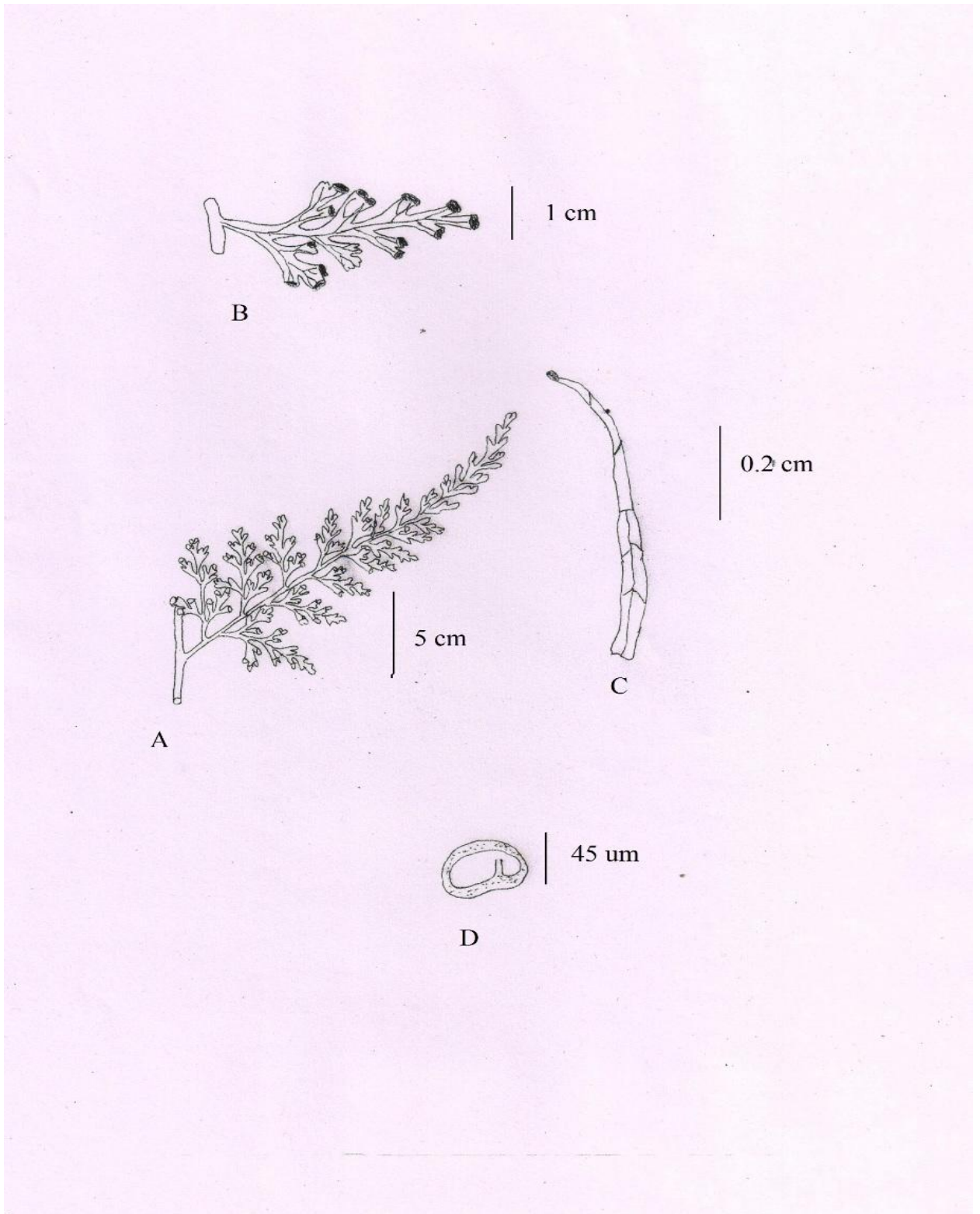


Figure 3. 10: A. *Odontosoria chinensis* (Linnaeus)Smith;Habit; B. Pinnae; C. Hairs 40x; D. Spore 400x.

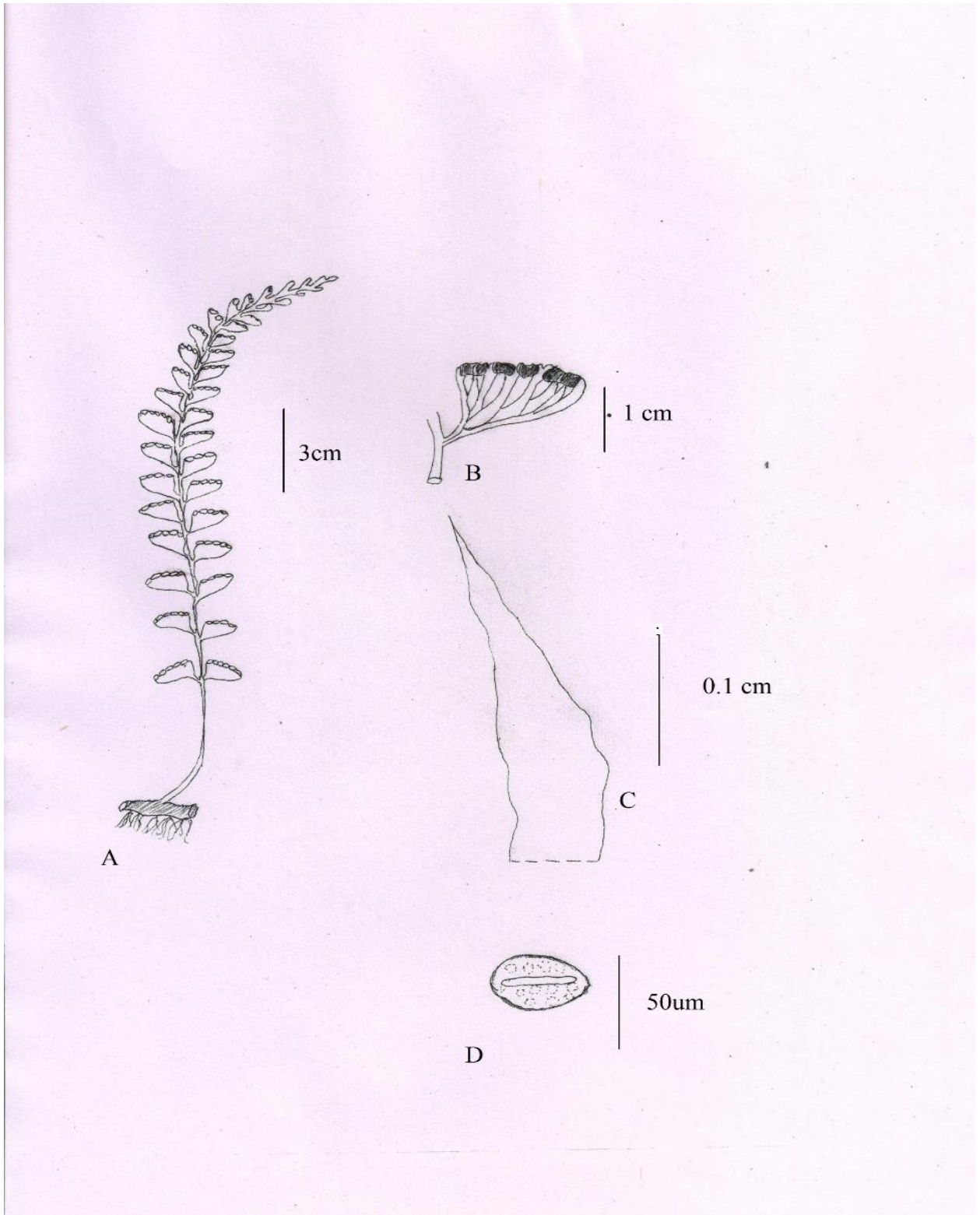


Figure 3. 11: A. *Lindsaea odorata* Roxburgh; B. Pinnae; C. Rhizome scale 40x; D. Spore 400x.

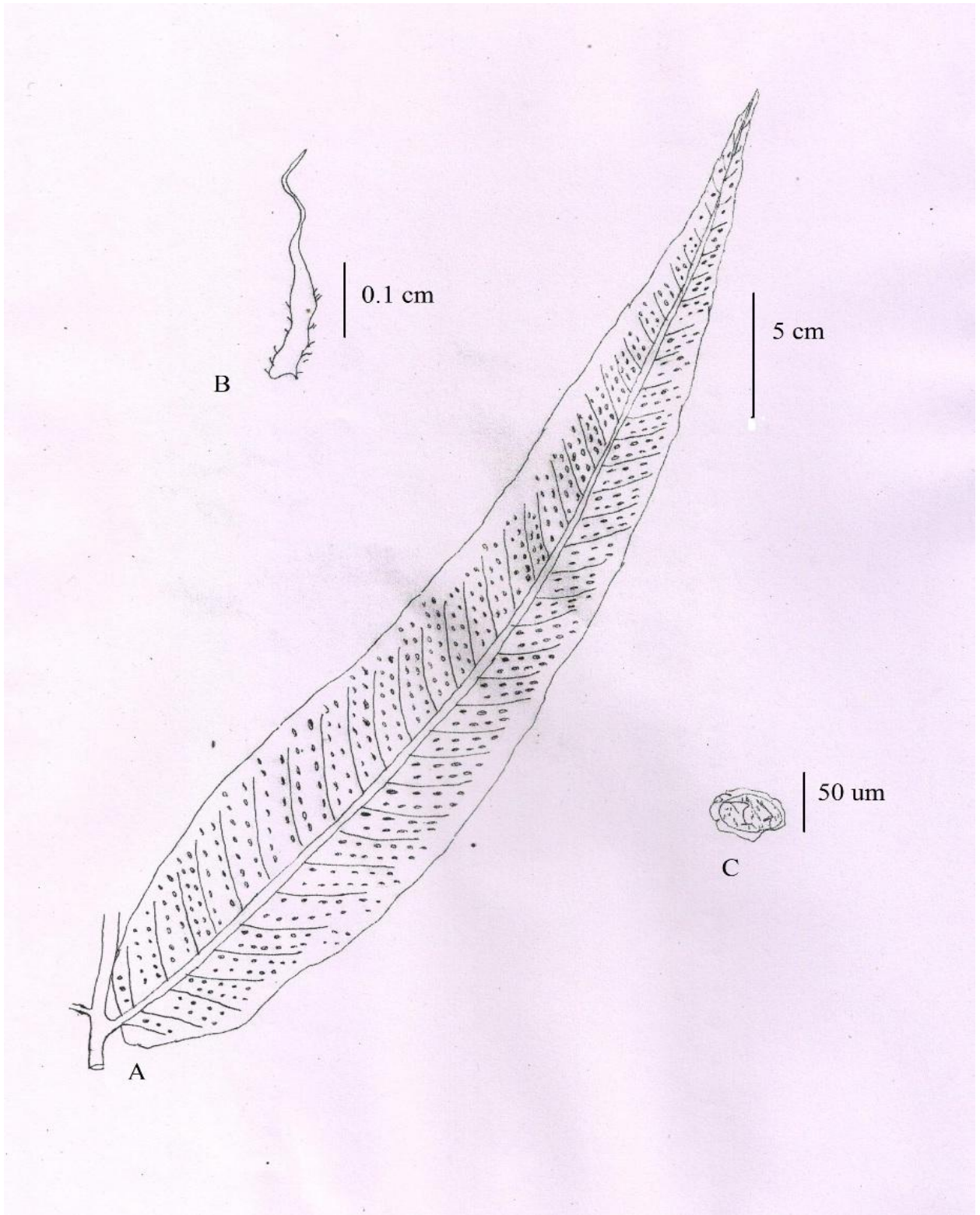


Figure 3. 12: A. *Tectaria polymorpha* (wallich ex Hooker)Copeland ; B. Rhizome scales 40x; C. Spore 400x.

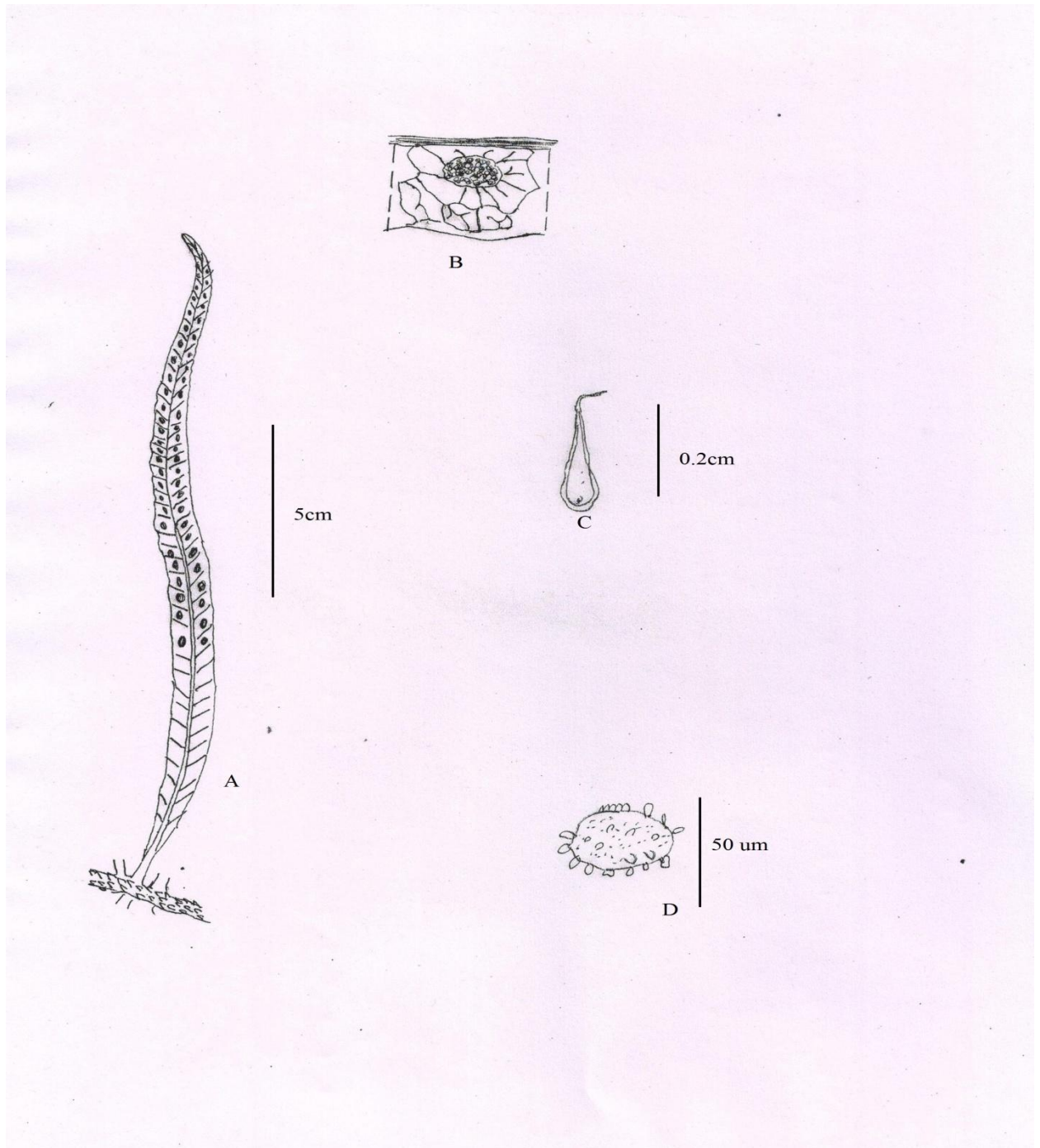


Figure 3.13: A. *Lepisorus mehrae* Fraser-Jenkins; B. Veins and sori; C. Rhizome scales;D. Spore 400x.

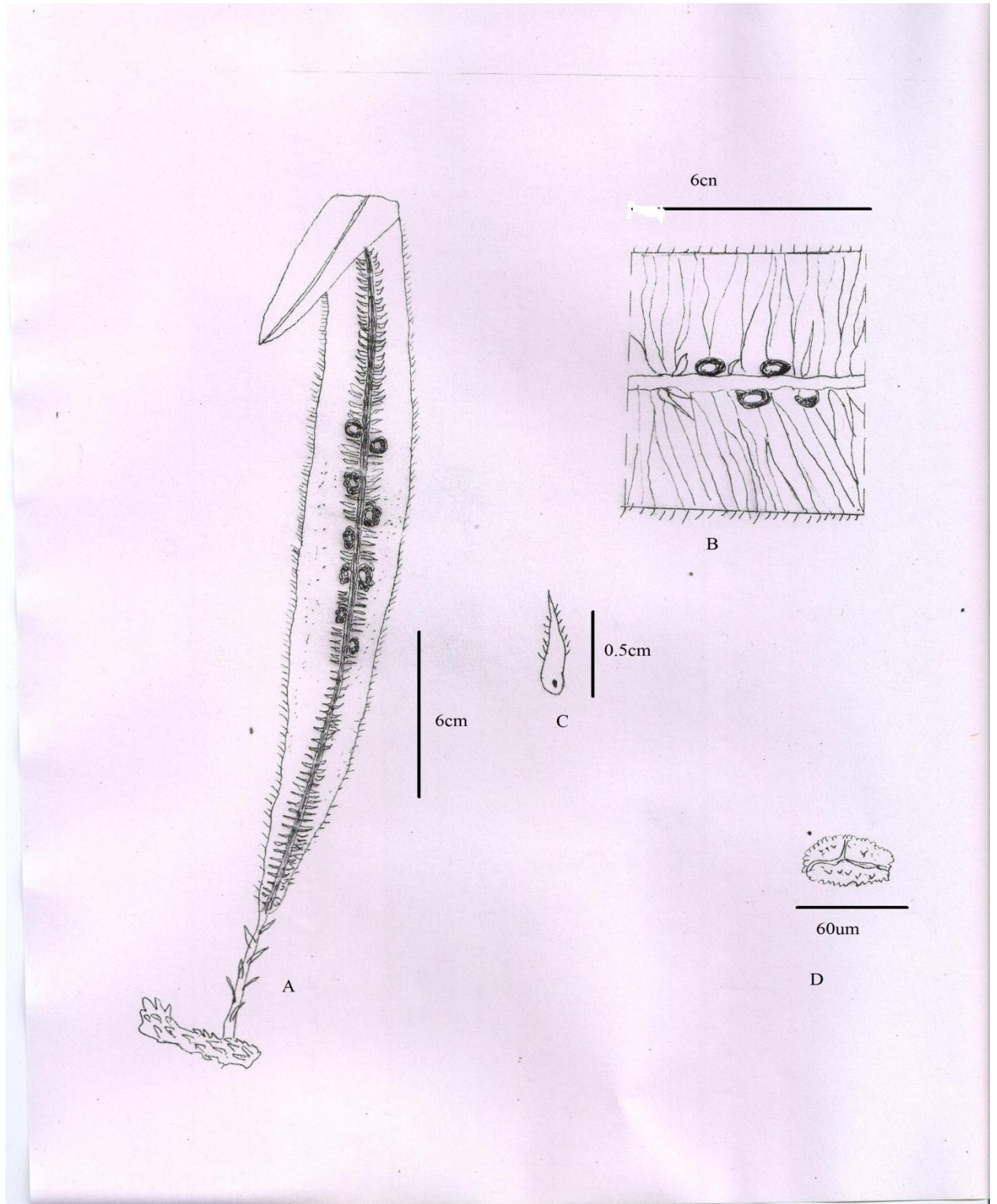


Fig 3.14:A. *Oleandra wallichii* (Hooker)Presl; B. Veins and Sori; C. Scales 20x; D.Spore 400x.

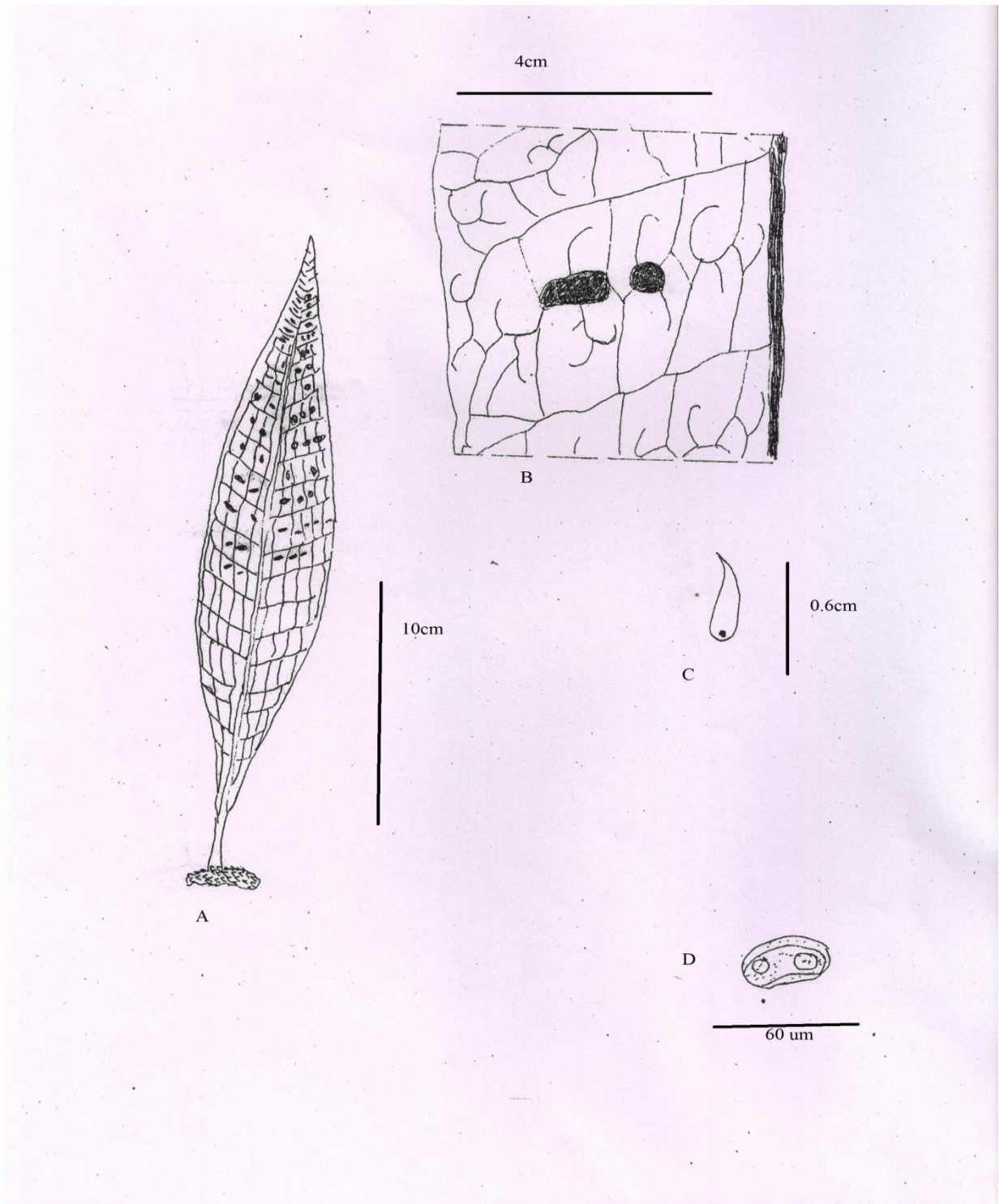


Figure 3.15: A. *Leptochilus decurrens* Blume subsp. *helmiontideus* Frase-Jenkins; B. Veins and sori; C. Scales 20x; Spore 400x.

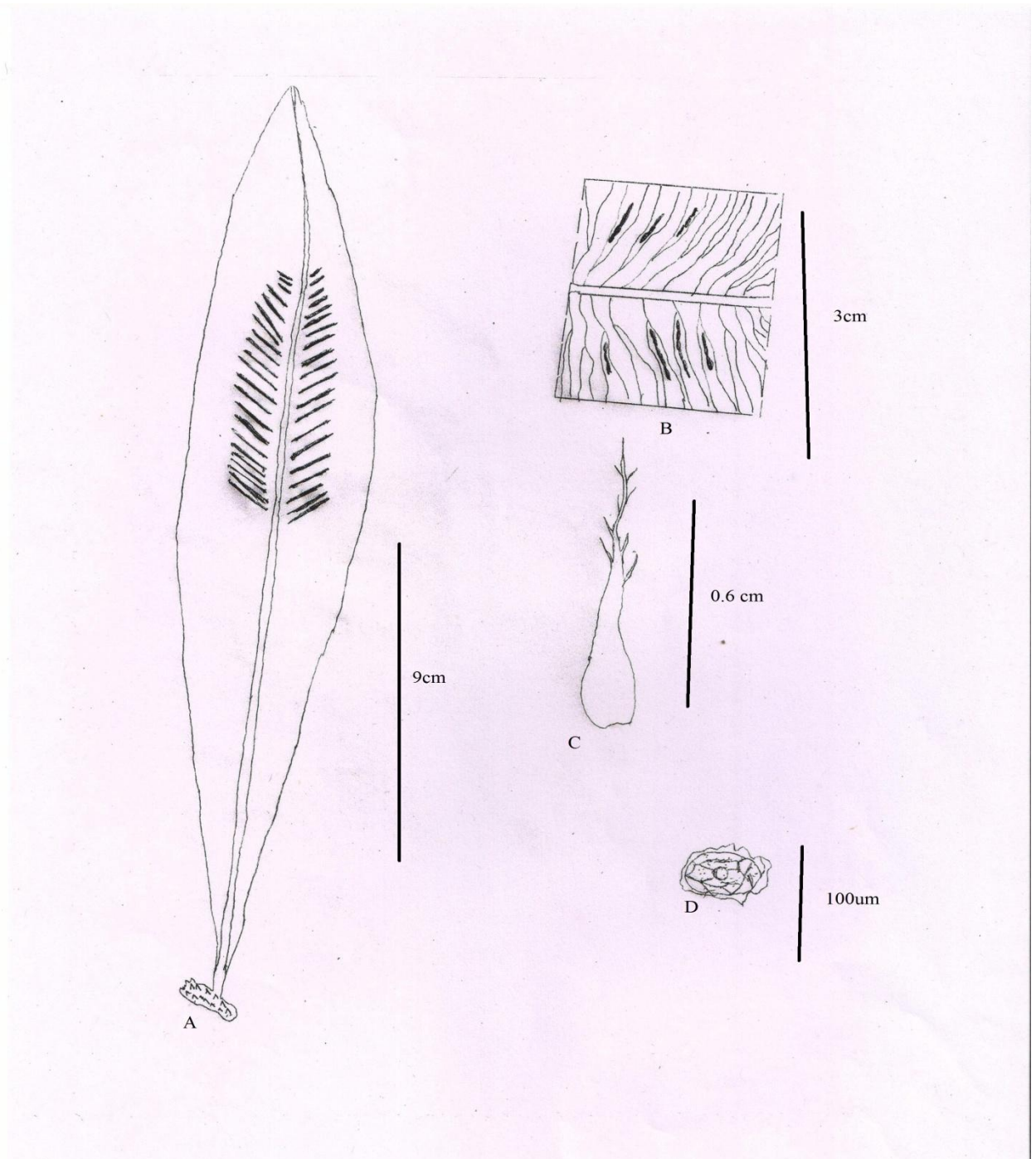


Figure 3.16: A. *Asplenium phyllitidis* D.Don; B. Veins and sori; C. Scales 20x; D. Spore 400x.

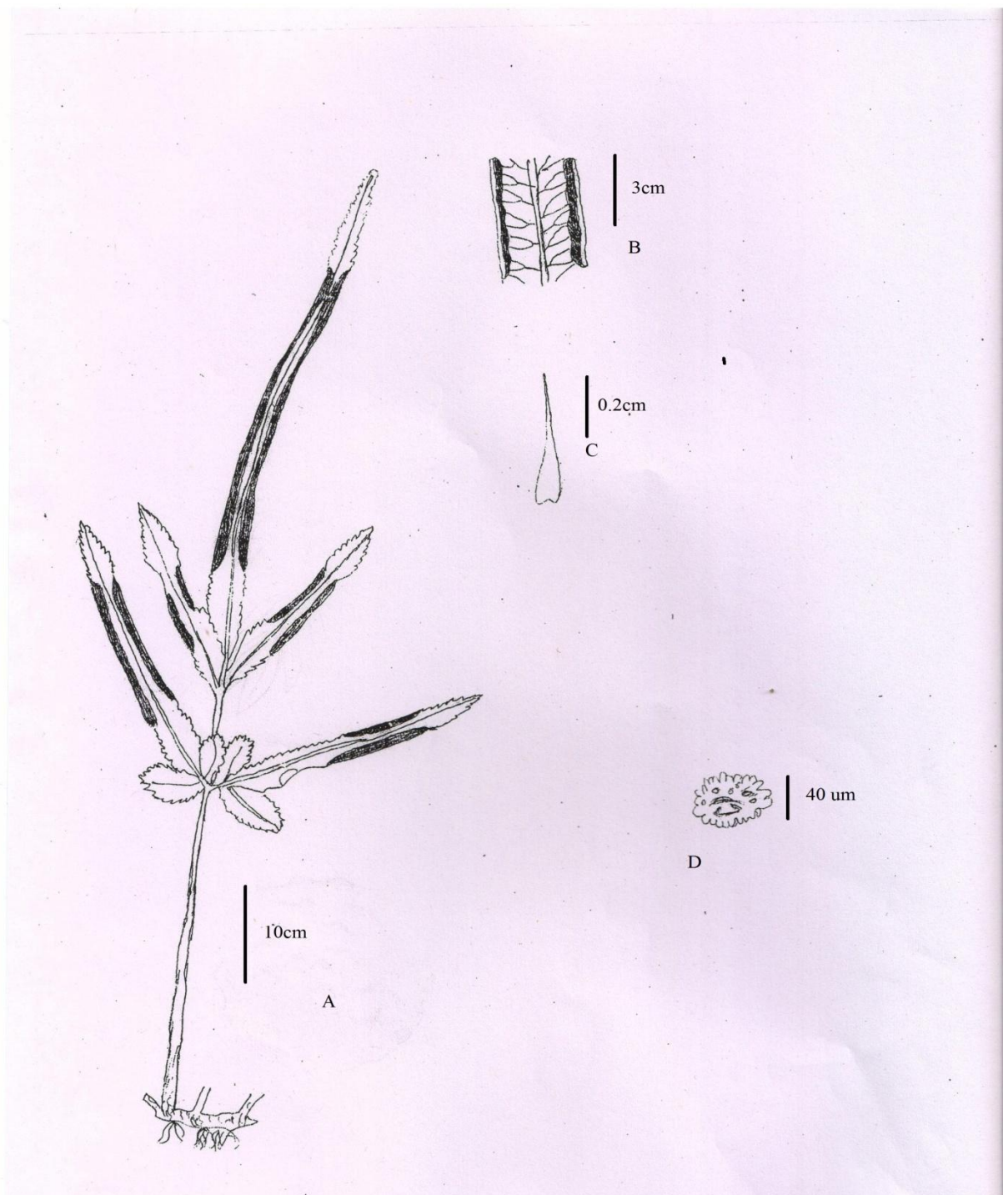


Figure 3.17: A. *Pteris ensiformis* N.L Burman; B. Pinnae with sori and veins; C. Scales 20x; spore 400x.

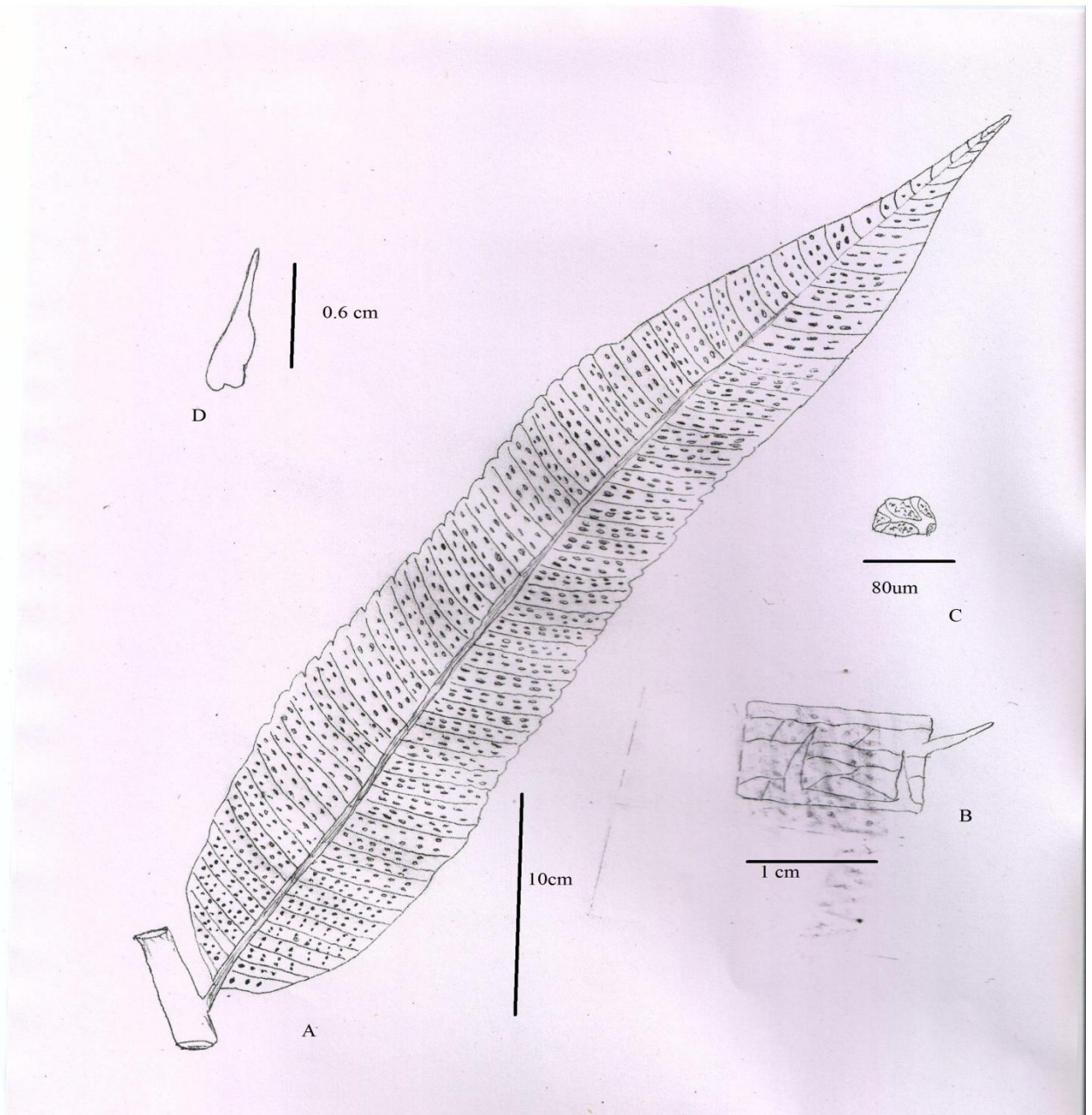


Figure 3.18: A. *Thelypteris lakhimpurensis* (Rosenst.) Iwatsuki ; B. Hairs 20x; C. Spore 400x.

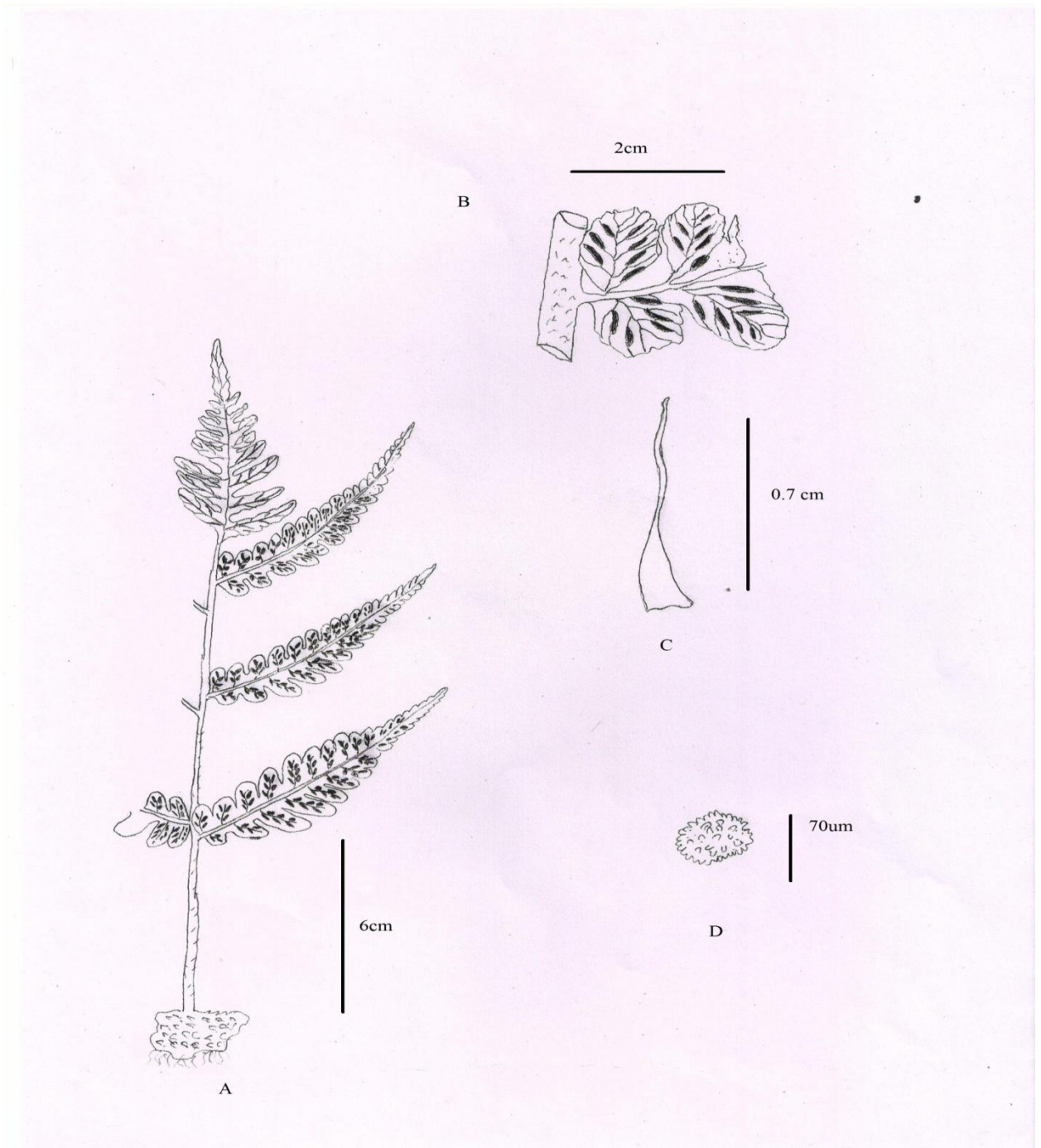


Figure 3.19: A. *Deparia petersenii* (Kunze)Kato; B. Portion of Pinnae; C. Scales 40x; Spore 400x.

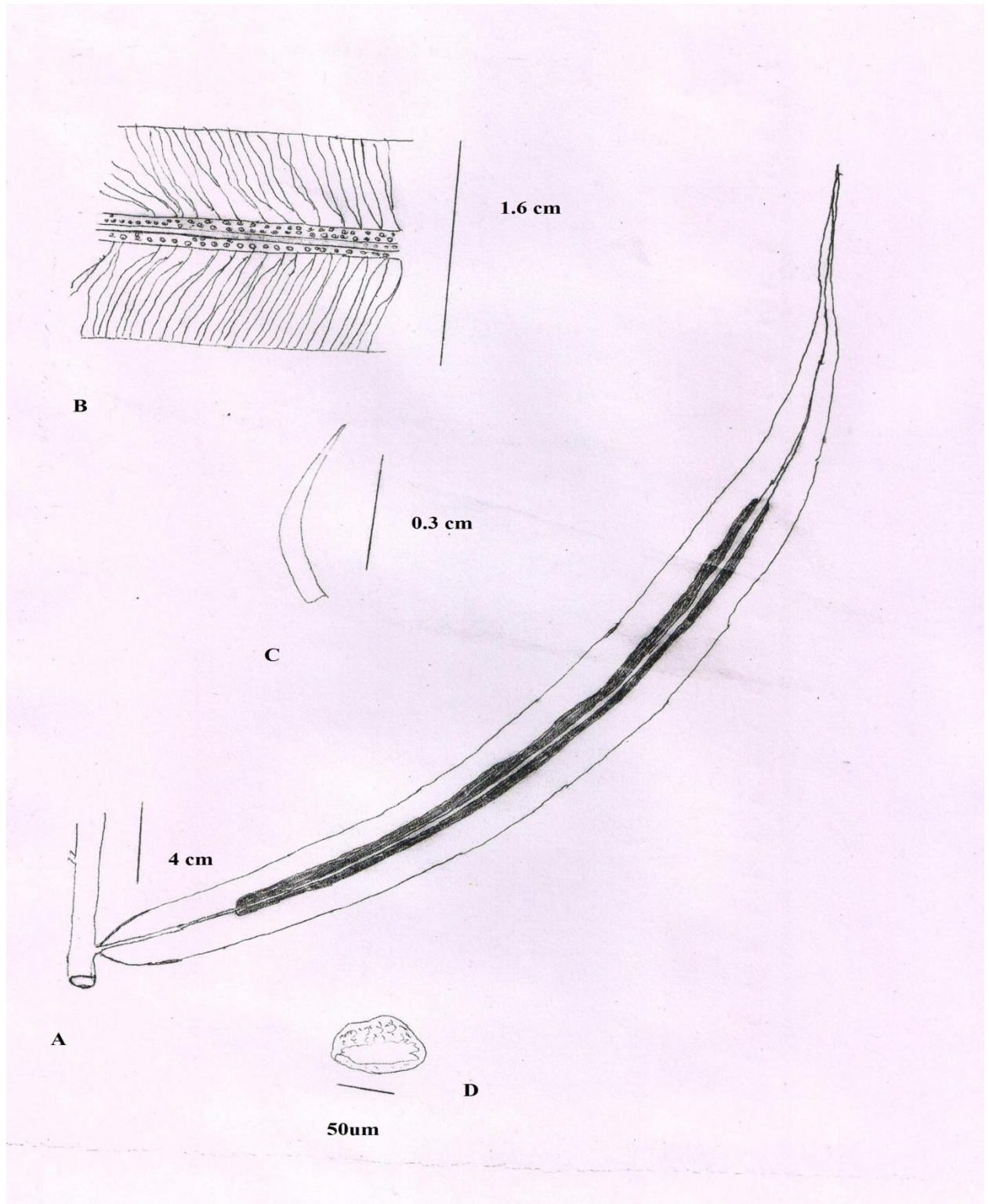


Figure 3.20: A. *Blechnum orientale* Linnaeus; B. Portion of Pinnae; C. Scales 20x; D. spore 400x.

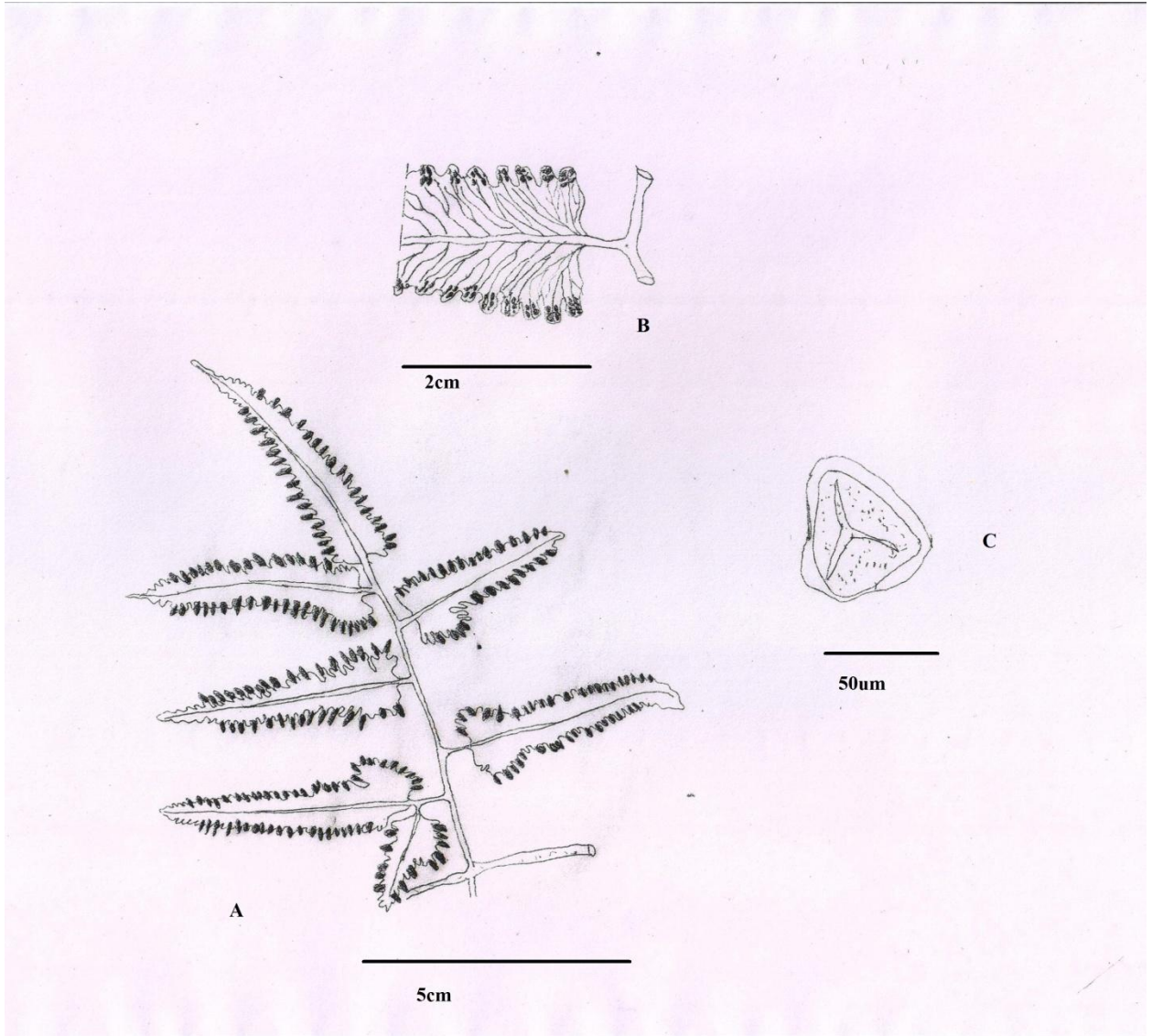


Figure 3.21:A. *Lygodium flexuosum*(Linnaeus)Swartz; B.Portion of Pinnae; C. Spores 400x.

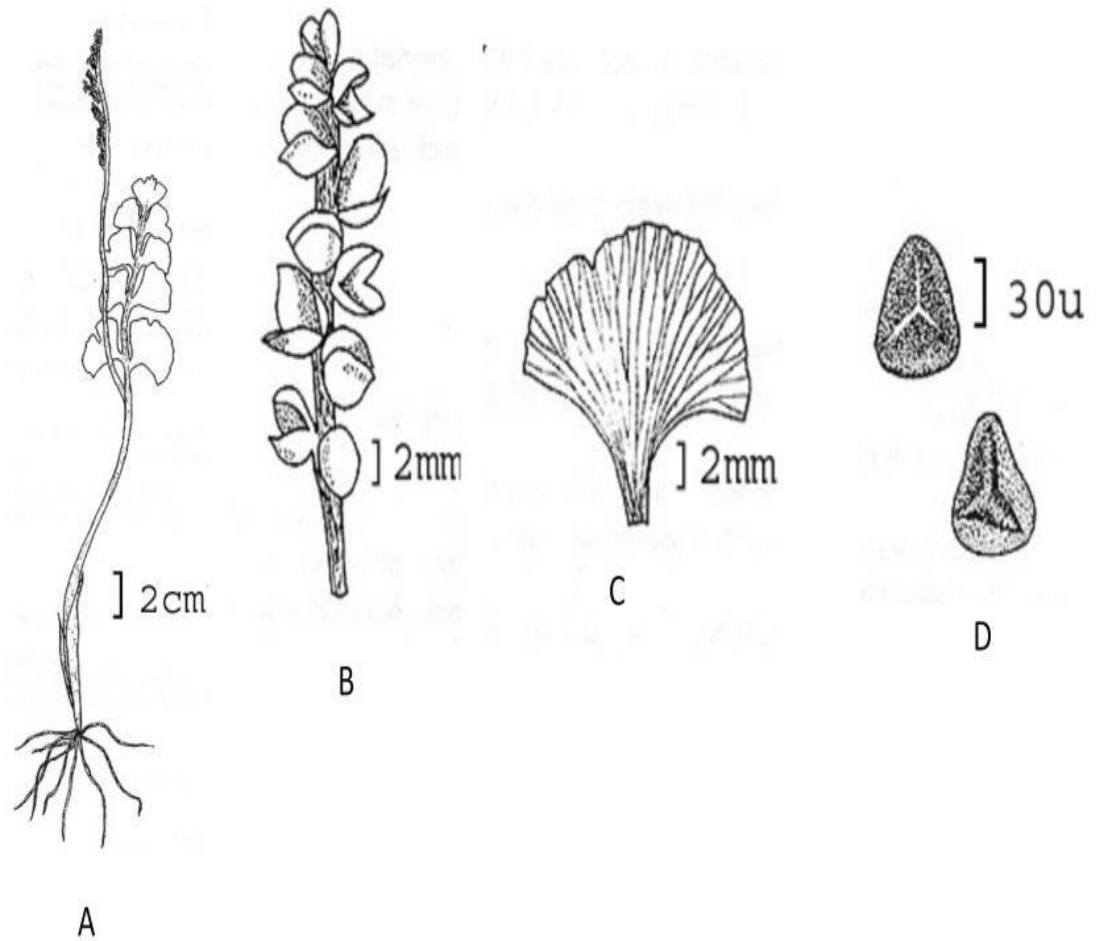


Figure 3.22: A *Botrychium lunaria*(Linnaeus) Swartz; B. Fertile sporophore; C. Sterile pinnae showing venation; D. Spores 400x.



PLATE – 3.1. Lycopods of Darjeeling Hills: A. *Huperzia serrata*(Thunberg)Trevisan; B. *Huperzia pulcherrima* (Wallich ex Hooker et Greville)Pich-Sermolli; C. *Huperzia squarrosa* (Froster) Trevisan; D. *Huperzia ceylanica*(Spring) Trevisan; E. *Huperzia heteriana*(Kummerle) T. Sen & U. Sen; F. *Huperzia hamiltonii* (Sprengel)Trevisan; G. *Lycopodium japonicum* Thunberg ;H. *Lycopodiella cernua*(Linnaeus)Pich-Sermolli



Plate 3.2: A. *Selaginella subdiaphana* (Wallich ex Hooker & Greville) Spring; B. Strobilus ; C. Ventral Leaf; D. Ventral Leaf base magnified 100x; E. Median leaf 40x; F. Microsporophyll (Microsporangium) 40x; G. Megasporangium 400x ; H. Megaspore 400x; I. Microspore 400x.

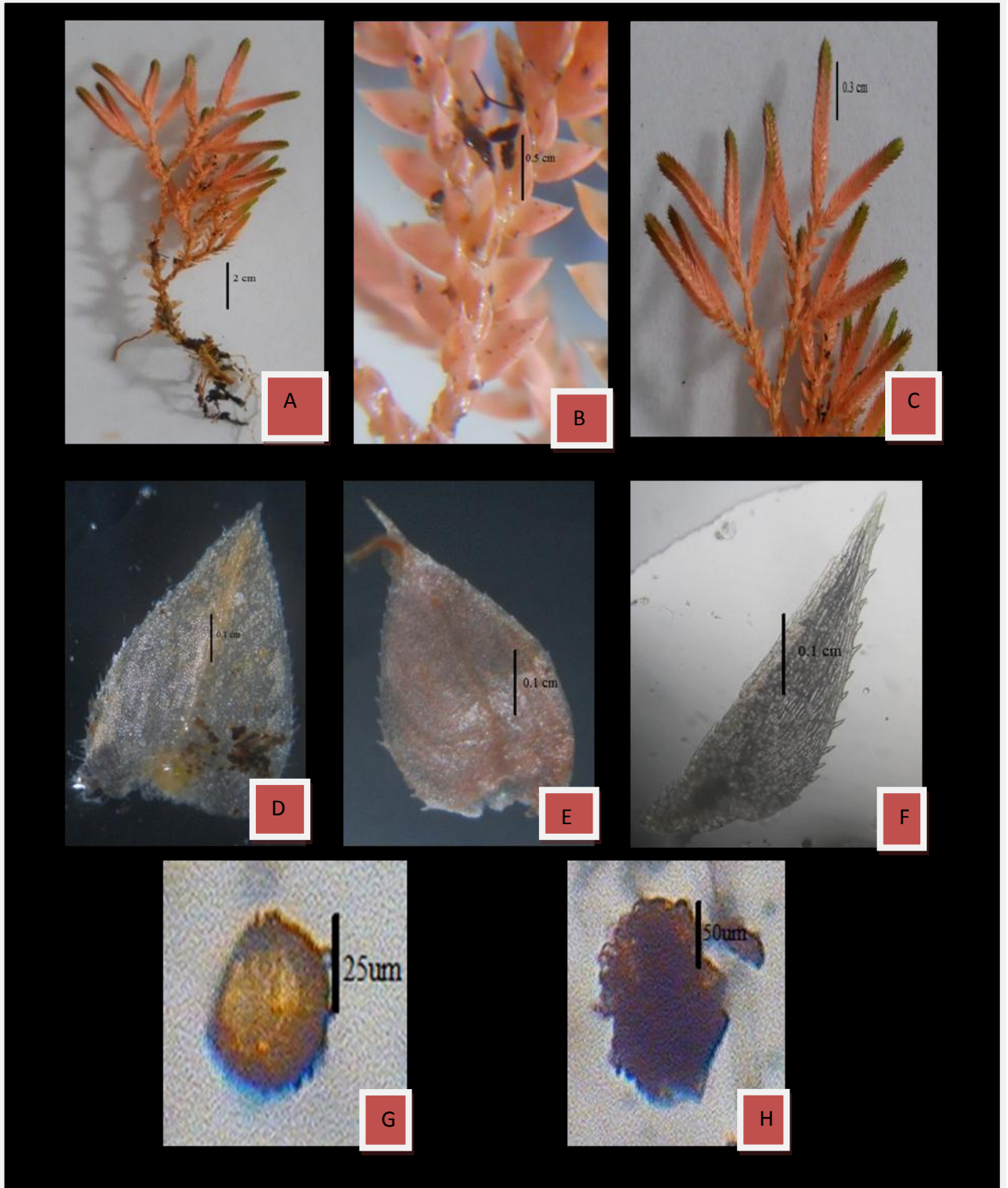


Plate 3.3: A. *Selaginella repanda* (Desvaux ex Poiret) Spring ;B. Stem with leaf; C.Strobilus; D. Ventral leaf;E. Median Leaf; F. Sporophyll; G. Microspore 400x; H. Megaspore 400x.



Plate 3.4: A.*Equisetum arvense* Linnaeus subsp.*diffusum* Fraser-Jenkins; **B.**Node and internode; **C.** Spore 100x.**D.** *Equisetum ramosissimum* Desf.;**E.** Strobilus;**F.** Immature spore 100x.

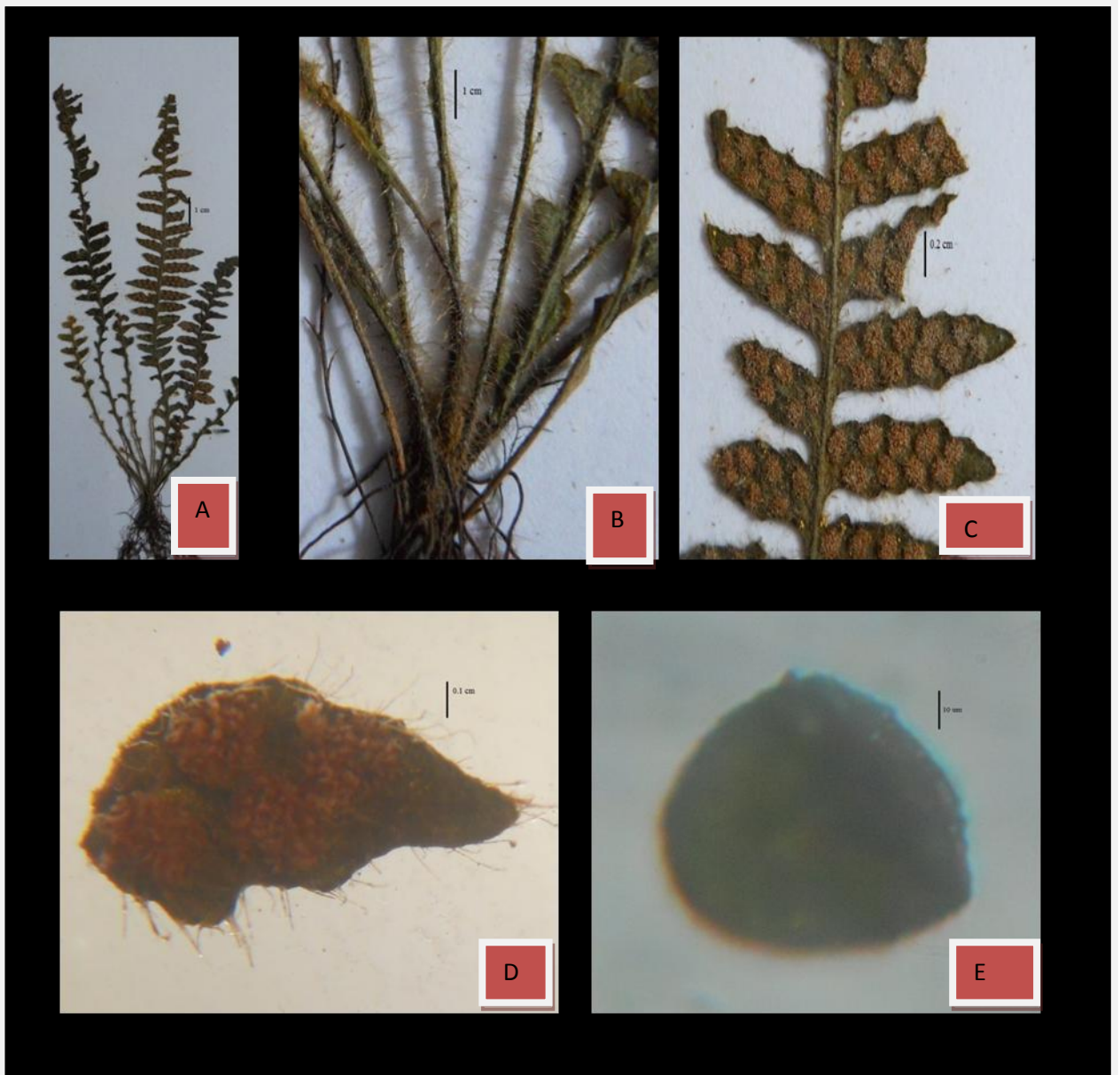


Plate 3.5: A. *Tomophyllum donianum* (D.Don)Fraser-Jenkins; B. Stipe with Hairs; C. Pinnae; D. Pinnae with sori; E. Spore 400x.



Plate 3.6: A. *Dryopsis apiciflora* (Wallich ex Mettineus)Holtum & Edwards; B. Pinnae; C. Lobes with veins 40x; D. Rhizome Scales 40x; E. Spore 400x; F. *Polystichum mehrae* Fraser-Jenkins(Habit).



Plate 3.7: A. *Osmunda claytoniana* Linnaeus subsp *vestita* (Wallich ex Milde) A.Love & D.Love (Habit); B. young crozier;C. Young fronds;D. Pinnae And sori; E & F. *Ophioglossum reticulatum* Linnaeus (Habit and Habitat); G. *Botrychium lanuginosum* Wallich ex Hooker & Greville; H. Forking of Sporophore and Tropophore;I. Spore 100x.



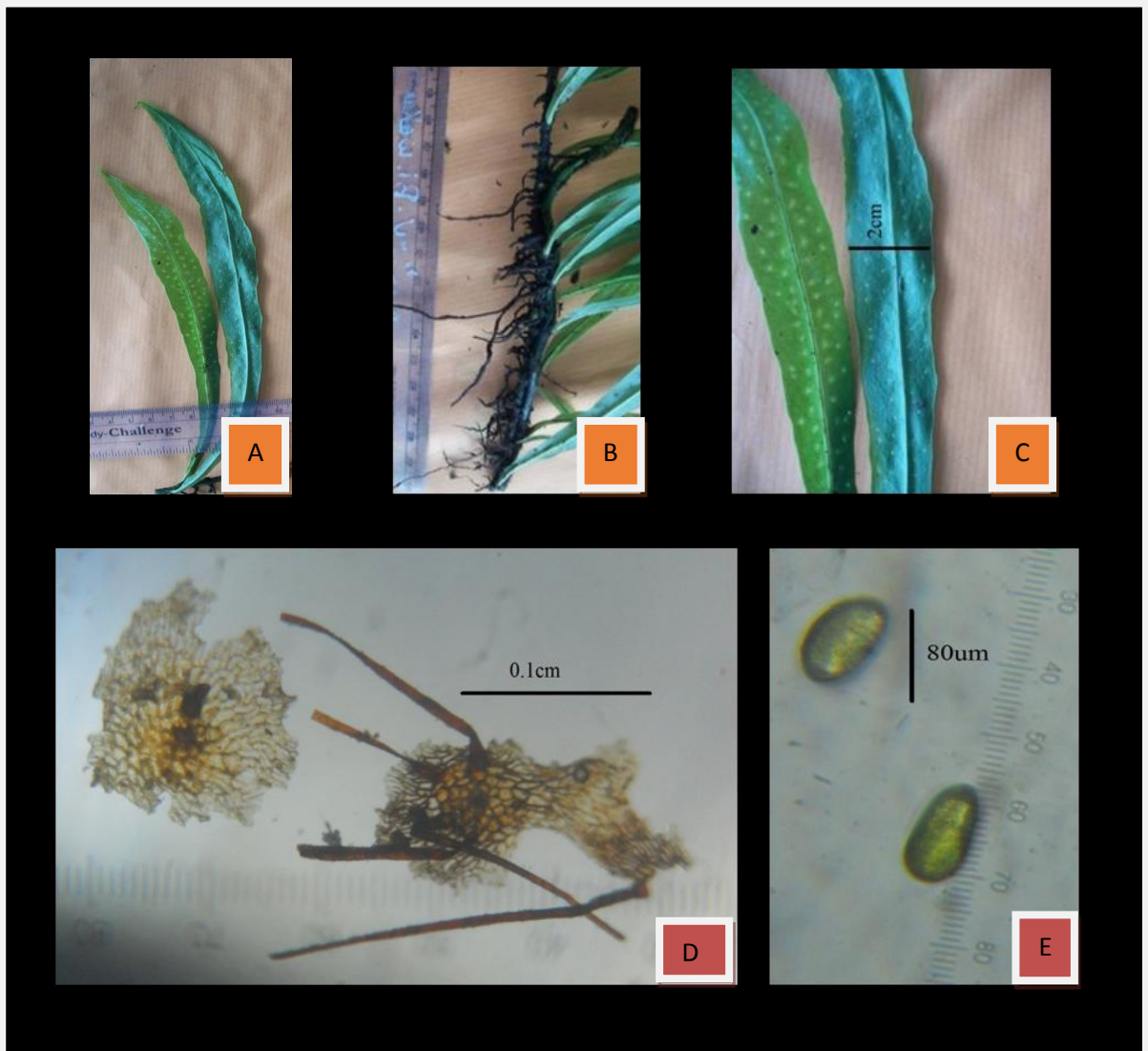
Plate 3.8: A. *Hymenophyllum exsertum* Wallich ex Hooker; B. Hairs 40x; C. Pinnae 20x; D. Sporangium 100x; E. Involucre 40x; F. Spore 100x; G. *Vittaria taeniophylla* Copeland; H. *Woodwardia unigemmata* (Makino) Nakai; I. *Dryopteris woodsii* Hayata.



Plate 3.9: A. *Seliguela griffithiana* (Hooker)Fraser-Jenkins; B.Pinnae; c. Rhizome scales 40x; D. Sporangium 100x; E. Spore 400x; F &G. *Crytomium caryotideum* (Wallich ex Hooker & Greville)C.Presl; H. Pinnae ; I. *Phanerophlebiopsis hookeriana* (C.Presl) Fraser-Jenkins.



Plate 3.10: A. *Aleuritopteris formosona* (Hayata)Tagawa;B. Stipe with scales; C.Scales 40x;D.Spore 100x;E. *Aleuritopteris chrysophylla* (Hooker)Ching; F.*Aleuritopteris albomarginata* (C.B Clarke) Ching.



**Plate 3.11: A. *Tricholepidium normale* (D.Don)Ching;B. Clinging root;
C.Veins and Sori; D. Scales with setae; Spore 100x.**



**Plate 3.12:A. *Polystichum perscotianum* (Wallich ex Mettenius)
T.Moore; B.Scales on Stipe; C.Micro scales on Segment; D.Spore 100x.**



Plate 3.13:A. *Thelypteris cana* (Baker)Ching;B.Pinnae; C.Segmnets hairy; D. Rachis hairy; E.Sporangium 100x; F. Spore 400x.

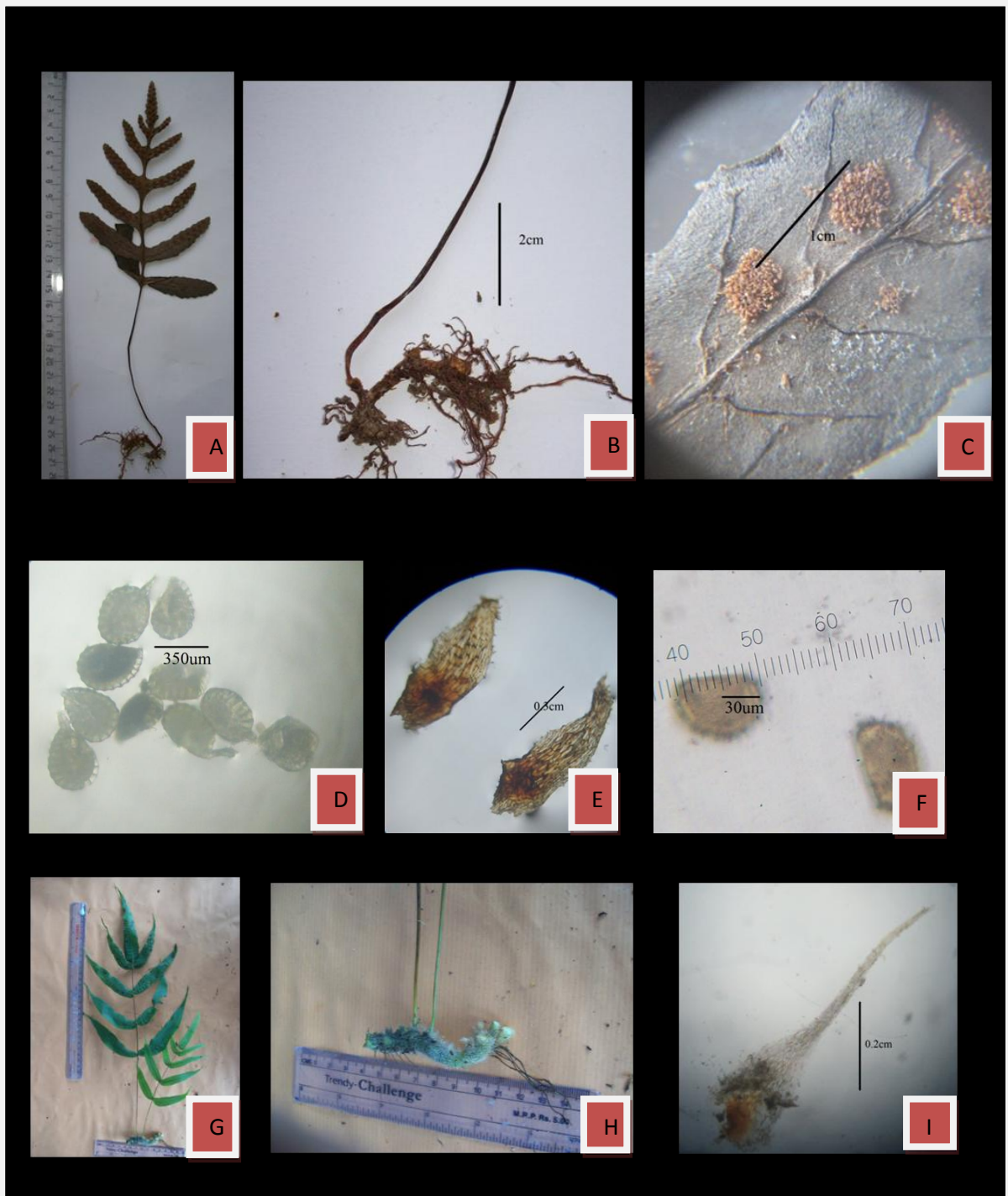


Plate 3.14: A. *Pichisermolodes crenato-pinnata* (C.B Clarke) Fraser-Jenkins; B.Stipe; C. Pinnae; D.Scales 40x; E. Spore 100x; F. *Atrthromers lehmannii* (Mettenius)Ching ;G. Rhizome;H. Scales 40x.

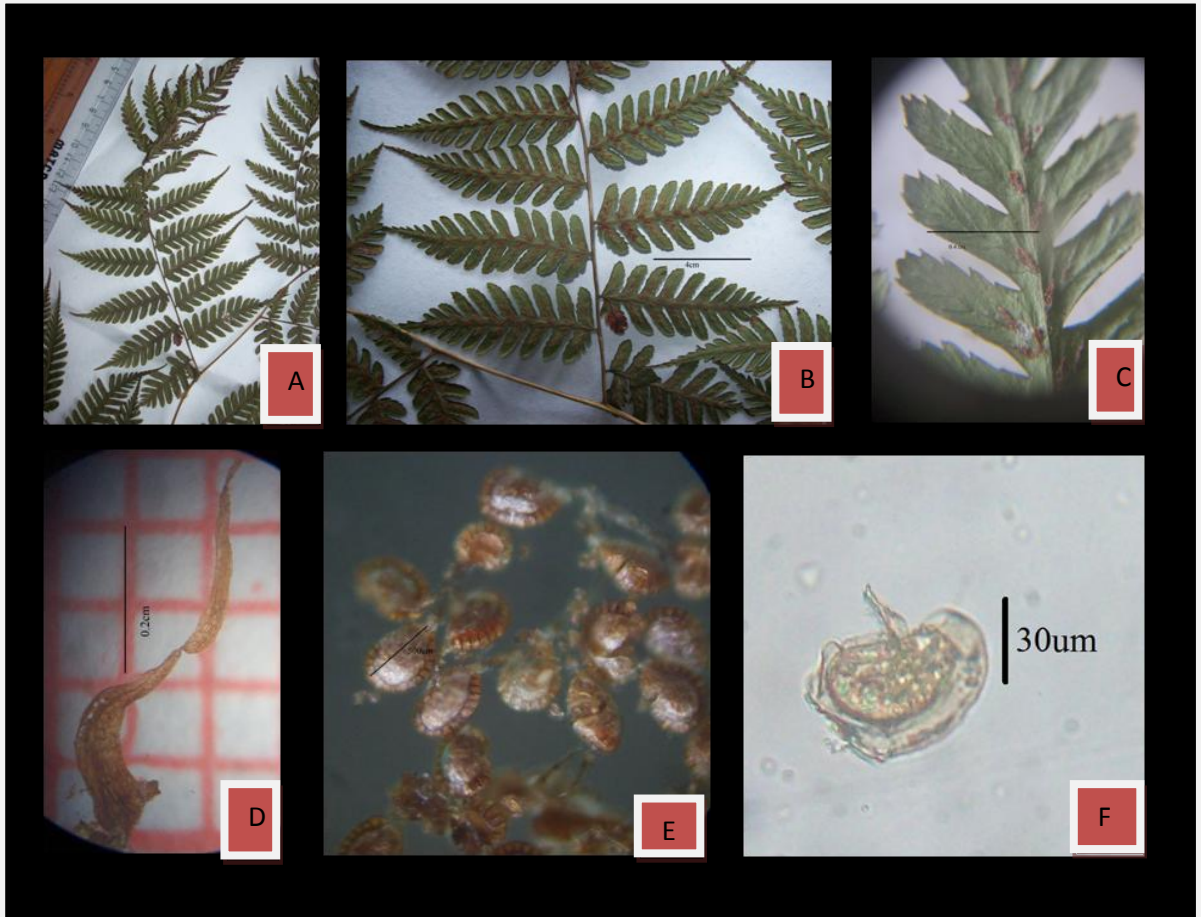


Plate 3.15: A. *Diplazium spectabile* (Wallich ex Mettenius)Ching; B. Pinnae; C. Segment 20x;D. Scales 40x; E.Sporangium 100x; F. Spore 400x.



Plate 3.16: A. *Athyrium clarkei* Beddome; B. Rachis with bulbils; C. Segment 20x; D. Scale 20x; E. Spore 400x.

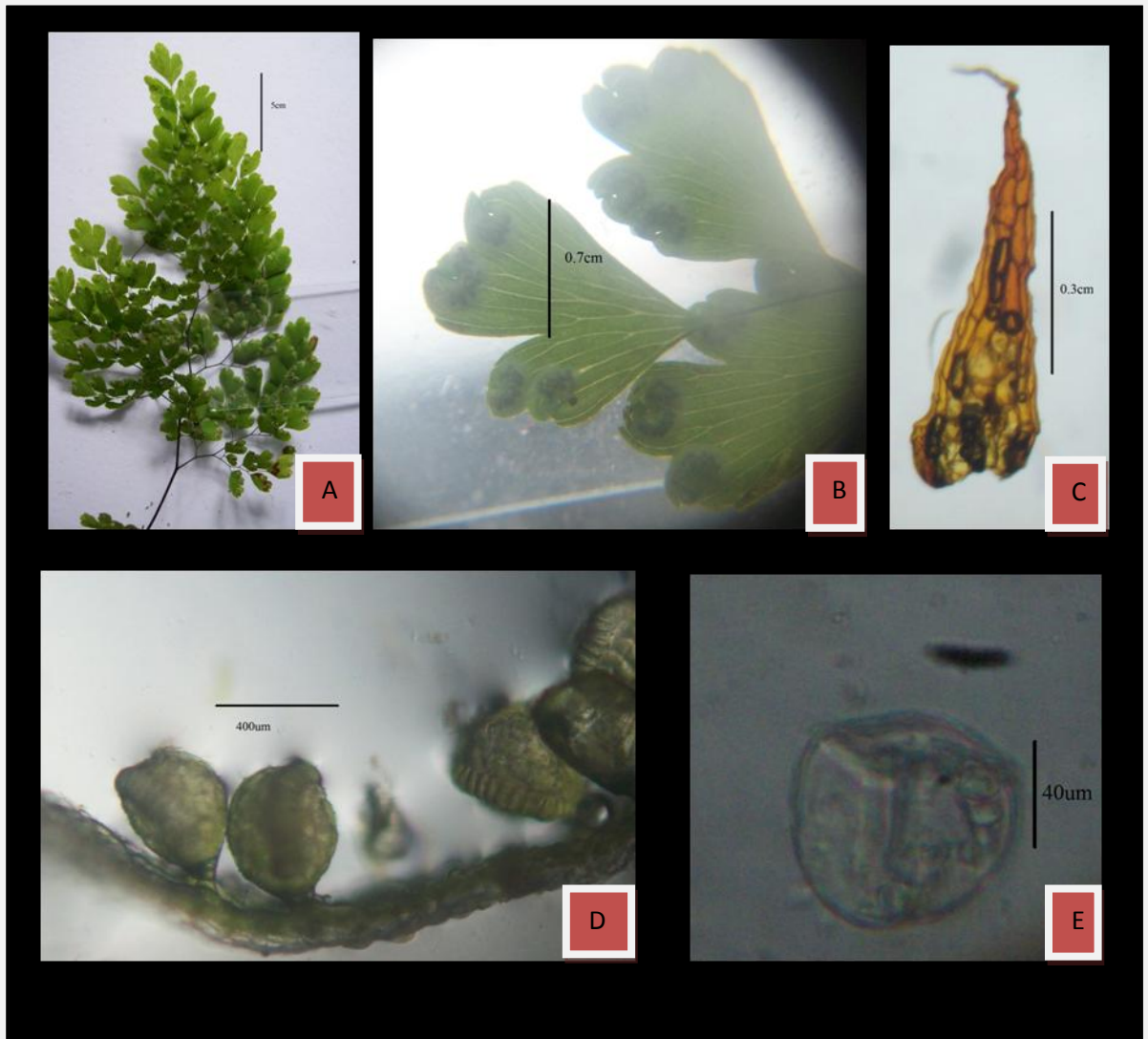


Plate 3.17: A. *Adiantum venustum* D. Don; B. Ultimate segment with sori; C. Scales 20x; D. Sporangium 100x; E. Spore 400x.



Plate 3.18: A. *Nothoperanema squamiseta* (Hooker) Ching; B. Scales on Stipe; C. Scale 20x; D. Segment with Sori; E. Sporangium 100x; F. Spore 400x.

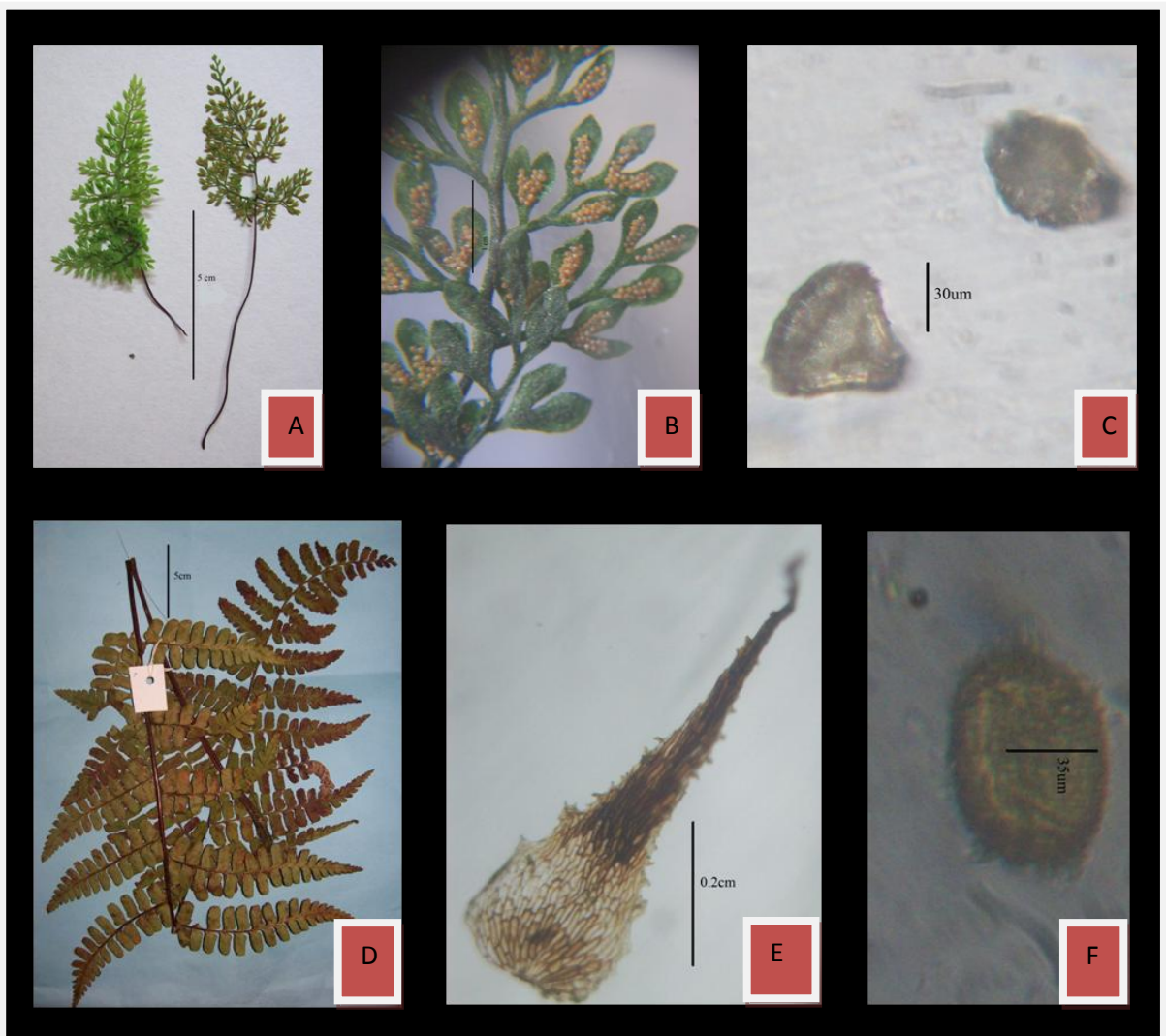


Plate 3.19: A. *Cerosora microphylla* (Hooker) R.M Tryon; B. Segments with Sori; C. Spore 400; D. *Dryopteris splendens* (Hooker) Kuntze; E. Scales; F. Spore 400x.

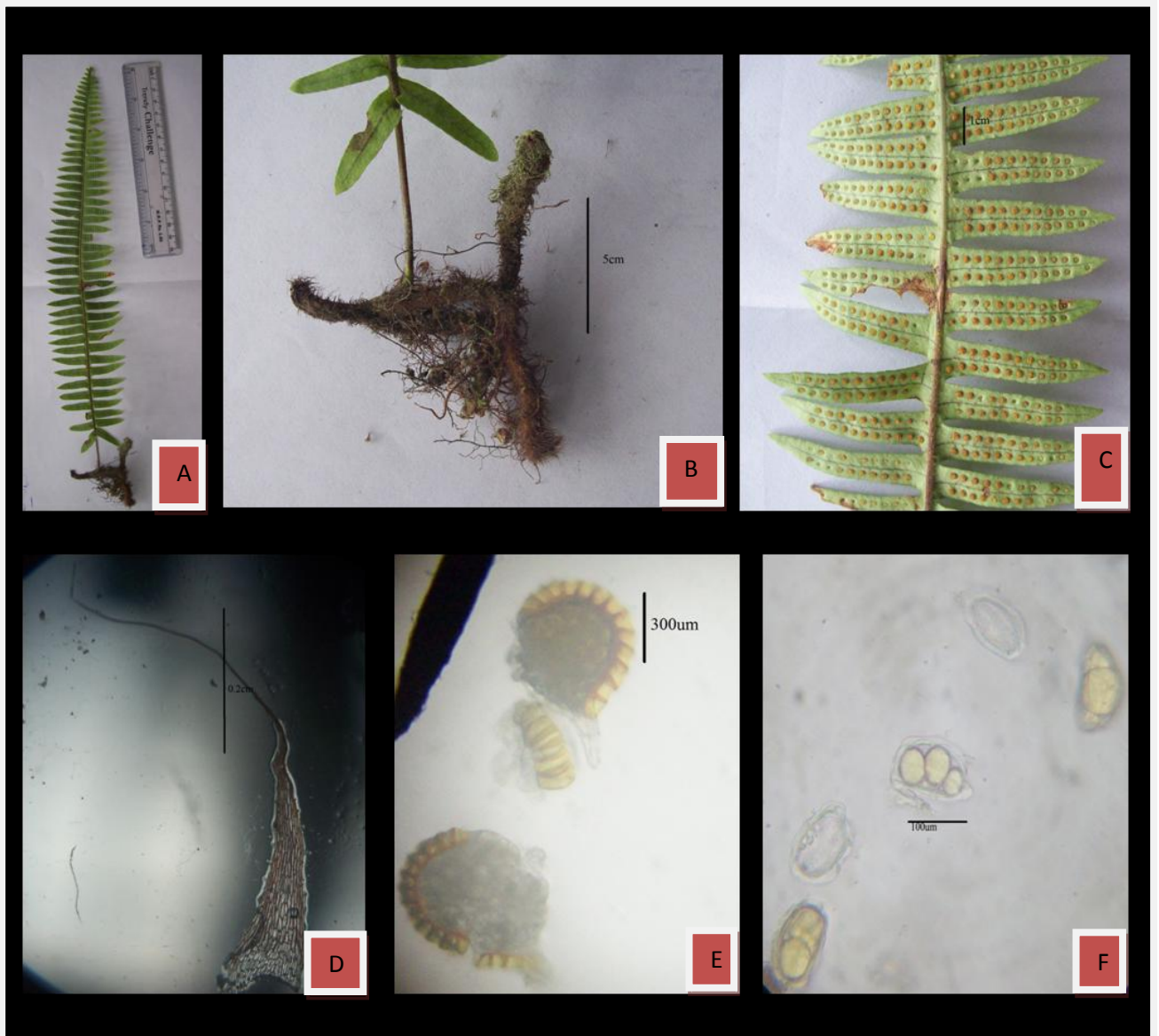


Plate 3.20:A. *Polypodiodes lachnopus* (Wallich ex Hooker)Ching; b. Rhizome scales; C. Segment with sori;D. Scales 20x; E. Sporangium 100x;F. Spore 400x.



Plate 3.21:A. *Deparia allantodiodes* (Beddome)M.Kato ; B. Pinnae; C. Pinnae with sori; D. Hairs in segment; E. Sori 40x;F. Spore 400x.



Plate 3.22:A. *Asplenium ensiforme* Wallich ex Hooker & Greville ; B. *Goniophlebium argutum* (Wallich ex Hooker) Smith(Close to *G.metzense*); C.*Botrychium Lanuginosum* Wallich ex Hooker et Greville (Close to *B. Virginanum*); D. Anormal monomorphic frond of *Plagiogyra pycnophylla* (Kunze)Mettenius; E. Abnormal bifurcation in *Loxogramme involuta* M.g Price; F. Abnormal stobilus in *Equisetum arvense* Linnaeus subsp *diffusum* Fraser-Jenkins.

3.2.Result

The present studies revealed 206 species of fern and fern allies representing 70 genera and 26 families (Table 1) and predominantly consist of Eastern Himalayan species belonging to Sino-himalayan and Malesian elements. Three families from fern allies have been documented consisting of 5 genera with 17 species, where lycopodiaceae with 3 genera and 8 species have shown the highest diversity (Thapa *et al.* 2015).The highest diversity in terms of genera and number of species is shown by family Polypodiaceae with 13 genera and 40 species. Mehra & Bir, 1964 documented 31 families, 86 genera and 338 species from the Darjiling and Sikkim himalaya. On the contrary Hara, 1974 in his famous expedition to eastern Himalaya listed 131 species from darjiling hills. The recent systematic and new classification has however decreased the number of families, genera and species.

Majority of the fern species in Darjiling hills depending upon habit and habitat can be classified into different groups like epiphytes, lithophytes, mesophytes and climbers. The epiphytes and lithophytes form the major chunk of the pteridophytic flora for the region. Around 26.8% are epiphytes, lithophytes 44.11%, mesophyte account for 27.13% and 2% is represented by climbers .Four climbers chiefly *Lygodium japonicum* , *Lygodium salicifolium* , *Stenochlaena palustris* from the warmer foot hills and *Tricholepidium normale* from the cool temperate region has been found.

The new record for the region is *Botrychium lunaria*, a high altitude species collected from Sandhakphu (Thapa *et al.* 2014; Thapa and Lama ,2015) which forms a connecting link between the species of western Himalaya and far- north east India. Similarly the present worker discovered a *Pteris* sp at an altitude of 323 m in the foothills and identified as *Pteris austrosinica*, the species which was endemic to China (Thapa *et al.* 2015). Exotic and adventives species that have naturalized in Darjiling hills are *Adiantum concinnum* and *Pityrogramma calomelanos*. However numerous

ornamental has been introduced like *Davallia fijiensis*, Stag horn etc yet they haven't naturalized.

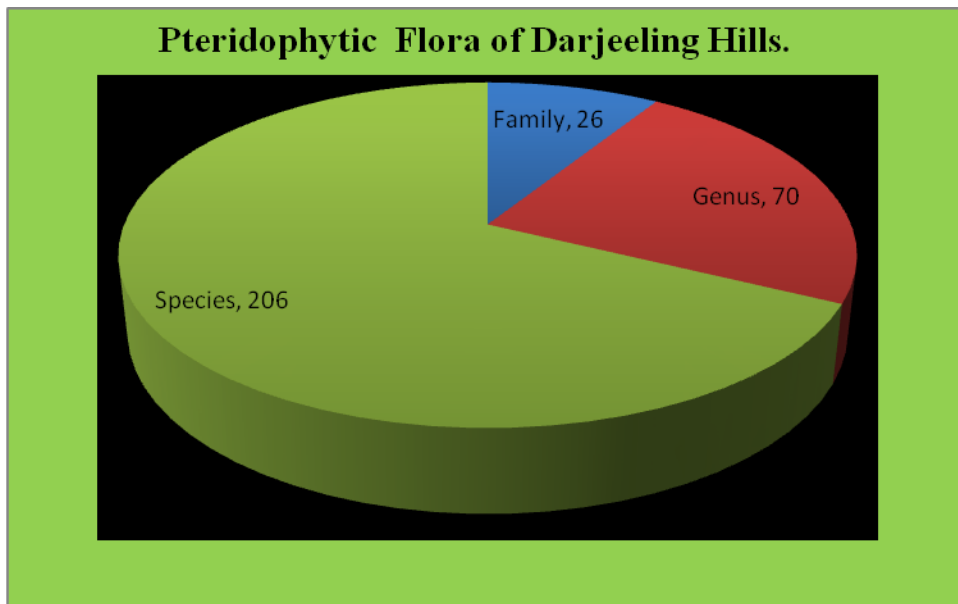


Figure 3.23 : Overall scenario of Pteridophytic flora Darjiling hills

Sl.No	Family	Genus	Species
1	Aspleniaceae	1	7
2	Blechnaceae	3	3
3	Cyatheaceae	1	2
4	Davallaceae	3	3
5	Dennstaedtiaceae	5	7
6	Dryopterideaceae	9	33
7	Equisetaceae	1	2
8	Gleichenaceae	2	4
9	Grammitadaceae	1	1
10	Hymenophyllaceae	2	4
11	Lindsaeaceae	2	3
12	Lomariopsidaceae	2	3
13	Lycopodiaceae	3	8
14	Lygodiaceae	1	2
15	Marattiaceae	1	1
16	Nephrolepidaceae	1	1
17	Oleandraceae	1	2
18	Ophioglossaceae	2	6

19	Osmundaceae	1	1
20	Plagiogyraceae	1	1
21	Polypodiaceae	13	40
22	Pterideaceae	7	31
23	Sellaginaceae	1	7
24	Thelypterideaceae	1	10
25	Vittariaceae	1	4
26	Woodsiaceae	4	20
Total	26	70	206

Table3.1: Family, Genus & Species of Pteridophytic flora.

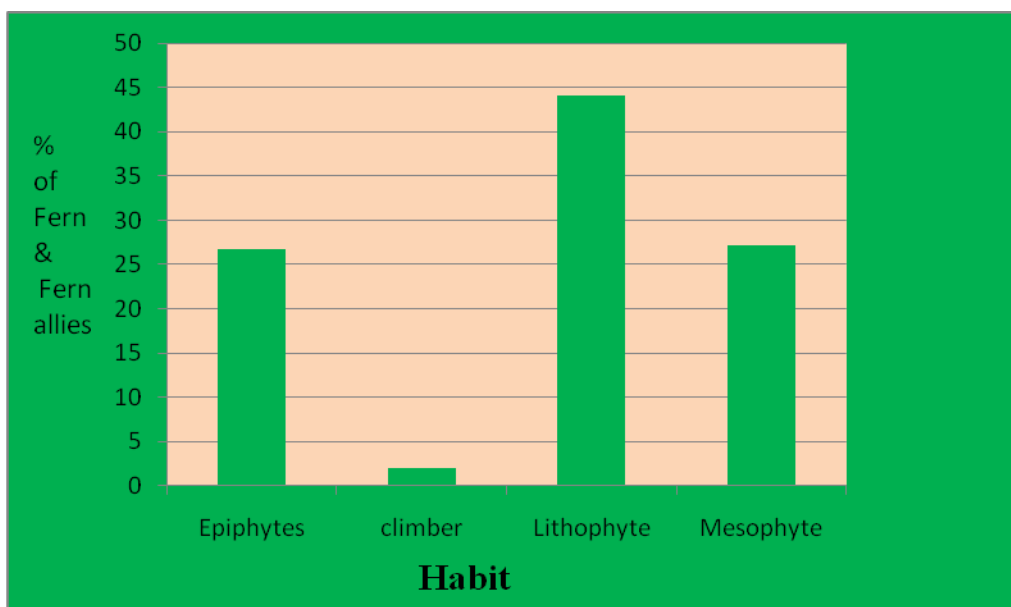


Fig 3.24: Graph representing Habit & % of Species.

Another remarkable finding of the present study was the abnormal specimen collected during the field survey. Abnormal specimen's of *Plagiogyra pycnophylla* having a monomorphic frond collected from three different location namely Ramam, Rechala and Senchel is quite fascinating i.e. Abnormality or speciation? If abnormality than what is it's triggering mechanism and if not, why not a speciation? Since abnormal specimen (Plate 3.22: A to F) have been collected by the present worker in different members of pteridophytes like *Asplenium ensiforme*, *Lepisorus mehra*,

Botrychium lanuginosum, *Equisteum arvense* subsp. *diffusum*, *Goniophlebium argutum* (Close to *G. metzense* {Thapa and lama, 2013}).

90% of the fern flora in Darjiling comprises of Sino –Himalayan and Malesian element. Some Malesian elements in the flora tend to be native to an area where temperature is usually high as for tropical and sub-tropical belt. Some important components of Malesian element in Darjiling hills confined to Foothills ranging in altitude of 300-1000 m are *Pteris biaurita*, *Microlepia rhomboidea*, *Microlepia speluncae*, *Bolbitis heteroclita* and *Stenochlaena palustris*. On the contrary Sino-himalayan elements prefer lower temperature, cool climatic condition and are restricted to temperate and sub-alpine region of Darjiling hills. The single species representing the Afro-Arabian connection migrated through Deccan in the foothills is *Aleuritopteris bicolor*.

The rarest of species collected from Darjiling hills at single location in this entire study are *Huperzia ceylanica* (Plate 3.1) and *Asplenium magnificum*. *Huperzia phlegmaria* couldn't be collected from the foothills is a matter of concern as previous literature indicates its presence. Similarly the dwindling population of *Cyathea sp* and its diversity at the present study revealed only two species. One-time collected species like *Pteris barbiger*, *Cyathea contaminans*, *Dipteris wallichii*, *Pteridrys cnemidaria*, *Christopteris tricupsis* could not be collected in the present study as well. *Pteris barbiger* is known only from one collection in Darjiling hills, after which it could not be seen in the wild neither be collected for 100 years.

3.3 Discussion

Floristically rich Darjiling hills is represented by pteridophytes which account to 206 species representing 70 genera and 26 families. The new record for the region are *Botrychium lunaria*, *Huperzia ceylanica* and *Pteris austrosinica*. The terrain complexity of the region and inaccessibility has lead to the new record for the region. As Darjiling hills is a segment of eastern himalaya the availability of the micro niche facilitates (Acharya & Acharya, 2003) the growth and development of species which are yet to be discovered. As for instance the *Botrychium lunaria* was collected from Sandhakphu (Singalila National Park) in the month of July 2014 when the national park is usually closed. The sub-alpine plants which has a short favourable growing condition are hard to be recorded due to numerous factor

which may be climatic as well as the government norms concerning the closure of parks during the breeding season. Similarly *Huperzia ceylanica* was collected from the fringes of National park in Chitrey whose population is very very small and conservation strategy should be implemented to safeguard this species.

Pteris austrosinica an endemic Chinese element was reorded from Tropical forest in Singla for the first time in Indian Sub-continent. However , debate arouse upon its name and its existence in china as well as in Darjiling hills (Fraser-Jenkins in Prep. Check-list of India, Part II).

The migration of temperate species towards the tropical region is quite common in angiosperm's, however such migration in ferns with respect to *Pteris wallichiana* descending the lower altitude has never been documented in Darjiling and Sikkim himalaya (Kholia, 2010). Contrary to descend the present worker highlighted the ascend of species to the cold temperate region from tropic's due to numerous factor, chief being the anthropogenic activity(Thapa *et al.*2014) .

The rarest of species collected from Darjiling hills at single location in this entire study is *Asplenium magnificum* collected from the streams of Gorkhey and this species is collected for second time from the region after R.C. Ching. The absence of *Huperzia phlegmaria* in the foothills of darjiling is a matter of concern as previous literature indicates its presence. However it's ornamental value and wide exploitation by local nursery and flower shop must be the reason for its disappearance. Similarly the dwindling population of *Cyathea sp* and its diversity as the present study revealed only two species which is due to over exploitation of species for its trunk to make a pot for growing the cymbidium hybrid by Local nursery and flower enthusiast. One-time collected species like *Pteris barbiger*, *Cyathea contaminans*, *Dipteris wallichii*, *Pteridrys cnemidaria* , *Christopteris tricupsis* could not be collected in the present study as well. This species tend to be rarest in the Indian sub-continent as well, as *Pteris barbiger* is known only from one collection in Darjiling hills, after which it could not be seen in the wild neither be collected for 100 years. Similarly the entire habitat of *Pteridrys cnemidaria* located in the valley of Great rangit in sumbong was washed away in flash flood of 1968. *Christopteris tricupsis* an epiphyte lost its

habitat too when the *Shorea robusta* trees were exploited in Goke for the timbers and their existence in darjiling hill is still unknown. *Dipteris wallichii* habitat was also entirely destructed once the Corporation, under forest department started clearing away the tress in Kalimpong. The reason for disappearance of *Cyathea contaminans* is basically for its trunk as it was used to prepare pots and its young tender croizer used as a delicacy by locals.

3.4 Conclusion

The study in Darjiling hills revealed a rich diversity of Pteridohytes along the altitudinal gradient from plains up to the sub-alpine region. 206 species of fern and fern allies representing 70 genera and 26 families has been documented. The highest diversity in terms of genera and number of species is shown by family Polypodiaceae with 13 genera and 40 species. This region chiefly consist of sino-himalayan and malesian element in pteridohytic flora. The new record for the region are *Botrychium lunaria*, *Huperzia ceylanica* and *Pteris austrosinica*. The one time collected species from the region couldn't be collected in the present study as well and their loss from the region is an effect of habitat destruction. Conservation measure should be implemented to safeguard some rarest species like *Asplenium magnificum* and *Huperzia ceylanica* which may be lost due to anthropogenic activity. The survey failed to record *Huperzia phlegmeria* from the foothills which may be due to over exploitation of the species for ornamental purposes. One-time collected species like *Pteris barbiger*, *Cyathea contaminans*, *Dipteris wallichii*, *Pteridrys cnemidaria*, *Christopteris tricupsis* could not be collected in the present study as well. Numerous abnormal specimen were encounterd in the study which has been documented and further research in molecular level is necessary to unearthed its hidden mystery.

3.5 Summary

The present study was undertaken in different forest tract of darjiling hill for enumeration of fern and fern allies. The District of Darjiling excluding the plains of siliguri and duars was the study area. The study area ranged in altitudinal variation from 150 m amsl to 3660m amsl covering chiefly 4 climatic zone i.e. tropical, sub-tropical, temperate and sub-alpine. The enumeration of pteridophytic flora was carried out and placed in respective families. The family keys has been provided in the first page of the chapter. 26 families has been documented in the present study with total of 70 genus

and 206 species. Three families from fern allies have been documented consisting of 5 genera with 17 species, where Lycopodiaceae with 3 genera and 8 species have shown the highest diversity (Thapa et al, 2015). The highest diversity in terms of genera and number of species is shown by family Polypodiaceae with 13 genera and 40 species. Mehra & Bir, 1964 documented 31 families, 86 genera and 338 species from the Darjiling and Sikkim Himalaya. On the contrary Hara, 1974 in his famous expedition to eastern Himalaya listed 131 species from Darjiling hills.

Majority of the fern species in Darjiling hills depending upon habit and habitat can be classified into different groups like epiphytes, lithophytes, mesophytes and climbers. The epiphytes and lithophytes form the major chunk of the pteridophytic flora for the region. Around 26.8% are epiphytes, lithophytes 44.11%, mesophytes account for 27.13% and 2% is represented by climbers. Four climbers chiefly *Lygodium japonicum*, *Lygodium salicifolium*, *Stenochlaena palustris* from the warmer foot hills and *Tricholepidium normale* from the cool temperate region has been found.

The new record for the region is *Botrychium lunaria*, a high altitude species collected from Sandhakphu (Thapa et al. 2014) which forms a connecting link between the species of western Himalaya and far-north east India. The present study recorded an endemic species of China for the first time in Indian sub-continent at an altitude of 323 m in the foothills which was *Pteris austrosinica* (Thapa & Lama, 2014). Exotic and adventive species that have naturalized in Darjiling hills are *Adiantum concinnum* and *Pityrogramma calomelanos*. However numerous ornamentals have been introduced like *Davallia fijiensis*, Stag horn etc yet they haven't naturalized.

Abnormality of species has been observed in the present study where abnormal specimen's of *Plagiogyra pycnophylla* having a monomorphic frond was collected from three different locations namely Ramam, Rechala and Senchel. The observation of such specimen was fascinating i.e. Abnormality or speciation? If abnormality then what is its triggering mechanism and if not, why not a speciation? And the finding of several specimens from different locations occupying different ecological niches and each species showing the same peculiarity needs further study. Since abnormal specimens have been collected by the present worker in different members of pteridophytes like *Asplenium ensiforme*, *Lepisorus mehra*,

Botrychium lanuginosum, *Equisteum arvense* subsp. *diffusum*,
Goniophlebium argutum (Thapa et al. 2013).

90% of the fern flora in Darjiling comprises of Sino –Himalayan and Malesian element. Some Malesian elements in the flora tend to be native to an area where temperature is usually high as for tropical and sub-tropical belt. Some important components of Malesian element in Darjiling hills confined to Foothills ranging in altitude of 300-1000 m are *Pteris biaurita*, *Microlepia rhomboidea*, *Microlepia speluncae*, *Bolbitis heteroclita* and *Stenochlaena palustris*. On the contrary Sino-himalayan elements prefer lower temperature, cool climatic condition and are restricted to temperate and sub-alpine region of Darjiling hills. The single species representing the afro-arabian connection migrated through Deccan in the foothills is *Aleuritopteris bicolor*.

The rarest of species collected from darjiling hills at single location in this entire study are *Huperzia ceylanica* and *Asplenium magnificum*. The absence of *Huperzia phlegmaria* in the foothills of darjiling is a matter of concern as previous literature indicates its presence. However it's ornamental value and wide exploitation by local nursery and flower shop must be the reason for its disappearance in the study area. Similarly the dwindling population of *Cyathea sp* and its diversity as the present study revealed only two species which is due to over exploitation of species for its trunk to make a pot for growing the cymbidium hybrid by Local nursery and flower enthusiast. One-time collected species like *Pteris barbiger*, *Cyathea contaminans*, *Dipteris wallichii*, *Pteridrys cnemidaria*, *Christopteris tricupsis* could not be collected in the present study as well. This species tend to be rarest in the Indian sub-continent as well, as *Pteris barbiger* is known only from one collection in Darjiling hills, after which it could not be seen in the wild neither be collected for 100 years. Similarly the entire habitat of *Pteridrys cnemidaria* located in the valley of Great rangit in sumbong was washed away in flash flood of 1968. *Christopteris tricupsis* an epiphyte lost its habitat too when the *Shorea robusta* trees were exploited in Goke for the timbers and their existence in darjiling hill is still unknown. *Dipteris wallichii* habitat was also entirely destructed once the Corporation, under forest department started clearing away the tress in Kalimpong. The reason for disappearance of *Cyathea contaminans* is basically for its trunk used to prepare pots and its young tender croizer used as a delicacy by locals.

Chapter 4

PHYTOSOCIOLOGICAL ANALYSIS

4. Introduction

The study was carried out in the Darjiling hills with elevation ranging from 180 m amsl and above in Darjiling district within the geographical boundary of west Bengal. The plant diversity characterization has been undertaken to understand the vegetation structure of fern and fern allies. The study area comprises of eight administrative blocks representing three sub-division with an area of 2228.13 km². The plains of Siliguri sub-division has been excluded in the present work.

The region can be distinguished into four zones on the basis of altitude (Champion and Seth, 1968). The lower hill comprises of tropical vegetation where temperature and rainfall are usually high. As we move along the altitude gradient in the range of 800-1600m amsl the sub-tropical vegetation can be observed. The temperate zone extends from 1600-3000 m and further along the altitude gradient of 3200m amsl a narrow stretch of sub-alpine vegetation occur. The important feature of this region is the descend of temperate species to the tropical zones and at the same time some species tend to ascend towards temperate from the tropical zone. The vegetation characterization for the region included four climatic zone where 80 sample plots were laid covering a total area of 0.8 ha in each climatic zone.

The hills of Darjiling present diverse topographical conditions and offer suitable habitat for the occurrence of wide range of plants (Das, 1995; Acharya & Acharya, 2001; Das, 2004). Though the district is floristically well explored but the occurrence of micro-niche in difficult terrains with negligible accessibility has lead some plants of the region remained undiscovered (Thapa *et al.* 2014). The climatic factor and the geographical feature contribute to the region being floristically diverse. The region is home to numerous species from surrounding region and contributes as different floristic elements which has migrated and successfully

established in Darjiling Hills. Numerous naturalised exotics and high proportion of endemics in the flora has been recorded (Das, 2002; Bhujel and Das, 2002) .

4.1 Result

The raw data collected by ground truth from 80 sample plots (Plate 4.2 and 4.3) in 4 climatic zone recorded a total of 406 species. The Pteridophyte's was represented by 53 species, where 49 species were herb, 2 species were climbers and 2 species were tree ferns (Figure 4.8 & 4.9). The quantitative analysis for each strata was conducted separately i.e. Tree, Shrub and Herb layers. Frequency (F), Density(D), Abundance (A), Relative frequency (RF), Relative density (RD), Relative abundance (RA), Importance value index (IVI) with Diversity indices namely Simpson Index, Shannon Index and Mehnick index were calculated. In case of tree strata the basal area (BA) with Relative dominance (Rdm) was calculated in place of Abundance(A) and Relative abundance(AB). The picture's of 4 different forest type of darjiling hills has been represented in Plate 4.1.

4.1.1 Tropical Forest

In The tropical forest(Plate 4.1 D) 20 sample plots covering an area of 0.8 ha was laid down. A total of 2541 individual belonging to 109 genus and 117 species has been recorded. 35 species of trees, 38 species of Shrub and 44 species of herb were recorded. In the present study 11 ferns representing 1 climber and 10 herbs were recorded. Rest of 106 species represented the angiosperms. The tree density for this tropical forest was calculated to be 385 individuals/ha and total basal area was 52.07911m²/ha. The dominance-diversity curve for all strata has been represented in Figure 4.4.

Shannon- Weiner index of diversity in the tropical forest was calculated to be 4.214229. The determined value for species diversity for tree layer was 2.657291, for shrub layer 3.153165 and for herb layer was 3.457137(Table 4.1 & Figure 4.2).

Simpson's index for concentration of dominance for this tropical forest was observed to be 0.020301607. The determined value for concentration of

dominance for tree layer was 0.124304, for shrub layer 0.057628 and for herb layer was 0.040559 (Table 4.1 & 4.3).

Menhinick's index for species richness was calculated to be 2.321045 for this forest. The determined species richness for tree layer was 1.99431, for shrub layer 1.201666 and for herb layer was 1.253058 (Table 4.1 & 4.4).

This forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The tree strata exhibited highest species richness in the forest.

4.1.2 Sub-tropical forest

In the sub-tropical forest (Plate 4.1C) 20 sample plots covering an area of 0.8 ha was laid down. A total of 3563 individual belonging to 94 genus and 100 species has been recorded. 26 species of trees, 30 species of Shrub and 43 species of herb were recorded. In the present study 16 ferns representing 1 tree fern i.e. *Cyathea brunoniana* , 1 climber *Lygodium japonicum* and 14 herbs were recorded. Rest 84 species represented the angiosperms and gymnosperm. The tree density for this tropical forest was calculated to be 521.25 individuals/ha and total basal area was 59.05898 m²/ha. The dominance-diversity curve for all strata has been represented in Figure 4.5.

Shannon- Weiner index of diversity in the Sub-tropical forest was calculated to be 4.308495. The determined value for species diversity for tree layer was 3.150891, for shrub layer 3.289477 and for herb layer was 3.50989 (Table 4.1 & Figure 4.2).

Simpson's index for concentration of dominance for this Sub-tropical forest was observed to be 0.017550023. The determined value for concentration of dominance for tree layer was 0.0531, for shrub layer 0.0526 and for herb layer was 0.0389 (Table 4.1 & 4.3).

Menhinick's index for species richness was calculated to be 1.6752 for this forest. The determined species richness for tree layer was 1.273 , for shrub layer 0.8415 and for herb layer was 1.032(Table 4.1 & 4.4).

This forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The tree strata exhibited highest species richness in the forest.

4.1.3 Temperate Forest

In the Temperate forest(Plate 4.1B) 20 sample plots covering an area of 0.8 ha was laid down. A total of 4304 individual belonging to 104 genus and 115 species has been recorded. 30 species of trees, 36 species of Shrub and 49 species of herb were recorded. In the present study 16 ferns representing 1 tree fern i.e. *Cyathea spinulosa* and 15 herbs were recorded. Rest 99 species represented the angiosperms. The tree density for this temperate forest was calculated to be 576.25 individuals/ha and total basal area was 62.83923m²/ha. The dominance-diversity curve for all strata has been represented in Figure 4.6.

Shannon- Weiner index of diversity in the temperate forest was calculated to be 3.8122. The determined value for species diversity for tree layer was 3.206, for shrub layer 2.516 and for herb layer was 3.451(Table 4.1 & Figure 4.2).

Simpson's index for concentration of dominance for this Temperate forest was observed to be 0.0588.The determined value for concentration of dominance for tree layer was 0.0449, for shrub layer 0.1642and for herb layer was 0.0434 (Table 4.1 & 4.3).

Menhinick's index for species richness was calculated to be 1.7376for this forest. The determined species richness for tree layer was 1.3972, for shrub layer 0.7249 and for herb layer was 1.3204 (Table 4.1 & 4.4).

This forest shows good species diversity with moderate concentration of dominance. The herb layer exhibit good diversity and low dominance than

tree and shrub layer. The tree strata exhibited highest species richness in the forest.

4.1.4 Sub-alpine Forest

In the Sub-alpine forest (Plate 4.1A) 20 sample plots covering an area of 0.8 ha was laid down. A total of 2237 individual belonging to 64 genus and 74 species has been recorded. 16 species of trees, 14 species of Shrub and 44 species of herb were recorded. In the present study 10 species of ferns and 64 species of angiosperms and gymnosperm has been recorded. The tree density for this temperate forest was calculated to be 685 individuals/ha and total basal area was 47.86782m²/ha. The dominance-diversity curve for all strata has been represented in Figure 4.7.

Shannon- Weiner index of diversity in the Sub-alpine forest was calculated to be 3.8077. The determined value for species diversity for tree layer was 1.925, for shrub layer 2.493 and for herb layer was 3.35 (Table 4.1 & Figure 4.2).

Simpson's index for concentration of dominance for this Sub-alpine forest was observed to be 0.0312. The determined value for concentration of dominance for tree layer was 0.2182, for shrub layer 0.0932 for herb layer was 0.0468 (Table 4.1 & 4.3).

Menhinick's index for species richness was calculated to be 1.5857 for this forest. The determined species richness for tree layer was 0.6834, for shrub layer 0.536 and for herb layer was 1.3865 (Table 4.1 & 4.4).

This forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The highest species richness was observed in herbaceous strata. The tree strata exhibited highest dominance in the sub-alpine forest as well as in all the forest zone of Darjiling hills. The two dominant *Rhododendron sp* in the sub-alpine tract namely *R. arboreum* and *R. falconeri* with highest number of individual and basal area should be accounted for high concentration of dominance in tree strata of sub-alpine forest.

Table 4.1: Diversity indices for different forest type in Darjiling Hills.

Sl. No.	Forest Types	Shannon-Weiner index	Simpson's index	Menhinick's index
1	Tropical forest	4.214	0.023	2.321
2	Sub-Tropical Forest	4.308	0.0176	1.6752
3	Temperate Forest	3.8122	0.0588	1.7376
4	Sub-alpine Forest	3.8077	0.0312	1.5857

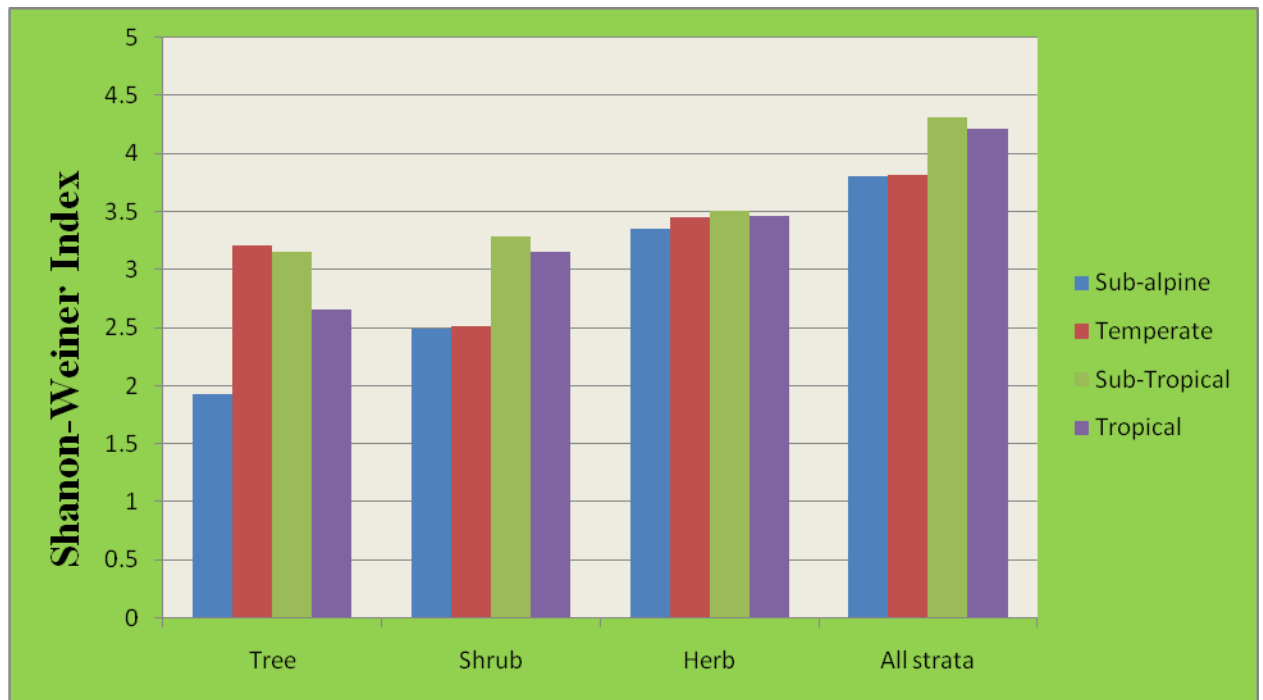


Figure 4.1: Shannon- Weiner Index of species diversity for different forest types in different Strata.

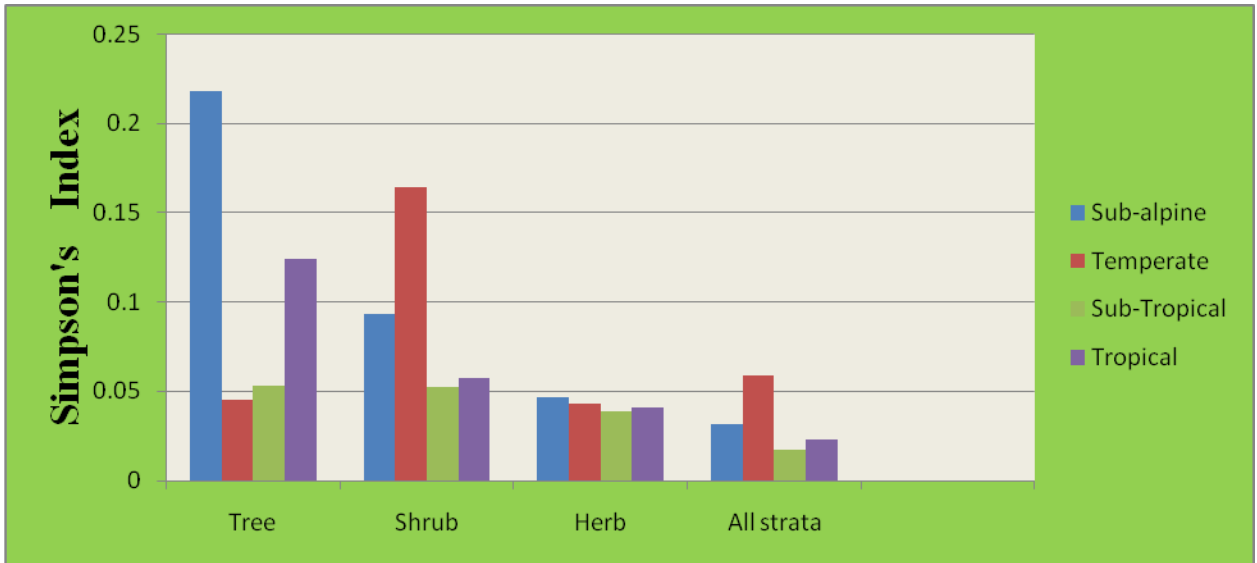


Figure 4.2: Simpson's Index of concentration of dominance for various forest types in different strata.

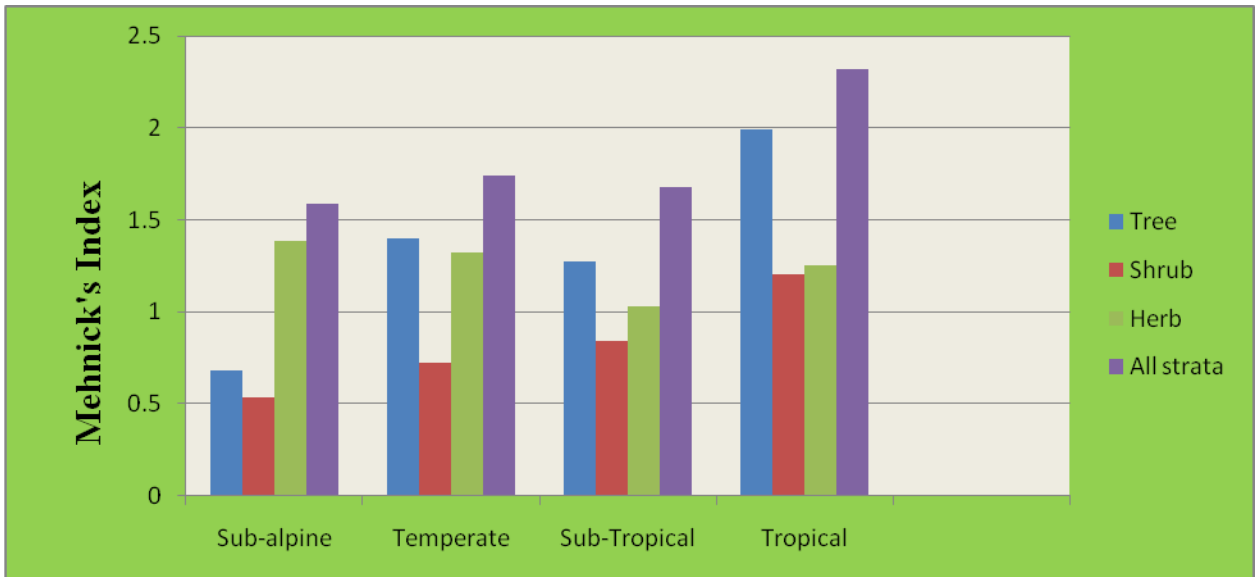


Figure 4.3: Menhinick's Index of species richness for various forest types in different strata.

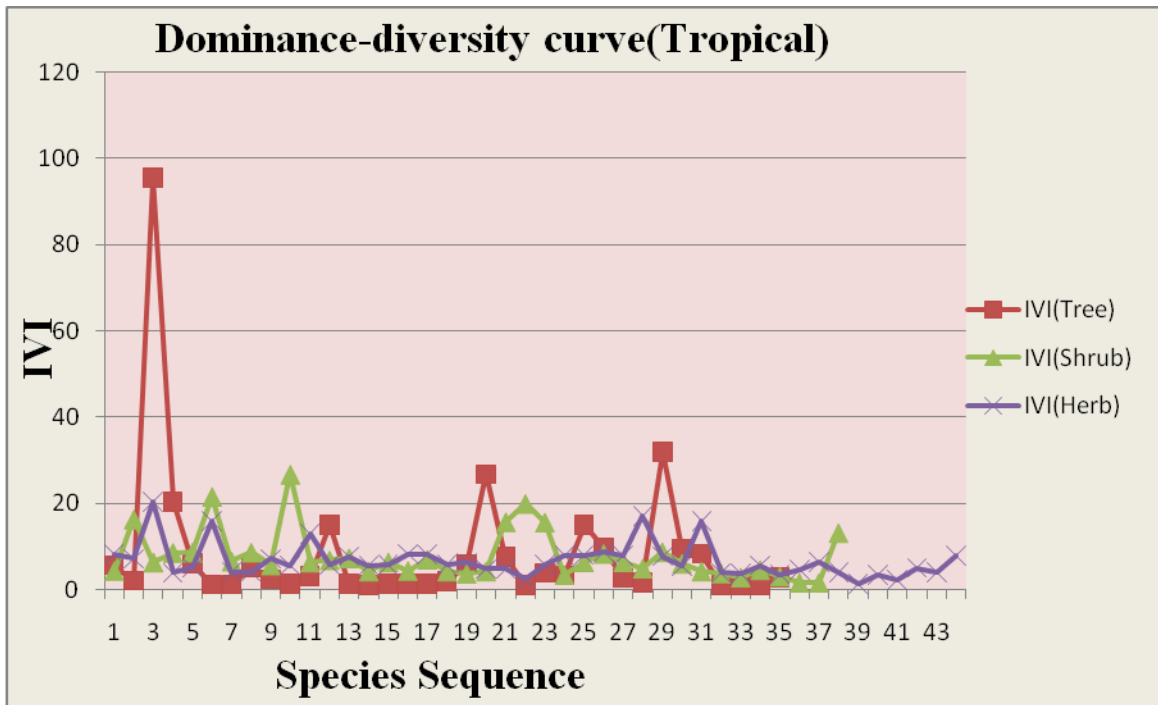


Figure 4.4: Dominance-diversity curve for different strata in Tropical Forest.

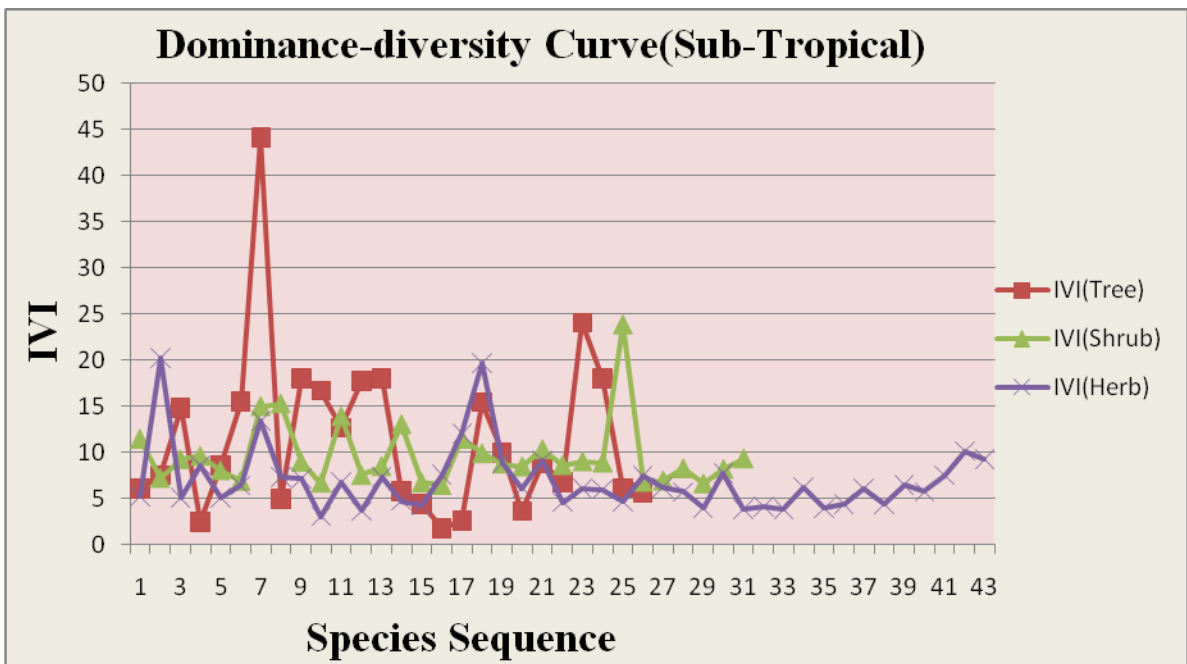


Figure 4.5: Dominance-diversity curve for different strata in Sub-Tropical Forest.

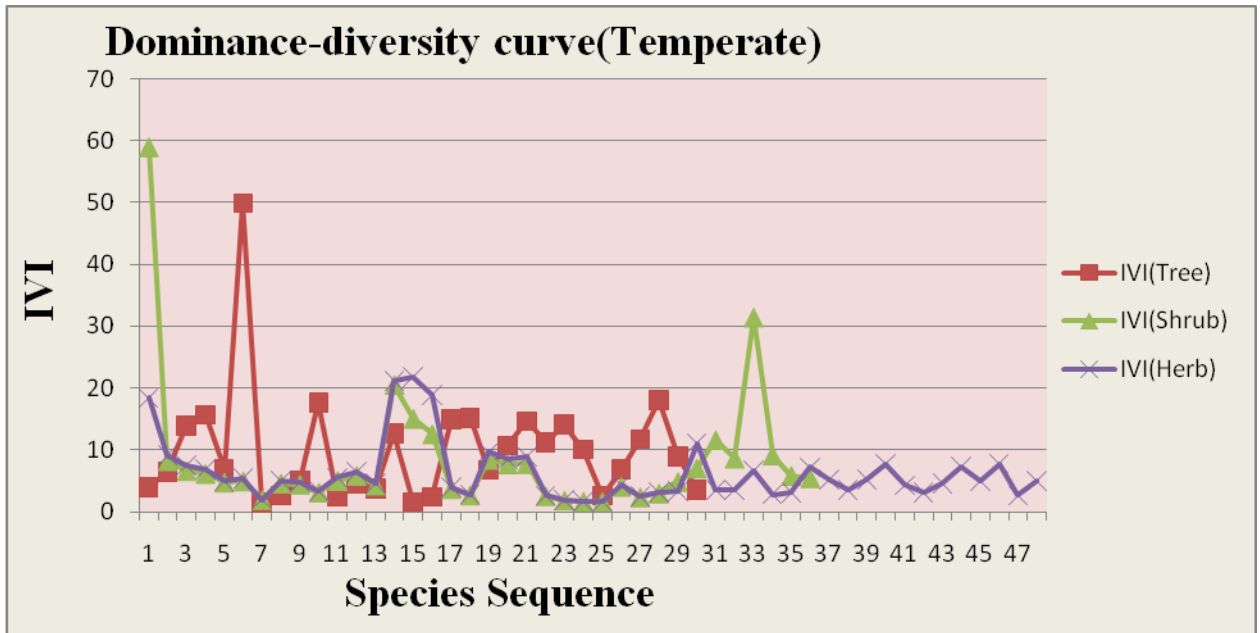


Figure 4.6: Dominance-diversity curve for different strata in Temperate Forest.

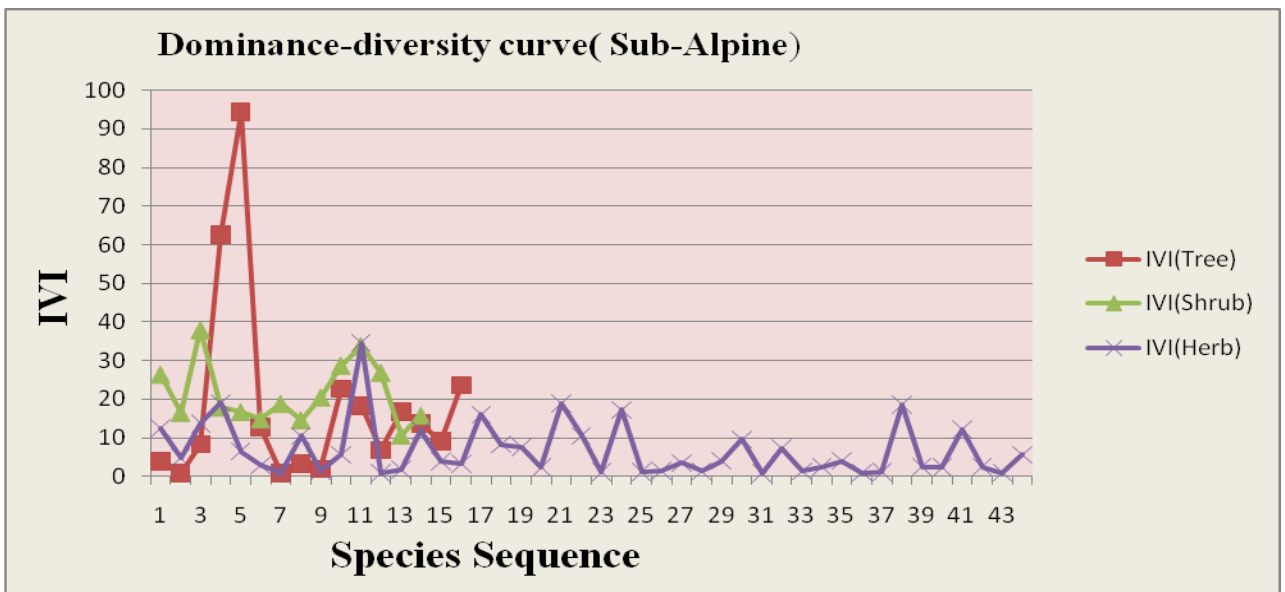


Figure 4.7: Dominance-diversity curve for different strata in Sub-alpine Forest.

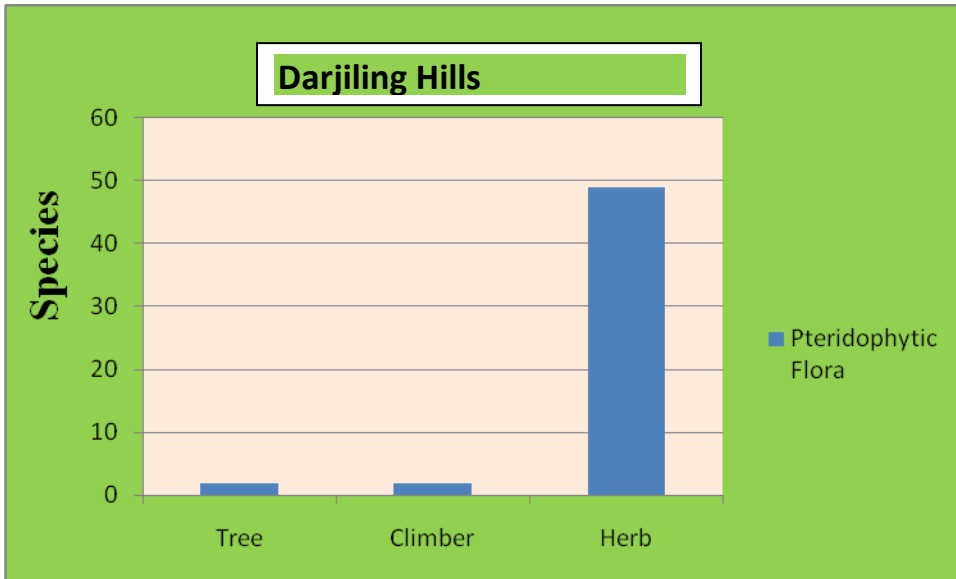


Figure 4.8: Species Distribution of Pteridophytes in Darjiling Hills.

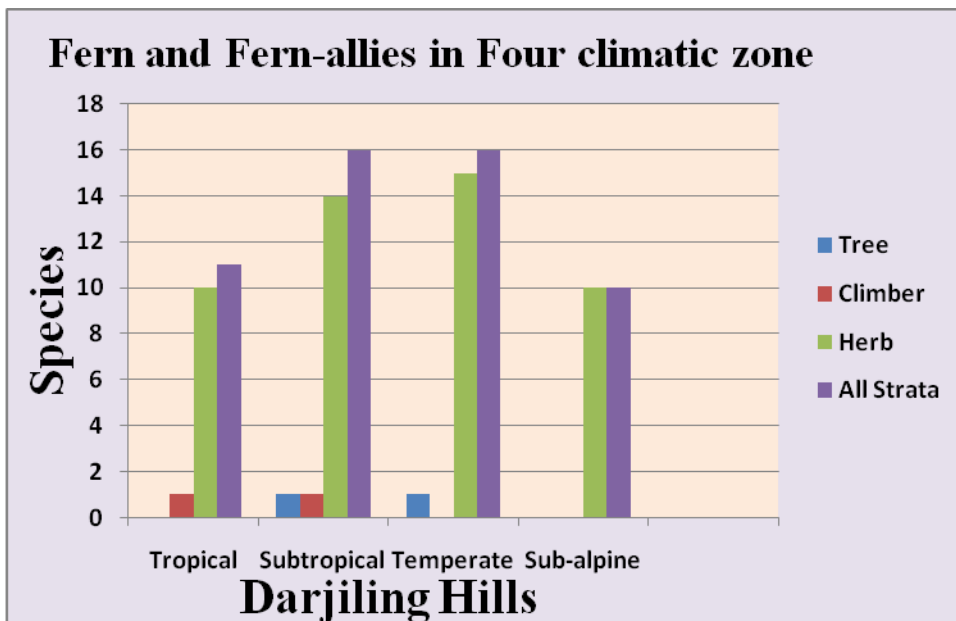


Figure 4.9: Species distribution of Pteridophytes in different strata.

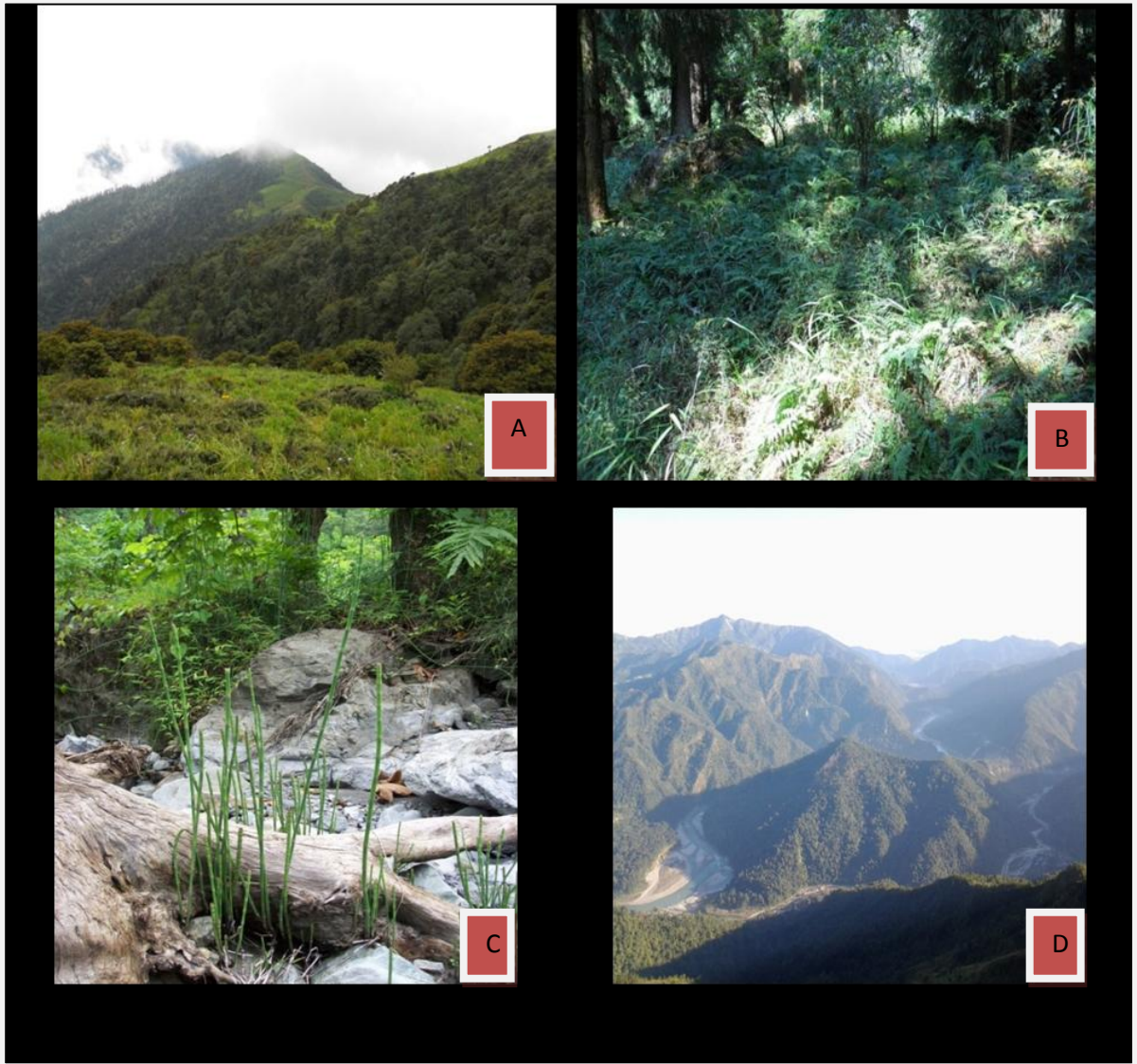


Plate 4.1: A. Sub-Alpine Forest; B. Temperate Forest; C. Sub-Tropical Forest; D. Tropical Forest.



Plate 4.2: A. Watch Tower at Neora Valley National Park; B. Biggest Girth *Rhododendron arboreum* Smith in Park; C. Field study; D. Sub-Alpine Vegetation; E. *Polystichum perscotianum* (Wallich ex Mettenius) T. Moore; F. Taking GPS reading on field .



Plate 4.3: A. Collecting Raw data; B. Field survey; C. Tagging for Quadrat study; D. Invasiveness of *Arundinaria sp* in the field; E. Measurement of girth; F. Tropical vegetation.

4.2 Discussion

The Phyto-sociological analysis with respect to fern and fern allies is the first of its kind studied in the region. Fragmentary work with respect to this group of Pteridophyte without proper identification and nomenclature update has been adopted in the previous work (Rai,2006). Floristic analysis with respect to angiosperms and gymnosperms has been conducted from time to time and numerous base line data can be cited (Das 1995,2004;Bhujel 1996; Lama ,2004; Rai,2006). In the post independence work (Mehra & Bir,1964) tried to classify the Pteridophytes on the basis of observation into epiphytes, climbers, ravine ferns etc. without creating a sampling plot neither ground truthing to assess the different parameter like Density, Frequency, Abundance,IVI etc. Different workers who studied the pteridophytes of the region just enumerated the species distribution but failed to study their ecology (Hara,1974;Matthews ,1971;Fraser-Jenkins,2008). Therefore this study is an attempt to observe and infer the ecology of Pteridophytes. 49 species of herbs, 2 species of climber and 2 species of tree fern has been recorded from Fern and fern allies in the study area. The highest importance value index was 19.62 for *Nephrolepis cordifolia* with respect to Pteridophytes in the study area. However it was found that Pteridophytes form a small portion of the vegetation in all the forest type studied. They are not a dominant partner in any forest type as their over all representation in our ecological studies contribute to be around 13.05%

4.3 Conclusion

The ground truth data from 80 sampling plot in four different forest types revealed 406 species of Plants. The Pteridophyte were represented by 53 species, angiosperm and gymnosperm constitute 353 species. 49 species of herbs, 2 species of climber and 2 species of tree fern has been recorded from Fern and fern allies in the study area. The sub-tropical forest showed the highest species diversity of 4.308 and least concentration of dominance .0176 .The species richness was Maximum in case of Tropical forest i.e. 2.321.And in case of Fern and fern- allies the subtropical and temperate forest showed the highest diversity of 16 species each and highest Importance value index was 19.62 of *Nephrolepis cordifolia*.

4.3 Summary

The present study was conducted in Darjiling hills to assess the Phytosociological analysis of Fern and Fern-allies in different forest tract. The ground truth raw data from the 20 sampling plot covering 0.8 ha under each forest type was collected and analyzed. The quantitative analysis was carried out where density, frequency, abundance Relative density, Relative frequency, relative abundance and importance value index was calculated for shrub and herb Strata. In case of tree strata basal area and relative dominance were calculated in place of abundance and relative abundance. The overall idea of vegetation of each forest type was computed on the basis of diversity-dominance curve , *Shannon-Weiner Index*, *Simpson's Index* and *Menhinick's Index*. The raw data collected by ground truth from 80 sample plots in 4 climatic zone recorded a total of 406 species. The Pteridophyte's was represented by 53 species, where 49 species were herb, 2 species were climbers and 2 species were tree ferns. The tropical forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The tree strata exhibited highest species richness in the forest. *Shannon- Weiner index* of diversity was 4.214229, Simpson Index was 0.020301607 and *Menhinick's index* was 2.321045 for the vegetation.

The sub-tropical forest 3563 individual was recorded belonging to 94 genus and 100 species of which 26 species was trees, 30 species was Shrub and 43 species was herb . In the present study 16 ferns representing 1 tree fern i.e. *Cyathea brunoniana* , 1 climber *Lygodium japonicum* and 14 herbs were recorded. *Shannon- Weiner index* of diversity was 4.308495, *Simpson's index* for concentration of dominance was 0.017550023 and *Menhinick's index* was 1.6752 for this forest.

This forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than

tree and shrub layer. The tree strata exhibited highest species richness in the forest.

The Temperate forest 4304 individual was recorded belonging to 104 genus and 115 species of which. 30 species was trees, 36 species was Shrub and 49 species was herb . In the present study 16 ferns representing 1 tree fern i.e. *Cyathea spinulosa* and 15 herbs were recorded. *Shannon- Weiner index* of diversity was 3.8122, *Simpson's index* for concentration of dominance was 0.0588 and *Menhinick's index* for species richness was calculated to be 1.7376 for this forest. This forest shows good species diversity with moderate concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The tree strata exhibited highest species richness in the forest.

The sub-alpine forest 2237 individual was recorded belonging to 64 genus and 74 species of which 16 species was trees, 14 species was Shrub and 44 species was herb. In the present study 10 species of ferns and 64 species of angiosperms and gymnosperm has been recorded. *Shannon- Weiner index* of diversity was 3.8077, *Simpson's index* for concentration of dominance was 0.0312 and *Menhinick's index* for species richness was calculated to be 1.5857 for this forest. This forest shows good species diversity with low concentration of dominance. The herb layer exhibit good diversity and low dominance than tree and shrub layer. The highest species richness was observed in herbaceous strata. The tree strata exhibited highest dominance in the sub-alpine forest as well as in all the forest zone of Darjiling hills. The two dominant *Rhododendron sp* in the sub-alpine tract namely *R. arboreum* and *R. falconeri* with highest number of individual and basal area should be accounted for high concentration of dominance in tree strata of sub-alpine forest. Pteridophytes form a small portion of the vegetation in all the forest type studied. They are not a dominant partner in any forest type as their over all representation in our ecological studies contribute to be around 13.05%

Chapter 5

UTILIZATION OF FERN AND FERN- ALLIES

5.Introduction

Biological resource has been utilized by mankind from time immemorial and yet that trend is still followed in 21st century too. The developing nation and under developed nation still has majority of population residing in rural areas in accessible to the modern facilities. The story of India and about its marginalized rural population directly or indirectly depends upon forest resources in day to day life. Considering Darjiling hills as a study area comprising of three sub-division namely, Darjiling, Kuresong and Kalimpong having in accessible terrain complexity and lack of modern facility where people still rely directly on forest for different needs. In day to day life people from villages depend directly on forest resources for maintaining their needs like food, fodder, medicine and household article. The region comprising an area of 2417km² has eight hospitals and 24 public health centers with doctor to people ratio of 1:4892. Health issues for down turn people in term of modern medicine are in accessible and they directly depend upon plants collected from their surroundings.

Darjiling hills has three important ethnic communities i.e Bhutia, Lepchas and Nepalese and each group following their own traditional way of utilizing natural resources. However with the turn in time the traditional utilization of plants by this different group is known to all and the knowledge has been amalgamated and passed from one generation to another. Therefore the marginalized population of far flung area utilizes the natural resource which has been passed by their fore fathers. In the present study an attempt has been made to document the utilization of fern and fern allies by the people of Darjiling hills.

5.1 Utilization of Fern and Fern allies

The forest is a reservoir of natural resources comprising of different groups of plants and animals. Past study through data mining and review revealed

that the utilization of plants revolved around the angiosperms (Yonzon *et al.* 1984; Rai and Sharma, 1994; Rai and Bhujel, 1999; Das and Mandal, 2003). However an attempt was made where 281 species were documented as ethno-medicine where 9 species belong to fern and fern allies (Chettri *et al.* 2003). Similarly 265 species belonging to 220 genera and 120 families were documented as ethno-medicine where on 3 species of ferns were reported from Darjiling District (Yonzon *et al.* 2011). The present study was carried out in villages in the form of questionnaires which were made under different sections representing ethno medicine, fodder, ornamentals and vegetables. The village elders and the healers were questioned and their answers were documented. The questionnaires have been provided in Table 5.1.

Table 5.1: Questionnaires For utilization of ferns in Darjiling hills.

Sl. no	Questionnaires for fern as non –timber forest Product	Local names
1.	Name some edible fern?	Sawuna ningro, lekh ningro
2.	Name some medicinal fern?	Rani sinka, Pira uniyew,
3.	Name some fern utilized as antiseptic?	Kali ningro
4.	Name some ferns used for preparing yeast cake?	Pira uniyew
5.	Name some ornamental ferns?	Nagbelli
6.	Name some ferns used as fodder?	Sottar uniyew
7.	Name some ferns used to make pot?	Rukh uniyew
8.	Name some ferns used for decoration?	Nagbeli, amala
9.	Name some ferns utilized for animal shed?	Rukh uniyew
10	Name some ferns utilized in religious ceremony?	Nagbelli



Plate 5.1: A. *Cyathea spinulosa* Wallich ex Hooker (croizer); B. *Deparia boryana* (Willdenow.)M.Kato croizer; C. *Tectaria fuscipes* (Wallich ex Beddome) C. Christensen; D. *Huperzia squarosa* (Forster)Trevisan; E. *Davallia fijiensis*; F. *Cyathea brunoniana* C.B Clarke trunks utilized for making pot; G. *Huperzia pulchermia*(Wallich ex Hooker et Greville)Pich.Sermolli; H. *Pteridium revolutum* (Blume)Nakai; I. *Thelypteris procera*(D.Don)Fraser-Jenkins.

5.2 Result

The study revealed rich traditional knowledge of ethnic people of Darjiling hills, natural resources from the surrounding area was utilized for day to day purposes (Plate5.1). In this survey, it was found that 40 species of fern and fern allies are used by people for different purposes and they have been categorized as Medicinal fern, Edible ferns, Cattle bed ferns and ornamental ferns. It was found that eleven species were used as medicinal ferns and young crozier of sixteen species was utilized as vegetable which fall under the category of edible fern from the genus *Diplazium*, *Deparia* and *Cyathea*. Four species of ferns were utilized as cattle bed fern (Sottar) for domesticated animals and nine species of fern were used for ornamental and decorative purposes.

Table 5.2 Cattle bed Fern (CBF) of Darjiling hills

Sl. No.	Scientific Name	Local Name	Family	Uses
1	<i>Dicranopteris lanigera</i> (Don)Fraser-Jenkins	Sottar	Gleicheniaceae	Cattle bed ferns.
2	<i>Dicranopteris taiwanseis</i> Ching & Chui	Sottar	Gleicheniaceae	Cattle bed ferns
3	<i>Diploterygium giganteum</i> Wallich ex Hooker & Bauer	Sottar	Gleicheniaceae	Used to cover the sowed zinger rhizome and used as cattle bed ferns too.
4.	<i>Pteridium revolutum</i> (Blume) Nakai	Sottarey uniyo	Dennstaedtiaceae	Cattle bed ferns

Table 5.3: Edible Fern (EF) of Darjiling hills.

Sl. no	Scientific name	Local name	Family	Uses
1	<i>Angiopteris helferiana</i>	Gaikhurey uniyo	Maratiaceae	Rhizomes edible

2	<i>Cythea brunoniana</i> C.B Clarke	Rukh uniyew	Cyatheaceae	Young croizer edible
3	<i>Deparia boryana</i> (Willdenow) Kato	Ghew ningro	Woodsiaceae	Young fronds edible
4	<i>Diplazium esculentum</i> (Retzius) Swartz	Auley Chipley ningro	Woodsiaceae	Young fronds edible
5	<i>Diplazium forrestii</i> (Ching ex Z. R. Wang) Fraser-Jenkins	Lekh chipley ningro	Woodsiaceae	Young fronds edible
6	<i>Diplazium himalayensis</i> (Ching) Panigrahi	Danthey ningro	Woodsiaceae	Young fronds edible
7	<i>Diplazium javanicum</i> (Blume) Makino	Sano Chipley ningro	Woodsiaceae	Young fronds edible
8	<i>Diplazium kawakamii</i> (Ching ex Z. R. Wang) Fraser-Jenkins	Jire ningro	Woodsiaceae	Young fronds edible
9	<i>Diplazium maximum</i> (D.Don)C.Christensen	Sawney ningro	Woodsiaceae	Young fronds edible
10	<i>Diplazium sikkimensis</i> (Clarke) Christensen	Sawaney ningro	Woodsiaceae	Young fronds edible
11	<i>Diplazium spectabile</i> (Wallich ex Mettenius) Ching	Kalo ningro	Woodsiaceae	Young fronds edible
12	<i>Diplazium succulentum</i> (Clarke) Christensen	Lekh Chipley ningro	Woodsiaceae	Young fronds edible
13	<i>Diplazium stoliczkae</i> Beddome	Lekh Chipley ningro	Woodsiaceae	Young fronds edible
14	<i>Lygodium japonicum</i> (Thunberg in Murray) Swartz	Pari anra	Lygodiaceae	Young frond edible.
15	<i>Ophioglossum</i>	Jibra sag	Ophioglossaceae	Fronds ediible

	<i>reticulatum</i> Linnaeus			
16	<i>Tectaria fuscipes</i> (Wallich ex Beddome) Christensen	Rato lekh ningro	Dryopterideaceae	Young fronds edible

Table 5.4: Medicinal Fern (MF) of Darjiling hills

Sl. no	Scientific name	Local name	family	Medicinal uses
1.	<i>Adiantum philippense</i> Linnaeus subsp. <i>philiphense</i> Fraser-Jenkins	Simsary uniyo	Adiantaceae	Paste used in cut and wounds
2.	<i>Adiantum venustum</i> Don	Rani sinka	Adiantaceae	Stipe used as antibiotic and antiseptic sticks in pierced nose and ear.
3	<i>Aleuritopteris bicolor</i> (Roxburgh)Fraser-Jenkins	Rani sinka	Pterideaceae	Stipe used as antibiotic and antiseptic sticks in pierced nose and ear.
4	<i>Equisetum arvense</i> Linnaeus subsp. <i>diffusum</i> Fraser-Jenkins	Salli-bisalli	Equisetaceae	Used against dog bites
5	<i>Lygodium japonicum</i> Thunberg	Parayo-Anri	lygodiaceae	Used against fever and cough.
6	<i>Nephrolepis cordifolia</i> (Linnaeus)C.Presl	Pani amala	Oleandraceae	It is used against chest congestion.
7	<i>Pteris biaurita</i> Linnaeus subsp. <i>fornicata</i> Fraser-	Thara uniyo	Pterideaceae	Used as antibiotic against

	Jenkins			pneumonia
8	<i>Pteris spinescens</i> Presl	Thara uniyow	Pterideaceae	Used as antiseptic as well as for blood coagulation
9.	<i>Tectaria coadunata</i> (J.Smith)C. Christensen	Aula kalo ningro	Dryopterideacea e	Rhizome used in diarrhea and pneumonia
10	<i>Thelypteris cana</i> (Baker)Ching	Pirey sottar	Thelypteridaceae	To eradicate bed bugs and lice of fowl
11	<i>Thelypteris procera</i> (Don) Fraser-Jenkins	Pirey sottar	Thelypterideacea e	Leaves used for preparation of yeast cake.

Table 5.5 : Ornamental Ferns (OF) of Darjiling hills.

Sl. no.	Scientific Name	Local Name	Family	Uses
1	<i>Cyathea brunoniana</i> Clarke	Rukh uniyew	Cyatheaceae	Pot made up of the trunk for orchid cultivation.
2	<i>Cyathea spinulosa</i> Wallich ex Hooker	Rukh uniyew	Cyatheaceae	Ornamnetal & its trunk are used for orchid cultivation.
3	<i>Davillia fejisensis</i>	Rabit foot	Daviallaceae	ornamental
4.	<i>Huperzia pulchermia</i> (Wall ich ex Hooker & Greville) Pich. Sermolli	..... ...	Lycopodiaceae	Ornamental.
5.	<i>Huperzia squarrosa</i> (Froste r) Trevisan	..... ....	lycopodiaceae	Ornamental

6.	<i>Lycopodiella cernua</i> (Linnaeus)Pich.S ermolli	Nagbeli	Lycopodiaceae	Used for decoration.
7.	<i>Lycopodium japonicum</i> Thunberg	Nagbeli	Lycopodiaceae	Utilized in decoration of Pandals as well in religious ceremony specially Saraswati puja.
8.	<i>Nephrolepis cordifolia</i> (Linnaeus)Presl	Pani amala	Oleandraceae	Ornamental, used for decoration.
9.	<i>Selaginella pulvinata</i> (Hooker et Greville) Maxim.	Kur kura jhar	Selaginaceae	Used for decoration purposes.

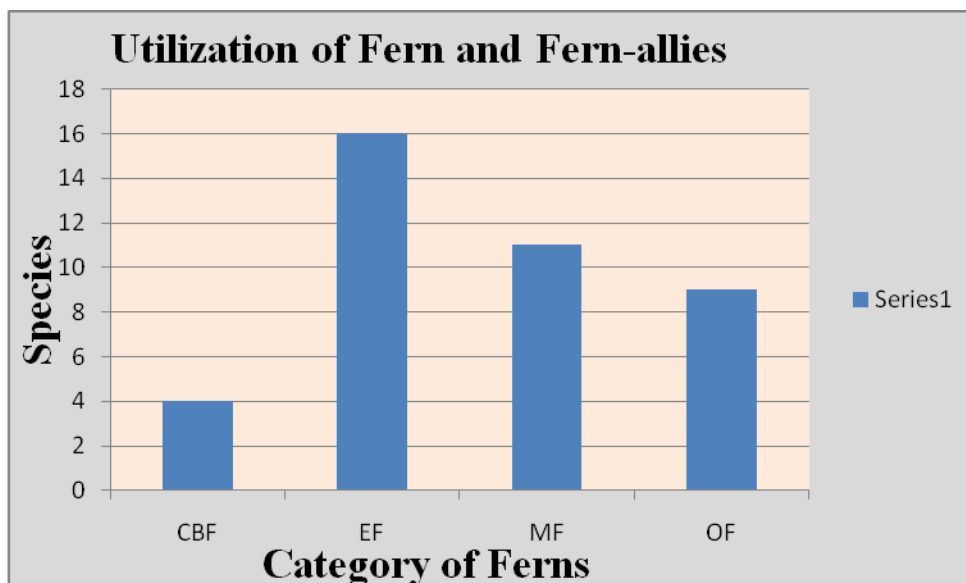


Figure 5.1: Utilization of Pteridophyte in Darjiling hills (CBF: Cattle bed ferns; Ef: Edible ferns; MF: Medicinal ferns; OF: Ornamental ferns)

5.3 Discussion

Utilization of biological resources by mankind is immemorial and we directly depend upon forest for fulfillment of our needs. The needs vary from person to person and in this study the need of Pteridophytes by rural people were investigated. The result shows 40 species of ferns utilized for different purposes which may be ethno-medicine, Cattle bed ferns, Edible Fern and ornamental fern. The documentation of utilization from this region for this group in such a large extent is for the first time. In the past some documentation of utilization of pteridophytes revealed 9 species (Chettri *et al.* 2003), 3 species (Yonzon *et al.* 2011). Kholia 2010 studied the utilization of Pteridophytes from the state of Sikkim and recorded 34 species. Rest of the literature on utilization focused on angiosperm (Rai and Sharma, 1994; Rai and Bhujel, 1999; Das and Mandal 2003; Rai, 2006). The overexploitation of the species is of great concern as some species are collected for foliage as well as for tubers. *Neprolepis cordifolia* (Linnaeus) C. Presl is overexploited as foliage is used for decoration and tubers for ethno-medicine. The collection is such huge that the humus content of its habitat has dwindled rapidly leading to decrease in the water holding capacity of the soil. An instance of *Huperzia phelegmeria* which had a sizeable population couldn't be collected in the present study due to the over exploitation of the species for ornamental purposes. Management measures and conservation strategy should be formulated in order to check the over exploitation of species. The craziness about young crozier (Ningro) is such that the villagers collect rampantly without knowing the species is edible yet they sell them in a local market as it is the easiest way to earn their livelihood.

5.4 Conclusion

In the study 40 Pteridophytes were found to be used by local people for different purposes. Young fronds are used as vegetable and preferred as delicacy. In some cases over exploitation of species were observed which has led to gradual decline in the population of a species and in certain extent some species tend to be rare in the study area. Proper conservation strategy and management is required to safe guard species like *Cyathea*

spinulosa Wallich ex Hooker, *Angiopteris helferiana* Presl etc. that has become rarest in the region.

5.5 Summary

A study was undertaken in Darjiling District comprising of three hill sub-division namely Darjeeling, Kalimpong, Kurseong excluding duars and siliguri to document the utilization of fern and fern allies. The area is inhabited by three communities i.e. Bhutia, Lepcha, Nepali and each community has their own traditional way to utilize the natural resources. Numerous field trips in the forest village, local market (Hatt) were undertaken with questionnaires prepared to interview the village head and local healers. The answer to the questionnaires and photographs were taken which revealed darjiling hills has rich traditional knowledge where people utilize Fern and fern-allies from the surrounding area for day to day purposes. In this survey, it was found that 40 species of fern and fern allies are used by people for different purposes and they have been categorized as Medicinal fern, Edible ferns, Cattle bed ferns and ornamental ferns. It was found that eleven species were used as medicinal ferns and young crozier of sixteen species was utilized as vegetable which fall under the category of edible fern from the genus *Diplazium*, *Deparia* and *Cyathea*. Four species of ferns were utilized as cattle bed fern (Sottar) for domesticated animals and nine species of fern were used for ornamental and decorative purposes.

References

- Smith, A. R., Kathleen, M. P., Eric, S., Petra, K., Harald, S., Paul, G.W. 2006. A classification of extant ferns. *Taxon* **55** (3): 705–731.
- Acharya, K. & Acharya, R. 2001. Cyathus and Geastrum-An addition to Darjeeling mycoflora. *The Indian Forester*, 127:959-952.
- Alston, A.H.G. 1945. An Enumeration of Indian Species of *Selaginella*. *Proc. Natn. Inst. Sci. India* IIB 11(3):211-235.
- Ambashat, R.S and Ambhasat, N.K. 1995. *A Text Book of Plant Ecology*, Student's Friend and Co. Lanka, Varanasi, India.
- Anderson, T. (1832-1870). *Dictionary of National Biography* 1. London: Smith, Elder & Co.
- Anderson, T. 1868. An enumeration of the Plants of Sikkim. *J. Linn. Soc.* 11:4-14.
- Anderson, T. 1871. An enumeration of the Palms of Sikkim-Tibet Frontier. *Kew Bull.* 297-315.
- Barcelona, J.F., Ranil, R.H.G., Park, C.H., Murakami, N. and Hoyo, A. 2012. Rare and Threatened Pteridophytes of Asia 1. An Enumeration of Narrowly Distributed Taxa. *Bull. Natl. Mus. Nat. Sci.*, Ser. B, 38(3): 93–119.
- Beddome, R. H. 1865-1870. The Ferns of British India. 1-120 (1865), 121-150 (1866); 2: 151-210 (1866), 211-255(1867); 256-300 (1868), 301-330(1869), 331-345 (1870). Ghant Brothers Madras. Reprinted in combined Volume.
- Beddome, R. H. 1883. Handbook to the Ferns of British India: Ceylon and the Malay Peninsula; With Supplement. Thacker, Spink, and Co., Calcutta, India.
- Bhujel, R.B., Tamang, K.K. and Yonzon, G.S. 1984. Edible wild plants of Darjeeling district. *Jour. Beng. Nat. Hist. Soc.* 4(2):150-152.
- Bhujel, R.B., Tamang, K.K. and Yonzon, G.S. 1984. Poisonous plants of Darjeeling district. *Journ. Him. Res dev. Nainital, India.* 31-34.

Bhujel, R.B. 1996. *Studies on the Dicotyledonous Flora of Darjeeling district*, Ph.D. Thesis, University of North Bengal.

Burkill, I. H. 1925. The botany of Abor expedition. *Rec. Bot. Surv. India*, 10, pp. 227-228.

Burkill, I. H. 1965. *Chapters in India on the history of botany*. Calcutta, Botanical Survey of India.

Champion, H.G. and Seth, S.K. 1968. *A revised survey of Forest types of India*. Manager of Publications, Govt. of India, Delhi.

Chandra, S and Fraser-Jenkins, C. R. 2008. Threatened Pteridophytes of India. In: S.C. Verma, S.P. Khullar & H.K. Cheema (Eds.): *Perspectives in Pteridophytes*, pp 207-233. Bishen Singh Mahendra Pal Singh, Dehradun, India.

Chandra, S. 1982. Checklist of ferns endemic to India, *Nova Hedwigia* 36: 241-247.

Chandra, S. 1998. Endemic Pteridophytes of India: A Review, *J. Econ. Tax. Bot.* 22: 157-172.

Chandra, S. 2000. *The ferns of India (Enumeration, Synonyms & Distribution)*. International Book Distributors, DehraDun, India. 459pp.

Chatterjee, D. 1939. Studies on the Endemic flora of India and Burma. *Journal of Asiat. Soc. Beng. Sci.*, 5(1): 19-68.

Champion, H.G. 1936. A preliminary survey of forest types of India and Burma. *Ind. For. Rec. Ser. 2. Silviculture* 1(1): 10286.

Chettri, D.R., Basnet, D., Chiu, P.F., Kalikotay, S., Chettri, G. & Parajuli, S. 2005. Current status of ethnomedicinal Plants in the Darjiling Himalaya. *Curr. Sci.* 89 (2), 264-268.

- Ching, R. C. 1930- 1958. *Icones Filicum Sinicarum*. 1: 1-50 (1930) 2: 51-101 (1934) 3: 101-150 (1935) 4: 151-200(1937)5: 201-250 (1958).
- Ching, R. C. 1931a. A revision of the genus *Tectaria* from China and Sikkim Himalaya. *Sunyatsenia* 2: 9-36.
- Ching, R. C. 1931b. The studies of Chinese ferns VI. The genus *Vittaria* in China and Sikkim, E. Himalaya. *Sinensia* 1:175-192.
- Chowdhury,N.P. 1973.Notes on some Indian species of *Lycopodium* with remarks on distribution of the genus in India.*Trans.Nat.Inst.Sci.India*,1:187-226.
- Clarke,C.B.1876. Botanic notes from Darjeeling to Tonglo. *J.Linn. Soc. Bot.* 15:116-159.
- Clarke,C.B.1880.A review of the ferns of Northern India. *Trans. Linn. Soc.Lond.II Bot.*1:425-619.
- Cowan,A.M and Cowan,J.M.1929. *The Tress of North Bengl including shrubs,woody climbers, bamboss,palms and tree ferns*.Bengal secretariat Book Depot.Calcutta.
- Chauhan,A.S.1996.Phytogeographic division of North Eastern India and North Bengal.*Flora of India* (Introductory volume)pp.251-294.Botanical Survey of India,Calcutta.
- Das, A.P. & Lahiri,A.k.1997.Phytosociological studies on the ground covering flora in different types of vegetation in Tiger Hill,Darjeeling district, westBengal (India).*Indian For.*123(12):1176-1187.
- Das, A.P. 1995. Diversity of the Angiospermic flora of Darjeeling Hills. In A.K. Pandey(ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118 – 127.
- Das, A.P. 2004.Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 46(1-4): 1 – 18.
- Dash, A.J.1947.*Bengal District Gazetteers:Darjeeling*.Govt. of west Bengal, Calcutta.

- Dixit, R.D. 1984. *A CENSUS OF THE INDIAN PTERIDOPHYTES*. Bot. Surv. Of India IV. Howrah-711103.
- Dixit, R.D. 1987. *Lycopodiaceae of India*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Dixit, R.D. 1992. *SELAGINELLACEAE OF INDIA*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Don, D. 1825. *Prodromus Florae Nepalensis*: 1-256. Londinium. Reprinted 1976. Dehra Dun & New Delhi.
- Ebihara, A., Kato, M., Fraser-Jenkins, C.R., Parris, B.S.; Zhang, X.C., Yang, Y.H., Chohi, U.W., Chang, H.M., Lindsay, S., Middleton, D., Praptosuwiryo, T.N., Amoroso, V.B., Barcelona, J.F., Ranil, R.H.G., Park, C.H., Murakami, N. & Hoyo, A. Rare and Threatened Pteridophytes of Asia 1. An Enumeration of Narrowly Distributed. 2012. *Taxa. Bull. Natl. Mus. Nat. Sci.*, Ser. B, 38(3), pp. 93–119.
- Fraser-Jenkins, C.F. 2009. A BRIEF COMPARISON OF MODERN PTERIDOPHYTE CLASSIFICATIONS (FAMILIES AND GENERA IN INDIA). *Indian Fern J.* 26:107-126.
- Fraser-Jenkins, C.R. 2008. *Taxonomic revision of Three hundred Indian Subcontinental Pteridophytes with a revised census list*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Fraser-Jenkins, C.R., Kandel, D.R. & Pariyar, S. 2015. *Ferns and fern-allies of Nepal I* pp. 352. National Herbarium and Plant Laboratories, Dept. of Plant Resources, Ministry of Forests and Soil Conservation, Govt. of Nepal, Kathmandu, Nepal.
- Fraser-Jenkins, C.R. 1997. *New Species Syndrome in Indian Pteridology and The Ferns of Nepal*: 1-403. Dehra Dun.
- Gamble, G.S. 1875. Darjeeling Forests. *Indian Forester* 1:73-99.
- Gamble, J.S. 1896. *List of the Trees, Shrub and Large Climbers found in Darjeeling District, Bengal*. ed. 2. Calcutta.
- Gammie, G.A. 1893. Notes on Sikkim Tree Fern. *J. Linn. Soc. Bot.* 29:482-485.

Gammie, G. A. 1893. Botanical exploration of Sikkim- Tibet Frontier. 82/82:297–314.

Gaur, R.D. & Bhatt, B.P. 2007. Folk Utilization of some Pteridophytes of Deoprayag area in Garhwal Himalaya: India. Ethnobotanical Leaflets 11: 164-172.

Ghosh, S.R., Ghosh, B., Biswas, A. & Ghosh, R.K. 2004. The Pteridophytic flora of Eastern India. Vols. 1, Botanical Survey of India.

Grierson, A.J.C and Long, D.G. (ed.). *Flora of Bhutan*, Vol. 1, Pt. 1, RBG, Edinburgh.

Hara, H. 1971. *The Flora of Eastern Himalayas*, 2nd report, Pteridophyta, University of Tokyo, Japan. Pp. 453 –500.

Heim, A. and Ganseer, A. 1939. *Central Himalayas*. *Denshr. Schweiz. Natur. Gessell.*, 73(1).

Holub, J. 1975. *Diphasiastrum*, a new genus in Lycopodiaceae. *Preslia*, 47:97-110.

Hooker, J.D. 1872-1897. *The Flora of British India*. Vols 1-7. L. Reeve & co., Kent, London.

<http://darjeeling.gov.in/darj-hist.html>

<http://www.darjeelingnews.net>.

<http://www.darjeelingtimes.com/columns/hilman/291-excluded-and-partially-excluded-areas.html>.

http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=242341962

Ilokar, V.M. and Khatri, P.K. 2003. Phytosociological study of Navegaon National Park (Maharashtra). *Indian Forester*, 129:377-387.

Jain, S.K. & Rao, R.R. 1977. *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.

Kato, M. 1979. Taxonomic Study of the Genus *Cornopteris* (Athyriaceae). *Acta Phytotax. Geobot.* 30(4-6):101-118. Japan.

- Kholia, B.S. 2010. *Fern and Fern-allies of Sikkim. Part I*. pp.207. Sikkim state biodiversity board & Botanical survey of India.
- King, G and Pantling, R. The Orchids of Sikkim and Darjeeling Himalaya. *Annals of the Royal Botanic Garden, Calcutta* 8:1-342, tt. 1-448.
- Kumarpal, S. 2013. Study of Activity of Some Medicinal Ferns of Darjeeling. *International Journal of Scientific and Research Publications*. Vol 3(8).
- Lahiri, S. and Gangopadhyay, P.k. 1974. Structural pattern in rocks in Pankhabari-Tindharia region in Darjeeling District, West Bengal, with special reference to its bearing on stratigraphy. *Himalayan Geology*, 4:151-170.
- Lama, D. 2004. *Taxonomical Distributional and Ecological Studies of Acer L. (Aceraceae) in the Darjiling and Sikkim Himalayas*. Ph.D. Thesis, North Bengal University.
- Matthew, K.M. 1971. Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97 – 102.
- Mehra, P.N. & Bir, S.S. 1964. *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Mehra, P.N. 1939. Ferns of Mussoorie, *Publs. Panjab Univ.* **29**: 1-29. Lahore.
- Menhinick, E.F. 1964. A comparison of some species diversity indices applied to samples of field insects: *Ecology*, 45:858-862.
- Mirbel, C.F & Brisseau .D.E, 1802. Vols 3-5 in J.A.P. Lamarck & Brisseau de C.F. Mirbel, *Histoire Naturelle des vegetaux*, 15 vols. Paris: Deterville.
- Misra, R. 1969. *Ecology Work Book*, Oxford and I.B.H. Calcutta.
- Mukhopadhyay, M.K. and Gangopadhyay, P.K. 1971. Structural characteristics of rocks around Kalimpong, West Bengal. *Himalayan Geology*. 1:213-230.
- Myers, N. 1988. Threatened biotas: “Hotspots” in Tropical forests. *Environmentalist*, 8(3) :1-20

Nayar,B.K. and Pushpa,Lata.1965.Spore morphology of some African Fern-allies.*Pollen et Spores*,7(2):313-318.

Nayar,B.K.1962. Ferns of India-VI.Cheliantes. *Bull.Nat. Bot.Gard.* Lucknow 68:1-36.

Noltie,H.J.194-2000.Flora of Bhutan vol.3.Royal Botanic Garden. Edinburgh.

O'Malley, L.S.S. 1907 (Repr. 1999). *Bengal District GazetteersDarjiling.* Logos Press.New.

Ohashi,H.1975.*Flora Eastern Himalayas,3rd report-pteridophyta.* Univ. Tokyo Bull.no.8.,166-205.

Pal,S.K.2013. Study of antimicrobial activity of different plant parts of ferns. *Ind J Biol Stud Res . 2 (2):* 134-138.

Pal,S.K.2014. Study of Activity of some ethnomedicinal ferns of Darjeeling. *International Journal of Pharmacology Research.* 4(1):pp23-26.

Phillips,E.A.1959.*Methods of vegetation study.*Henry Holt and Co.Inc.New York,U.S.A.

Pothewde, M.S. and Saha, S.S.1982. Geology of the Darjeeling Himalaya, Himalayan Geology,*IB.GSI Misc.Pub.*41(11):50-54.

Puri,G.S.1960.*Forest Ecology.*Second Edition Vol.1,New Delhi.

Rai,S.2002. *Studies on the ethnobotany of Darjeeling Himalaya.*Ph.D Thesis,North Bengal University.

Rai,U.2006.*CHARACTERIZATION OF PLANTS BIODIVERSITY IN DARJILING HILLS USING REMOTE SENSING TECHNIQUES.*PH.D Thesis,North Bengal University.

Rai.P.C.2001. *Survey of the Flora of Neora Valley National Park in Darjeeling,*West Bengal.Ph.D Thesis, North Bengal University.

Rao,R.R . and Murti,S.K.1990.North-east India.A major center for plant diversity in India. *Indian Journal of Forestry*.22:12-23.

Rodger,W.A and Panwar,H.S.1998. *Biogeographical classification of India*.Willife Institute of India,Dehradun.

Samanta,A.K. and Das,A.P.1998. Notes on the distribution and conservation of Angiospermic climbers in Sikkim Himalaya.*Proc.State.Sci.Cong.*,N.B.U. Sarkar, S. and Margules,C.2002. Operationalizing biodiversity for conservation planning .*Journal of Bioscience(Suppl.2)*27(4):299-308.

Sen,T&Sen,U. 1978. Morphology,anatomy and taxonomy of Lycopodiaceae of the Darjeeling Himalayas.*Fern Gaz.*11(6):413-427,figs.1-5.

Shanon,C.E. and Weaver,W.1963.Mathematical theory of communication. University of Illinios Press , Illinos, U.S.A.

Simpson, E. H. 1949.Measurement of diversity. *Nature*, 163, 688.

Singh, S. & Panigrahi, G. 2004. *Fern and Fern-Allies of Arunachal Pradesh*, Bishen Singh Mahendra Pal Singh, Dehra Dun ,India.

Takhtajan,A.1969.*Flowering plants.Origin and Dispersal*.Edinburgh.

Thapa,N. 2002. *Pteridophytes of Nepal*. pp. 175. National Herbarium and Plant Laboratories, Godavary,Lalitpur,Nepal.

Thapa,N., Tamang,K., & Lama,D.2014.Occurence of *Botrychium dusenii* Alston[Botrychiaceae] in Darjiling Hills: a new record for the state of West Bengal,India.*Pleione* 8(1):214-216.

Thapa,N. & Lama,D.2015.Occurence of *Pteris austrosinica*(Ching)Ching [Pterideaceae] in Darjiling Hills. A new record of endemic Chinese element in Indian sub-continent. *Researcher* 7(5):36-38.

Thapa,N. & Lama,D.2015.Diversity and distribution of Lycopodiaceae P.Beauvois ex Mirbel in Darjiling hills,West Bengal.*Pleione* 9(2):348-335.

Thapa,N. & Lama,D.2016.Ethno-botany and Utilization of Fern and Fern-allies as Non Timber Forest Product in Darjiling Hills.*International Journal of Life Science*.5(2):120-123.

Thapa,N. & Lama,D.2016.Diversity and distribution of *Botrychium* Swartz (Ophioglossaceae) in Darjiling Hills, West Bengal,India.*Pleione* 10(1):1-7.

Watt, G. 1890.*Dictionary of the Commercial Products of India.Vol.1-10.* Calcutta and London.

Wilson,E.O.1992. *The Diversity of Life.*Allen Lane.The Penguin Press ,London.

Yonzone .R, Rai.S &Bhujel,R.B.2011.Genetic diversity of Ethnobotanical and Medicinal plants resources of Darjeeling district ,westbengal, India. Journ.Adv .in. Phar. Res.1-17.

APPENDIX A

Phytosociological table for the tree layers in different forest in Darjiling hills

Table 1: Tropical forest

Sl.No.	Name	Indiv	FQ	D/ha	BA/m ²	RF	RD	RDm	IVI
1	<i>Lagestromia parviflora</i> Roxburgh	6	20	7.5	0.420843	2.877698	1.948052	0.808085	5.633834
2	<i>Sterculia villosa</i> Smith	2	5	2.5	0.350835	0.719424	0.649351	0.673658	2.042434
3	<i>Shorea robusta</i> Gaertner.f.	89	80	111.25	28.71917	11.51079	28.8961	55.14528	95.55218
4	<i>Pinus roxburghii</i> Sargent	34	60	42.5	0.318218	8.633094	11.03896	0.611028	20.28308
5	<i>Amoora rohituka</i>	5	20	6.25	0.814638	2.877698	1.623377	1.564232	6.065306
6	<i>Tetrameles nudiflora</i>	1	5	1.25	0.050915	0.719424	0.324675	0.097764	1.141864
7	<i>Anthocephalus cadamba</i> Miquel	1	5	1.25	0.061607	0.719424	0.324675	0.118295	1.162395
8	<i>Zizyphus xylopyrus</i> Willdenow	4	20	5	0.477526	2.877698	1.298701	0.916924	5.093323
9	<i>Castanopsis armata</i> Spach	2	10	2.5	0.167263	1.438849	0.649351	0.321172	2.409371
10	<i>Tectona grandis</i> Linnaeus.f.	1	5	1.25	0.134447	0.719424	0.324675	0.258159	1.302259
11	<i>Schima wallichii</i> (D.C)Korthals	3	10	3.75	0.350835	1.438849	0.974026	0.673658	3.086533
12	<i>Michellia champaca</i> Linaeus	12	25	15	3.89817	3.597122	3.896104	7.485094	14.97832
13	<i>Machilus villosa</i> (Roxburgh)Hook.f.	1	5	1.25	0.114558	0.719424	0.324675	0.21997	1.26407
14	<i>Albizia procera</i> (Roxburgh)Bentham	1	5	1.25	0.024065	0.719424	0.324675	0.046209	1.090309
15	<i>Magnifera indiana</i> Linnaeus	1	5	1.25	0.134447	0.719424	0.324675	0.258159	1.302259
16	<i>Bridella sikkimensis</i> Gehrman	1	5	1.25	0.124304	0.719424	0.324675	0.238683	1.282783
17	<i>Ficus semicordata</i> Smith	1	5	1.25	0.155927	0.719424	0.324675	0.299404	1.343504
18	<i>Ficus cunia</i> Roxburgh	1	5	1.25	0.420843	0.719424	0.324675	0.808085	1.852184
19	<i>Bridella retusa</i> (Linnaeus)Sprengel	7	15	8.75	0.71599	2.158273	2.272727	1.374813	5.805814
20	<i>Terminalai bellirica</i> (Gaetner)Roxburgh	22	65	27.5	5.349244	9.352518	7.142857	10.27138	26.76676
21	<i>Terminalai alata</i> Roth	10	20	12.5	0.71599	2.877698	3.246753	1.374813	7.499264
22	<i>Bombax ceiba</i> Linnaeus	1	5	1.25	0.012729	0.719424	0.324675	0.024441	1.068541
23	<i>Terminalia chebula</i> Retzius	5	10	6.25	0.420843	1.438849	1.623377	0.808085	3.87031

24	<i>Phoebe sp</i>	4	10	5	0.257757	1.438849	1.298701	0.494933	3.232483
25	<i>Castanopsis hystrix</i> A.Dc	17	40	21.25	1.988862	5.755396	5.519481	3.818925	15.0938
26	<i>Litsea sp</i>	11	30	13.75	0.974543	4.316547	3.571429	1.871273	9.759249
27	<i>Rhus semialata</i> Murray	3	10	3.75	0.114558	1.438849	0.974026	0.21997	2.632845
28	<i>Acacia sp</i>	2	5	2.5	0.096261	0.719424	0.649351	0.184836	1.553611
29	<i>Mallotus philippensis</i> (Lamarck)Mueller	34	105	42.5	3.058075	15.10791	11.03896	5.87198	32.01885
30	<i>Bauhinia purpurea</i> Linnaeus	11	35	13.75	0.458234	5.035971	3.571429	0.87988	9.48728
31	<i>Albizia chinensis</i> (Osbeck)Merrill	9	25	11.25	0.91965	3.597122	2.922078	1.765871	8.285071
32	<i>Callicarpa arborea</i> Roxburgh	1	5	1.25	0.012729	0.719424	0.324675	0.024441	1.068541
33	<i>Dalbergia sericea</i> G.Don	1	5	1.25	0.02864	0.719424	0.324675	0.054993	1.099092
34	<i>Toona serrata</i> Royle	1	5	1.25	0.012729	0.719424	0.324675	0.024441	1.068541
35	<i>Casearia vareca</i> Roxburgh	3	10	3.75	0.20366	1.438849	0.974026	0.391058	2.803933
	Total	308	695	385	52.07911	100	100	100	300

Table 2: Sub-tropical forest

Sl.No.	Name	Indiv	FQ	D/ha	BA/m ²	RF	RD	RDm	IVI
1	<i>Ailanthus integrifolia</i> Lamarck	10	30	12.5	0.537788	2.752294	2.398082	0.910595	6.060971
2	<i>Albizia gamblei</i> Prain	13	35	16.25	0.71599	3.211009	3.117506	1.212331	7.540846
3	<i>Betula alnoides</i> D.Don	23	55	28.75	2.494829	5.045872	5.515588	4.224301	14.78576
4	<i>Bombax cebia</i> Linnaeus	3	10	3.75	0.497216	0.917431	0.719424	0.841897	2.478752
5	<i>Castanopsis indica</i> (Roxburgh)A.DC	13	20	16.25	2.151154	1.834862	3.117506	3.642382	8.59475
6	<i>Brassaiopsis mitis</i> Clarke	18	95	22.5	1.470963	8.715596	4.316547	2.490667	15.52281
7	<i>Chukrasia tabularis</i> Jussieu	37	75	46.25	16.72633	6.880734	8.872902	28.3214	44.07504
8	<i>Cinnamomum tamala</i> (Hamilton) Nees & Ebermaier	7	10	8.75	1.403341	0.917431	1.678657	2.376169	4.972257
9	<i>Cryptoperia japonica</i> (Linnaeus f.)D.Don	21	75	26.25	3.571201	6.880734	5.035971	6.046839	17.96354
10	<i>Cupressus cornyeana</i> Carriere	25	60	31.25	3.058075	5.504587	5.995204	5.178001	16.67779

11	<i>Dubanga grandiflora</i> (D.C)Walpers	11	60	13.75	2.676213	5.504587	2.63789	4.531425	12.6739
12	<i>Engelhardtia spicata</i> Blume	13	35	16.25	6.733492	3.211009	3.117506	11.4013	17.72982
13	<i>Eurya acuminata</i> DC.	31	95	38.75	1.071512	8.715596	7.434053	1.814308	17.96396
14	<i>Ficus nerifolia</i> J.E Smith	13	20	16.25	0.497216	1.834862	3.117506	0.841897	5.794265
15	<i>Ficus religiosa</i> Linnaeus	7	15	8.75	0.814638	1.376147	1.678657	1.379364	4.434167
16	<i>Gmelina arborea</i> Roxburgh	3	5	3.75	0.350835	0.458716	0.719424	0.594042	1.772182
17	<i>Leucosceptrum cannum</i> Smith	5	15	6.25	0.025576	1.376147	1.199041	0.043306	2.618493
18	<i>Macaranga denticulata</i> (Blume)Mueller	31	85	38.75	0.114558	7.798165	7.434053	0.193973	15.42619
19	<i>Magnifera indica</i> Linnaeus	21	40	26.25	0.720772	3.669725	5.035971	1.220427	9.926123
20	<i>Michelia doltsopa</i> DC.	9	10	11.25	0.327836	0.917431	2.158273	0.5551	3.630804
21	<i>Phyllanthus emblica</i> Linnaeus	17	45	21.25	0.350835	4.12844	4.076739	0.594042	8.799221
22	<i>Quercus griffithii</i> Miquel	13	25	16.25	0.814638	2.293578	3.117506	1.379364	6.790447
23	<i>Schima wallichii</i> (DC)Korthals	30	85	37.5	5.349244	7.798165	7.194245	9.057461	24.04987
24	<i>Tectona grandis</i> Linnaeus	20	45	25	5.349244	4.12844	4.796163	9.057461	17.98206
25	<i>Wrightia arborea</i> (Dennstaedt) Mabblerley	13	25	16.25	0.420843	2.293578	3.117506	0.712581	6.123665
26	<i>Cyathea brunoniana</i>	10	20	12.5	0.814638	1.834862	2.398082	1.379364	5.612307
	Total	417	1090	521.25	59.05898	100	100	100	300

Table 3: Temperate forest

Sl. No.	Name	Indiv	FQ	D/ha	BA/m ²	RF	RD	RDm	IVI
1	<i>Photina sp</i>	7	20	8.75	0.420843	1.746725	1.518438	0.669714	3.934877
2	<i>Quercus lamellosa</i> Smith	11	20	13.75	1.470963	1.746725	2.386117	2.340835	6.473677
3	<i>Quercus lineata</i> Bl.	26	55	32.5	2.151154	4.803493	5.639913	3.423265	13.86667
4	<i>Lithocarpus plachyphylla</i> (Kurz) Rehder	23	80	28.75	2.319809	6.9869	4.989154	3.691657	15.66771
5	<i>Symplocos theifolia</i> D. Don	13	40	16.25	0.350835	3.49345	2.819957	0.558306	6.871713
6	<i>Tsuga dumosa</i> (Don)Eichler	23	85	28.75	23.5354	7.423581	4.989154	37.45336	49.86609
7	<i>Maesa chisia</i> D. Don	2	10	2.5	0.064439	0.873362	0.433839	0.102546	1.409748

8	<i>Eurya acuminata</i> DC.	5	15	6.25	0.144988	1.310044	1.084599	0.230729	2.625371
9	<i>Rhododendron arboreum</i> Smith	9	25	11.25	0.601631	2.183406	1.952278	0.957413	5.093097
10	<i>Taxus baccata</i> Linnaeus	18	35	22.5	6.733492	3.056769	3.904555	10.71543	17.67675
11	<i>Prunus napaulensis</i> Schn.	3	15	3.75	0.257757	1.310044	0.650759	0.410184	2.370987
12	<i>Machillus edulis</i> Hook.f.	5	25	6.25	0.764519	2.183406	1.084599	1.216626	4.484631
13	<i>Gamblea ciliata</i> Clarke	5	15	6.25	0.814638	1.310044	1.084599	1.296384	3.691027
14	<i>Rhododendron grande</i> Wight	28	35	35	2.234686	3.056769	6.073753	3.556195	12.68672
15	<i>Acer campbelli</i> Hiern	3	10	3.75	0.050915	0.873362	0.650759	0.081024	1.605146
16	<i>Dodecadenia grandiflora</i> Nees	4	10	5	0.420843	0.873362	0.867679	0.669714	2.410756
17	<i>Alnus nepalensis</i> D.Don	23	75	28.75	2.151154	6.550218	4.989154	3.423265	14.96264
18	<i>Exbucklandia populnea</i> (Griffith)Brown	21	65	26.25	3.058075	5.676856	4.555315	4.866506	15.09868
19	<i>Michelia cathcartii</i> Hk.f& T.	11	35	13.75	0.814638	3.056769	2.386117	1.296384	6.73927
20	<i>Engelhardtia spicata</i> Bl.	21	45	26.25	1.403341	3.930131	4.555315	2.233225	10.71867
21	<i>Evodia fraxinifolia</i> HK.f.,	27	45	33.75	3.058075	3.930131	5.856833	4.866506	14.65347
22	<i>Eriobotrya petiolata</i> HK.f.	23	45	28.75	1.470963	3.930131	4.989154	2.340835	11.26012
23	<i>Magnollia campbelli</i> Hook.f. & Thomson	21	70	26.25	2.151154	6.113537	4.555315	3.423265	14.09212
24	<i>Viburnum erubescens</i> DC.	23	50	28.75	0.420843	4.366812	4.989154	0.669714	10.02568
25	<i>Cinnamomum caudatum</i> (Ness)Merrill	5	10	6.25	0.385044	0.873362	1.084599	0.612744	2.570705
26	<i>Daphne bhoola</i> D.Don	19	25	23.75	0.350835	2.183406	4.121475	0.558306	6.863187
27	<i>Macaranga pustulata</i> Hook.f.	21	75	26.25	0.385044	6.550218	4.555315	0.612744	11.71828
28	<i>Cryptomeria japonica</i> (L.f.)Don	33	60	41.25	3.571201	5.240175	7.158351	5.683076	18.0816
29	<i>Celtis tetrandia</i> Roxburgh	21	35	26.25	0.861106	3.056769	4.555315	1.370332	8.982415
30	<i>Cyathea spinulosa</i>	7	15	8.75	0.420843	1.310044	1.518438	0.669714	3.498196
	Total	461	1145	576.25	62.83923	100	100	100	300

Table 4:Sub -Alpine forest

Sl. No.	NAME	Indiv	FQ	D/ha	BA/m ²	RF	RD	RDm	IVI
1	<i>Acer cambelli</i> Hiern	4	12.5	5	0.350835	2.484472	0.729927	0.732925	3.947324
2	<i>Dodecadenia grandiflora</i> Ness	1	3.125	1.25	0.050915	0.621118	0.182482	0.106366	0.909965
3	<i>Betuala utilis</i> Don	9	25	11.25	0.814638	4.968944	1.642336	1.701849	8.313129
4	<i>Rhododendron arboreum</i> Smith	169	81.25	211.25	7.485282	16.14907	30.83942	15.6374	62.62588
5	<i>Rhododendron falconeri</i> Hooker	179	90.625	223.75	20.87828	18.01242	32.66423	43.61653	94.29319
6	<i>Symplocos glomerata</i> Clarke	25	28.125	31.25	1.272872	5.590062	4.562044	2.659139	12.81125
7	<i>Photina</i> sp	1	3.125	1.25	0.045951	0.621118	0.182482	0.095995	0.899595
8	<i>Sorbus cupsidata</i> (Spanch)Hedl	4	6.25	5	0.623707	1.242236	0.729927	1.302978	3.275141
9	<i>Taxus baccata</i> Linnaeus	2	6.25	2.5	0.171909	1.242236	0.364964	0.359133	1.966333
10	<i>Rhododendron barbaratum</i>	40	62.5	50	1.403341	12.42236	7.29927	2.931701	22.65333
11	<i>Rhododendron campanulatum</i>	33	46.875	41.25	1.403341	9.31677	6.021898	2.931701	18.27037
12	<i>Magnolia campbelli</i> Hook.f. & Thomson	11	15.625	13.75	0.814638	3.10559	2.007299	1.701849	6.814738
13	<i>Tsuga dumosa</i> (D.Don)Eichler	23	18.75	28.75	4.239459	3.726708	4.19708	8.856595	16.78038
14	<i>Lyonia ovalifolia</i> (Wallich)Drude	21	40.625	26.25	0.814638	8.074534	3.832117	1.701849	13.6085
15	<i>Acer sikkimensis</i> Miq.	11	28.125	13.75	0.764519	5.590062	2.007299	1.597145	9.194507
16	<i>Abies densa</i> Miller	15	34.375	18.75	6.733492	6.832298	2.737226	14.06685	23.63637
	Total	548	503.125	685	47.86782	100	100	100	300

APPENDIX B

Phytosociological table for the Shrub layers in different forest in Darjiling hills.

Table1: Tropical forest

Sl. No.	Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Desmodium laxiflorum</i> DC	7	3.75	0.0035	2.333333	0.47619	0.7	3.228337	4.404528

2	<i>Phyllanthus emblica</i> Linnaeus	67	61.25	0.0335	1.367347	7.777778	6.7	1.891824	16.3696
3	<i>Smilax lanceifolia</i> Roxburgh	21	16.25	0.0105	1.615385	2.063492	2.1	2.235003	6.398495
4	<i>Thysanolaena maxima</i> (Roxburgh)Kuntze	31	28.75	0.0155	1.347826	3.650794	3.1	1.864816	8.61561
5	<i>Acacia sp</i>	21	6.25	0.0105	4.2	0.793651	2.1	5.811007	8.704658
6	<i>Eupatorium odoratum</i> Linnaeus	91	83.75	0.0455	1.358209	10.63492	9.1	1.879181	21.6141
7	<i>Shorea robusta</i> Gaertner f.	21	22.5	0.0105	1.166667	2.857143	2.1	1.614169	6.571311
8	<i>Croton caudatus</i> Geiseier	33	21.25	0.0165	1.941176	2.698413	3.3	2.68576	8.684172
9	<i>Maesa chisa</i> D.Don	13	6.25	0.0065	2.6	0.793651	1.3	3.59729	5.690941
10	<i>Clerodendron viscosum</i> Ventennat	131	87.5	0.0655	1.871429	11.111111	13.1	2.589258	26.80037
11	<i>Artemisia indica</i> Willdenow	21	16.25	0.0105	1.615385	2.063492	2.1	2.235003	6.398495
12	<i>Tinospora sp</i>	23	15	0.0115	1.916667	1.904762	2.3	2.651848	6.85661
13	<i>Asparagus sp</i>	21	8.75	0.0105	3	1.111111	2.1	4.150719	7.36183
14	<i>Stenochleana palustris</i>	5	2.5	0.0025	2.5	0.31746	0.5	3.458933	4.276393
15	<i>Heynea trijuga</i> Sims	21	16.25	0.0105	1.615385	2.063492	2.1	2.235003	6.398495
16	<i>Strobilanthus sp</i>	7	3.75	0.0035	2.333333	0.47619	0.7	3.228337	4.404528
17	<i>Urena lobata</i> Linnaeus	24	20	0.012	1.5	2.539683	2.4	2.07536	7.015042
18	<i>Flemingia sp</i>	5	2.5	0.0025	2.5	0.31746	0.5	3.458933	4.276393
19	<i>Litsea monopetala</i> (Roxburgh)Persoon	7	5	0.0035	1.75	0.634921	0.7	2.421253	3.756174
20	<i>Leea alata</i> Edgeworth	5	2.5	0.0025	2.5	0.31746	0.5	3.458933	4.276393
21	<i>Morinda sp</i>	64	58.75	0.032	1.361702	7.460317	6.4	1.884014	15.74433
22	<i>Mikania micrantha</i> Kunth	81	80	0.0405	1.265625	10.15873	8.1	1.751085	20.00981
23	<i>Piper sp</i>	67	53.75	0.0335	1.55814	6.825397	6.7	2.1558	15.6812
24	<i>Cestrum aruntiaceum</i> Lindley	7	6.25	0.0035	1.4	0.793651	0.7	1.937002	3.430653
25	<i>Calamus erectus</i> Roxburgh	21	18.75	0.0105	1.4	2.380952	2.1	1.937002	6.417955
26	<i>Coffea benglensis</i> Schutles	31	23.75	0.0155	1.631579	3.015873	3.1	2.257409	8.373282
27	<i>Malotus philippensis</i> (Lamarck)Mueller	21	15	0.0105	1.75	1.904762	2.1	2.421253	6.426015
28	<i>Mucuna macrocarpa</i> Wallich	13	8.75	0.0065	1.857143	1.111111	1.3	2.569493	4.980604
29	<i>Tylophora sp</i>	31	31.25	0.0155	1.24	3.968254	3.1	1.715631	8.783885

30	<i>Bauhinia vahlii</i> Wight & Arnott	10	3.75	0.005	3.333333	0.47619	1	4.61191	6.088101
31	<i>Acacia pennata</i> (Linnaeus) Willdenow	5	2.5	0.0025	2.5	0.31746	0.5	3.458933	4.276393
32	<i>Sida acuta</i> Burman f.	6	3.75	0.003	2	0.47619	0.6	2.767146	3.843337
33	<i>Solanum torvum</i> Swartz	5	5	0.0025	1.25	0.634921	0.5	1.729466	2.864387
34	<i>Mimosa himalayana</i> Gamble	3	1.25	0.0015	3	0.15873	0.3	4.150719	4.609449
35	<i>Celtis tetrandra</i> Roxburgh	2	1.25	0.001	2	0.15873	0.2	2.767146	3.125876
36	<i>Woodfordia fruticosa</i> (Linnaeus)Kurz	1	1.25	0.0005	1	0.15873	0.1	1.383573	1.642303
37	<i>Quercus glauca</i> Thunberg	1	1.25	0.0005	1	0.15873	0.1	1.383573	1.642303
38	<i>Dioscorea sp</i>	56	41.25	0.028	1.69697	5.238095	5.6	2.347882	13.18598
	Total	1000	787.5	0.5	72.27663	100	100	100	300

Table 2:Sub-tropical forest .

Sl.No.	Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Aconogonum molle</i> (D.Don)Hara	80	56.25	0.04	1.777778	3.385012	5.669738	2.402435	11.45719
2	<i>Argyreia hookeri</i> Clarke	21	42.85714	0.0105	2.333333	2.579057	1.488306	3.153196	7.220559
3	<i>Artemisia dubia</i> Besser	41	75.60976	0.0205	1.322581	4.550043	2.905741	1.787296	9.24308
4	<i>Bambusa nutans</i>	45	77.77778	0.0225	1.285714	4.680511	3.189227	1.737475	9.607214
5	<i>Cassia floribunda</i> Cavanilles	21	80.95238	0.0105	1.235294	4.871552	1.488306	1.669339	8.029197
6	<i>Desmodium heterocarpon</i> (Linnaeus)DC	12	33.33333	0.006	3	2.005933	0.850461	4.054109	6.910503
7	<i>Dioscorea hispida</i> Dennstedt	125	32	0.0625	3.125	1.925696	8.858965	4.223031	15.00769
8	<i>Eupatorium adenophorum</i> Sprengel	130	33.07692	0.065	3.023256	1.990503	9.213324	4.085537	15.28936
9	<i>Eupatorium odoratum</i> Linnaeus	45	55.55556	0.0225	1.8	3.343222	3.189227	2.432466	8.964915
10	<i>Fleminga stricta</i> Roxburgh	13	53.84615	0.0065	1.857143	3.240354	0.921332	2.509687	6.671373
11	<i>Lantana camara</i> Linnaeus	101	86.13861	0.0505	1.16092	5.183649	7.158044	1.568832	13.91052
12	<i>Maesa macrophylla</i> (Wallich)A.DC	21	66.66667	0.0105	1.5	4.011866	1.488306	2.027055	7.527227
13	<i>Melastoma malabathricum</i> Linnaeus	34	67.64706	0.017	1.478261	4.070864	2.409639	1.997677	8.47818

14	<i>Mikania micrantha</i> Kunth	101	61.38614	0.0505	1.629032	3.694095	7.158044	2.201425	13.05356
15	<i>Mussaendra roxburghii</i> Hoof.f.	14	42.85714	0.007	2.333333	2.579057	0.992204	3.153196	6.724457
16	<i>Phlogacanthus thyriformis</i> (Hardwicke)Mabberley	8	37.5	0.004	2.666667	2.256675	0.566974	3.603653	6.427301
17	<i>Smilax ovalifolia</i> Roxburgh	81	50.61728	0.0405	1.97561	3.046047	5.740609	2.669779	11.45644
18	<i>Solanum torvum</i> Swartz	56	62.5	0.028	1.6	3.761125	3.968816	2.162192	9.892133
19	<i>Stephania japonica</i> (Thunberg)Miers	36	72.22222	0.018	1.384615	4.346188	2.551382	1.871127	8.768698
20	<i>Thunbergia fragrans</i> Roxburgh	32	71.875	0.016	1.391304	4.325293	2.267895	1.880167	8.473355
21	<i>Tithonia diversifolia</i> (Hemsley)A.Gray	65	52.30769	0.0325	1.911765	3.147772	4.606662	2.583501	10.33794
22	<i>Croton caudatus</i> Geiseler	31	29.03226	0.0155	3.444444	1.747103	2.197023	4.654718	8.598845
23	<i>Calamus erectus</i> Roxburgh	46	54.34783	0.023	1.84	3.270543	3.260099	2.48652	9.017163
24	<i>Elatostema liniolatum</i> Wight	45	46.66667	0.0225	2.142857	2.808306	3.189227	2.895792	8.893326
25	<i>Bridelia retusa</i> (Linnaeus)Sprengel	45	6.666667	0.0225	15	0.401187	3.189227	20.27055	23.86096
26	<i>Strobilanthes</i> sp	15	53.33333	0.0075	1.875	3.209493	1.063076	2.533818	6.806387
27	<i>Rubus</i> sp	17	52.94118	0.0085	1.888889	3.185894	1.204819	2.552587	6.9433
28	<i>Mallotus philippensis</i> (Lamarck)Mueller	31	67.74194	0.0155	1.47619	4.076574	2.197023	1.994879	8.268476
29	<i>Camelia sinensis</i> Linnaeus	13	46.15385	0.0065	2.166667	2.777446	0.921332	2.927968	6.626746
30	<i>Hedychium</i> sp	35	42.85714	0.0175	2.333333	2.579057	2.48051	3.153196	8.212763
31	<i>Lygodium japonicum</i>	51	49.01961	0.0255	2.04	2.949902	3.614458	2.756794	9.321154
	Total	1411	1661.737	0.7055	73.99899	100	100	100	300

Table 3: Temperate forest

Sl. No.	Name	Indiv	FQ	D/M ²	AB	RF	RD	RA	IVI
1	<i>Arundinaria racemosa</i> Munro	876	68.75	0.438	15.92727	10.67961	35.52311	12.76666	58.96938
2	<i>Zanthoxylum budrunga</i> (Roxburgh)DC	53	26.25	0.0265	2.52381	4.07767	2.14923	2.022984	8.249883

3	<i>Smilax ferox</i> wallich ex Kunth	39	12.5	0.0195	3.9	1.941748	1.581509	3.126082	6.649338
4	<i>Lithocarpus plachyphylla</i> (Kurz) Rehder	33	10	0.0165	4.125	1.553398	1.3382	3.306433	6.198031
5	<i>Urena lobata</i> Linnaeus	10	2.5	0.005	5	0.38835	0.405515	4.007798	4.801662
6	<i>Melastoma normale</i> D. Don	25	11.25	0.0125	2.777778	1.747573	1.013788	2.226554	4.987915
7	<i>Mahonia nepaulensis</i> (Linnaeus)Roth	5	5	0.0025	1.25	0.776699	0.202758	1.001949	1.981406
8	<i>Rubus niveus</i> Thunberg	20	7.5	0.01	3.333333	1.165049	0.81103	2.671865	4.647944
9	<i>Dichroa febrifuga</i> Loureiro	20	8.75	0.01	2.857143	1.359223	0.81103	2.29017	4.460423
10	<i>Rhododendron arboreum</i> Smith	11	6.25	0.0055	2.2	0.970874	0.446067	1.763431	3.180371
11	<i>Rubus moluccanus</i> Linnaeus	25	10	0.0125	3.125	1.553398	1.013788	2.504873	5.072059
12	<i>Rubus ellipticus</i> Smith	33	13.75	0.0165	3	2.135922	1.3382	2.404679	5.8788
13	<i>Rubus thomsonii</i> Focke	19	8.75	0.0095	2.714286	1.359223	0.770479	2.175662	4.305363
14	<i>Smilax rigida</i> Wallich ex Kunth	219	38.75	0.1095	7.064516	6.019417	8.880779	5.66263	20.56283
15	<i>Symplocos theifolia</i>	139	36.25	0.0695	4.793103	5.631068	5.636659	3.841958	15.10968
16	<i>Symplocos glomerata</i>	107	22.5	0.0535	5.944444	3.495146	4.339011	4.764826	12.59898
17	<i>Strobilanthus sp</i>	14	6.25	0.007	2.8	0.970874	0.567721	2.244367	3.782961
18	<i>Litsea elongata</i> (Ness)Hook.f.	7	3.75	0.0035	2.333333	0.582524	0.283861	1.870306	2.73669
19	<i>Urtica dioica</i> Linnaeus	59	20	0.0295	3.6875	3.106796	2.392539	2.955751	8.455085
20	<i>Tsuga dumosa</i> (Don)Eichler	29	5	0.0145	7.25	0.776699	1.175994	5.811306	7.763999
21	<i>Berberis angulosa</i> Hook.f. & Thompson	51	15	0.0255	4.25	2.330097	2.068127	3.406628	7.804852
22	<i>Flemingia sp</i>	5	2.5	0.0025	2.5	0.38835	0.202758	2.003899	2.595006
23	<i>Eupatorium odoratum</i> Linnaeus	2	1.25	0.001	2	0.194175	0.081103	1.603119	1.878397
24	<i>Viburnum erubescens</i> DC	3	2.5	0.0015	1.5	0.38835	0.121655	1.202339	1.712343
25	<i>Ilex sp</i>	3	2.5	0.0015	1.5	0.38835	0.121655	1.202339	1.712343
26	<i>Rhododendron grandis</i> Wight	17	7.5	0.0085	2.833333	1.165049	0.689376	2.271085	4.125509
27	<i>Hypericum sp</i>	6	3.75	0.003	2	0.582524	0.243309	1.603119	2.428952
28	<i>Cestrum sp</i>	6	2.5	0.003	3	0.38835	0.243309	2.404679	3.036337
29	<i>Eurya acuminata</i> DC	21	18.75	0.0105	1.4	2.912621	0.851582	1.122183	4.886386

30	<i>Pilea scripta</i> (Don)Weddell	43	21.25	0.0215	2.529412	3.300971	1.743715	2.027474	7.072159
31	<i>Acer campbelli</i> Hiern	56	53.75	0.028	1.302326	8.349515	2.270884	1.043891	11.66429
32	<i>Symlocus caudata</i> G.Don	45	36.25	0.0225	1.551724	5.631068	1.824818	1.243799	8.699685
33	<i>Smilax minutiflora</i> A.DC	351	83.75	0.1755	5.238806	13.00971	14.23358	4.199215	31.4425
34	<i>Symplocus phyllocalyx</i> Clarke	56	33.75	0.028	2.074074	5.242718	2.270884	1.662494	9.176096
35	<i>Lonicera hispida</i> Willdenow	33	13.75	0.0165	3	2.135922	1.3382	2.404679	5.8788
36	<i>Osbeckia chinensis</i> Linnaeus	25	21.25	0.0125	1.470588	3.300971	1.013788	1.178764	5.493522
	Total	2466	643.75	1.233	124.7568	100	100	99.99999	300

Table 4: Sub alpine forest

Sl.No.	Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Rhododendron lepidotum</i> Wallich ex G.Don	65	63.75	0.0325	1.27451	10.22044	9.530792	6.667433	26.41867
2	<i>Aconogonon molle</i> (Meisner)Reichenbach	32	30	0.016	1.333333	4.809619	4.692082	6.975161	16.47686
3	<i>Arundinaria racemosa</i> Munro	108	88.75	0.054	1.521127	14.22846	15.83578	7.957578	38.02181
4	<i>Daphne bholua</i> D.Don	37	38.75	0.0185	1.193548	6.212425	5.42522	6.243894	17.88154
5	<i>Paris sp</i>	33	32.5	0.0165	1.269231	5.210421	4.83871	6.639816	16.68895
6	<i>Rubus thomsonii</i> Focke	26	23.75	0.013	1.368421	3.807615	3.812317	7.158717	14.77865
7	<i>Rhododendron arboreum</i> Smith	40	41.25	0.02	1.212121	6.613226	5.865103	6.341055	18.81938
8	<i>Rhododendron falconeri</i> Hooker	24	20	0.012	1.5	3.206413	3.519062	7.847056	14.57253
9	<i>Hypericum sp</i>	43	30	0.0215	1.791667	4.809619	6.304985	9.372872	20.48748
10	<i>Vacciniumretusum</i> (Griffith)Hook.f.	74	66.25	0.037	1.396226	10.62124	10.85044	7.304178	28.77586
11	<i>Berberis wallichiana</i> DC	91	83.75	0.0455	1.358209	13.42685	13.34311	7.105294	33.87526
12	<i>Smilax rigida</i> Wallich ex Kunth	67	63.75	0.0335	1.313725	10.22044	9.824047	6.872585	26.91707
13	<i>Cirsum sp</i>	12	11.25	0.006	1.333333	1.803607	1.759531	6.975161	10.5383

14	<i>Rosa laevigata</i> Michx	30	30	0.015	1.25	4.809619	4.398827	6.539213	15.74766
	Total	682	623.75	0.341	19.11545	100	100	100	300

APPENDIX C

Phytosociological table for Herbaceous layers in different forest in Darjiling hills

Table 1: Tropical forest

Sl. No.	Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Commelina sikkimensis</i> C.B Clarke	37	20	0.37	1.85	3.355705	3.000811	1.92083	8.277346
2	<i>Commelina suffruticosa</i> Blume	31	15	0.31	2.066667	2.516779	2.514193	2.145792	7.176764
3	<i>Nephrolepis cordifolia</i> Linnaeus	111	55	1.11	2.018182	9.228188	9.002433	2.095451	20.32607
4	<i>Drynaria coronans</i> (Wallich Ex Mettinus)T.Moore	12	9	0.12	1.333333	1.510067	0.973236	1.384382	3.867685
5	<i>Costus speciosus</i> (J.Koenig)Smith	13	4	0.13	3.25	0.671141	1.054339	3.374431	5.099911
6	<i>Cyanotis sp</i>	91	35	0.91	2.6	5.872483	7.380373	2.699545	15.9524
7	<i>Curcuma aromatica</i> Salisbury	6	2	0.06	3	0.33557	0.486618	3.11486	3.937048
8	<i>Pandanus nepalensis</i> St John	13	7	0.13	1.857143	1.174497	1.054339	1.928247	4.157082
9	<i>Elahoglossum stelligerum</i> (Wallich ex Baker)Moore	31	13	0.31	2.384615	2.181208	2.514193	2.475914	7.171315
10	<i>Diplazium esculentum</i> (retzius)Swartz	21	9	0.21	2.333333	1.510067	1.703163	2.422669	5.635899
11	<i>Eupatorium odoratum</i> Linnaeus	67	31	0.67	2.16129	5.201342	5.433901	2.244039	12.87928
12	<i>Cucruligo orchioides</i> Gaertner	21	8	0.21	2.625	1.342282	1.703163	2.725502	5.770947
13	<i>Carex stramentitia</i> Boott ex Boeckeler	34	17	0.34	2	2.852349	2.757502	2.076573	7.686424
14	<i>Adenostemma lavenia</i> (Linnaeus)Kuntze	21	14	0.21	1.5	2.348993	1.703163	1.55743	5.609586
15	<i>Strobilanthus capitata</i> (nees)Anderson	23	13	0.23	1.769231	2.181208	1.865369	1.836969	5.883546
16	<i>Pteris biaurita</i> Linnaeus	37	20	0.37	1.85	3.355705	3.000811	1.92083	8.277346
17	<i>Dioscorea pubera</i> Blume	34	9	0.34	3.777778	1.510067	2.757502	3.922416	8.189985
18	<i>Fleminga sp</i>	23	13	0.23	1.769231	2.181208	1.865369	1.836969	5.883546

19	<i>Polygala crotalarioides</i> DC	25	15	0.25	1.666667	2.516779	2.027575	1.730478	6.274831
20	<i>Liparis</i> sp	10	3	0.1	3.333333	0.503356	0.81103	3.460955	4.775341
21	<i>Tectaria polymorpha</i> (Wallich ex Hooker)Copeland	15	6	0.15	2.5	1.006711	1.216545	2.595717	4.818973
22	<i>Stephania japonica</i> (Thunberg)Miers	2	1	0.02	2	0.167785	0.162206	2.076573	2.406564
23	<i>Dryopteris marginata</i> (Clarke)Christ	20	7	0.2	2.857143	1.174497	1.62206	2.966533	5.76309
24	<i>Zeuxine</i> sp	34	19	0.34	1.789474	3.187919	2.757502	1.857987	7.803408
25	<i>Thelypteris pyrrorhachis</i> (Kunze)Nayar & Kaur	35	20	0.35	1.75	3.355705	2.838605	1.817002	8.011311
26	<i>Tylophora</i> sp	41	17	0.41	2.411765	2.852349	3.325223	2.504103	8.681675
27	<i>Bolbitis heteroclita</i> (Pr.)Ching	34	20	0.34	1.7	3.355705	2.757502	1.765087	7.878294
28	<i>Ageratum conyzoides</i> Linnaeus	91	45	0.91	2.022222	7.550336	7.380373	2.099646	17.03035
29	<i>Vigna pillosa</i> (willdenow)Baker	32	21	0.32	1.52381	3.52349	2.595296	1.582151	7.700937
30	<i>Urena lobata</i> Linnaeus	21	13	0.21	1.615385	2.181208	1.703163	1.677232	5.561603
31	<i>Cyperus cyperoides</i> (Retzius)Kuntze	86	40	0.86	2.15	6.711409	6.974858	2.232316	15.91858
32	<i>Alpinia nigra</i> (Gaertner)B.L Burt	12	8	0.12	1.5	1.342282	0.973236	1.55743	3.872948
33	<i>Butea parviflora</i> Roxburgh	11	7	0.11	1.571429	1.174497	0.892133	1.631593	3.698223
34	<i>Crotalaria albida</i> Roth	21	9	0.21	2.333333	1.510067	1.703163	2.422669	5.635899
35	<i>Leea aequata</i> Linnaeus	3	1	0.03	3	0.167785	0.243309	3.11486	3.525954
36	<i>Digitaria ciliaris</i> (Retzius)Koel	13	5	0.13	2.6	0.838926	1.054339	2.699545	4.59281
37	<i>Saccharum arundinaceum</i> Retzius	17	4	0.17	4.25	0.671141	1.378751	4.412718	6.46261
38	<i>Hedychium</i> sp	11	5	0.11	2.2	0.838926	0.892133	2.284231	4.01529
39	<i>Curculigo capitulata</i> (Loureiro)Kuntze	1	1	0.01	1	0.167785	0.081103	1.038287	1.287175
40	<i>Chloris gayana</i> Kunth	5	2	0.05	2.5	0.33557	0.405515	2.595717	3.336802
41	<i>Argyria roxburghii</i> Choisy	4	3	0.04	1.333333	0.503356	0.324412	1.384382	2.21215
42	<i>Vermonia cinerea</i> (Linnaeus)Less	18	9	0.18	2	1.510067	1.459854	2.076573	5.046494
43	<i>Vermonia attenuata</i> DC	10	4	0.1	2.5	0.671141	0.81103	2.595717	4.077887
44	<i>Pteris venusta</i> Kunze	35	17	0.35	2.058824	2.852349	2.838605	2.137649	7.828603
	Total	1233	596	12.33	96.31252	100	100	100	300

Table 2:Sub tropical Forest

Sl.No.	Plant Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Aeschynanthus hookeri</i> C.B Clarke	23	10	0.23	2.3	0.953289	1.325648	2.98492	5.263857
2	<i>Ageratum houstonianum</i> Miller	170	80	1.7	2.125	7.626311	9.798271	2.757807	20.18239
3	<i>Begonia</i> sp	23	11	0.23	2.090909	1.048618	1.325648	2.713564	5.08783
4	<i>Bidens pilosa</i> Linnaeus	45	12	0.45	3.75	1.143947	2.59366	4.866717	8.604324
5	<i>Boehmaria</i> sp	21	9	0.21	2.333333	0.85796	1.210375	3.02818	5.096514
6	<i>Costus speciosus</i> (Koenig) Smith	33	13	0.33	2.538462	1.239276	1.902017	3.294393	6.435686
7	<i>Cyperus cyperoides</i> (Bentham)Moore	89	70	0.89	1.271429	6.673022	5.129683	1.650049	13.45275
8	<i>Drymaria cordata</i> (Linnaeus) Roemer & Schultes	34	10	0.34	3.4	0.953289	1.959654	4.412491	7.325434
9	<i>Drynaria coronans</i> (Wallich ex Mettinus) T.Moore	44	23	0.44	1.913043	2.192564	2.536023	2.482731	7.211319
10	<i>Leptochillus</i> sp	7	4	0.07	1.75	0.381316	0.403458	2.271135	3.055909
11	<i>Polypoidodes</i> sp	34	12	0.34	2.833333	1.143947	1.959654	3.677075	6.780676
12	<i>Drynaria mollis</i> Beddome	10	5	0.1	2	0.476644	0.576369	2.595583	3.648596
13	<i>Elastostema lineolatum</i> Wight	45	23	0.45	1.956522	2.192564	2.59366	2.539157	7.325381
14	<i>Globba racemosa</i> Smith	23	15	0.23	1.533333	1.429933	1.325648	1.989947	4.745528
15	<i>Equisetum arvense</i> Linnaeus	19	13	0.19	1.461538	1.239276	1.095101	1.896772	4.231148
16	<i>Hedychium</i> sp	46	32	0.46	1.4375	3.050524	2.651297	1.865575	7.567396
17	<i>Imaptiens</i> sp	89	46	0.89	1.934783	4.385129	5.129683	2.510944	12.02576
18	<i>Nephrolepis cordifolia</i> Linnaeus	159	84	1.59	1.892857	8.007626	9.164265	2.456534	19.62843
19	<i>Oxalis corniculata</i> Linnaeus	56	39	0.56	1.435897	3.717827	3.227666	1.863495	8.808987
20	<i>Pepormia</i> sp	34	26	0.34	1.307692	2.478551	1.959654	1.697112	6.135317
21	<i>Persicaria chinensis</i> (Linnaeus)H.Gross	59	40	0.59	1.475	3.813155	3.400576	1.914242	9.127974
22	<i>Phymatosorus cupsidatus</i> D.Don	11	4	0.11	2.75	0.381316	0.634006	3.568926	4.584247
23	<i>Pouzolzia hirta</i> (Blume)Hasskarl	34	21	0.34	1.619048	2.001907	1.959654	2.101186	6.062747

24	<i>Piper sp</i>	31	14	0.31	2.214286	1.334604	1.786744	2.873681	5.995029
25	<i>Pteris biaurita</i> Linnaeus	23	17	0.23	1.352941	1.620591	1.325648	1.755835	4.702075
26	<i>Rubia sp</i>	45	31	0.45	1.451613	2.955195	2.59366	1.883891	7.432746
27	<i>Setaria palmifolia</i> (J.Koening)Stapf	34	27	0.34	1.259259	2.57388	1.959654	1.634256	6.16779
28	<i>Selaginella sp</i>	31	23	0.31	1.347826	2.192564	1.786744	1.749197	5.728505
29	<i>Strobilanthus himalayana</i> J.R.I wood	17	12	0.17	1.416667	1.143947	0.979827	1.838538	3.962311
30	<i>Carex sp</i>	45	37	0.45	1.216216	3.527169	2.59366	1.578395	7.699224
31	<i>Dryopteris marginata</i> (Clarke) Christ	13	7	0.13	1.857143	0.667302	0.74928	2.410184	3.826766
32	<i>Tectaria codunata</i> (Wall. Ex Hook. Et Grev.) C.Chr	17	10	0.17	1.7	0.953289	0.979827	2.206245	4.139361
33	<i>Tectaria polymorpha</i> (Wallich ex Hooker)Copeland	9	4	0.09	2.25	0.381316	0.518732	2.92003	3.820078
34	<i>Elaphoglossum stelerigium</i> (Wallich ex Baker)Moore ex Saloman	35	25	0.35	1.4	2.383222	2.017291	1.816908	6.217421
35	<i>Sida rhombifolia</i> Linnaeus	17	13	0.17	1.307692	1.239276	0.979827	1.697112	3.916214
36	<i>Urena lobata</i> Linnaeus	19	11	0.19	1.727273	1.048618	1.095101	2.24164	4.385358
37	<i>Urtica dioica</i> Linnaeus	34	23	0.34	1.478261	2.192564	1.959654	1.918474	6.070693
38	<i>Triumfetta rhomboidea</i> Jacquin	21	17	0.21	1.235294	1.620591	1.210375	1.603154	4.43412
39	<i>Phaseolus coccineus</i> Linnaeus	37	27	0.37	1.37037	2.57388	2.132565	1.778455	6.4849
40	<i>Persicaria microcephalla</i> (D.Don)H.Gross	31	23	0.31	1.347826	2.192564	1.786744	1.749197	5.728505
41	<i>Rhynchoglossum obliquum</i> Blume	45	33	0.45	1.363636	3.145853	2.59366	1.769715	7.509229
42	<i>Selaginella monospora</i> Spring	67	46	0.67	1.456522	4.385129	3.861671	1.890261	10.13706
43	<i>Saccharum arundinaceum</i> Retzius	56	47	0.56	1.191489	4.480458	3.227666	1.546305	9.254428
	Total	1735	1049	17.35	77.05399	100	100	100	300

Table 3: Temperate Forest

Sl.No.	Name	Indiv	FQ	D/m ²	AB	RF	RD	RA	IVI
1	<i>Ajuga lobata</i> Don	81	75	0.81	1.08	11.66407	5.882353	0.846883	18.39331
2	<i>Pteris sp</i>	53	21	0.53	2.52381	3.265941	3.848947	1.979049	9.093937

3	<i>Ainsliaea aptere</i> DC.	39	10	0.39	3.9	1.55521	2.832244	3.05819	7.445644
4	<i>Viola sikkimensis</i> Becker	33	8	0.33	4.125	1.244168	2.396514	3.234624	6.875306
5	<i>Dryopteris subimpressa</i> Loyal	10	2	0.1	5	0.311042	0.726216	3.920757	4.958015
6	<i>fragaria nubicola</i> (Hook.f.)Lacaita	25	9	0.25	2.777778	1.399689	1.815541	2.178198	5.393428
7	<i>Hemiphragma</i> sp	5	4	0.05	1.25	0.622084	0.363108	0.980189	1.965381
8	<i>Cyperus squarrosus</i> Linnaeus	20	6	0.2	3.333333	0.933126	1.452433	2.613838	4.999397
9	<i>Oleandra wallichii</i> (Hooker)Presl	20	7	0.2	2.857143	1.088647	1.452433	2.240432	4.781512
10	<i>Ophiopogon intermedius</i> D.Don	11	5	0.11	2.2	0.777605	0.798838	1.725133	3.301576
11	<i>Polystichum lentum</i> (Don)Moore	25	8	0.25	3.125	1.244168	1.815541	2.450473	5.510182
12	<i>Potentilla polyphylla</i> Lehmann	33	11	0.33	3	1.710731	2.396514	2.352454	6.459699
13	<i>Plantago</i> sp	19	7	0.19	2.714286	1.088647	1.379811	2.128411	4.596869
14	<i>Gallium elegans</i> Roxburgh	143	56	1.43	2.553571	8.709176	10.38489	2.002387	21.09646
15	<i>Rubia</i> sp	112	81	1.12	1.382716	12.5972	8.133624	1.084259	21.81508
16	<i>Trifolium repens</i> Linnaeus	107	63	1.07	1.698413	9.797823	7.770516	1.331813	18.90015
17	<i>Smilax lanceifolia</i> Roxburgh	14	5	0.14	2.8	0.777605	1.016703	2.195624	3.989932
18	<i>Swertia bimaculata</i> (Siebold&Zuccarini)Clarke	7	3	0.07	2.333333	0.466563	0.508351	1.829687	2.804601
19	<i>Stellaria patens</i> D.Don	59	16	0.59	3.6875	2.488336	4.284677	2.891558	9.664571
20	<i>Hymenophyllum</i> sp	29	4	0.29	7.25	0.622084	2.106028	5.685097	8.413209
21	<i>Ranunculus</i> sp	51	12	0.51	4.25	1.866252	3.703704	3.332643	8.902599
22	<i>Anaphilis busua</i> (Don)D.C	5	2	0.05	2.5	0.311042	0.363108	1.960378	2.634529
23	<i>Gentiana capitata</i> D.Don	2	1	0.02	2	0.155521	0.145243	1.568303	1.869067
24	<i>Selaginella</i> sp	3	2	0.03	1.5	0.311042	0.217865	1.176227	1.705134
25	<i>Tupistra clarkei</i> Hook.f.	3	2	0.03	1.5	0.311042	0.217865	1.176227	1.705134
26	<i>Bulbophyllum</i> sp	17	6	0.17	2.833333	0.933126	1.234568	2.221762	4.389456
27	<i>Viola serpens</i> Roxburgh	6	3	0.06	2	0.466563	0.43573	1.568303	2.470596
28	<i>Malaxis</i> sp	6	2	0.06	3	0.311042	0.43573	2.352454	3.099226
29	<i>Scutellaria violacea</i> Bentham	10	4	0.1	2.5	0.622084	0.726216	1.960378	3.308679
30	<i>Centella asiatica</i> (Linnaeus)Urban	71	21	0.71	3.380952	3.265941	5.156137	2.651178	11.07326

31	<i>Plagiogyra pycnophylla</i> (Kuntze)Mett	11	4	0.11	2.75	0.622084	0.798838	2.156416	3.577338
32	<i>Permanea cyatheoides</i> D.Don	7	2	0.07	3.5	0.311042	0.508351	2.74453	3.563923
33	<i>Elstostema obtusum</i> Weddell	35	15	0.35	2.333333	2.332815	2.541757	1.829687	6.704259
34	<i>Globba hookeri</i> Baker	7	3	0.07	2.333333	0.466563	0.508351	1.829687	2.804601
35	<i>Pilea ternifolia</i> Weddell	11	6	0.11	1.833333	0.933126	0.798838	1.437611	3.169575
36	<i>Huperzia serrata</i> (Thunberg)Trevisan	33	7	0.33	4.714286	1.088647	2.396514	3.696714	7.181875
38	<i>Swertia nervosa</i> (Don)Clarke	21	17	0.21	1.235294	2.643857	1.525054	0.968658	5.137569
39	<i>Athyrium clarkei</i> Beddome	11	4	0.11	2.75	0.622084	0.798838	2.156416	3.577338
40	<i>Rubus calycinus</i> D.Don	21	18	0.21	1.166667	2.799378	1.525054	0.914843	5.239276
41	<i>Deparia petersenii</i> (Kunze)Kato	35	27	0.35	1.296296	4.199067	2.541757	1.016493	7.757317
42	<i>Habenaria sp</i>	17	13	0.17	1.307692	2.021773	1.234568	1.025429	4.28177
43	<i>Clematis buchanania</i> DC	8	3	0.08	2.666667	0.466563	0.580973	2.09107	3.138606
44	<i>Ceropegia longifolia</i> Wallich	19	7	0.19	2.714286	1.088647	1.379811	2.128411	4.596869
45	<i>Aleuritopteris formosona</i> (Hayata)Tagawa	34	24	0.34	1.416667	3.732504	2.469136	1.110881	7.312521
46	<i>Lyndsia odorata</i> Roxburgh	21	7	0.21	3	1.088647	1.525054	2.352454	4.966156
47	<i>Poa annua</i> Linnaeus	41	21	0.41	1.952381	3.265941	2.977487	1.530962	7.77439
48	<i>Monachosorum henryi</i> Christ	5	2	0.05	2.5	0.311042	0.363108	1.960378	2.634529
49	<i>Lycopodium japonicum</i> Thunberg	21	7	0.21	3	1.088647	1.525054	2.352454	4.966156
	Total	1377	643	13.77	127.5264	100	100	100	300

Table 4: Sub –alpine Forest

Sl.No	NAME	Indiv	FQ	D/ m ²	AB	RF	RD	RA	IVI
1	<i>Anaphalis contorta</i> Hook.f.	43	22	0.43	1.9545455	3.9497307	4.2701092	4.270109	12.489949
2	<i>Aconitum violaceum</i> Jacquemont ex Stapf	15	10	0.15	0.6818182	1.7953321	1.489573	1.4895729	4.774478
3	<i>Aconogonum campanulatum</i> (Hooker)Hara	41	31	0.41	1.8636364	5.5655296	4.0714995	4.0714993	13.708528
4	<i>Anaphilis triplinervis</i> (Sims)Clarke	57	43	0.57	2.5909091	7.7199282	5.6603774	5.660377	19.040683

5	<i>Dryopteris serratodentata</i> (Beddome)Hayata	21	13	0.21	0.9545455	2.3339318	2.0854022	2.0854021	6.504736
6	<i>Ligularia sp</i>	9	6	0.09	0.4090909	1.0771993	0.8937438	0.8937437	2.8646868
7	<i>Cyperus squarrosus</i> Linnaeus	3	2	0.03	0.1363636	0.3590664	0.2979146	0.2979146	0.9548956
8	<i>Woodsia elongata</i> Hooker	34	21	0.34	1.5454545	3.7701975	3.3763654	3.3763652	10.522928
9	<i>Sanicula elata</i> D. Don	5	3	0.05	0.2272727	0.5385996	0.4965243	0.4965243	1.5316483
10	<i>Deparia allantodoides</i> (Beddome)Kato	21	8	0.21	0.9545455	1.4362657	2.0854022	2.0854021	5.60707
11	<i>Polystichum thomsonii</i> (Hooker)Beddome	119	61	1.19	5.4090909	10.951526	11.817279	11.817278	34.586083
12	<i>Lycopodium japonicum</i> Linnaeus	3	1	0.03	0.1363636	0.1795332	0.2979146	0.2979146	0.7753624
13	<i>Halenia elliptica</i> D.Don	6	3	0.06	0.2727273	0.5385996	0.5958292	0.5958292	1.730258
14	<i>Panax sp</i>	36	26	0.36	1.6363636	4.6678636	3.5749752	3.574975	11.817814
15	<i>Ajuga lobata</i> Don	13	7	0.13	0.5909091	1.2567325	1.2909633	1.2909632	3.8386589
16	<i>Anemone rupicola</i> Cambessedes	12	5	0.12	0.5454545	0.8976661	1.1916584	1.1916583	3.2809828
17	<i>Hymenophyllum exertum</i> Wallich ex Hooker	67	15	0.67	3.0454545	2.6929982	6.653426	6.6534256	15.99985
18	<i>Impatien sp</i>	23	21	0.23	1.0454545	3.7701975	2.2840119	2.2840118	8.3382212
19	<i>Ainsliaea aptere</i> DC.	23	17	0.23	1.0454545	3.0520646	2.2840119	2.2840118	7.6200883
20	<i>Asplenium magnificum</i> (Ching)Bir	9	3	0.09	0.4090909	0.5385996	0.8937438	0.8937437	2.3260872
21	<i>Oxalis acetocella</i> Linnaeus	67	31	0.67	3.0454545	5.5655296	6.653426	6.6534256	18.872381
22	<i>Pilea sp</i>	34	21	0.34	1.5454545	3.7701975	3.3763654	3.3763652	10.522928
23	<i>Pimpinella tongloensis</i> Mukherjee	4	2	0.04	0.1818182	0.3590664	0.3972195	0.3972194	1.1535053
24	<i>Pichisermollodes malacodon</i> (Hook.) Fras.-Jenk.	55	35	0.55	2.5	6.2836625	5.4617676	5.4617673	17.207197
25	<i>Viola sikkimensis</i> Becker	4	2	0.04	0.1818182	0.3590664	0.3972195	0.3972194	1.1535053
26	<i>Primulla scultyi</i> Craib	5	3	0.05	0.2272727	0.5385996	0.4965243	0.4965243	1.5316483
27	<i>Potentilla polyphylla</i> Lehmann	13	5	0.13	0.5909091	0.8976661	1.2909633	1.2909632	3.4795925
28	<i>Rubus wardii</i> Merrill	5	2	0.05	0.2272727	0.3590664	0.4965243	0.4965243	1.3521151
29	<i>Arisaema griffithii</i> Schott	15	6	0.15	0.6818182	1.0771993	1.489573	1.4895729	4.0563452
30	<i>Poa annua</i> Linnaeus	33	17	0.33	1.5	3.0520646	3.2770606	3.2770604	9.6061856

31	<i>Meconopsis sp</i>	3	1	0.03	0.1363636	0.1795332	0.2979146	0.2979146	0.7753624
32	<i>Smilicenia sp</i>	21	17	0.21	0.9545455	3.0520646	2.0854022	2.0854021	7.2228689
33	<i>Biswarea tonglensis</i> (Clarke)Cogniaux	5	2	0.05	0.2272727	0.3590664	0.4965243	0.4965243	1.3521151
34	<i>Spiranthus sp</i>	10	3	0.1	0.4545455	0.5385996	0.9930487	0.9930486	2.5246969
35	<i>Gentiana capitata</i> D.Don	13	8	0.13	0.5909091	1.4362657	1.2909633	1.2909632	4.0181921
36	<i>Iris clarkei</i> Hooker	4	1	0.04	0.1818182	0.1795332	0.3972195	0.3972194	0.9739721
37	<i>Primulla scapigera</i> (Hook.f.)Craib	4	2	0.04	0.1818182	0.3590664	0.3972195	0.3972194	1.1535053
38	<i>Potentilla fulgens</i> Hooker	61	36	0.61	2.7727273	6.4631957	6.0575968	6.0575965	18.578389
39	<i>Pedicularis fu</i> Ruracea Bentahm	10	3	0.1	0.4545455	0.5385996	0.9930487	0.9930486	2.5246969
40	<i>Botrychium dusenii</i> Alston	9	3	0.09	0.4090909	0.5385996	0.8937438	0.8937437	2.3260872
41	<i>Polystichum perscotianum</i> (Wallich ex Mettenius) T. Moore	37	27	0.37	1.6818182	4.8473968	3.67428	3.6742798	12.195957
42	<i>Viola hookeri</i> Thomsan	10	3	0.1	0.4545455	0.5385996	0.9930487	0.9930486	2.5246969
43	<i>Primulla edgeworthii</i> (Hooker)Pax	4	1	0.04	0.1818182	0.1795332	0.3972195	0.3972194	0.9739721
44	<i>Ophipogon intermedius</i> D. Don	21	8	0.21	0.9545455	1.4362657	2.0854022	2.0854021	5.60707
	Total	1007	557	10.07	45.772727	100	100	100	300

A

Acharya, 3, 247, 252, 278
 Adiantum concinnum, 74
 Adiantum incisum, 74
 Adiantum philippense, 75
 Adiantum venustum, 75 Afro-
 Arabian, 250 Aleuritopteris
 albomarginata, 76
 Aleuritopteris bicolor, 77
 Aleuritopteris chrysophylla,
 78 Aleuritopteris formosana, 79
 Aleuritopteris subdimorpha, 79
 Angiopteris helferiana, 51.
 Arachniodes assamica, 135
 Arthromeris lehmanni, 169
 Arthromeris wallichiana, 168
 Aspleniaceae, 32, 103, 248
 Athyrium clarkei, 120
 Athyrium distans, 119
 Athyrium fimbriatum, 122
 Athyrium flabellulatum, 123
 Athyrium foliolosum, 121
 Athyrium pectinatum, 121

B

Blechnaceae, 31, 116, 248
 Bolbitis appendiculata, 160
 Bolbitis heteroclita, 160
 Botrychiaceae, 248
 Botrychium daucifolium, 47
 Botrychium lanuginosum, 50
 Botrychium lunaria, 48
 Botrychium multifidum, 49
 Botrychium ternatum, 50

C

Cerosora microphylla, 80
 Christopteris tricupsis, 251
 Coniogramme procera, 81
 Coniogramme serrulata, 82
 Cyatheaceae, 31, 66, 248, 275,
 278 Cyathea brunoniana, 63
 Cyathea contaminans, 250, 251, 252, 254
 Cyathea spinulosa, 62
 Cyrtomium caryotideum, 136

D

Das, 2, 3, 4, 13, 14, 15, 16, 17, 25, 181, 252,
 265, 268, 276, 280, 284
 Davallaceae, 248
 Davallia fijiensis, 247
 Davallia trichomanoides, 165
 Density, 25
 Dent, 6
 Dennstaedtiaceae, 32, 68, 248, 275
 Dennstaedtia appendiculata, 64
 Dennstaedtia scabra, 65
 Deparia allantodiodes, 124
 Deparia boryana, 124 Deparia
 petersenii, 125 Dicranopteris
 splendida, 56 Dicranopteris
 lanigera, 57 Dicranopteris
 taiwanensis, 56 Diplazium
 esculentum, 127 Diplazium
 forrestii, 133 Diplazium
 himalayense, 131 Diplazium
 javanicum, 127 Diplazium
 kawakamii, 132 Diplazium
 maximum, 129 Diplazium
 sikkimense, 128 Diplazium
 spectabile, 131 Diplazium
 stoliczkae, 130 Diplazium
 succulentum, 129
 Diplopterygium giganteum, 58
Dipteris wallichii, 250, 251, 252, 254
 Dixit, 18
 Drynaria coronans, 172
 Drynaria mollis, 172
 Drynaria propinqua, 171
 Dryopsis apiciflora, 136
 Dryopterideaceae, 248, 276,
 278 Dryopteris atrata, 141
 Dryopteris cochleata, 141
 Deparia allantodiodes, 121
 Deparia boryana, 121
 Deparia petersenii, 122
 Dryopteris conjugata, 143
 Dryopteris juxtaposita, 137
 Dryopteris marginata, 138
 Dryopteris serratodentata, 142
 Dryopteris splendens, 140
 Dryopteris subimpressa, 143
 Dryopteris wallichiana, 139
 Dryopteris woodsiiisora, 139
 Duars, 2, 3

E

Elaphoglossum stelligerum, 161
Equisetaceae, 30, 48, 248, 277
Equisetum, 45, 46, 225, 243, 273
Equisetum arvense, 45
Equisetum ramosissimum, 45

F

Frequency, 25, 26, 253, 265

G

Geology, 4
Gleichenaceae, 248
Gondwanas, 4
Goniophlebium argutum, 173
Grammitadaceae, 248

H

Hara, 247
Huperzia ceylanica, 36, 225, 250, 252, 254
Huperzia hamiltonii, 38
Huperzia herteriana, 36
Huperzia pulcherrima, 38
Huperzia serrata, 35, 225
Huperzia squarrosa, 225, 278
Hymenophyllaceae, 31, 63, 248
Hymenophyllum badium, 60
Hymenophyllum exsertum, 61
Hymenophyllum tenellum, 61
Hypolepis polypodioides, 66

J

Jaldhaka, 2
Jenkins, 18

K

Katoella pulchra, 166
Kholia, 18

L

Lepisorus contortus, 177
Lepisorus loriformis, 178

Lepisorus mehrae, 179
Lepisorus scolopendrium, 180
Lepisorus sublinearis, 180
Leptochilus decurrens, 183
Leptochilus ellipticus, 181
Leptochilus insignis, 182
Leptochilus pedunculatus, 183
Leucostegia truncata, 166
Lindsaeaceae, 33, 74, 248
Lindsaea himalaica, 70
Lindsaea odorata, 71
Location, 2, 24
Lomariopsidaceae, 248
Loxogramme chinensis, 186
Loxogramme involuta, 184
Loxogramme porcata, 185
Lycopodiaceae, 18, 30, 248, 278, 279, 284, 286, 288
Lycopodiella cernua, 34, 225, 278
Lycopodium japonicum, 33, 225, 279
Lygodiaceae, 30, 58, 249, 276
Lygodium flexuosum, 55
Lygodium japonicum, 55

M

Malley, 2, 12, 283
Marattiaceae, 31, 55, 248
Mehra & Bir, 247
Menhinick's index, 28, 257, 258, 259, 265
Microlepidia rhomboidea, 68
Microlepidia speluncae, 67
Microsorium punctatum, 208
Microsorium membranaceum, 174
Microsorium punctatum, 175
Microsorium zippelii, 176
Monachosorum henryi, 69

N

Nephrolepidaceae, 32, 162, 248
Nephrolepis cordifolia, 162
Nothoperanema squamiseta, 144

O

Odontosoria chinensis, 72
Oleandra pistillaris, 163
Oleandra wallichii, 164
Oleandraceae, 32, 163, 248, 277, 279

Onychium siliculosum, 83
Onychium vermae, 83
Ophioglossaceae, 30, 50, 248, 276
Ophioglossum reticulatum, 51
Osmundaceae, 31, 56,
Osmunda claytoniana, 53

P

Patiram, 6
Peranema aspidioides, 146
Peranema cyatheoides, 145
Peranema paleolulata, 147
Pityrogramma calomelanos, 84
Phalut, 3
Phanerophlebiopsis hookeriana, 147
Plagiogyria pycnophylla, 54
Phymatosorus cuspidatus, 186
Pichisermollodes crenato-pinnata,
190 *Pichisermollodes ebenipes*, 188
Pichisermollodes erythrocarpa, 191
Pichisermollodes malacodon, 190
Pichisermollodes stewartii, 189
Plagiogyraceae, 249
Polypodiaceae, 32, 167, 247, 249, 252
Polypodiodes amoena, 192
Polypodiodes hendersonii, 193
Polypodiodes lachnopus, 193
Polypodiodes subamoena, 194
Polystichum atkinsonii, 149
Polystichum lentum, 149
Polystichum manmeiense, 150
Polystichum mehrae, 151
Polystichum neolobatum, 151
Polystichum nepalense, 155
Polystichum prescottianum, 152
Polystichum scariosum, 155
Polystichum semifertile, 154
Polystichum stenophyllum, 153
Polystichum thomsonii, 156
Pterideaceae, 249, 277, 278
Pteridium revolutum, 69
Pteridrys cnemidaria, 250
Pteris barbiger, 250
Pteris medogensis, 94
Pteris aspericaulis, 93
Pteris austrosinica, 86
Pteris biaurita, 87
Pteris cretica, 89
Pteris ensiformis, 95
Pteris longipes, 91

Pteris medogensis, 95
Pteris puberula, 94
Pteris scabririgens, 92
Pteris semipinnata, 91
Pteris spinescens, 92
Pteris venusta, 90
Pteris vittata, 89
Pteris wallichiana, 88
Pyrrosia costata, 196
Pyrrosia lanceolata, 197
Pyrrosia lingua, 196
Pyrrosia mannii, 198
Pyrrosia nuda, 198
Pyrrosia porosa, 199

R

Rathong, 6

S

Sellaginaceae, 249
Selaginella bisulcata, 39
Selaginella chrysocaulos, 40
Selaginella monospora, 41
Selaginella pulvinata, 39,
42 *Selaginella repanda*, 42
Selaginella subdiaphana, 43
Selaginella vaginata, 44
Selliguea griffithiana, 200
Shannon-Weiner index, 256, 257
Sikkim, 5
Simpson's index, 256, 257, 258, 259, 270,
271 Singalila, 4 *Stenochlaena palustris*, 117,
247, 250, 253, 254

T

Tectaria coadunata, 158
Tectaria fuscipes, 157
Tectaria polymorpha, 159
Thelypterideaceae, 22, 32, 108, 249, 278
Thelypteris arida, 105
Thelypteris aurita, 106
Thelypteris cana, 108
Thelypteris flaccida, 106
Thelypteris lakhimpurensis,
104 *Thelypteris nudata*, 108
Thelypteris ornata, 110

Thelypteris ornatipes, 110
Thelypteris procera, 107
Thelypteris pyrrohorhachis, 109
Tomophyllum donianum, 202
Topography, 3, 4
Tricholepidium normale, 201, 235, 247, 253
Trichomanes auricuata, 44
Vittariaceae, 32, 100, 249
Woodsia elongata, 133
Woodsiaceae, 31, 119, 249, 275, 276

Publication and Seminar Delivered

Pleione 9(2): 348 - 355. 2015.
© East Himalayan Society for Spermatophyte Taxonomy

ISSN: 0973-9467

Diversity and distribution of Lycopodiaceae P. Beauvois ex Mirbel in Darjiling Hills, West Bengal, India

Nayan Thapa¹ and Dorjay Lama

Department of Botany, St Joseph College, North Point, Darjeeling – 734104, West Bengal, India
¹Corresponding author, E-mail: nayanthapa16@yahoo.com

[Received 30.10.2015; Revised 15.12.2015; Accepted 24.12.2015; Published 31.12.2015]

Abstract

The paper deals with the diversity and distribution of Lycopodiaceae P. Beauvois ex Mirbel in Darjiling Hills areas of Eastern Himalaya. It revealed the occurrence of 3 genera viz *Huperzia* Bernhardt, *Lycopodiella* Holub and *Lycopodium* Linnaeus in the study area. While, *Huperzia* is represented by the highest number of 6 spp., the two other genera *Lycopodium* and *Lycopodiella* were represented by single species. The distribution of species ranged from tropical region up to the sub-alpine indicating wide ecological amplitude of the taxon. Repeated survey and failure to collect *Huperzia phlegmaria* (Linnaeus) Rothmaler and *Lycopodium veitchii* Christ by the author in the span of four years from the study area is of great concern. *Huperzia ceylanica* (Spring) Trevisan is recorded first time from West Bengal.

Key words: Lycopodiaceae, *Lycopodium ceylanica*, New record, West Bengal, distribution

INTRODUCTION

Lycopodiaceae P. Beauvois ex Mirbel is the largest family of Fern-allies with about 500 species world wide and 25 species in India (Dixit 1987). Mirbel (1802) described the group in French and named the group *Lycopodia* in Latin. They occur in both the hemispheres and have wide ecological amplitude, making their presence from tropics to arctic. Presently, 3 genera are recognized viz. *Lycopodium* Linnaeus, *Huperzia* Bernhardt, *Lycopodiella* Holub from the 12 genera concept of Holub (1975). The Darjiling Himalayan region is well explored during the post-independence period by different Indian pteridologists and enumerated Lycopodiaceae of the area. The number of species recorded by different authors include 12 spp. (Mehra & Bir 1964), 7 spp. (Hara 1971), and 13 spp. (Sen & Sen 1978). The District of Darjiling, West Bengal lies between 26°31' and 27° 13' N latitude and between 87°59' and 88°53' E longitude (O'Malley, 1907). The Hills of Darjiling with an area of 2436.55 km² with altitudinal variation ranging from ±150 m (at Sukna) to 3660 m (at Sandakphu – Phalut), presents diverse topographical conditions and offer suitable habitat for the occurrence of wide range of plants (Das 1995, 2004; Acharya & Acharya 2001). Though the district is floristically well explored but the occurrence of micro-niche in difficult terrains with negligible accessibility has lead some plants of the region remained undiscovered.

MATERIALS AND METHOD

Regular field trips were made during April 2010 to July 2014 to document the occurrence and distribution of different members of Lycopodiaceae in various vegetation tracts of Darjiling

Hills and processed into mounted herbarium-sheets following conventional techniques (Jain & Rao 1977). Specimens were identified by matching with the pre-identified specimens in the Herbarium of the Llyod's Botanical Garden, Darjiling as well as through consultation of published literature including (Mehra & Bir 1964; Hara 1971; Mathew 1971; Chowdhury 1973; Ghosh *et al.* 2004; Fraser-Jenkins 2008; Fraser-Jenkins *et al.* 2015). The distribution of the species was noted in the field note book along with the precise altitude and coordinates with a GPS.

Voucher specimens have been deposited in the Herbarium of the Llyod's Botanical Garden and at the Herbarium of the Botany department, St. Joseph College, Darjiling.

RESULT AND DISCUSSION

The field study revealed the occurrence of 3 genera of Lycopodiaceae within the Darjiling Hill area with a total of 8 species. The artificial key and suitable description has been provided for their identification. The absence of two species i.e. *Lycopodium veitchii* Christ and *Huperzia phlegmaria* (Linnaeus) Rothmaler is a matter of concern, as literature review revealed its presence in the Darjiling hills (Fraser-Jenkins 2008). However, *Lycopodium vetichi* was listed as a rare plant for Darjiling hills region (Fraser-Jenkins 2015) but the absence of *H. phlegmaria* with the extent of survey for four years in foothills namely Samsing, Sukuna, Kalijhora, Rangeet valley yielded no result. The overexploitation of this species by local nursery for ornamental purposes from the natural habitat has lead to their dwindling population. Proper conservation strategy should be undertaken by appropriate authorities for their conservation. The occurrence of *Huperzia ceylanica* from this segment of the Himalayas is a new record for West Bengal. A small population of this species is available in restricted small patches in Tumling and Jalapahar areas. The taxonomic treatment with suitable artificial keys of the species of Lycopodiaceae occurring in the Darjiling Hills has been enumerated below.

ENUMERATION

Lycopodiaceae P. Beauvois *ex* Mirbel in Lamarck & Mirbel, Hist.Nat.Veg. 4: 293. 1802.

Key to the Genera:

1. Sporangia organized in a strobilus 2
 - 1a. Sporangia occurring freely i.e. does not produce strobilus *Huperzia*
2. Sporophytic plants erect *Lycopodiella*
 - 2a. Sporophytic plants scrambling *Lycopodium*

LYCOPODIUM Linnaeus, Sp. Pl. 2: 1100. 1753.

Lycopodium japonicum Thunberg. Fl. Jap. 341. 1784; Dixit, Cens. Indian Pterid. 9. 1984; Thapa, Pterid. Nepal 24. 2002; Ghosh, Pterid. Fl. East. Ind. I: 86. 2004; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 519. 2008.

Lycopodium pseudoclavatum Ching, Acta Bot. Yunnan. 4(3): 222. 1982.

Herbaceous with creeping Runner, forked, green; lateral branches erect, up to 30 cm tall, 0.5 – 1 cm in diameter, multiple times dichotomously branched; Leaves microphyllous, spirally arranged, dense, angled upward, linear-lanceolate, 0.4 – 0.6 × 0.2 – 0.4 cm, herbaceous, midrib indistinct, base cuneate, sessile, margin entire, apex acuminate; strobili 3 – 4 on a

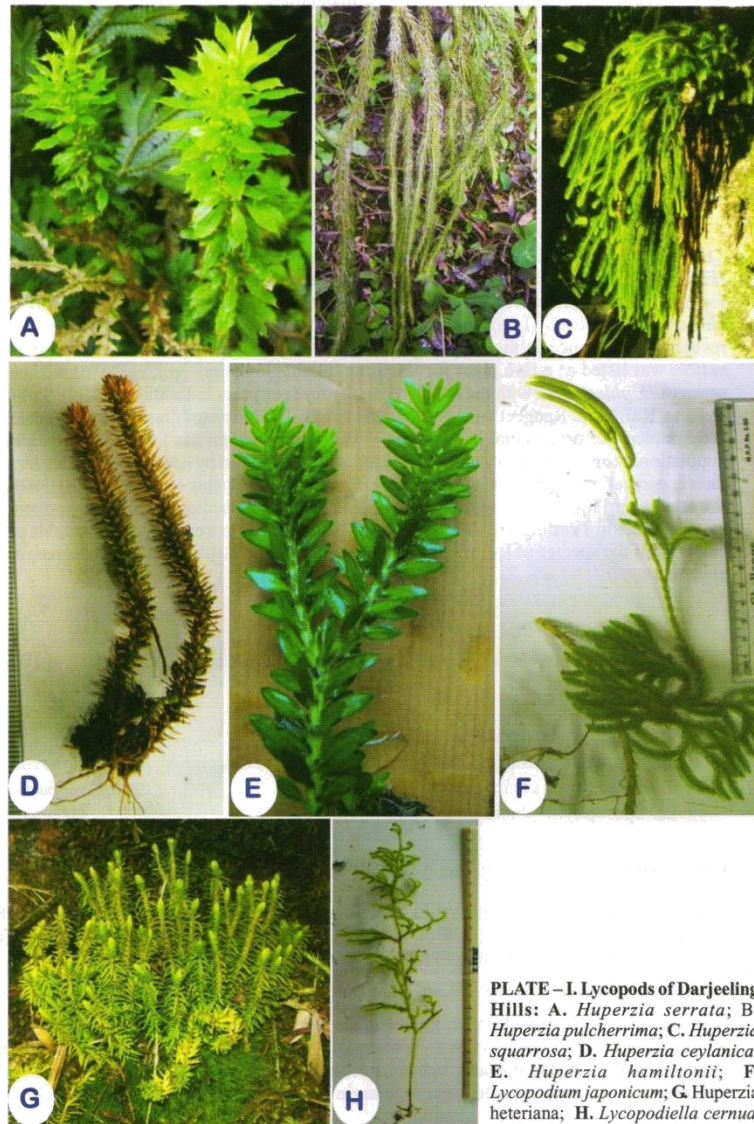


PLATE - I. Lycopods of Darjeeling Hills: A. *Huperzia serrata*; B. *Huperzia pulcherrima*; C. *Huperzia squarrosa*; D. *Huperzia ceylanica*; E. *Huperzia hamiltonii*; F. *Lycopodium japonicum*; G. *Huperzia heteriana*; H. *Lycopodiella cernua*

with only vegetative leaves; sporangium ca. $0.4 - 0.6 \times 0.2 - 0.3$ cm, reniform, yellowish; spores $35 - 40$ μ m, tetrahedral, pitted, pale yellow.

Exsiccatae: West Bengal, Darjiling Hills, Chitrey, 10.08.2011, *Nayan Thapa 160A* (S/CBH), 160B(LBH), $26^{\circ} 59' 23''$ N and $88^{\circ} 06' 57.2''$ E, alt. 2232 ± 15 m.

Local Distribution: Chitrey, Jalapahar, Tonglu.

Global Distribution: India, Srilanka, Java.

Huperzia squarrosa (Froster) Trevisan, Atti Soc. Ital. Sci. Nat. 17: 247 (1875); Dixit, Cens. Indian Pterid. 8, 1984; Dixit, Lycopod. India 65, 1987; Thapa, Pterid. Nepal 23, 2002; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 519, 2008. *Lycopodium squarrosus* Froster, Fl. Ins. Austr. Prodr.: 86, 1786. *Lycopodium verticillatum* Willdenow, Sp. Pl. 5: 48, 1810. *Lycopodium hookeri* Wallich ex Hooker & Greville, Ic. Fil. 2: t. 185, 1829. *Phlegmariurus squarrosus* (Froster) A. Löve & D. Löve, Taxon 26 (2-3): 324, 1977. *Urostachys squarrosus* (Froster) Herter, Bot. Arch. 3: 14 (1923), Ind. Lycopod. 83, 1949.

Epiphytic; stems caespitose, branches pendulous, 1–8 times forked, 25–75 cm long, 0.2–0.5 cm in diameter. Trophophylls lustrous, lanceolate, attached at right angles, $0.5 - 2 \times 0.2 - 0.4$ cm, leathery, midrib distinct, margin entire, acute, base cuneate, decurrent. Strobili terminal on branches; sporophylls densely arranged, ovate-lanceolate, $0.6 - 1.2 \times$ ca. 0.2 cm, entire, acute; sporangia yellowish, reniform, vertically bisected; spores 28–35 μ m, tetrahedral, greenish-white.

Exsiccatae: West Bengal, Darjiling Hills, Mangwa, 10.09.2012, *Nayan Thapa 075A* (S/CBH), 075B(LBH), $27^{\circ} 02' 12''$ N and $88^{\circ} 20' 1.3''$ E, alt. 1050 ± 15 m

Local Distribution: Mangwa, Teesta valley, Makaibari, Pandam.

Global Distribution: India, Nepal, Bhutan, China, Cambodia, Laos, Madagascar, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand.

Huperzia hamiltonii (Sprengel) Trevisan, Atti Soc. Ital. Sci. Nat., 248, 1875; Dixit, Cens. Indian Pterid. 7, 1984; Dixit, Lycopod. India 48, 1987; Thapa, Pterid. Nepal 22, 2002; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 518, 2008. *Lycopodium hamiltonii* Sprengel in Linnaeus, Syst. Veg. 5: 492, 1828. *Lycopodium obtusifolium* Hameed ex D. Don, Prodr. Fl. Nepal.: 18, 1825, non Swartz (1806). *Lycopodium aloifolium* Wallich ex Hooker & Greville, Ic. Fil.: t. 233, 1831. *Lycopodium empetrifolium* Dalzell, Hook. J. Bot. 1852. *Phlegmariurus hamiltonii* (Sprengel) A. Löve & D. Löve, Taxon 26 (2–3): 324, 1977. *Urostachys hamiltonii* (Spring) Herter ex Nessel, Lycopod.: 68, 1939; Ind. Lycopod.: 63, 1949.

Plants epiphytic, pendulous, $8 - 10 \times 0.2 - 0.4$ cm, forked dichotomously; Trophophylls slightly angled upward, slightly oblong, $1 - 1.5 \times 0.3 - 0.5$ cm, base cuneate, decurrent, lustrous, leathery, midrib distinct, margin entire, apex obtuse; Sporophyll like vegetative leaves, sporangia on the axil of sporophyll in the upper half, Sporangia Ca. $0.6 - 1 \times 0.2 - 0.4$ cm, reniform, vertically bisected yellowish; Spores 28–32 μ m, tetrahedral, pitted, pale in colour.

Exsiccatae: West Bengal, Darjiling Hills, Singamari, 02.07.2011, *Nayan Thapa 010A* (S/CBH), 010B (LBH), $27^{\circ} 03' 15.1''$ N and $88^{\circ} 14' 23.1''$ E, alt. 1950 ± 12 m

Local Distribution: Singamari, Senchal, Lava, Chimney.

51. 2004; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List. 519. 2008. *Lycopodium serratum* Thunberg in Murray, Fl. Jap. 341, t.38. 1784. *Urostachys serratus* (Thunberg) Herter, Bot. Arch. 3: 13. 1923.

Terrestrial, herbaceous, rooted at base, isodichotomous branching. Stem erect, 5–25 cm, 0.1–0.4 cm in diameter, 2–3 times dichotomously branched, bulbils at the tip. Leaves sparse, forming right angle to the stem, lustrous, elliptic, contracted toward base, straight, 1–2.5 × 0.4–0.6 cm, thinly leathery, both surfaces glabrous, midrib conspicuously raised, base cuneate, decurrent, petiolate, irregularly toothed, acuminate. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, yellowish, reniform to kidney shaped; ca. 0.4–0.8 × 0.2–0.4 cm; spores 22–32 µm, tetrahedral, yellowish.

Exsiccatae: West Bengal, Darjiling Hills, Lebong, 15.08.2011, *Nayan Thapa 049A (SJC BH), 049B (LBH)*, 27° 04' 13.5" N and 88° 16' 59.7" E, alt. 1550 ± 11.5 m

Local Distribution: Lebong, Jalapahar, Lava, Takdah, Third mile.

Global Distribution: Australia, Bhutan, Cambodia, China, India, Indonesia, Japan, Korea, Laos, Malaysia, Myanmar, Nepal, Philippines, Russia, Sri Lanka, Thailand, Vietnam.

Huperzia herteriana (Kümmeler) T. Sen & U. Sen, Fern Gaz. 11 (6): 415, f.1a-j. 1978; Dixit, Cens. Indian Pterid. 7, 1984; Thapa, Pterid. Nepal 22. 2002; Ghosh, Pterid. Fl. East. Ind. I: 58–59, 2004; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 518. 2008. *Lycopodium herterianum* Kümmeler, Magyar Bot. Lap. 26: 99. 1928. *Lycopodium sikkimense* Herter, Bot. Jahrb. 43: 42. 1909. *Urostachys sikkimensis* (Herter) Herter ex Nessel, Lycopod.: 52, t.7, f.1. 1939. *Urostachys herterianus* (Kümmeler) Herter, Ind. Lycopod.: 64. 1949.

Herbaceous, terrestrial, rooting at base, isodichotomous branching; erect, ascending. Stem 4–12 cm, 0.2–0.4 cm in diameter, 2–4 times dichotomously branched, ultimate end with bulbils. Leaves dense, reflexed, lustrous, oblanceolate, falcate, 0.6–1.2 × 0.1–0.3 cm, leathery, midrib indistinct, base cuneate, decurrent, sessile, margin straight, upper portion with small teeth, apex acute. Sporophylls homomorphic with trophophylls; sporangia visible on both sides of sporophylls, ca. 0.3–0.6 × 0.1–0.3 cm, reniform yellowish; spores 25–30 µm, tetrahedral, pitted, creamish-yellow.

Exsiccatae: West Bengal, Darjiling Hills, Chitrey, 10.08.2011, *Nayan Thapa 055A (SJC BH), 055B (LBH)*, 26° 59' 23" N and 88° 06' 57.2" E, alt. 2232 ± 15 m

Local Distribution: Chitrey, Tonglu, Senchal, Rachel, Jalapahar.

Global distribution: India, Nepal, Bhutan, China.

Huperzia ceylanica (Spring) Trevisan, Atti. Soc. Ital. Sci. Nat. 17: 248. 1875; Dixit, Lycopod. India 44. 1987; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 518. 2008. *Lycopodium ceylanicum* Spring, Mem. Acad. Sci. Belg. 15(1): 37. 1843; 24(2): 16. 1850; Bak. Handb. Fern allies 11. 1887. *Huperzia ceylanica* (Spring) Rothmaler, Feddes Repert. 54(1): 59. 1944 (Superfl).

Terrestrial, herbaceous, rooting at base, growing on exposed rocky surfaces; erect, 7–16 cm high, 0.3–0.6 cm in diameter, 1–4 times dichotomously branched. Leaves 8 whorled, green to pale green, ascending in the upper half, reflexed at the basal part, thin, ligulate, ca. 0.8–1 × 0.2–0.4 cm, sparsely serrate towards apex, midrib distinct. Sporophylls homomorphic with trophophylls, sporangia borne on the axil of leaves at the upper half, short apical part

peduncle, pedicels erect with varying length, $2 - 5 \times 0.2 - 0.4$ cm, strobili cylindrical, $3 - 8 \times 0.4 - 0.7$ cm; sporophyll broadly ovate, $2 - 3 \times$ ca. 3 mm, papery, apex acute, with long aristate tip; sporangia slightly exposed, spores $30 - 35 \mu\text{m}$, tetrahedral, creamish in colour.

Exsiccatae: West Bengal, Darjiling Hills, Third mile, 12.08.2011, *Nayan Thapa 026A (SJC BH)*, *026B (LBH)*, $27^{\circ} 00' 31.7''$ N and $88^{\circ} 17' 37.4''$ E, alt. 2154 ± 15 m.

Local Distribution: Third mile, Sukhia, Tonglu, Lava, Chimney.

Global Distribution: Bhutan, Cambodia, China, India, Japan, Laos, Myanmar, Nepal, Vietnam.

LYCOPODIELLA Holub, *Preslia* 36: 22. 1964.

Lycopodiella cernua (Linnaeus) Pich. Sermolli, *Webbia* 23: 166. 1968; Thapa, *Pterid. Nepal* 24. 2002; Fraser-Jenkins, *Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List* 519. 2008.

Lycopodium cernuum Linnaeus, *Sp. Pl.* 2: 1103. 1753. *Lycopodium clavatum* sensu Clarke, *Trans. Linn. Soc. Ser. II. Bot.* 1: 592. 1880. *Lycopodium cernuum* Linnaeus var. *sikkimensis* (O.F. Mull) H.S. Kung, *Acta Phytotax. Sin.* 18 (2): 239. 1980.

Herbaceous with creeping, forked, creamish runner; Stem erect, 30 - 60 cm high, Ca. 0.5 - 1 cm in diameter, dichotomously branched. Leaves microphyllous, spirally arranged, monomorphic, sessile, lanceolate, $0.2 - 0.4 \times 0.8 - 1$ cm, entire, acuminate, base cuneate, decurrent, midrib indistinct. Strobili solitary, $1 - 1.4 \times 0.4 - 0.6$ cm, drooping, stalked, pedicels $0.2 - 1 \times 0.1 - 1.2$ cm. Sporophylls different from trophophylls, subulate to lanceolate, imbricate, margin membranous and irregularly toothed, apex acute; sporangia yellow, reniform; spores $25 - 32 \mu\text{m}$, tetrahedral, yellowish.

Exsiccatae: West Bengal, Darjiling Hills, Lebong, 15.08.2011, *Nayan Thapa 048A (SJC BH)*, *048B (LBH)*, $27^{\circ} 04' 13.5''$ N and $88^{\circ} 16' 59.7''$ E, alt. 1550 ± 11.5 m

Local Distribution: Rungdung, Dhotrey, lebong, Jamuna.

Global Distribution: Bhutan, China, India, Nepal.

HUPERZIA Bernhardt in *Shrad. J. Bot.* 1800(2): 126. 1801.

Key to the Species:

- | | |
|--|-----------------------|
| 1. Plants usually epiphytic | 2 |
| 1a. Plants usually terrestrial | 3 |
| 2. Leaves linear and scaly | 4 |
| 2a. Leaves ovate-lanceolate and glossy | <i>H. hamiltonii</i> |
| 3. Leaf margin entire | 5 |
| 3a. Leaf margin serrate | <i>H. serrata</i> |
| 4. Sporangia arise in the axil of sporophylls | <i>H. squarrosa</i> |
| 4a. Sporangia arise throughout the length of the stem in the axil of microphylls | <i>H. pulcherrima</i> |
| 5. Leaves reflexed, green, $0.5 - 1.5 \times 0.1 - 0.4$ cm | <i>H. heteriana</i> |
| 5a. Leaves ascending, greenish to brownish, $0.4 - 1 \times 0.1 - 0.3$ cm | <i>H. ceylanica</i> |

Huperzia serrata (Thunberg) Trevisan, *Atti. Soc. Ital. Sci. Nat.* 17: 248. 1875; Dixit, *Cens. Indian Pterid.* 7. 1984; Thapa, *Pterid. Nepal* 23. 2002; Ghosh, *Pterid. Fl. East. Ind.* 1:

Global Distribution: India, Nepal, Bhutan, China, N. Myanmar.

Huperzia pulcherrima (Wallich ex Hooker & Greville) Pich. Sermolli, Webbia 25(1): 219–297. 1970; Dixit, Cens. Indian Pterid. 8, 1984 & Lycopod. India 60. 1987; Thapa, Pterid. Nepal 23. 2002; Fraser-Jenkins, Tax. Revi. Three Hundr. Ind. Subcon. Pter. With Rev. Cen. List 519. 2008. *Lycopodium pulcherrimum* Wallich ex Hooker & Greville, Ic. Fil.: t.38. 1827. *Lycopodium setaceum* Hameed ex D. Don, Prodr. Fl. Nepal. 18. 1825. *Lycopodium setaceum* Hameed ex D. Don var. *pulcherrimum* (Wallich ex Hooker & Greville) C.B. Clarke, Trans. Linn. Soc. Lond. II Bot. 1: 590. 1880. *Lycopodium taiwanense* C.M. Kuo, Taiwania 30: 51. 1985; Tsai & Shieh, Fl. Taiwan ed.2, 1: 43. 1994. *Phlegmariurus pulcherrimus* (Wallich ex Hooker & Greville) A. Löve & D. Löve, Taxon 26 (2–3): 324. 1977. *Urostachys pulcherrimus* (Wallich ex Hooker & Greville) Herter, Ind. Lycopod.: 77. 1949.

Epiphytic herb; stem pendulous, 10–50 cm long, 0.8–1.4 cm in diameter, 2–4 times forked. Leaves linear, 0.8–1.2 × 0.2–0.5 cm, erecto-patent, margins wavy, involucre slightly decurrent at base, midrib indistinct, yellowish-green. Sporophyll like vegetative leaf, fertile from the middle to the apex; sporangia in the axil of sporophylls, ca. 0.3–0.6 × 0.1–0.3 cm, kidney shaped, yellowish; spores 28–30 µm, tetrahedral, pitted, yellowish.

Excscicatae: West Bengal, Darjiling Hills, Rungdung, 05.07.2011, *Nayan Thapa 012A (SJCBF), 012B(LBH)*, 27° 01' 16" N and 88°16' 24.5" E, Alt.1455 ± 13.1 m

Local Distribution: Rungdung, Mungpoo, Mangwa, Balason, Barnesbeg.

Global Distribution: Sri lanka, India, Bhutan, Nepal.

LITERATURE CITED

- Acharya, K. & Acharya, R. 2001. *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. *Indian For.* 127: 959–952.
- Chowdhury, N.P. 1973. Notes on some Indian species of *Lycopodium* with remarks on distribution of the genus in India. *Trans. Nat. Inst. Sci. India* 1: 187–226.
- Das, A.P. 1995. Diversity of the Angiospermic flora of Darjeeling Hills. In A.K. Pandey (ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118–127.
- Das, A.P. 2004. Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 46(1-4): 1–18.
- Dixit, R.D. 1987. *Lycopodiaceae of India*. Bishen Singh Mahendra Pal Singh, Dehradun
- Fraser-Jenkins, C.R. 2008. *Taxonomic revision of three hundred Indian subcontinental pteridophytes with a revised census list*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Fraser-Jenkins, C.R.; Kandel, D.R. & Pariyar, S. 2015. *Ferns and fern-allies of Nepal 1* pp. 352. National Herbarium and Plant Laboratories, Dept. of Plant Resources, Ministry of Forests and Soil Conservation, Govt. of Nepal, Kathmandu, Nepal.
- Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. 2004. *The Pteridophytic flora of Eastern India*. Vol. 1. Botanical Survey of India, Kolkata.
- Hara, H. 1971. Pteridophyta. In, *The Flora of Eastern Himalayas*, 2nd report, University of Tokyo, Japan. Pp. 453–500.
- Holub, J. 1975. *Diphasiastrum*, a new genus in Lycopodiaceae. *Preslia* 47: 97–110.

- Jain, S.K. & Rao, R.R. 1977. *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.
- Matthew, K.M. 1971. Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97-102.
- Mehra, P.N. & Bir, S.S. 1964. *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Mirbel, C.F. & Brisseau, D.E. 1802. Vols 3-5 In: J.A.P. Lamarck & Brisseau de C.F. Mirbel (Eds), *Histoire Naturelle des vegetaux*, 15 vols. Deterville, Paris.
- O'Malley, L.S.S. 1907 (Repr. 1999). *Bengal District Gazetteers Darjiling*. Gyan Publishing House, New Delhi.
- Sen, T. & Sen, U. 1978. Morphology, anatomy and taxonomy of Lycopodiaceae of the Darjeeling Himalayas. *Fern Gaz.* 11(6): 413-427, figs. 1-5.

Diversity and distribution of *Botrychium* Swartz (Ophioglossaceae) in Darjiling Hills, West Bengal, India

Nayan Thapa¹ and Dorjay Lama

Department of Botany, St Joseph College, North Point, Darjeeling – 734104, West Bengal, India
¹Corresponding author, E-mail: nayanthapa16@yahoo.com

[Received 20.04.2016; Revised & accepted 17.06.2016; Published 30.06.2016]

Abstract

The paper deals with the diversity and distribution of *Botrychium* Swartz in West Bengal. It revealed the occurrence of 5 species in the study area. The distribution of species ranged from sub-tropical region up to the sub-alpine indicating wide ecological amplitude of the taxon. *Botrychium lunaria* (Linnaeus) Swartz was the rarest, confined to single location in sub-alpine region of Singalilla National Park.

Key words: Ophioglossaceae, *Botrychium*, distribution, ecological amplitude.

INTRODUCTION

The Pteridophytes are the second most diverse group of land plants after the angiosperms with 45 families (Smith *et al.* 2006; Christenhusz *et al.* 2011). The sister clades Ophioglossaceae and Psilotaceae are the most basal ferns, which diverged from other ferns approximately 300 mya (Pryer *et al.* 2004).

The genus *Botrychium sensu lato* belongs to the Ophioglossaceae, the taxonomy of which has been revised several times (Clausen 1938; Kato 1987). Basically five segregate genera are accepted which are *Botrychium* Swartz, *Botrypus* Michaux, *Japanobotrychium* Masamune, *Osmundopteris* (Milde) Small and *Sceptridium* Lyon (Kato 1987; Hauk 1995; Hauk *et al.* 2003). However, presently single genus *Botrychium* is recognized (Smith *et al.* 2006; Fraser-Jenkins 2008; Fraser-Jenkins *et al.* 2015). The genus *Botrychium* is represented by 50 – 60 species worldwide of which 12 species occur in China (www.efloras.org) and 7 species are found in the Indian sub-continent.

In the Indian state of West Bengal the genus *Botrychium* is restricted to the hilly terrain of Darjiling and one species is confined to the foothills and terai extending up to Duars. The hills of Darjiling lies between 26°31' and 27° 13' N latitude and between 87°59' and 88°53' E longitude (O'Malley 1907) and covers an area of 2436.55 km² with altitudinal variation ranging from ±150 m (at Sukna) to 3660 m (at Sandakphu – Phalut), presents diverse topographical conditions and offer suitable habitat for the occurrence of wide range of plants (Das 1995, 2004; Acharya & Acharya 2001). Though the district is floristically well explored but the occurrence of micro-niche in difficult terrains with negligible accessibility has lead some plants of the region remained undiscovered.

MATERIALS AND METHODS

Regular field trips were made during April 2010 to July 2014 to document the occurrence and distribution of different members of Ophioglossaceae in various vegetation tracts of

Darjiling Hills and processed into mounted herbarium-sheets following conventional techniques (Jain & Rao 1977). Specimens were identified by matching with the pre-identified specimens in the Herbarium of the Llyod's Botanical Garden, Darjiling as well as through consultation of published literature including (Mehra & Bir 1964; Hara 1971; Mathew 1971; Thapa 2002; Ghosh *et al.* 2004; Fraser-Jenkins 2008; Fraser-Jenkins *et al.* 2015). The distribution of different species was noted in the field note book along with the precise altitude and coordinates with a GPS.

Voucher specimens have been deposited in the Herbarium of the Llyod's Botanical Garden and at the Herbarium of the Botany department, St. Joseph College, Darjiling.

RESULT AND DISCUSSION

The field study revealed the occurrence of 5 species within the study area i.e. the hills of Darjiling. An artificial key for distinguishing the recorded species and their suitable descriptions have been provided for the recognition of these plants. The genus *Botrychium* is restricted to the hilly terrain of West Bengal having a land mass of 0.15 % harbours 71.42 % of the species occurring in the Indian sub-continent. *Botrychium daucifolium* and *Botrychium languniosum* are basically found in the sub-tropical forests. *Botrychium lunaria* is a sub-alpine species and the rest 2 species grow in temperate habitat. *Botrychium dusenii* Alston, based on molecular taxonomy and described from Argentina is said to replace *Botrychium lunaria* in North America (Stensvold 2008) which has not been accepted for the Asian population. Morphological differences among species may be subtle, especially in the *Botrychium lunaria* complex (Stensvold 2008). According to Paris *et al.* (1989) the three criteria those define cryptic species in homosporous ferns including *Botrychium* sp are: "(1) poor morphological differentiation, (2) reproductive isolation, and (3) misinterpretation of taxa as members of a single broader species." The erroneous error of nomenclature and confusion regarding *Botrychium dusenii* from Darjiling hills (Thapa *et al.* 2014) is being rectified as *Botrychium lunaria* in the present article.

Enumeration

Botrychium Swartz, J. Bot. (Schrader). 1800(2): 8, 110. 1801.

- 1a. Plants less than 10 cm in height.....*B. lunaria*
- 1b. Plants more than 10 cm in height..... 2
- 2a. Common stalk 1 – 4 cm long 3
- 2b. Common stalk more than 5 cm long 4
- 3a. Ultimate pinnules acute-tipped *B. ternatum*
- 3b. Ultimate pinnules rounded-tipped *B. multifidum* subsp. *robustum*
- 4a. Fertile spike arising above the second pinnae..... *B. langunisoum*.
- 4b. Fertile spike arising below the sterile lamina..... *B. daucifolium*.

Botrychium daucifolium Wallich *ex* Hooker & Greville, Ic, Fil.: t.161. 1829; Beddome, Handb. Ferns Brit. India (with Supl), 469. 1892; Dixit, A Cen. Indian Pterid. 21 .1984; Thapa, Pterid. Nepal 32. 2002; Fraser-Jenkins, Tax. Rev. Three Hundred Ind. Subcon. Pterid. With Revi. Cen. List 526. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal 1: 92. 2015.

Sceptridium daucifolium (Wallich ex Hooker & Greville) Lylon, Bot. Gaz. 40: 457 (1905); Ghosh, Pterid. Flo. East. Ind. 1: 38 – 39. 2004. *Botrychium subcarnosum* Wallich ex Hooker & Greville, Hook. Bot. Misc. 3: 222. 1883. *Botrychium subcarnosum* Wallich, List no. 49 (1829), *nom. nud.*

Plants lithophytic, terrestrial, erect; rhizomes erect, cylindrical, bearing fleshy roots. Fronds 27 – 50 cm; stipe 12–20 × 0.3 – 0.5 cm, greenish, fleshy, hairy; sterile lamina glabrous, tri-pinnatifid, subpentagonal, 15–30 × 16–24 cm, herbaceous; pinnae 6 – 7 pairs, alternate, shortly stalked; basal pinnae largest, triangular, 7–12 × 4–8 cm; pinnules 4 or 5 pairs, narrowly ovate to broadly lanceolate, lower basal pinnule largest, 2 – 3 × 1–1.5 cm, ultimate segments sharply serrate, acute, rachis and costae with sparse white, long hairs. Sporophore arising from the middle of common stipe, as long as sterile lamina, with stalk 14–16 cm, bi-tripinnate, with long soft hairs; sporangia globose, shortly stalked, 0.5 – 1 cm in diam.; spores yellowish, spherical, smooth, 30 – 35 µm.

Exsiccatae: West Bengal, Darjiling hills, Mirik, 12.07.2011, *Nayan Thapa & Dorjay Lama*, 023A (SJCBH), 023B (LBH); N 26°54' 1.23" and E 88°10' 2.31"; Alt: 1436 ± 15 m.

Global Distribution: Bhutan, India, Indonesia (Sumatra), Myanmar, Nepal, Philippines, Sri Lanka, Vietnam.

Local Distribution: Mirik, Mungpoo, Mangwa, Sukuna, Relli; 160 – 1436 m.

Botrychium lanuginosum Wallich ex Hooker & Greville, Ic. Fil.: 1, t.29. 1831; Mehra & Bir, Pterid. Fl. Darj. Sikk. Him. 102. 1965; Thapa, Pterid. Nepal 32. 2002; Fraser-Jenkins, Tax. Rev. Three Hundred Ind. Subcon. Pterid. With Revi. Cen. List 526. 2008; Fraser-Jenkins, Kandel & Pariyar, Ferns and fern-allies of Nepal 1: 93. 2015.

Botrychium lanuginosum Wallich ex Hooker & Greville *var nepalensis* (Nishida) N.C. Nair & R.D. Dixit, J. Bomb. Nat. Hist. Soc. 78(3): 447. 1981. *Botrypus lanuginosum var. nepalensis* (Nishida) S.R. Ghosh, J. Econ. Tax. Bot. 5(1): 246. 1984.

Plants terrestrial, medium sized, 26–75 × 5–25 cm; rhizomes short, erect; stipes stramineous, 12–30 × 0.3 – 0.6 cm, fleshy, hairy; hairs white, 0.5–1 cm long. Sterile lamina 3 – 4 pinnate, deltoid to sub-pentagonal, 14 – 45 × 5 – 25 cm, thin, herbaceous, pubescent; pinnae 5 – 8 pairs, alternate, long stalked, 2 – 6 cm apart, lowest pair largest, 7 – 20 × 5 – 10 cm; pinnules 6 – 10 pairs, alternate, stalked, basiscopic pinnules larger than acroscopic ones, basal pinnule largest, ultimate lobes acute; veins free, simple or forked. Sporophore with stalk 2 – 10 cm, 3-pinnate, hairy, arising between the lowest two pairs of pinnae of sterile lamina. Sporangia globose, brown, in two rows, on ultimate branches of panicles; spores yellowish to pale green, spherical to tetrahedral, 34 × 30 µm.

Exsiccatae: West Bengal, Darjiling hills, Third mile, 15.07.2011, *Nayan Thapa & Dorjay Lama* 024A (SJCBH), 024B (LBH); N 27° 00' 31.7" and E 88° 17' 37.4", Alt: 2154 ± 15 m.

Global Distribution: India, Sri Lanka, Bhutan, Indonesia, Nepal, Philippines, Taiwan.

Local Distribution: Mangwa, Chitrey, Pandam, Alu Bari, Makaibari, Third Mile; 1200 – 2120 m.

Botrychium lunaria (Linnaeus) Swartz, Schrad. J. Bot. 1800 (2): 110 .1801; Beddome, Handb. Ferns Brit. India (with Supl), 469, f.293. 1883.

Osmunda lunaria Linnaeus, Sp. Pl. 2: 1004. 1753. *Botrychium dusenii* Alston, Lilloa 30: 107. 1960.

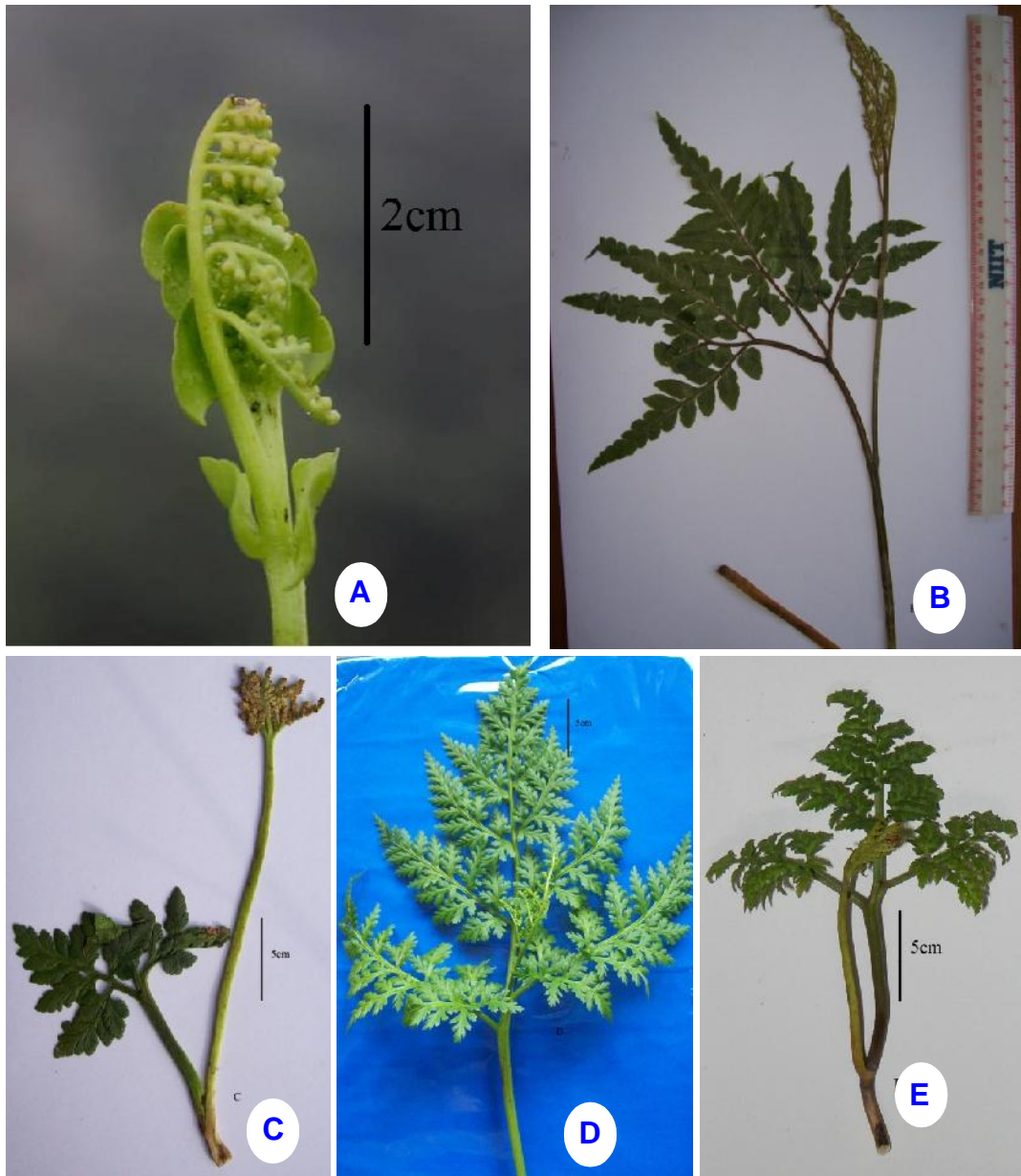


PLATE – I. Different recorded species of *Botrychium*: **A.** *B. lunaria* (Linnaeus) Swartz; **B.** *B. daucifolium* Wallich ex Hooker & Greville; **C.** *B. multifidum* (Gmelin) Ruprecht subsp. *robustum* Fraser-Jenkins *et al.*; **D.** *B. lanuginosum* Wallich ex Hooker & Greville; **E.** *B. ternatum* (Thunberg) Swartz

Plants small, terrestrial, erect, 5–15 cm tall; rhizomes short, erect; common stipe greenish, cylindrical, 4–12 × 0.2–0.3 cm, hollow. Sterile lamina pinnate, sessile, oblong, 3–8 × 1.5–2.5 cm, fleshy, leathery, glabrous, apex rounded or blunt; pinnae 4–6 pairs, approximate, opposite, flabellate, lunate, 1–1.5 × 0.2–0.4 cm, shortly stalked to almost sessile, margin entire, veins free, flabellately forked, glabrous. Sporophore stalked, 4–7 cm long, glabrous, panicle 2–3-pinnate, 3–6 × 1.5–2 cm; sporangia sessile, large, 0.5–1 cm in diam.; spores spherical, yellowish, verrucose, 20–25 μm.

Exsiccatae: West Bengal, Darjiling hills, Sandhakphu, 24.06.2013, *Nayan Thapa & Dorjay Lama*, 142A (SJCBH), 014252 (LBH), N 27°07' 41.4" and E 87°59' 29.5", Alt: 3521 ± 11 m.

Global Distribution: Asia, Australia, Europe, North America, Pacific islands.

Local distribution: Sandhakphu, Phalut; 3000 – 3660 m.

Botrychium multifidum (S.G. Gmelin) Ruprecht subsp. ***robustum*** (Ruprecht *ex Milde*) Fraser-Jenkins, Kandel & Pariyar, *Ferns and fern-allies of Nepal* 1: 159. 2015.

Osmunda multifidia Gmelin, Nov. Comm. Acad. Sci. Pterid. 12: 517, t.11. 1768. *Sceptridium multifidum* (Gmelin) Nishida *ex Tagawa*, J. Jap. Bot. 33: 200. 1958. *Sceptridium robustum* (Ruprecht *ex Milde*) Lyon, Bot. Gaz. 40: 458. 1905; *Botrychium multifidum* (Gmelin) Ruprecht, *Beitr. Pflanzenk. Russ. Reiches*. 40. 1859. *Botrychium rutaefolium* var. *robustum* Ruprecht

Plants lithophytic, terrestrial; rhizomes erect, cylindrical. Fronds 35 – 40 cm tall; sterile lamina stalk 2–7 × 0.5 – 1 cm, fleshy; lamina bi- or tripinnatifid, dull green, pentagonal, 6 – 11 × 7 – 11 cm; pinnae 4 – 6 pairs, sub-opposite, lower ones stalked; basal pinnae largest, ovate to triangular, 4 – 6 × 2.5 – 4.5 cm, bipinnate to tripinnatifid; pinnules 3 – 4 pairs, narrowly oblong-lanceolate, lower basal pinnule longest, 2.5 – 4 × 1.5 – 2 cm; ultimate segments oblong, dentate; costae and costules beneath sparsely lanuginose, lateral veins obscure. Sporophore arising from middle or lower part of common stipe, with longer stalk, 10 – 25 cm, bi-tripinnate, sporangia ellipsoid-globose, in ultimate branches of panicle; spore creamish, spherical – ellipsoidal, 28 – 33 µm.

Exsiccatae: West Bengal, Darjiling hills, Gayribas, 13.07.2013, *Nayan Thapa & Dorjay Lama*, 0174A (SJCBH), 0174B (LBH), N 27°03' 31.7" and E 88°01' 25"; Alt: 2501 ± 15 m.

Global Distribution: Japan, Korea, Russia, India, Nepal, Bhutan.

Local Distribution: Gayribas, Alubari, Phalut; 2550 – 3540 m.

Botrychium ternatum (Thunberg) Swartz, *Scrad. J. Bot.* 1800 (2), 111. 1801; Beddome, *Handb. Ferns Brit. India* (with Supl), 110. 1892; Dixit, *A Cen. of Indian Pterid.* 22. 1984; Thapa, *Pterid. Nepal* 33. 2002; Fraser-Jenkins, *Tax. Rev. Three Hundred Ind. Subcon. Pterid. With Revi. Cen. List* 526. 2008; Fraser-Jenkins, Kandel & Pariyar, *Ferns and fern-allies of Nepal* 1: 198. 2015.

Osmunda ternate Thunberg, *Fl. Jap.*: 329, t.32. 1784. *Sceptridium ternatum* (Thunberg) Lyon, Bot. Gaz. 40, 458. 1905.

Plants terrestrial, lithophytic, erect, small; rhizomes erect, short, annually producing single frond; fronds 15 – 25 cm; Sterile lamina stalk 5–12 × 0.2 – 0.4 cm; ternate, dull green, sub-pentagonal, 5 – 10 × 8 – 12 cm, herbaceous, glabrous, acute; pinnae sub-deltoid, basal ones stalked; segments broadly elliptic, sparsely crenate, acute, veins pinnate, free. Sporophore arising 2 – 4 cm above base of common stipe, 3-pinnate, stalk 12 – 25 cm; sporangia globose, 0.5 – 0.7 cm; spore yellowish, tetrahedral, 33 × 30 µm.

Exsiccatae: West Bengal, Darjiling hills, Mungpoo, 02.08.2013, *Nayan Thapa & Dorjay Lama*, 0190A (SJCBH), 0190B (LBH); N 27° 00' 27" and E 88° 17' 33"; Alt: 1950 ± 12 m.

Global Distribution: India, Japan, Korea, Nepal, and Vietnam, China.

Local distribution: Mungpoo, Kafer, Deer Park; 1850 – 2430 m.

LITERATURE CITED

- Acharya, K. & Acharya, R. 2001. *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. *Indian For.* 127: 959 – 952.
- Christenhusz, M.J.; Zhang, X.C. & Schneider, H. 2011. A linear sequence of extant families and genera of lycophytes and ferns. *Phytotaxa* 19: 7– 54.
- Clausen, R.T. 1938. A monograph of the Ophioglossaceae. *Mem. Torr. Bot. Club* 19: 1 – 177.
- Das, A.P. 1995. Diversity of the Angiospermic flora of Darjeeling Hills. In: A.K. Pandey (ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118 – 127.
- Das, A.P. 2004. Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 43(1-4): 1 – 18.
- Fraser-Jenkins, C.R. 2008. *Taxonomic revision of Three hundred Indian Subcontinental Pteridophytes with a revised census list*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Fraser-Jenkins, C.R., Kandel, D.R. & Pariyar, S. 2015. *Ferns and fern-allies of Nepal*, Vol. 1. National Herbarium and Plant Laboratories, Dept. of Plant Resources, Ministry of Forests and Soil Conservation, Govt. of Nepal, Kathmandu, Nepal.
- Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. 2004. *The Pteridophytic flora of Eastern India*. Vol. 1. Botanical Survey of India, Kolkata.
- Hara, H. 1971. Pteridophyta in *The Flora of Eastern Himalayas*, 2nd report, University of Tokyo, Japan. Pp. 453 – 500.
- Hauk, W.D. 1995. A molecular assessment of relationships among cryptic species of *Botrychium* subgenus *Botrychium* (Ophioglossaceae). *American Fern Journal* 85: 375 – 394.
- Hauk, W.D.; Parks, C.R. & Chase, M.W. 2003. Phylogenetic studies of Ophioglossaceae: Evidence from *rbcL* and *trnL-F* plastid DNA sequences and morphology. *Mol. Phylo. Evol.* 28: 131– 151.
- <http://www.efloras.org>. Missouri Botanical Garden, St. Louis, MO & Harvard University Herbaria, Cambridge, MA.
- Jain, S.K. & Rao, R.R. 1977. *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.
- Kato, M. 1987. A phylogenetic classification of Ophioglossaceae. *Gardens' Bull. Singapore* 40: 1 – 14.
- Matthew, K.M. 1971. Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97 – 102.
- Mehra, P.N. & Bir, S.S. 1964. *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- O'Malley, L.S.S. 1907 (Repr. 1999). *Bengal District Gazetteers Darjiling*. Logos Press. New York.
- Paris, C.A.; Wagner, F.S. & Wagner, W.H. 1989. Cryptic species, species delimitation, and taxonomic practice in the homosporous ferns. *American Fern J.* 79: 46 – 54.
- Pryer, K.M.; Schuettpelz, E.; Wolf, P.G., Schneider, H., Smith, A.R. & Cranfill, R. 2004. Phylogeny and evolution of ferns (monilophytes) with a focus on the early leptosporangiate divergences. *American J. Bot.* 91: 1582 – 1598.

- Smith, A.R.; Pryer, K.M.; Schuettpelz, E.; Korall, P.; Schneider, H & Wolf, P.G. 2006 . A classification for extant ferns. *Taxon* 55: 705 – 731.
- Stensvold, M.C. 2008. *A taxonomic and phylogeographic study of the Botrychium lunaria complex*. Ph.D. Dissertation, Iowa State University, Ames, Iowa, USA.
- Thapa, N. 2002. *Pteridophytes of Nepal*. National Herbarium and Plant Laboratories, Godavary, Lalitpur, Nepal.
- Thapa, N.; Tamang, K. & Lama, D. 2014. Occurrence of *Botrychium dusenii* Alston [Botrychiaceae] in Darjiling Hills: a new record for the state of West Bengal, India. *Pleione* 8(1): 214 – 216.

Occurrence of *Pteris austrosinica* (Ching) Ching [Pterideaceae] in Darjiling Hills: a new record of endemic Chinese element in Indian Sub-continent.

Nayan Thapa¹ and Dorjay Lama²

Department of Botany, St Joseph College, Darjiling- 734104, West Bengal, India

¹Corresponding author: E-mail: nayanthapa16@yahoo.com

Abstract: Recent collection of *Pteris austrosinica* (Ching) Ching [Pterideaceae] from the tropical habitat of Singla (343 m ± 10) in Darjiling hills is a new record of its occurrence in Indian subcontinent. The plant is a Chinese element, being stated as endemic to Guangdong, Guangxi, Jiangxi in China and its discovery in Darjiling hills has widened its geographical distribution. It assumes significance as this species has been included in the threatened Pteridophytes in Asia.

[Nayan Thapa and Dorjay Lama. Occurrence of *Pteris austrosinica* (Ching) Ching [Pterideaceae] in Darjiling Hills: a new record of endemic Chinese element in Indian Sub-continent. *Researcher* 2015;7(5):36-38]. (ISSN: 1553-9865). <http://www.sciencepub.net/researcher>. 7

Key words: *Pteris austrosinica*, Endemic, New record, Darjiling Hills, Indian subcontinent.

Introduction

Pteris L. has a global distribution of Ca. 250-300 species (<http://www.efloras.org>), is represented in India by 50 spp and 7 sub species (Fraser-Jenkins, 2008). Darjiling and Sikkim Himalaya, a segment of eastern Himalaya in the Indian subcontinent rich in genus *Pteris* L. with occurrence of 22 sp and 5 sub sp. The District of Darjiling, West Bengal lies between 26°31' and 27° 13' N latitude and between 87°59' and 88°53' E longitude (O'Malley 1907). The Hills of Darjiling with an area of 2436.55 km² with altitudinal variation ranging from 150 m (Sukna) to 3660 m (Sandakphu - Phalut), presents diverse topographical condition and offer suitable habitat for the occurrence of wide range of plants (Das 1995, 2004; Acharya & Acharya 2001). Floristically well explored but the occurrence of micro-niche in a difficult terrain with negligible accessibility has lead some plants of the region to be undiscovered. Recently *Pteris roseoilacina* Hieron., a Chinese element was reported from Majuwa, a forest village in the fringes of Singallila National park, Darjiling (Fraser-Jenkins, 2008).

Materials and Method

Regular field trips were made during April 2012 to July 2014 for enumeration, documentation and studies of Fern and fern allies in various forest tracts of Darjiling hills and processed into mounted herbarium-sheets following conventional techniques (Jain & Rao, 1977). Specimen were identified by matching with the pre-identified specimens in the Herbarium of the Llyod's Botanical Garden, Darjiling as well as through consultation of published literature including Mehra & Bir (1964); Hara (1966); Mathew (1971); Chowdhury (1973); Ghosh *et al* (2004) and

Fraser-jenkins (2008). As the plant couldn't be identified, further literature survey was carried out utilizing the www.efloras.org, Ching (1978) and Ching and wu (1990).

Result and Discussion

The plant was identified as *Pteris austrosinica* Ching [Pterideaceae]. Voucher specimens have been deposited in the Herbarium of Llyod's Botanical Garden and at the Herbarium of the Botany department, St. Joseph College, Darjiling. However, available literature shows the distribution of the species, being endemic and threatened species of China (Ebihara, 2012) Thus the present collection of the species from Darjiling Hills forms the new record for the region and the Indian subcontinent. A brief description of the species a long with sketches is provided here for its easy identification.

***Pteris austrosinica* (Ching) ching**, Acta Phytotax. Sin. 10: 302. 1965.

Pteris wallichiana J. Agardh var. *austrosinica* Ching, Bull. Dept. Biol. Sun Yatsen Univ. 6. 27. 1933.

Plant terrestrial, erect, ca. 2 m tall, Rhizome erect, short, thick, ca. 2.5 cm in diameter. Stem woody, apex with brown scales. Fronds clustered, stipe castaneous, up to 1.5 m, ca. 2 cm in diameter, glabrous, broadly grooved adaxially. Rachis chestnut, narrowly grooved adaxially. Lamina usually 3-pinnatipartite, pentagonal-broadly ovate in outline, 90-120 × 90 cm, central division a long ovate column, 75-85 cm, middle ones 25 cm wide, stalked (8-10 cm), lateral branches smaller, usually again divided; lateral pinnules 14-20 pairs, alternate, decumbent, sessile or slightly shortly stalked, basal several pairs slightly shorter, ca. 1.5 cm apart, middle pinnules lanceolate,

15-20 × 3-4 cm, base broadly cuneate, nearly symmetrical, deeply pectinately divided leaving broadly winged costule, apex shortly linear-caudate; segments 22-30 pairs, alternate, sinuses obtuse-acute, 0.3-0.55 cm wide, slightly decumbent, falcate-lanceolate, 2-2.5 × ca. 0.3 cm, basally enlarged, apex shortly acuminate, sterile apex obtusely dentate; terminal pinnules similar to median lateral pinnules, stalked (ca. 1 cm); costules straw-colored, glabrous,

with short spines on both sides of adaxial groove; veins conspicuous, oblique, anastomosing to form a series of narrow areoles along costa, several simple veinlets reaching incision in outer edge of arcuate vein, and veinlet free outward from areole, and basal veinlet of segment 2-forked at base; lamina brown-green, papery when dried, below with brown slender multicellular hairs.

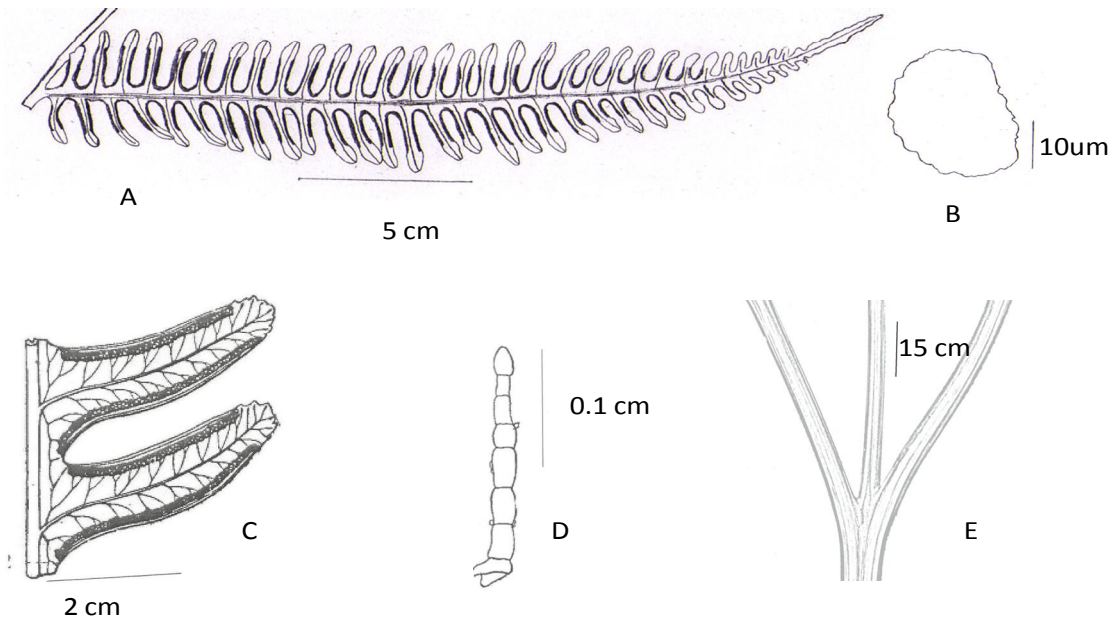


PLATE I: *Pteris austrosinica*; A. Pinnules, B. . Spore; C.Ultimate segment, D. Hairs on the Costules, E. Tripartite stipe apex

Exsiccates: West Bengal, Darjiling hills, Singla, 24.06.2013, *Nayan Thapa* 250A(SJCBH), LB014240 (Llyod's Botanical Garden).

Global Distribution: China (Guangdong, Guangxi, Jiangxi).

Local Distribution: Singla (N27°06'45.8'' EO88°16'31''; Alt 335±14).

Literature Cited

- Acharya, K. & Acharya, R. 2001. *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. *Indian For.* 127: 959 – 952.
- Ching, R.C & Wu, S.H. 1990. *Pteris*, in Ching, R.C & Shing, K.H. (eds.), *Flora Reipublicae Popularis Sinicae* 3(1):10-89. Science Press, Beijing.
- Ching, R.C. 1965. *Pteris austrosinica*, *Act. Phytotax. Sinica* 16(3):8-19.
- Ching, R.C. 1978. The Chinese fern families and genera. Systematic arrangement and historical origin, *Act. Phytotax. Sinica* 16(3):8-19.
- Ching, R.C. 1978. The Chinese fern families and genera. Systematic arrangement and historical origin, *Act. Phytotax. Sinica* 16(4):16-37.
- Chowdhury, N.P. 1973. *The Pteridophyte Flora of the Upper Gangetic Plain*. Navayug Traders. New Delhi.
- Das, A.P. 1995. Diversity of the Angiospermic flora of Darjeeling Hills. In A.K. Pandey (ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118 – 127.
- Das, A.P. 2000. Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 46(1-4): 1 – 18. Delhi, India.
- Ebihara, A; Kato, M; Fraser Jenkins, C. R; Parris, B.S; Zhang, X.C; Yang, Y.H; Chioiu, W; Chang, H.M; Lindsay, S; Middleton, D; Praptosuwiryo, T.N; Amoroso, V.B; Barcelona, J.F; Ranil,

- R.H.G; Park, C.H; Murakami. N & Hoyo, A. Rare and Threatened Pteridophytes of Asia 1. An Enumeration of Narrowly Distributed Taxa. *Bull. Natl. Mus. Nat. Sci.*, Ser. B, 38(3), pp. 93–119, August 22, 2012.
10. Fraser-Jenkins, C. 2008. *Taxonomic revision of Three hundred Indian Subcontinental Pteridophytes with a revised census list*. Bishen Singh and Mahendra Pal Singh, Dehradun.
 11. Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. 2004. *The Pteridophytic flora of Eastern India*. Vols. 1. Botanical Survey of India, Kolkata.
 12. Hara, H. 1966. *The Flora of Eastern Himalayas*. University of Tokyo, Japan. Pp. 453–500.
 13. http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=242341962.
 14. Jain, S. K. & Rao, R.R. 1977. *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.
 15. Matthew, K.M. 1971. Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97 – 102.
 16. Mehra, P.N. & Bir, S.S. 1964. *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh and Mahendra Pal Singh, Dehradun.
 17. O'Malley, L.S.S. 1907 (Repr. 1999). *Bengal District Gazetteers Darjiling*. Logos Press. New.

5/9/2015

Occurrence of *Botrychium dusenii* Alston [Botrychiaceae] in Darjiling Hills: a new record for the state of West Bengal, India

Nayan Thapa¹, Karma Tamang and Dorjay Lama

Department of Botany, St Joseph College, Darjiling- 734104, West Bengal, India

¹Corresponding author: E-mail: nayanthapa16@yahoo.com

[Received 20.03.2014; Revised 05.05.2014; Accepted 20.05.2014; Published 30.06.2014]

Abstract

Recent collection of *Botrychium dusenii* Alston [Botrychiaceae] from the subalpine habitat of Sandhakphu (3660 m) in Darjiling hills is a new record of its occurrence for the state of West Bengal. The plant is very sparsely distributed in the area.

Key words: *Botrychium dusenii*, New record, Darjiling hills, West Bengal

The District of Darjiling, West Bengal lies between 26°31' and 27° 13' N latitude and between 87°59' and 88°53' E longitude (O'Malley 1907). The hills of Darjiling forms a small segment of Eastern Himalaya and is spreading over around 2436.55 km² or 77 % area of the Darjiling District. The altitudinal variation ranges from 150 m (at Sukna) to 3660 m (at Sandakphu-Phalut) which presents diverse topographical condition and offer suitable habitat for the occurrence of wide range of plants (Das 1995, 2004; Acharya & Acharya 2001).

Regular field trips were made during April 2012 to July 2013 for documentation of fern and fern allies in various forest tracts of Darjiling hills and the collected specimens were processed into mounted herbarium-sheets following conventional techniques (Jain & Rao 1977). Specimen were identified by matching with the pre-identified specimens in the Herbarium of the Llyod's Botanical Garden, Darjiling (Accession no:1585, location: near quantiola sikkim, Altitude: 12000m, Collected by Smith and Cave) as well as consulting published literature including Mehra & Bir (1964); Hara (1966); Mathew (1971); Chowdhury (1973); Ghosh *et al* (2004) and Fraser-jenkins (2008). The plant was identified as *Botrychium dusenii* Alston of Botrychiaceae. Voucher specimens have been deposited in the Herbarium of Llyod's Botanical Garden and at the Herbarium of the Botany department, St. Joseph college, Darjilling. However, while studying the distribution of the species, it was revealed that the plant was not recorded previously from the Darjiling hills as well as from the state of West Bengal. So, the present collection of the species from Darjiling Hills forms the new record for this region as well as for the state of West Bengal. A brief description of the species along with sketches is provided here for its easy identification.

Botrychium dusenii Alston, Lilloa 30: 107. 1960. *Botrychium lunaria* (Linnaeus) Swartz in Schrad. J. 1800 (2): 110. 1801; Clarke in Trans.Linn. Sco. Lond., II, Bot., 1, 587, 1880; Beddome, Handb. Ferns Brit. India (with Suppl.), 469, t. 293. 1892. *Osmunda lunaria* Linnaeus, Sp. Pl. 2: 1004. 1753.

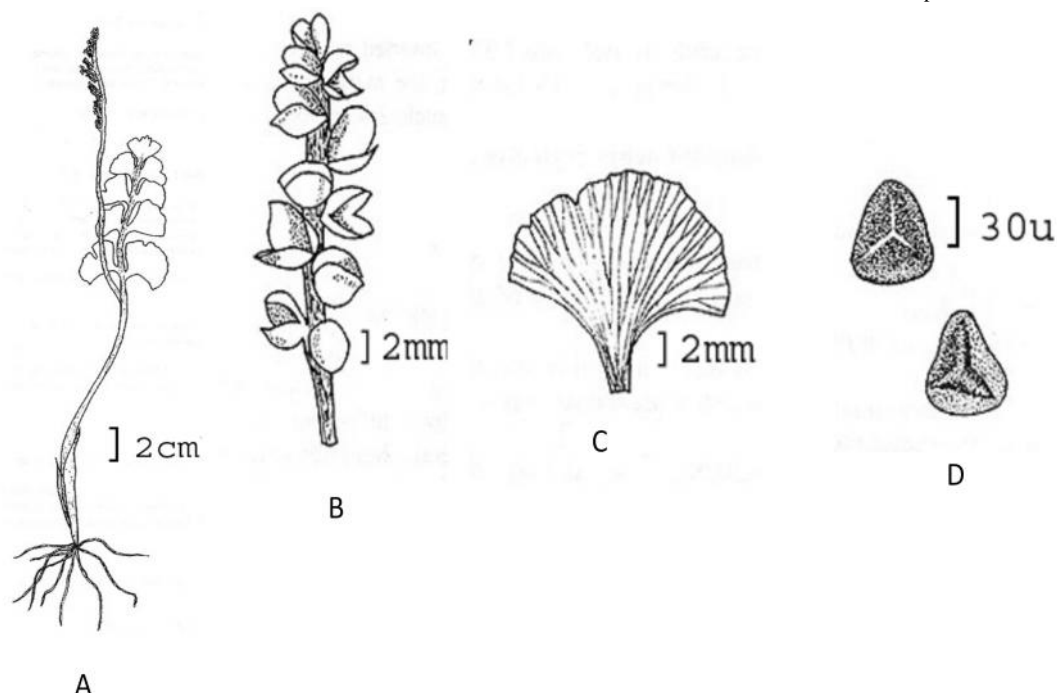


PLATE - I: *Botrychium dusenii* Alston: A. Habit; B. Fertile sporophore; C. Sterile pinnae showing venation; D. Spores

Rhizome short, erect, annually producing 1 frond, 5 – 15 cm tall. Common stipe greenish, cylindrical, 4 – 12 cm, 2 – 3 mm in diameter, hollow, succulent. Sterile lamina pinnate, sessile, broadly lanceolate or oblong, 3 – 8 x 1.5 – 2.5 cm, fleshy, leathery, glabrous, apex rounded or blunt, pinnae 4 – 6 pairs, approximate, often overlapping, opposite or almost opposite, flabellate, lunate or reniform, 1 – 1.5 cm long and wide, shortly stalked to almost sessile, lowest 1 or 2 pairs 1 – 2 cm apart, margin entire, veins free, flabellately forked, glabrous. Sporophore with stalk 4 – 7 cm, glabrous; panicle 2 – 3 pinnate, racemose, 3 – 6 x 1.5 – 2 cm, glabrous; sporangia sessile, large, 0.5 – 1 mm in diameter. Spores yellowish, 40 – 50 μm, tetrahedral, verrucose.

Exsiccates: West Bengal, Darjiling hills, Sandhakphu, 24.06.2013, *Nayan Thapa* 142A (SJC BH), LBG014252 (Llyod's Botanical Garden).

Distribution: India (Western Himalaya, Sikkim, and now from West Bengal), Nepal, China, Thailand, Australia, North America, Pacific Island.

LITERATURE CITED

- Acharya, K. & Acharya, R. 2001. *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. *Indian For.* 127: 959 – 952.
- Chowdhury, N.P. 1973. *The Pteridophyte Flora of the Upper Gangetic Plain*. Navayug Traders. New Delhi.
- Das, A.P. 1995. Diversity of the angiospermic flora of Darjeeling Hills. In A.K. Pandey (ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118 – 127.

- Das, A.P. 2000. Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 46(1-4): 1 – 18.
- Fraser-Jenkins, C. 2008. *Taxonomic revision of Three hundred Indian Subcontinental Pteridophytes with a revised census list*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. 2004. *The Pteridophytic flora of Eastern India*. Vols. 1. Botanical Survey of India, Kolkata
- Hara, H. 1966. *The Flora of Eastern Himalayas*. University of Tokyo, Japan. Pp. 453 – 500.
- Jain, S.K. & Rao, R.R. 1977. *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.
- Matthew, K.M. 1971. Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97 – 102.
- Mehra, P.N. & Bir, S.S. 1964. *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- O'Malley, L.S.S. 1907 (Repr. 1999). *Bengal District Gazetteers Darjiling*. Logos Press. New Delhi, India.
- Smith, A.R; Pryer, K.M; Schuettpflez, E; Korall, P.; Schneider, H. & Wolf, P.G. 2006. A Classification for Extant ferns. *Taxon* 55(3):705-731.

Full Length Research Paper

Ethno-botany and Utilization of Fern and Fern-allies as Non Timber Forest Product in Darjiling Hills.

Nayan Thapa & Dorjay Lama

Department of Botany, St. Joseph College, Darjiling, India.

Article history

Received: 15-04-2016

Revised: 27-04-2016

Accepted: 21-05-2016

Corresponding Author:

Nayan Thapa

Department of Botany,

St. Joseph College,

Darjiling, India.

Abstract

This paper deals with the ethno-medicinal use and utilization of ferns and fern allies of Darjiling hills, an alienated group in terms of study compared to angiosperms. Darjiling hills is inhabited by multiethnic race in remote region, in accessible by modern transport in 21st century. Due to lack of facility they are directly dependent on forest resources for day to day purposes. An attempt has been made to record the uses of 39 species, which falls under different category as ethno-medicine, food, fodder –cattle bed and ornamentals.

Keywords: Darjiling, ethno-medicine, ethno-botany.

Introduction

The District of Darjiling, West Bengal lies between 26°31' and 27° 13' N latitude and between 87°59' and 88°53' E longitude (O'Malley 1907). The hill of Darjiling is a segment of Eastern Himalaya and is spreading over around 2436.55 km² or 77 % area of the Darjiling District. The altitudinal variation ranges from 150 m (at Sukna) to 3660 m (at Sandakphu-Phalut) which presents diverse topographical condition and offer suitable habitat for the occurrence of wide range of plants (Das 1995, 2004; Acharya & Acharya 2001). The ethnobotany of the region has been studied by different worker like Bhujel (1996), Bhujel *et al.* (1984), Yonzon *et al.* (1981), Yonzon *et al.* (1984, 1985, 1996), Lama (1989), Rai *et al.* (1998) and Rai & Bhujel (1997, 1999, 2002), Chettri *et al.* (2003) on identification and enlisting such plants in the past. But they mostly concentrated upon the angiosperms and alienated the entire group of Fern and Fern allies.

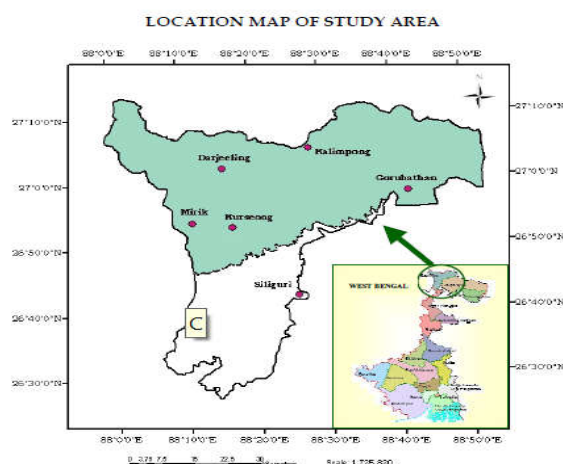


Fig 1. Location of Darjiling Hills in west Bengal

Materials and Methods

Regular field trips were made during April 2011 to July 2014 for documentation of ethnobotanical information of fern and fern allies in remote forest villages of Darjiling hills. The information were collected through interviews to local healer, herbal practitioner, Phedangba, Mata, Jhankri, Bijuwa village Head. Local market were surveyed throughout the year and plants were collected, photographed and documented. The collected specimens were processed into mounted herbarium-sheets following conventional techniques (Jain & Rao 1977). Specimen were identified by matching with the pre-identified specimens in the Herbarium of the

Llyod's Botanical Garden, Darjiling as well as consulting published literature including Mehra & Bir (1964); Hara (1966); Mathew (1971); Chowdhury(1973); Ghosh *et al* (2004) and Fraser-jenkins (2008).

Data Collection and Analysis

The survey was conducted in different forest village; local market as well as questionnaires was made for general people for documenting a raw data. This raw data served as a primary source while data mining and the information from herbalist served as a secondary source (Rai & Bhujel,1999; Rai *et al*,1998; Chettri *et al*,2003; Yonzon *et al* 2011). The available raw data was verified in term of triplicate from different forest village and accepted for documentation.

Results

The study revealed rich traditional knowledge of ethnic people of Darjiling hills, natural resources from the surrounding area was utilized for day to day purposes. In this survey it was found that 39 species of fern and fern allies are used by people for different purposes, where 12 species were used as medicine. Young croizer of Fourteen species of the genus *Diplazium*, *Deparia* and *Cyathea* were utilized as vegetables. Five species of ferns were utilized as cattle bed (Sottar) for domesticated animals and ten species of fern were used for ornamental purposes. *Pteridium revolutum* fronds were used to cover the sowed zinger rhizome in order to insulate the heat loss for speedy germination and to safe guard from domesticated animals.

Table 1:Cattle bed ferns

Sl.No.	Scientific Name	Local Name	Family	Uses
1.	<i>Pteridium revolutum</i>	Sottarey uniyo	Dennstaedtiaceae	Cattle bed ferns
2.	<i>Glechiema giganteum</i>	Sottar	Gleicheniaceae	Used to cover the sowed zinger rhizome and used as cattle bed ferns too.
3.	<i>Dicranopteris taiwanseis</i>	Sottar	Gleicheniaceae	Cattle bed ferns
4.	<i>Dicranopteris lanigera</i>		Gleicheniaceae	Cattle bed ferns.

Table 2: Edible fern

Sl. no	Scientific name	Local name	Family	Uses
1	<i>Diplazium dilatatum</i>	Lekh Chipley ningro	Woodsiaceae	Young fronds edible
2	<i>Diplazium esculentum</i>	Auley Chipley ningro	Woodsiaceae	Young fronds edible
3	<i>Diplazium kawakamii</i>	Jire ningro	Woodsiaceae	Young fronds edible
4	<i>Diplazium forrestii</i>	Lekh chipley ningro	Woodsiaceae	Young fronds edible
5	<i>Diplazium himalayensis</i>	Danthey ningro	Woodsiaceae	Young fronds edible
6	<i>Diplazium succulentum</i>	Lekh Chipley ningro	Woodsiaceae	Young fronds edible
7	<i>Diplazium maximum</i>	Sawney ningro	Woodsiaceae	Young fronds edible
8	<i>Diplazium spectabile</i>	Kalo ningro	Woodsiaceae	Young fronds edible
9	<i>Diplazium sikkimensis</i>	Sawaney ningro	Woodsiaceae	Young fronds edible
10	<i>Diplazium javanicum</i>	Sano Chipley ningro	Woodsiaceae	Young fronds edible
11	<i>Deparia boryana</i>	Ghew ningro	Woodsiaceae	Young fronds edible
12	<i>Tectaria fuscipes</i>	Rato lekh ningro	Dryopterideaceae	Young fronds edible
13	<i>Angiopteris indiaca</i>	Gaikhurey uniyo	Maratiaceae	Rhizomes edible
14	<i>Cytha chinensis</i>	Rukh uniyew	Cyatheaceae	Young croizer edible

Discussion

The remote area where modern medical facilities couldn't be available by people had their faith on traditional herb for healing of wounds, Pneumonia, chest congestion etc. This traditional knowledge tends to be a blessing in disguise as it facilitated to be the source of income for down turn people. The young croizer of edible ferns were utilized as vegetable, collected from the forest area and were taken to local market to earn a living. In the survey we could find some fern allies which were taken by Flower shop as ornamentals. The point of concern is the over exploitation of some species like *Nephrolepis cordifolia* whose foliage is used for decoration purposes and its tubers are used for ethno-medicine purposes which has led to a steady decline in the population of this species. Furthermore the humus content and the water holding capacity of the soil have depleted making it dry and inhospitable for its growth and development.

Table 3: Medicinal Fern's

Sl.no.	Scientific name	Local name	Family	Medicinal uses
1	<i>Adiantum capillus-veneris</i>	Simsary uniyo	Adiantaceae	Foliage used against pneumonia
2.	<i>Adiantum philippense</i>	Simsary uniyo	Adiantaceae	Paste used in cut and wounds
3	<i>Adiantum venustum</i>	Rani sinka	Adiantaceae	Stipe used as antibiotic and antiseptic sticks in pierced nose and ear.
4	<i>Aleuritopteris bicolor</i>	Rani sinka	Pterideaceae	Stipe used as antibiotic and antiseptic sticks in pierced nose and ear.
5	<i>Equisetum diffusum</i>	Salli-bisalli	Equisetaceae	Used against dog bites
6	<i>Lygodium japonicum</i>	Parayo-Anri	lygodiaceae	Used against fever and cough.
7	<i>Nephrolepis cordifolia</i>	Pani amala	Oleandraceae	It is used against chest congestion.
8	<i>Pteris biurata</i>	Thara uniyo	Pterideaceae	Used as antibiotic against pneumonia
9	<i>Pteris spinescens</i>	Thara uniyow	Pterideaceae	Used as antiseptic as well as for blood coagulation
10	<i>Tectaria codunata</i>	Aula kalo ningro	Dryopterideaceae	Rhizome used in diarrhea and pneumonia
11	<i>Thelypteris cana</i>	Pirey sottar	Thelypteridaceae	To eradicate bed bugs and lice of fowl
12	<i>Thelypteris procera</i>	Pirey sottar	Thelypterideaceae	Leaves used for preparation of yeast cake.

Table 4:Ornamental ferns

Sl.no	Scientific Name	Local Name	Family	Uses
1.	<i>Davillia fejisensis</i>	Rabit foot	Daviallaceae	Ornamental
2.	<i>Nephrolepis cordifolia</i>	Pani amala	Oleandraceae	Ornamental, used for decoration.
3.	<i>Selaginella pulvinata</i>	Kur kura jhar	Selaginaceae	Used for decoration purposes.
4.	<i>Huperzia pulchermia</i>	.....	Lycopodiaceae	Ornamental.
5.	<i>Huperzia squarrosa</i>	.....	lycopodiaceae	Ornamental
6.	<i>Cyathea spinulosa</i>	Rukh uniyew	Cyatheaceae	Ornamnetal & its trunk are used for orchid cultivation.
7.	<i>Cyathea brunoniana</i>	Rukh uniyew	Cyatheaceae	Pot made up of the trunk for orchid cultivation.
8.	<i>Lycopodium japonicum</i>	nakbeli	Lycopodiaceae	Utilized in decoration of Pandals as well in religious ceremony specially Saraswati puja.
9.	<i>Lycopodiella cernua</i>	nagbeli	lycopodiaceae	Used for Decoration.



Plate I: A. *Cyathea spinulosa* croizer; B. *Deparia boryana* croizer; C. *Tectaria fuscipes*; D. *Huperzia squarosa*; E. *Davallia fijiensis*; F. *Cyathea brunoniana* trunks utilized for making pot; G. *Huperzia pulchermia*; H. *Pteridium revolutum*; I. *Thelypteris procera*.

The study revealed only two species of *Cyathea* but past literature survey points out that there was five species of *Cyathea*. Similarly the disappearance of *Huperzia phlegmeria* from the study area makes it clear that some conservational strategy should be formulated to safeguard this alienated, neglected group of lower vascular plant.

Conclusion

The present study revealed rich traditional practices of ethnic communities of Darjiling hill. The people in far flung and remote area utilized fern and fern-allies for different purposes. However management practices should be adopted in order to prevent over exploitation of species like *Nephrolepis cordifolia* whose demand is high in terms of foliage as well tuber. The intervention of Government and Forest department is necessary in order to educate the people regarding the ill effect of loss of species from the habitat.

Ethics

All the authors read and approved the manuscript and no ethical issues involved.

References


- Acharya, K. & Acharya, R. (2001). *Cyathus* and *Geastrum* – An addition to Darjeeling mycoflora. *Indian For.* 127: 959 – 952.
- Bhujel, R.B. Tamang, K.K & Yonzon, G.S.(1984). Edible wild plants of Darjeeling district. *Jour. Beng. Nat. Hist. Soc.* 4(2):150-152.
- Bhujel, R.B. Tamang, K.K & Yonzon, G.S.(1984). Poisonous plants of Darjeeling district. *Journ. Him. Res dev.* Nainital, India.31-34.
- Bhujel, R.B.(1996). Studies on the Dicotyledonous Flora of Darjeeling district. *Ph. D. Thesis*, University of North Bengal, Raja Rammohanpur, Darjeeling .
- Biswas, K.P & Chopra, R.N.(1956). *Common medicinal plants of Darjeeling and Sikkim Himalayas*, Alipur, Calcutta .
- Chettri, D.R. Basnet, D. Chiu, P.F. & Chettri, G.(2003). Current status of ethnomedicinal plants in the Darjeeling himalaya. *Curr. Scien.* 89(2):264-268.
- Cowan, A.M & Cowan, J.M. (1929). *The trees of north Bengal including shrubs, woody climbers, bamboos, palms and tree ferns*. Bengal Secretariat Book Depot. Calcutta .
- Das, A.P. (1995). Diversity of the Angiospermic flora of Darjeeling Hills. In A.K. Pandey(ed.), *Taxonomy and Biodiversity*. CBS, New Delhi. Pp. 118 – 127.
- Das, A.P.(2004). Floristic studies in Darjiling hills. *Bull. Bot. Surv. India* 46(1-4): 1 – 18
- Fraser-Jenkins, C. (2008). *Taxonomic revision of Three hundred Indian Subcontinental Pteridophytes with a revised census list*. Bishen Singh and Mahendra Pal Singh, Dehradun
- Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. (2004). *The Pteridophytic flora of Eastern India*. Vols. 1. Botanical Survey of India, Kolkata.
- Hooker, J.D. (1897). *Flora of British India*. Vols. I-VII. International Book Distributors, Dehra-Dun.
- Jain, S.K. & Rao, R.R. (1977). *Field and Herbarium methods*. Today and Tomorrow's Printers and publisher, New Delhi.
- Matthew, K.M. (1971). Pteridophytes from the Darjeeling District. *Bull. Bot. Soc. Bengal* 25(1-2): 97 – 102.
- Mehra, P.N. & Bir, S.S. (1964). *Pteridophytic flora of Darjeeling and Sikkim Himalayas*. Bishen Singh and Mahendra Pal Singh, Dehradun.
- Rai S.K & Bhujel, R.B.(1999). Note on some less known ethnomedicinal plants from the Darjeeling Himalayas. *Jour. Hill. Res.* 12 (2):160-163. Sikkim.
- Rai, P.C. Sarkar, A. Bhujel, R.B & Das, A.P.(1998). Ethnobotanical studies in some fringe areas of Sikkim and Darjeeling Himalayas. *Jour. Hill Res. Sikkim* 11(1): 12-21.

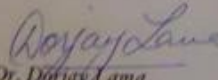


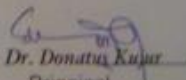
Certificate of Appreciation



This is to certify that Nayan Thapa
 was part of the organising Team in the 4 Days National Seminar and Workshop on the
 'Recent Trends in Biological Sciences' to commemorate the Silver Jubilee Year
 organized by the Department of Botany St. Joseph's College, Darjeeling
 from the 13th - 16th November 2014.


 Dr. Upakar Rai
 Organizing Secretary


 Dr. Dhritya Lama
 Convener


 Fr. Dr. Donatus Kumar
 Principal



WORKSHOP ON CLIMATE CHANGE AND MOUNTAIN AREAS: AWARENESS, ADAPTATION & SUSTAINABILITY

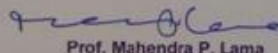


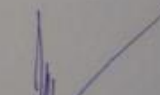
DECEMBER 17-18, 2012
 DARJEELING, WEST BENGAL, INDIA

This is to certify that Mr. / Ms. / Dr. Nayan Thapa
 of St. Joseph's College
 presented a paper / participated in the
 workshop on "Climate Change and Mountain Areas: Awareness, Adaptation & Sustainability"
 held at Darjeeling, West Bengal, India, on December 17-18, 2012.

Supported by:
 FRIEDRICH EBERT STIFTUNG

Organised by:
 FOSEP, Darjeeling


 Prof. Mahendra P. Lama
 Chief Guest


 H. Aljay
 Chairman, FOSEP

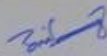
UGC Sponsored National Seminar
On
Global climate change and its Impacts on Floral, Faunal and Microbial biodiversity

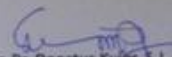
Organized by:
Department of Botany, St. Joseph's College, Darjeeling
In collaboration with
Teesta Torsa Agro Care Welfare Society, Kalimpong
June 26 - 28, 2015



Certificate of Participation

This is to certify that Prof./Dr./Mr./Ms. Nayan Thapa
participated as a registered delegate in the Seminar. He/She presented a paper on PHYTOCONII- (A new
approach in conservation strategy and an indicator of changing climate)-
A case study of Fern and allies in a campus of St. Joseph College, in the plenary/special/oral/poster session,
Darjiling, India
chaired the session


Dr. Anirudra Gurung
Organizing Secretary


Fr. Dr. Donatus Kujur, S.J.
Patron

UGC Sponsored National Seminar
On
Global climate change and its Impacts on Floral, Faunal and Microbial biodiversity

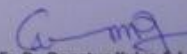
Organized by:
Department of Botany, St. Joseph's College, Darjeeling
In collaboration with
Teesta Torsa Agro Care Welfare Society, Kalimpong
June 26 - 28, 2015



Certificate of Participation

This is to certify that Prof./Dr./Mr./Ms. Nayan Thapa
participated as a registered delegate in the Seminar. He/She presented a paper on Disappearance and
occurrence of Fern's in Darjiling Hills, is it a climate
change or anthropogenic activity? in the plenary/special/oral/poster session,
chaired the session (2) Climate change and human climate ecosystem interaction

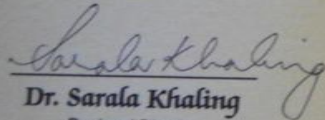

Dr. Anirudra Gurung
Organizing Secretary


Fr. Dr. Donatus Kujur, S.J.
Patron

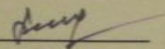


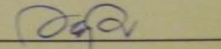
Certificate of Participation

This is to certify that Dr./Mr./Ms. Nayam Thapa of
St. Joseph's College, Darjeeling participated in the Workshop on
Northeast India Biodiversity Portal
organized by
Ashoka Trust For Research in Ecology and the Environment (ATREE) in collaboration
with the Padmaja Naidu Himalayan Zoological Park, Darjeeling and The Himalayan
Society for Nature and Science at Padmaja Naidu Himalayan Zoological Park, Darjeeling on
April 21st 2016.

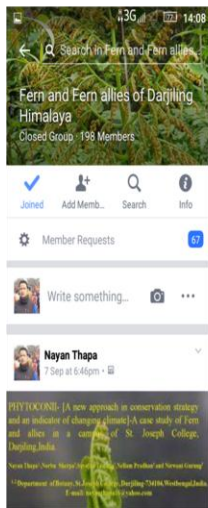
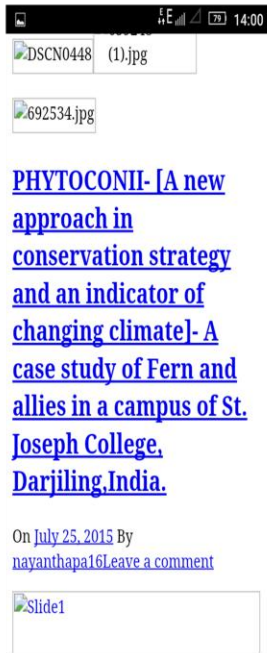


Dr. Sarala Khaling
Regional Director
ATREE, Regional Office
Eastern Himalayas


Mr. Piar Chand, IFS
Director
Padmaja Naidu Himalayan Zoological
Park, Darjeeling


Saibal Sengupta
The Himalayan Society for
Nature and Science,
Darjeeling

Blogs and Pages :Creation of Database of Pteridophytic Flora of Darjiling Hills



WWW.FERNYDARJ.WORDPRESS.COM
Fern and Fern-allies of Darjiling Himalaya