Vegetation Structure and Vascular Plant Diversity of Lower Montane Forest at Korila, Mongar, Eastern Bhutan

Tshering Tobgye

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science in Botany
Prince of Songkla University
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I hereby certify that this work has not already been accepted in substance for any degree, and is not being concurrently submitted in candidature for any degree

…….Signature

(Tshering Tobgye)

Candidate

ชื่อวิทยานิพนธ์ โครงสร้างสังคมพืช และ ความหลากหลายของพรรณไม้ที่มีท่อลำเลียงของป่าบนภูเขาระดับต่ำของภูเขา Korila ในจังหวัด Mongar ภาคตะวันออกของภูฏาน

ผู้เขียน Mr. Tshering Tobgye

สาขาวิชา พฤกษาศาสตร์

ปีการศึกษา 2558

บทคัดย่อ

ศึกษาโครงสร้างสังคมพืชของ ป่าไม้ใบกว้างบนภูเขาระดับต่ำของภูเขา Korila ในจังหวัด Mongar ภาคตะวันออกของภูฏาน ตั้งแต่ เดือน กุมภาพันธ์ ถึง กันยายน พ.ศ. 2557 พบพืชที่มีท่อลำเลียง 124 ชนิด ซึ่งส่วนมากเป็นไม้ล้มลุกที่พบถึงร้อยละ 43.5 พบไม้ต้นร้อยละ 23.4 พบไม้พุ่มร้อยละ 20.9 พบไม้ต้นขนาดเล็กร้อยละ 4.8 พบพืชจำพวกเฟินร้อยละ 4.8 และพบไม้เลื้อยร้อยละ 2.4 จากลักษณะองค์ประกอบของพันธุ์ไม้ และการวิเคราะห์สังคมพืชพบว่าเป็นสังคมพืชประเภทสังคมป่าไม้ใบกว้างบนภูเขาระดับต่ำ ซึ่งพืชเด่นที่พบในบริเวณนี้ได้แก่กลุ่มของ *Castanopsis* spp. and *Quercus* spp. ในวงศ์ Fagaceae และจากการวิเคราะห์ตามวิธี cluster analysis จากไม้เด่นที่พบในแต่ละบริเวณประกอบกับการศึกษาภาพหน้าตัดของสังคมพืชในแปลงตัวอย่างที่เลือกวางตามแนวเส้นที่ลากตัดผ่านความสูงตั้งแต่ 2,000 ถึง 2,500 เมตรจากระดับน้ำทะเล สามารถวิเคราะห์และบรรยายลักษณะสังคมพืชย่อยได้ 4 แบบ ที่แตกต่างกันได้แก่ สังคมพืช *Daphniphyllum chartaceum* heath ที่พบในบริเวณที่ถูกรบกวนเล็กน้อยจนถึงมาก สังคมพืช *Quercus – Persea* Woodland ถือได้ว่าที่เป็นตัวแทนที่ดีของสังคมป่าไม้ใบกว้างตามธรรมชาติในบริเวณนี้โดยไม่พบพืชรุกรานเลย และสังคมพืช *Castanopsis – Elaeocarpus – Quercus* Woodland ที่มีองค์ประกอบพันธุ์ไม้ระหว่างสังคมพืช *Daphniphyllum chartaceum* heath และสังคมพืช *Quercus – Persea* Woodland ซึ่งสังคมพืช *Castanopsis – Elaeocarpus – Quercus* Woodland นี้น่าจะเป็น “ecotone” ระหว่างสองสังคมพืชข้างต้น และสุดท้ายคือ สังคมพืช *Symplocos glomerata* ที่น่าจะเป็นสังคมพืชที่เริ่มฟื้นตัวตามธรรมชาติหลังถูกรุกราน และเนื่องจากป่าบริเวณภูเขา Korila นี้ถูกรบกวนโดยกิจกรรมของมนุษย์อย่างต่อเนื่อง การศึกษารายละเอียดของพรรณไม้และสังคมพืชของบริเวณทั้งหมดจึงจำเป็นเพื่อการอนุรักษ์พรรณไม้ และ ใช้ประโยชน์อย่างยั่งยืนในอนาคต

Thesis Title Vegetation Structure and Vascular Plant diversity of Lower Montane Forest at Korila, Mongar, Eastern Bhutan

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ABSTRACT

The investigation of the vegetation structure and the species composition of lower montane broad-leaf vegetation at Korila Mountain of Bhutan Himalaya in Mongar district, Bhutan was carried out from February – September 2014. The study revealed 124 species of vascular plants occurring as important components of the forest. Out of which, the majority were herb species (43.5%) followed by trees (23.4 %), shrubs (20.9%), small trees (4.8%), ferns (4.8%) and climbers/creepers (2.4%) of the total flora. The plant species composition as well as the vegetation analysis of Korila forest had shown that the vegetation belongs to the broad-leaf lower montane forest type in general as the major component of the tree species of the area belongs to *Castanopsis* spp. and *Quercus* spp. (Fagaceae). Based on cluster analysis of the dominant species components and the vegetation profiles of selected sampling plots along the altitudinal gradient transect line from ca. 2000 – 2500 m asl., four plant association types were described i.e. *Daphniphyllum chartaceum* heath; *Castanopsis – Elaeocarpus – Quercus* woodland; *Quercus – Persea* Woodland *and Symplocos glomerata* community. The *Daphniphyllum chartaceum* heath occurred in the more/less disturbed area whilst *Quercus – Persea* woodland performed as a good representative of a broadleaved lower montane forest of this region of Himalaya according to its natural component and few of alien species. The *Castanopsis – Elaeocarpus – Quercus* woodland contained elements of both *Daphniphyllum chartaceum heath* and *Quercus – Persea* woodland, therefore it is suggested that this association type might be an "ecotone" between those *Daphniphyllum chartaceum* heath and *Quercus – Persea* woodland, while *Symplocos glomerata* community might be a secondary vegetation. As the Korila forest is under stress concerning the frequent anthropogenic disturbances, more detailed studies concerning the flora and vegetation of the whole areas is, therefore, needed as to

support the conservation policy as well as the sustainable uses of natural resources from the forest in future.

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Tshering Tobgye

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Abbreviations

asl.	above sea level
BA	basal area
ca.	about
cm	centimeter
dbh	diameter at breast height
diam.	diameter
et al.	and others
i.e.	that is
k.m	kilometer
m	meter
mm	millimeter
sp.	species (singular)
spp.	species (plural)
var.	variety

Symbols

>	larger/more than
≥	larger than or equal to
±	more or less
<	smaller/less than
≤	smaller or equal to

List of Colour Plates

List of Colour Plates *(continued)*

List of Colour Plates *(continued)*

List of Colour Plates *(continued)*

List of Colour Plates *(continued)*

CHAPTER I

INTRODUCTION

Vegetation structure and composition of montane forest of the Himalayan ranges were studied by several researchers (Ohsawa, 1991b; Bhattarai and Vetaas, 2003; Gairola et al., 2008; Hussain et al., 2008; Tripathi and Singh, 2009; Khali and Bhatt, 2014) yet only limited studies were carried out in the Bhutan Himalayas. The general descriptions of vegetation structure, regeneration and the population structures of some dominant tree species belonging to Fagaceae; Theaceae and Juglendaceae and other emergent dominant tree species above the Fagaceous canopy, e.g. Aceraceae; Hamamelidaceae; Tiliaceae; Meliaceae in the montane evergreen broad-leaved forest distributed between 100 m asl. in the south and 3,000 m asl in central Bhutan was reported by Oshawa (1991a). However, there are very few literatures on comprehensive structure of vegetation in terms of taxonomic diversity and composition. The montane evergreen-broad leaved forest of Bhutan is one of the last and most extensive tropical humid montane rain forests on the Eurasian continent Ohsawa (1991a). In particular, evergreen broad leaved forests of warm temperate or subtropical zones, laurel-leaved forests, which have been heavily disturbed in Nepal Himalaya, are still well preserved in Bhutan Himalaya (Oshawa, 1991a). Although, the forest of Bhutan are still well managed under the stringent conservation policies, due to increasing pressures on natural environment from the demands of a growing population and associated anthropogenic activities, the forest are under threat of degradation. Degradation occurs when peoples are not equipped with an adequate knowledge and understanding of the structure and dynamics of forests (Hubbell and Foster, 1992). Many studies had agreed well that understanding the vegetation structure is a source of relevant information for sustainable management of forest resources (Kint et al., 2000). Moreover, many studies had focused on the sustainable and better management of forest resources of Bhutan and provided some qualitative and quantitative description of vegetation. (Sargent et al., 1985; Wangda and Ohsawa,

2006a; Daranbant et al., 2007; Moktan et al., 2008; Moktan et al., 2009; Kubisszewski et al., 2013; Covey et al., 2015; Gilani et al., 2015). However, there have been no such ecological quantitative studies in this region so far.

Due to the geographical complexities along the mountain slopes of Korila. The forest consists of diverse patterns of species distribution and the variation of vegetation structure. However, the diverse natural vegetation are under the great pressure of anthropogenic activities by the people and animals of Ngatshang, Chashkar and Mongar villages. The anthropogenic activities impacts are rather destructive resulting in an alternation of species richness and diversity of the area. Continuous threat to natural vegetation by human activities may result in permanent changes in vegetation structure and plant species composition of the area (Girriraj et al., 2008). Therefore, the study of vegetation structure and composition may provide an essential background for planning strategies for sustainable conservation of natural vegetation. The study on vegetation structure and composition of Korila lower montane forest in eastern Bhutan is aimed to determined current status of forests, their floristic structure and to determine the pattern of vegetation (Vegetation profile and stand structure) as well as to explore the effect of various disturbances on species composition of the montane vegetation. Furthermore, the study on vegetation structure and vascular plant diversity along the Korila Mountain slopes, eastern Bhutan may provide clearer representation of the structure and diversification of the montane vegetation of the eastern Himalaya in general.

OBJECTIVES

- To determine the vegetation structure of Korila lower montane forest and identify knowledge gap of the forest as basis for future research.
- To document the composition of plant species of the study area.
- To describe the plant species collected from the study areas in detail.

LITERATURE REVIEWS

Overview of Bhutan vegetation

Geographically, Bhutan is located in the confluence of three biotic zone viz. the Palearctic realm in Asia to the north of Himalaya, the boreal zone along the Himalayan ranges and the Palaeotropic distribution in the Indian subcontinent and Southeast Asia. Thus, the region represents an admixture of flora making one of the 'hot spot' of biodiversity in the world. (Grierson & Long, 1983; Norbu, 1994; Lobzang, 1998). About 72% of Bhutan is covered with forests. The forest are protected as Wild life Sanctuaries and National Parks. In Bhutan, the vegetation ranges from sub-tropical forests in the south at an elevation of ca. 200 m asl. to mid-elevation temperate forest, to the northern alpine zone above 7,000 m asl. The Land Use Planning Project of Bhutan (LUPP) in 1994 identified eight types of forest as follows:

1) The **Fir forest** from ca. 2,700 – 3,800 m asl. The understory in this forest are usually characterizes by thick layer of moss with Rhododendron, sub-alpine bamboo, and *Primula* spp. The fir forest becomes stunted and grade into juniper and Rhododendron scrub towards the tree line.

2) The **mixed conifer forest** occupying the largest portion of the sub-alpine regions of the country at an altitude ca. 2,000 – 2,700 m asl. with a dominant species *Picea spinulosa* (Griff.) A. Henry (Pinaceae); *Tsuga canadensis* (L.) Carrière (Pinaceae) and *Larix* spp. (Pinaceae). The undergrowth in this forest consist of *Rhododendron* spp., bamboo and other shrubs.

3) The **blue pine forest** in the temperate regions of west and central parts of Bhutan at an altitude ca. 1,800 – 3,000 m asl. The forest are usually mixed with oak and *Rhododendron* spp.

4) The **Chir pine** forest in the lower altitude ca. 900 – 1,800 m asl. in the deep valleys and river systems under sub-tropical conditions. These forests are influenced by biotic activities such as resin tapping, tree felling, and frequent ground fires, which are

deliberately set to produce fresh grazing for livestock and to promote new lemon grass growth for essential oil production.

5) The **broadleaf mixed conifer** forest. These forests are dominated by oak with Blue pine or upper hill forest mixed with Spruce or Hemlock.

6) The **upland hardwood forest** which dominates the hillsides at an altitude 2,000 - 2,900 m asl. and the forest consists of two types a) Evergreen oak forest which are common at dry areas and b) Cool broadleaf forest usually in the wetter hills with rich and diverse plant species.

7) The **lowland hardwood forest** at an altitude between 1,000 – 2,000 m occupying the sub-tropical hills. The forest are rich and diverse with mixture of sub-tropical and temperate genera.

8) The **tropical lowland forest** occupying the low hills at an altitude below 700 m asl. The vegetation usually consist of two types' semi-evergreen or deciduous forest and evergreen forest mostly in the moist valleys.

Account of the vegetation studies based structure and composition in the Himalayan ranges

The flora and vegetation of Himalayan regions in terms of taxonomic diversity and composition have been studied by several researchers. On an account of various literatures of the Himalayan ranges, it indicates that scientific studies or quantitative studies were conducted less in the east Himalaya compared to the West Himalayan region.

Ohsawa et al. (1986) investigated the distribution of the western Himalaya forest type dominated by *Pinus roxburghii*, *P. wallichiana,* and *Quercus semecarpifolia* with the pattern of forest distribution in the eastern Himalaya in Nepal. The study revealed that the forest of western Himalaya occurred in the east as a relict

patches in a local dry habitats. The successional status of western Himalayan species and the changes along gradient from west to east Himalaya was investigated.

Bhattarai and Vetaas (2003) studied about the plant species richness of different life-forms along a subtropical elevation gradient in the Himalayas of the east Nepal.

Koirala (2004) surveyed and compared the vegetation structure and composition of two forest Tamafok (TF) and Madimulkharka (MM) in Nepal, eastern Himalaya. A total of 20 tree species were reported, with high species in the non-degraded. The vegetation closer to residential area has experienced higher pressure leading a significant difference in structure and composition.

Hussain et al. (2008) described species composition and community structures of forest stands in Kumaon Himalaya at an altitude between 1500 - 3000 m asl. 19 tree communities and 17 ground vegetation were identified through cluster analysis. They recorded 63 tree species, 56 shrubs and 21 grass species. The study revealed that the distribution of the tree communities in the forest stand were governed by the gradients of altitude, slopes and canopy cover.

Adhikari et al. (2009) has surveyed the vegetation structure and community pattern at Teri Dam Submergence Zone, in India, western Himalaya. Four major plant communities were identified with varied association types through Two Way Indicator Species Analysis (TWINSPAN). The plant communities are 1) *Dalbergia-Carrissa-Murraya-Adhatoda* community occurring in flat areas with moist soil, 2) *Melia-Ficus* community near habitation, 3) *Carissa-Euphorbia-Bombax-Pinus* community and 4*) Lantana-Carissa – Rhus – Euphorbia-Pyrus* community in moderate slopes and rocky outcrops of dry soils.

Lalfakawma et al. (2009) investigated the composition and tree population structure in the disturbed and undisturbed forest located at northeast India in western Himalaya. The study revealed the anthropogenic activities, the main factor causing disruption of forest structure and changes the community composition which

ultimately leads to disruption of tree population structure. The study revealed the number of species in the disturbed stand was comparatively lower than undisturbed forest. Trees species e.g. *Castanopsis tribuloides* Sm. was common in both the stands and dominance in the undisturbed stand and *Schima wallichi* (DC) Korth Choicy dominated the disturbed stand of the study area.

Rana and Gairola (2009) described the variation of vegetation structure and composition along the altitudinal gradient of Parshuram Kund Area, India, eastern Himalaya. The study revealed the tree species e.g. *Albizia lucida* dominated the upper altitude and *Artocarpus chaplasha* in mid-altitude and in the lower altitude of the study area dominated by *Dubanga grandiflora*. The study also found the dominant species of shrubs in the upper and mid-altitude of the study area was *Musa nagensium* and at lower altitude dominated by *Piper peepuloides*.

Tripathi and Singh (2009), investigated the species diversity and vegetation structure across various strata in natural and plantation forest in north India, western Himalayan ranges. Distribution of selected indicator taxa and their abundance have been compared during the study.

Khan et al. (2013) identified vascular plant species and communities across the environmental gradient of Naran valley in northwest Pakistan of the Western Himalayas. A total of 198 vascular plant species including tree, herbs, and shrubs that belonged to 150 genera were identified. Five plant communities: 3 temperate vegetation and 2 sub-alpine and alpine species dominated communities were identified and described. 1) *Pinus wallichiana – Sambucus wightiana* community at an altitude from 2,450-2,900 m, 2) *Abies pindrow – Betula* community at an altitude of 2,800-3,300 m, 3) *Juniperus excelsa – Abies brevifolia* community at an altitude range 2,800-3,300 m, 4) *Rheum australe –Sibbaldia cuneata* community at a high altitude of 3,300 -4,000 m and 5) *Aster falconeri-I.hookeriana* community at an altitude of 3,700 m and above. The study found that the pattern of plant communities in the valley is largely determined by aspect and altitude.

Khali and Bhatt (2014) studied the community structure and composition of montane vegetation at Garhwal Himalaya in India. Four types of forest were identified through vegetation analysis of plant species composition and association types. The four vegetation types are; Chir-pine forest, pine-oak forest, oak-pine forest and oak-mixed forest.

Account of the vegetation studies based structure and composition in Bhutan Himalaya

In Bhutan the study of flora and vegetation dates back to 1838 when William Griffith collected ca. 1,200 plants and published them in the flora of British India (Grierson and Long, 1983). The major work on Bhutanese flora ever recorded in the history was conducted by Grierson and Long (1983; 1984; 1987, 1991, 1999; 2001). Five thousand six hundred three species of angiosperm and gymnosperm including 369 species of orchids and 46 species of rhododendrons was recorded. Of the recorded species, 105 are likely to be endemic to Bhutan. They also classified, the vegetation of Bhutan into 12 major zones. However, Ohsawa (1987) reclassified into six zones (five forest and one scrub) on the basis of frequency of distribution limits at certain altitudes (Table. 1). The comprehensive vegetation studies in Bhutan are rather limited. The major vegetation studies of Bhutan Himalaya was conducted by Ohsawa in 1987 in his life zone ecology of Bhutan Himalaya.

Hara (1991) surveyed the forest structure in five plots located in the evergreen broad-leaved zone in western Bhutan. Floristic composition, vertical stratification and structure of component species were analysed for each stand and the regeneration pattern of each forest were discussed.

Tsuchida (1991) surveyed the grassland vegetation between tropical and subalpine zone of Bhutan from west to East. Six altitudinal types of grasslands were recognized and described. 1) *Cynodon/Paspalum* types, 2) *Heteropogon/Imperata* type, 3) *Chrysopogon/Sporobolus* type, 4) *Eragrostic* type, 5) *Arundinella/Carex* type and 6) *Agrostis/Arundinaria* types. Whereas in the forb lands bushlands five types were recognized and described 1)*Eupatorium/Cymbopogon/Cassia* type, 2)

Ageratum/Artimisia type, 3) *Anaphalis/Pteridium* type, 4) *Sorbus/Elaeagnus/Potentilla* type and, 5)*Senecio/Arundinaria/Helictotrichon* types.

Ohsawa (1991a), surveyed the montane evergreen broadleaved forest of east slope of Dochula, the west slope of Pelela, Shemgang and Lingmethang near Mongar in terms of population structure, topographical distribution, succession and forest-structural differentiation. Four physiognomic types of forest were identified: 1) the evergreen broad-leaved, 2) sclerophyllous 3) deciduous broad leaved and 4) needle-leaved trees. Beside they also described the vegetation pattern in riverine habitats and landslides slopes.

Norbu (1994) surveyed and documented the situation of broadleaved forest and the impact of cattle grazing on broadleaved forest around Gedu, in western Bhutan, a typical broadleaved forest where grazing and wood production are practiced.

Wangda and Ohsawa (2006a) studied the gradational forest change along the climatically dry valley slopes of Bhutan in the midst of eastern Himalaya. Five altitudinal forest zone were identified base on cluster analysis of dominant species. In the same year they studied and characterized the structure and regeneration dynamic of dominant tree species along the altitudinal gradient in a dry valley slopes of Bhutan Himalaya. Forest stratification, tree crown projection and population structure was surveyed across five major forest types. 83 tree species comprising of 37 evergreen species belonging to 35 families were recorded. Five forest were classified based on the quantitative data form 15 sampling plots. 1) warm, dry west pine forest type, 2) wide-ranging mixed broadleaved forest east-west Himalayan forest type, 3) humid evergreen broadleaved east Himalayan forest type, 4) cool, humid conifer east Himalayan forest types and 5) wide ranging cold, wet conifer forest type.

Darabant et al. (2007) investigated the relation between the cattle grazing and tree generation in a conifer forest with palatable bamboo understory in Chumey valley in central Bhutan.

Moktan et al. (2009) studied the regeneration and structure of mixed conifer forests under single tree harvest management in western Bhutan. The study revealed single-tree harvest is not detrimental to regeneration, species composition and structure of logged stands compared to unlogged stands.

Jamtsho and Sridith (2015) studied the pattern of alpine vegetation along the altitudinal gradient in Sakten Wildlife Sanctuary, eastern Bhutan. Five types vegetation communities were identified by cluster analysis based on the floristic composition. The vegetation types are 1) Riverine Community, 2) Abies–Rhododendron Woodland Community, 3) Juniperus Scrub Community, 4) Rhododendron Krummholz and 5) Alpine Meadow.

Table. 1. Six vegetation zone of Bhutan classified by Ohsawa (1987).

Altitude (m)	**Forest zones and scrubs**
1,000	Tropical/Subtropical
2,000	Subtropical/Warm temperate
2,500	Warm-temperate/Cool temperate
3, 000	Cool-temperate/Subarctic (cold temperate)
3,500	Sub-boundary within a subarctic zone
4,000	Subarctic (cold-temperate)/arctic boundary

CHAPTER II

MATERIALS AND METHODS

THE STUDY AREA

Location

The Korila forest is located in Mongar district, eastern Bhutan at 91°14' N to 91°25' N longitude and 27° 13' E to 27° 25' E latitude (Fig.1). The study area is about 15 Km on the way from Mongar district to Tashigang district. Vegetation survey was done specifically along the east slope of mountain forest. The lower parts of the mountain forest is near to Ngatshang village and study plots was laid 1 km away from the village at N 27°18.357' to E 091°20.064' at an elevation from 1,984 to 2,500 m asl. The detailed location of study plots is shown in Table 1. The vegetation along the mountain slope is mostly evergreen cool broadleaved temperate forest. The forest is not in protected area system of the country. Mongar, Ngatshang and Chaskhar are three villages in which people are mostly benefited from the forest. Almost entire vegetation of the area are under great influence of anthropogenic activities.

Topography and Geology

The topography of study sites is characterized by gentle mountain slopes with varying degree. Elevation ranges from 1,500 to 2,500 m asl. Geologically, the type of soils found in the area is yellow brown soil, usually compose of silt loam, moist and non-sticky. The parent material of this types of soils are granite found at an altitude of 1,500 to 2,500 m in Bhutan Himalaya (Okazaki, 1987).

Climate

Bhutan is located in the monsoon Asia and most unknown region with regard to climate (Eguchi, 1987). There is a wide variety of climatic conditions influenced by topography, elevation and rainfall. It is divided in to six climatic zones. Which includes, alpine (> 3,500 m), cool temperate (2,500-3,500 m), warm temperate (1,800-2,500 m), dry sub-tropical (1,200 -1,800 m), humid sub-tropical (600-1,200 m) and Wet sub-tropical (200-600 m). There is no meteorological station in the study area. However, the nearest meteorological station of Yadi Renewable Natural

Resource Centre (RNRC) recorded the most common form of precipitation is in the form of rain. The climate of the study area is cool temperate with four distinct season, heavy rainfall during summer season and cold winter. The rainfall is maximum during summer season in the month of May, June and July and minimum during winter season in the month of November, December and January. (Fig.2).

The Study plots

Table 2: Study plots, map references, elevation and the plant communities

Plot references	**Map references**	**Elevation**	**Vegetation community**
Plot 1	N 27°18.357' E 091°20.064'	1, 984	
Plot 2	N 27°18.209' E 091°20.025'	2, 050	*Daphniphyllum chartaceum* heath
Plot 3	N 27°18.122' E 091°20.017'	2,086	
Plot 4	N 27°17.699' E 091°18.897'	2,201	*Castanopis – Elaeocarpus – Quercus* woodland
Plot 5	N 27°17.187' E 091°18.641'	2,239	
Plot 6	N 27°17.060' E 091°18.427'	2,298	*Quercus – Persea* woodland
Plot 7	N 27°16.031' E 091^{0}18.583'	2,385	*Symplocos glomerata* community
Plot 8	N 27°15.995' E 091^{0}18.630'	2,413	
Plot 9	N 27°15.920' E 091^{0}18.643'	2,561	*Quercus – Persea* woodland

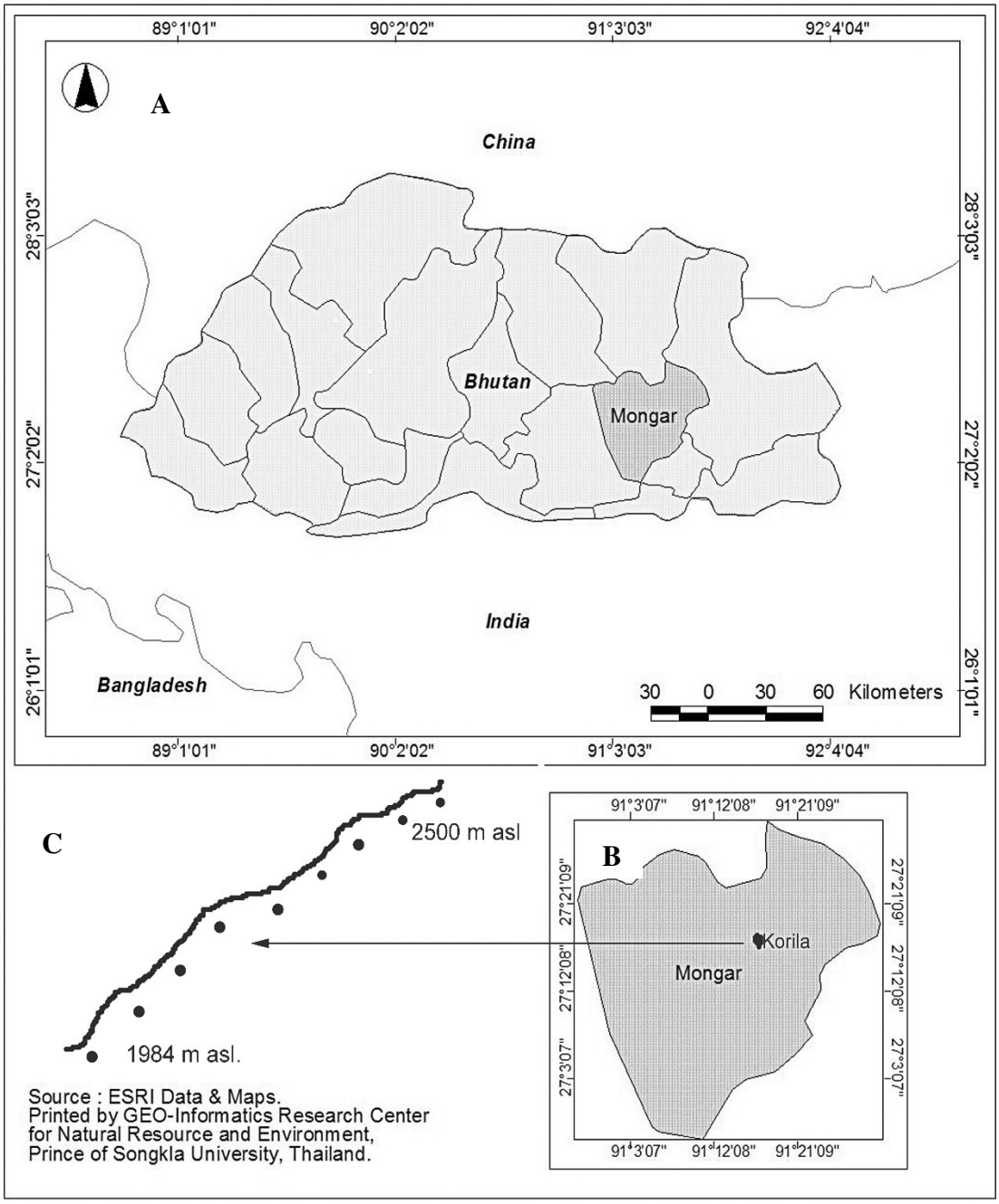

Figure 1. A. Map of Bhutan showing Mongar district; B. Map showing location of Korila forest under Mongar district; C. Study plots along Korila mountain slope.

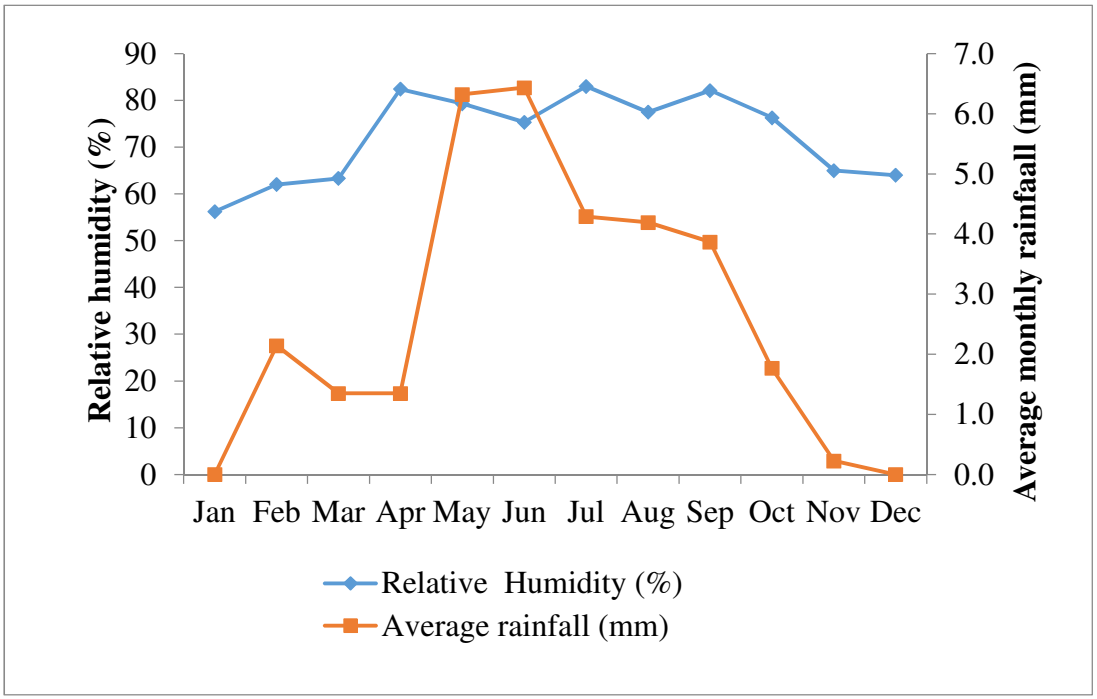

Figure 2. Relative humidity and average rainfall of study area. (Source: Yadi Natural Renewable Resource Centre meteorological station, 2014)

DATA COLLECTION

Plant collections

All vascular plants had been collected twice a month starting from February to September 2014 covering all the flowering seasons. Scientific name, author names and abbreviation followed the International Plant Name Index (IPNI). Plants collected were identified using available taxonomic literature. Voucher specimens were deposited at the National Herbarium of Bhutan, Serbithang, Thimphu (THIM).

Plot layout and tree inventory

A total of nine plots (P1-P9) with the dimension of (40 m × 20 m) were laid specifically along east slope of mountain. All individual trees occurring in the study plots were identified and measured their height, diameter at breast height (dbh in cm at 1.3 m above ground) and canopy size. For ground flora five quadrates of (1m

× 1m) were laid in every plot. Field works was carried out from February to September 2014.

LABORATORY STUDY

The specimens collected were identified and authenticated at herbarium of Prince of Songkla University (PSU) using all available taxonomic literatures. The specimens were also processed accordingly as per the guidelines of the herbarium handbook by Forman and Bridson. (1999). The morphological and ecological data of the plants species collected was obtained by doing the detailed descriptions of every dried specimens collected during the field work. The Botanical/Scientific names and author citations of every identified plants species were written with the strict compliance the standards of the International Plant Name Index (IPNI), the Plant List, and tropicos.org which are accessible online. The voucher specimens have been deposited at National Herbarium of Bhutan at Serbithang, Thimphu, Bhutan

VEGETATION AND FLORISTIC ANALYSIS

The plants species richness of the study area was calculated as the number of species occurred in the study plots (Kent and Coker, 1994). The diversity of plants species was quantified by means of two diversity indices; Shannon – Weiner diversity index (H') (Kent and Coker, 1994) and Simpson's diversity index (D). The Shannon-Weiner diversity was calculated as

Diversity (H') = $-\sum_{i=1}^{s} \text{Pi} \ln \text{Pi}$

Where s = the number of species

Pi = the proportion of individuals or the abundance of the ith species expressed as a proportion of total cover

Ln = log base_n

Simpson diversity Index (D) was calculated as

Diversity index (D) = 1- [$\sum$n (n -1)/N (N -1)]

Where n = the total number of particular species

N = the total number of all species

Cluster analysis was performed based on Squared Euclidian Distance (Average linkage method) using the software SPSS statistic 20. The vegetation types were described based on the physiognomy and dominant species.

The basal area (BA) was calculated from the DBH measured for every tree species occurred in the sampling plots. Due to large variation, diameter at breast height (DBH) measurements were grouped into eleven classes. Class interval was 10 cm. Vegetation profile of representative study plots was drawn accounting the measurement of tree height and canopy size measured.

CHAPTER III

RESULT

PART I: FLORISTIC STUDY

Plant species Diversity

A total of 124 species of vascular plants belonging to 103 genera in 63 families were identified and recorded from Korila lower montane forest. Out of which 1 species is lycophyte, 5 species are monilophytes and 118 species are flowering plants. (Table. 2). When considering the flowering plants 107 species are eudicots and 11 species are monocots. The most common families of eudicots are Ericaceae (9 species, 7.3%); Rosaceae (9 species, 7.3%); Asteraceae (6 species, 4.8%); Fabaceae (6 species, 4.8%); Fagaceae (6 species, 4.8%); Polygonaceae (5 species, 4%); Urticaceae (5 species, 4%), respectively. Orchidaceae (4 species, 4%) were the most diverse group from monocots. The dominant families with largest number of species are shown in Table 3.

Table 3: Number of families, genera, and species of vascular plants at Korila lower montane forest.

Plant groups	Families	Genera	Species	% of Total Flora
Lycophytes	1	1	1	0.8
monilophytes	4	5	5	4
Angiosperms				
Eudicots	52	88	107	86.3
Monocots	6	9	11	8.9
Total	63	103	124	100.0

Table 4: Predominant families of each major group of plants of Korila

Plant groups	Number of species	% of Total Flora
Eudicots		
Ericaceae	9	7.3
Rosaceae	9	7.3
Asteraceae	6	4.8
Fabaceae	6	4.8
Fagaceae	6	4.8
Polygonaceae	5	4.0
Urticaceae	5	4.0
Acanthaceae	3	2.4
Hydrangeaceae	3	2.4
Lamiaceae	3	2.4
Rubiaceae	3	2.4
Symplocaceae	3	2.4
Other eudicots	46	37.1
Monocots		
Orchidaceae	5	4.0
Araceae	2	1.6
Other monocots	4	3.2
Monilophytes		
Polypodiaceae	2	1.6
Other monilophytes	4	3.2
Total	**124**	**100.0**

Plant Habits/life Forms

In terms of the habits/life forms of vascular plants, six forms could be encountered. Out of which, the most abundant are herbaceous plants (54 species, 43.5%) followed by trees (29 species, 23.4%), shrubs (26 species, 20.9%), small trees (6 species, 4.8%), ferns (6 species, 4.8%) and climber/creepers (3 species, 2.4%) (Fig.3). Amongs the various habits, majority of the plant groups are terrestrial except 5 species are epiphytes either growing on the host plants or on the dead woods. Those plant species includes *Vaccinium vacciniaceum* (Roxb.) Sleumer (Ericaceae); *Polygonatum punctatum* Royle ex Kunth (Asparagaceae); *Coelogyne corymbosa* Lindl. (Orchidaceae); *Cautleya gracilis* (Sm.) Dandy (Zingiberaceae) and *Drynaria propinqua* (Wall. ex Mett.) J. Sm. (Polypodiaceae).

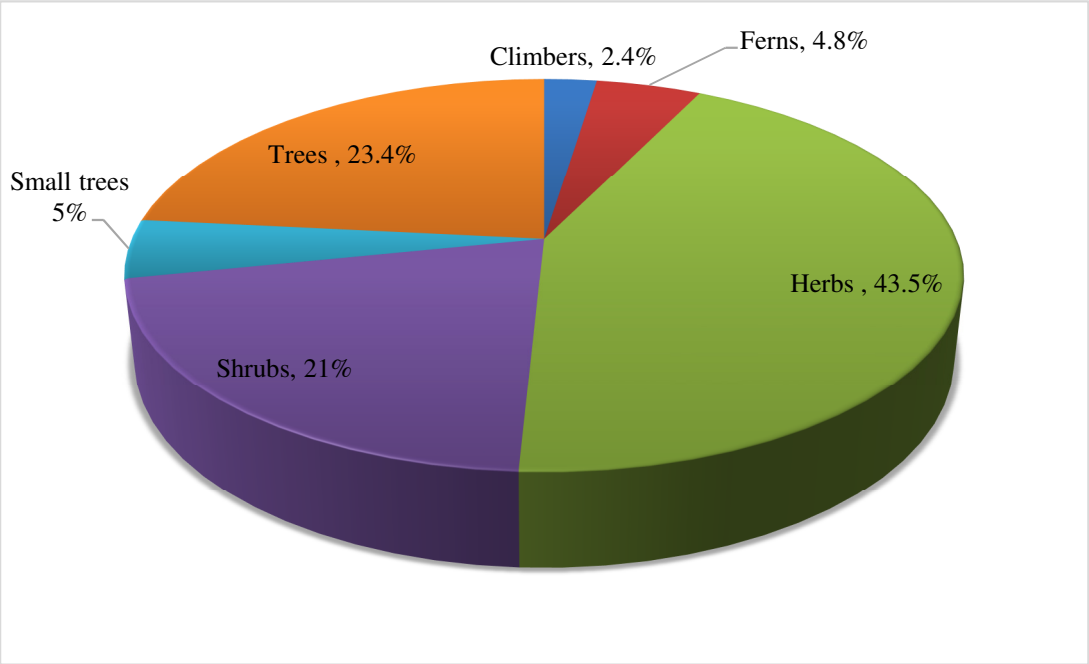

Figure 3. Pie diagram showing the coverage percentage by habit/life form of vascular plants at Korila forest

The detail descriptions of collected plant species of the studied area

The full descriptions of 102 species along with their localities, ecological data, and distribution range are provided. Due to poor collections and damages occurred while processing and transporting from Bhutan to Thailand some of the specimens cannot be described.

MONILOPHYTES

DAVALLIACEAE

Nephrolepis cordifolia (L.) C. Presl, Tent. Pterid.79. 1836; R.E. Holttum, Rev. Fl. Malaya 2: 379, 1968; S.B. Rajabhandari et al. in Fl. Kathmandu 11: 50. 1986. – *Aspidium tuberosum* Bory, Willd.Sp. Pl.5: 234. 1810. – *Nephrolepsis tuberosa* Presl, Tent. Pterid. 79. 1836. (**Plate 22 C-D).**

Terrestrial. ***Rhizome*** short, erect, densely clothed with yellowish brown scales towards the apex, scales narrowly lanceolate; runners many, bearing tubers. ***Stipes*** 5 – 6 cm long, tufted, shinning dark olive-brown and scaly. ***Fronds*** 30 – 50 cm long. ***Lamina*** linear – lanceolate, 30 – 40 cm by 4 – 5 cm; pinnae numerous, lanceolate, 10 mm by 5 mm, sessile, crowded, usually imbricate at the base, apex rounded or bluntly pointed, base ± rounded, margin slightly serrate or entire; texture more or less coracious; mid-rib prominent; lateral veins inconspicuous; rachis grooved with linear scales. ***Sori*** in a single row, borne on mid-way between mid-rib and margin; indusium circular, attached by broad curve base oblique to the vein, the free edge of the indusium facing the apex of the pinna; basal indusium circular with a narrow sinus.

Bhutan – Mongar district

Distribution – Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, Nepal, Pakistan, Srilanka, Thailand, Veitnam

Ecology – Found in rock crevices, shaddy and dry open places at an altitude above 1,900 – 2,161 m asl.

Specimen examined – T Tob 69 (THIM)

HYPODEMATIACEAE

Leucostegia sp. (**Plate 22 E).**

Terrestrial or epiphytes up to 70 – 80 cm tall. ***Rhizome*** creeping, robust, 2 – 3 mm in diam., bearing many small fine hairy roots, densely covered with fibrillose scales; scales brown, linear, ca. 1 – 2 mm; membranous, margin entire with a long acuminate apex. ***Stipes*** pale, slightly reddish when dry, 20-30 cm long, sparsely covered by brown fibrillose scales; grooved on the upper surface. ***Lamina*** pale green, broadly deltoid, 30 – 35 cm, glabrous, quadripinnate at the base, tripinnate over large parts of frond; pinnae 10 – 12 paired, sub-opposite – alternate, narrowly triangular and broader towards the base, 10 – 12 cm by 5 – 6 cm with a stalk 5 – 20 mm long; largest pinnae ovate – lanceolate, 15 – 20 cm by 7 – 8 cm, apex acuminate; pinnules 8 – 10 pairs, shortly stalk, deflexed, alternate; basal pinule 7 – 8 cm; ultimate leaflets rhombic, shallowly lobed; ultimate segments 2 – 3 mm wide with a serrate margin; veins distinct. ***Sori*** separate, 1 or 2 per segment, oblique; indusium semi-orbicular, impressed and closed to the margin, fixed at the base. ***Sporangia*** long stalked.

Bhutan – Mongar districts

Distribution –

Ecology – found in an open as well as in a shady place. Altitude of 1,500 – 2,000 m asl.

Specimen examined – T Tob 72 (THIM)

LYCOPODIACEAE

Lycopodium clavatum L, Sp. Pl. 2: 1101. 1753; S.B. Rajabhandari et al. in Fl. Kathmandu 11: 5. 1986. –*Lepidotis ciliata* P. Beauv., Prodr. Aethéogam.108. 1805. – *Lepidotis clavata* (L.) P. Beauv., Prodr. Aethéogam.108. 1805. – *L. inflexa* P. Beauv.,

Prodr. Aethéogam.109. 1805. – *Lycopodium aristatum* Humb. & Bonpl. ex Willd., Sp. Pl.5: 17. 1810. – *Lycopodium aristatum* var. *desvauxianum* Spring, Fl. Bras. 1(2): 114. 1840. – *L. aristatum* var. *incurvum* Grev. & Hook., Bot. Misc.2: 376. 1831. – *L. aristatum* var. *robustius* Grev. & Hook., Bot. Misc.2: 376. 1831. – *L. ciliatum* (P. Beauv.) Sw., Syn. Fil.179. 1806. (**Plate 23 C-D).**

Main stem creeping, subterranean, rooting at regular interval; aerial stems ascending to erect; branches dichotomously forked, with linear, subulate, flat, scale-like and tip incurved leaves. ***Leaves*** spirally arranged, very dense, usually in a upward angle, linear, 4 mm by 0.5 mm, apex acuminate with a narrow hair tip 2 – 3 mm, margin entire, sessile; viens inconspicuous; texture coriaceous, green or yellowish green. ***Stalks*** erect, ca. 10 cm long with adpressed linear leaves; cones cylindrical, erect, 6-8 cm long, ca. 3-4 mm in diam. ***Sporophyll*** oblong-ovate, ca. 1.5 mm by 1.3 mm, apex acuminate with setaceous membrane. ***Sporangia*** slightly exposed

Bhutan – Mongar
Distribution – Bhutan, China, India, Nepal, Sri Lanka
Ecology – Found among the dry moss in an open and shady area. Altitude 2,440 m asl.
Specimen Examined – T Tob 040 (THIM)

POLYPODIACEAE

Drynaria propinqua (Wall. ex Mett.) J. Sm., J. Bot. (Hooker) 4: 61. 1842; S.B. Rajabhandari et al. in Fl. Kathmandu 11: 98. 1986. – *Drynaria propinqua* var. *mesosora* Christ, Bull. Acad. Int. Géogr. Bot. 16(199–200–201): 108. 1906. – *Polypodium propinquum* Wall. ex Mett., Abh. Senckenberg. Naturf. Ges. 1: 120, pl. 3, f. 50. 1856. (**Plate 22 F).**

Epiphytic ferns. ***Rhizome*** creeping, 2 – 3 mm in diam., strong and stout, covered with brown hairy scales; scales linear, 3 – 4 mm by 1 mm, margin dentate. ***Frond*** dimorphic, pinnate, glabrous. ***Stipes*** 4-5 cm long, jointed to rhizome, sparsely scaly. Sterile ***lamina*** brown, glabrous, pinnate, ovate, 15 cm by 8 cm, scale-like, sessile, cut half way down into acute, lobes 7 – 8 in both sides; lobes apex acute, margins irregularly dentate. Fertile ***lamina*** green, 30 cm by 15 cm, cut down nearly to the rachis, glabrous; lobes linear, 10 cm by 2.5 cm, apex acuminate, margins serrate; main veins distinct; lateral veins anastomosing; rachis raised above and grooved below; texture sub-coriaceous. ***Sori*** round, brown, single row between the mid-rib and at the point of union of veinlets.

Bhutan – Mongar districts
Distribution – Myanmar, China, India, Nepal, Philippines, Thailand, Vietnam
Ecology – Epiphytic or terrestrial in a shaded areas. Altitude 2,434 m asl.
Specimen examined – T Tob 62 (THIM)

Neocheiropteris normalis (D. Don) Tagawa, J. Jap. Bot. 27(7): 217. 1952; Z. Xianchu and H.P. Noteboom in Fl. China 2-3: 805.2014. – *Microsorum normale* (D. Don) Ching, Bull. Fan Mem. Inst. Biol. 4(10): 299. 1933. –*Neocheiropteris normalis* (D. Don) Ching, Bull. Fan Mem. Inst. Biol., Bot. 10(1): 13. 1940. – *Pleopeltis normalis* (D. Don) T. Moore, Index Fil. 347. 1862. – *Polypodium longifrons* Wall. ex Hook. & Grev., Icon. Filic. 1(4): pl. 65. 1828. – *P. normale* D. Don, Prodr. Fl. Nepal. 1. 1825. - *Neocheiropteris normalis* (D. Don) Tagawa, J. Jap. Bot. 27(7): 217. 1952. (**Plate 23 A-B**).

Terrestrial or epiphytes. ***Rhizome*** creeping, somewhat flattened, 2 – 3 mm in diam., bearing fronds 1-2 cm apart, covered by dense brown scales throughout; scales, small, pale, ovate, 2 mm by 1 mm, apex ± acute, base rounded, margin entire. ***Stipes*** 6 – 7 cm long, winged in the upper part, usually scaly in the lower parts. ***Lamina*** narrowly

lanceolate, 50 – 54 cm by 2 – 3 cm, apex long acuminate, base attenuate, margin entire, slightly wavy; mid-rib distinctly raised on both surfaces; lateral veins copiously anastomosing. ***Sori*** round, irregularly arranged in single row between margin and mid-rib, 1 – 2 mm in diam.

Bhutan – Mongar districts
Distribution – Myanmar, China, India, Nepal, Thailand, Vietnam
Ecology – Found as low epiphytes in moist leaved forests. Altitude above 1,500 – 2,032 m asl.
Specimen examined – T Tob 085 (THIM)

WOODSIACEAE

Athyrium thelypterioides (Michx.) Desv., Mém. Soc. Linn. Paris 6: 266. 1827; S.B. Rajabhandari et al. in Fl. Kathmandu 11: 60. 1986. (**Plate 23 E-F).**

Terrestrial. ***Rhizome*** creeping, 3 – 4 mm in diam., clothed with linear-lanceolate, brownish, membranous scales. ***Stipes*** erect, 15 – 30 cm, straminous, laterally grooved, scaly at the base and lightly scaly at the top. ***Fronds*** ca. 20 – 90 cm long, 10-20 cm broad, linear, bipinnatifid; pinnae numerous pairs, sub-opposite to altenate, sessile, obliquely spreading, linear, apex acuminate; rachis laterally grooved, pubescent; texture herbaceous; veins repeatedly forked and free. ***Sori*** oblong, placed obliquely on the main veins; indusium membranous.

Bhutan – Mongar districts
Distribution – China, India, Nepal
Ecology – Found in moist and shaddyforest slopes. Altitude of 1,500 – 2,500 m asl.
Specimen examined – T Tob 138 (THIM)

EUDICOTS

ACANTHACEAE

Justicia adhatoda L. Sp. Pl. 1: 15. 1753; J.R.I. Wood in Fl. Bhutan 2(3): 1287. 2001; H. Jiaqi et al. in Fl. China 19: 450,456,457. 2011. – *Adhatoda vasica* Nees, Pl. Asiat. Rar. 3: 103. 1829-1830; – *A. zeylanica* Medik., Hist. & Commentat. Acad. Elect. Sci. Theod.-Palat. 6: 393. 1790. (**Plate 1 A).**

Shrubs, up to 3-4 m tall. ***Stem*** erect, branched; bark greenish brown, glabrescent. ***Leaves*** simple, alternate; leaf blade elliptic, 14–16 cm by 4–6 cm, apex acuminate, base attenuate, margin entire; mid-rib conspicuous on both surfaces; lateral veins 8 – 10 paired; abaxially puberulent, adaxially densely tomentose; petiole 1.5 – 3 cm long, puberulent. ***Inflorescence*** terminal or axillary; spikes 2–7 cm, many-flowered; peduncle 2–5 cm long, pubescent; bracts ovate – oblong, 15 mm by 5 mm, apex acute, base rounded, margin ciliate, 3–5 veined; bracteoles linear-lanceolate, 10 mm by 2 mm, puberulent, apex acute, margin ciliate, 1–2 veined. ***Calyx*** 5-lobed, lobes oblong-lanceolate, 7 mm by 2 mm, apex acute, margin ciliate. ***Corolla*** white with purplish strips outside, 2–3 cm, broadly tubular, tube basally cylindric, 3-4 mm and slightly inflated and bent upward; upper lip ovate – oblong, 15 mm by 10 mm, shallowly 2-lobed, glabrous; lower lip with 3 – ovate lobes, 12 mm by 5 mm, apex rounded, margin entire; middle lobe sub-orbicular, 8 mm by 4 mm; lateral lobes ovate, 8 mm by 3.5 mm. ***Stamens*** exserted; filament 2.5 cm long, glabrous; anther thecae ellipsoid. ***Ovary*** superior, densely pubescent; style 2.4 cm long; stigma simple. ***Capsule*** woody, 2-3 cm, pubescent. ***Seeds*** ovoid, 1-2 mm in diam., dark brown.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Sarpang, Tashigang districts

Distribution – China, India, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka

Ecology – Found in broadleaved forest especially in wooded gullies at an altitude 989 – 1,900 m asl. Flowering in December – April

Specimen Examined – T Tob 031 (THIM)

Mackaya indica (Nees) Ensermu, Kew Bull. 47(4): 673. 1992; J.R.I. Wood in Fl. Bhutan 2(3): 1283. 2001**. (Plate 1 B).**

Shrubs, up to 1 – 2 m tall. ***Stem*** erect, brown, glabrous. ***Leaves*** simple, opposite, blade ovate – elliptic, 10 – 15 cm by 5 – 9 cm, apex shortly acuminate, base rounded, margin entire; mid-rib distinct on both the surface; lateral vein conspicuous on both surfaces, 6 – 7 paired; petiole 2 – 2.5 cm long, glabrous. ***Inflorescence*** terminal, racemes; rachis 5 – 10 cm long, glabrous; many-flowered, flowers usually in opposite pairs; internodes 4 – 5 mm; pedicel 1 – 3 mm long; bracts linear – triangular, 2 mm. ***Calyx*** cup-shaped, 5-lobed; lobes lanceolate, 3 mm by 1.5 mm, pubescent, apex shortly acuminate, margin finely ciliated. ***Corolla*** white or pink with darker red veins; corolla tube, 5-lobed; lobes finely pubescent, weakly 2 – lipped. ***Stamens*** 2; filaments 2 cm long; anthers basifixed. ***Ovary*** superior, glabrous; style slender 2 cm long. ***Capsule*** 1-2 cm, glabrous.

Bhutan – Mongar, Punakha, Samdrup Jongkhar, Sarpang, Tashigang districts
Distribution – China, India, Nepal, Sri Lanka
Ecology – Found in moist areas. Altitude 2,095 m asl. Flowering in January – April
Specimen Examined – T Tob 042 (THIM)

Strobilanthes capitata (Nees) T. Anderson, J. Linn. Soc., Bot.9: 475. 1867; J.R.I. Wood in Fl. Bhutan 2(3): 1263. 2001; H. Jiaqi et al. in Fl. China 19: 384,420,421. 2011. – *Goldfussia capitata* Nees, Pl. Asiat. Rar. 3: 88. 1832**. (Plate 1 C).**

Shrubs, up to 1 – 1.5 m tall. ***Stem*** branched, pilose, glabrescent, often leaf less when in flower. ***Leaves*** simple, opposite and usually unequal size, elliptic or lanceolate, 4 – 10 cm by 2 – 5 cm, apex shortly acuminate, base attenuate, margin serrate; abaxially pubescent along the veins; adaxially sparsely pilose; lateral veins 6 – 7 paired.

Inflorescence axillary; flowers in dense, pedunculate; peduncle 1 or 2 in each axil, 2 – 3 cm long, glabrous or sparsely pubescent; sterile bracts at the branching point of peduncle; outer floral bracts sterile, ovate 1 – 2 cm, concave, glabrous or pubescent, apex acute, margin crenate; inner bracts oblong-elliptic, 1 – 1.5 cm, margin entire with 1 or 2 teeth; bracteoles oblong – elliptic 5 – 10 mm, pilose. ***Calyx*** pale green, 5 – lobed, lobes linear – oblanceolate, 7 mm by 2 mm, apex acute, pubescent outside, margin ciliate. ***Corolla*** light purple, 3 cm, thinly pilose outside and inside glabrous, tube straight, narrowly cylindrical and gradually widened at the mouth; lobes oblong 5 mm by 2 mm. ***Stamens*** 4, unequal; filaments slender, 2 – 3 cm long; anther basifixed. ***Ovary*** gland-tipped pilose; style slender 3.5 cm long, thinly pilose. ***Capsule*** oblong, 1-2 cm, 4-seeded. ***Seeds*** ovate, ca. 2 mm by 1.5 mm, pubescent.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Sarpang, Samchi districts
Distribution – Myanmar, China, India, Nepal
Ecology – Found in forest margins, moist gullies at an altitude of 2,410 m asl. Flowering in September – February
Specimen Examined – T Tob 070 (THIM)

ACERACEAE

Acer campbellii Hook. f. & Thomson, Fl. Brit. India 1(3): 696. 1875; A.J.C. Grierson and D.G. Long in Fl. Bhutan 2(1): 67. 1991; X. Tingzhi et al. in Fl. China 11: 528. 2008. (**Plate 1 D).**

Trees, up to 20 – 25 m. Branchlets glabrous. ***Leaves*** simple, opposite, 10.5 – 11 by 6 – 7 cm, 5 – lobed; lobes caudate – acuminate, base truncate, margin finely and regularly serrulate, sparsely pubescent on veins and in vein axils beneath; petiole 4.5 – 5 cm long, sparesly pubescent. ***Inflorescence*** terminal, simple cyme, many-flowered; flowers in panicles, diam. 4 – 5mm; pedicel glabrous, 3 – 4 mm long. ***Calyx*** slightly reddidh, sepals – 5; lobes ovate, 3 mm by 2 mm, pubescent, apex acute, margin entire. ***Corolla*** greenish, 5 – petals, polypetalous; lobes ovate, 3 mm by

1 mm, apex acuminate, margin entire, glabrous. ***Stamens*** 5, glabrous, extrastaminal; filaments ca. 1 mm long. ***Ovary*** superior, pubescent. ***Fruit*** not seen.

Bhutan – Chukha, Bumthang, Mongar, Thimphu, Tashigang districts
Distribution – Myanmar, China, India, Nepal, Vietnam
Ecology – Evergreen broad-leaved forest at an altitude of 1,500-2,500 m asl. Flowering in April – May.
Specimen Examined – T Tob 059 (THIM)

ACTINIDIACEAE

Saurauia roxburghii Wall. Pl. Asiat. Rar.2: 40. 1831; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(2): 360. 1984. (**Plate 1 E-F).**

Shrubs or small tree, up to 6-7 m. ***Stem*** branched, glabrous. ***Leaves*** simple, alternate; leaf blade lanceolate, 15 – 16 cm by 5 – 6 cm, apex short acuminate, base rounded, margin finely serrate; mid-rib distict on both surface; lateral veins conspicuous in both surface, 25 – 30 paired; petiole and under surface of leaves covered by sparingly brownish-tormentose hairs; petiole 1.5 – 2 cm long, pubescent. ***Inflorescences*** axillury, compound cyme, 3 – 10 flowered; bracts ovate, 1.5 cm by 0.5 cm, apex acute, margin entire; pedicels 1-1.5 cm long, glabrous; peduncle 4.7 – 5.6 cm, sparsely pubescent. ***Calyx*** green, sepals 5, lobes elliptic, 4 mm by 3 mm, apex acute, margin entire. ***Corolla*** white, petals 5, polypetalous; lobes orbicular, 5 by 4 mm, apex rounded, margin entire, glabrous. ***Stamens*** numerous; filaments free, 1 – 2 mm long; anthers basifixed. ***Ovary*** superior, 1 – 2 mm diam., 5 – locules. ***Berry*** globose, 4 – 5 mm in diam.

Bhutan – Mongar, Punakha, Tashigang districts
Distribution –Bhutan, Myanmar, Nepal, India, Northern Thailand

Ecology – Found in moist broad-leaved forest, thickets at an altitude of 1,650 m asl. Flowering in May – August.

Specimen Examined – T.Tob 076 (THIM)

ADOXACEAE

Viburnum cylindricum Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 142. 1825; R.A. King in Fl. Bhutan 2(3): 1358. 2001; Y. Qiner et al. in Fl. China 19: 573,595,599. 2011. – *Viburnum crassifolium* Rehder, Trees & Shrubs 2(2): 112: 1908; – *V. cylindricum* var. *crassifolium* (Rehder) C.K. Schneid., Bot. Gaz. 64(1): 77. 1917. (**Plate 2 C).**

Shrubs or small trees, up to 5-8 m tall. ***Stem*** branched, glabrous; branchlets brownish, terete, glabrous, with a small rounded lenticels. ***Buds*** lanceolate – triangular, pairs of separate scales; scales glabrous. ***Leaves*** simple, opposite; leaf blades elliptic to oblong or ovate – oblong, 6 – 11cm by 4 – 2.5 cm, apex acute or shortly acuminate, base cuneate, margin entire; abaxially glabrous with dispersed reddish or yellow tiny glandular dots; adaxially glabrous; mid-rib distinct at both the surfaces, prominently raised abaxially; lateral veins conspicuous at both the surfaces; petiole 1 – 2 cm long, glabrous. ***Inflorescence*** terminal, a compound umbel-like cyme, many – flowered; peduncles 1 – 2.5 cm long, sparsely pubescent; bracts whitish green, caducous, linear – lanceolate, 2 mm by 1 mm, glabrous; bracteoles scale-like. ***Calyx*** greenish, tube 1 – 1.5 mm; lobes reduced, glabrous. ***Corolla*** white or reddish, campanulate, 3 – 4 mm; lobes erect, orbicular – ovate, ca. 2 mm, apex rounded, margin entire. ***Stamens*** 4, filaments ca. 2 – 3 mm long; anthers brown, oblong, ca. 2 mm, dorsifixed. ***Ovary*** superior, ovoid; style ca. 1 mm; stigma capitate. ***Drupe*** oblong-round, ca. 4 mm by 3 mm, black. ***Pyrenes*** compressed ovoid, ca. 4 mm by 3.5-4 mm, with 2 shallow dorsal grooves and 1 shallow ventral groove, apex rounded.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Indonesia, Nepal, Pakistan, Thailand, Vietnam

Ecology – Found in moist broad-leaved forests. Altitude of 2,564 m asl. Flowering in July – August.

Specimen Examined – T. Tob 043 (THIM)

V. erubescens Wall., Pl. Asiat. Rar.2: 29, pl. 134. 183; R.A. King in Fl. Bhutan 2(3): 1359. 2001; Y. Qiner et al. in Fl. China 19: 587. 200. – *Solenotinus erubescens* (Wall.) Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 12: 295. 1860; – *V. botryoideum* H. Lév., Cat. Pl. Yun-Nan 28. 1915; – *V. Myanmar nicum* var. motoense P.S. Hsu., Acta Phytotax. Sin. 79. 1979; – *V. erubescens* var. Myanmar nicum Rehder, Pl. Wilson. 108. 1911. (**Plate 2 A-B).**

Shrubs or small trees, up to 4-5 m tall. ***Stem*** erect, branched, bark light brown. ***Leaves*** simple, opposite; leaf blade elliptic, 6 – 7 cm by 3.5 – 4 cm; apex shortly acuminate; base cuneate; margin serrulate; mid-rib conspicuous at both the surfaces and prominently raised beneath; lateral veins 5 – 7 paired; abaxially stellate – pubescent on mid-vein and lateral veins; petiole 1 cm long, glabrous. ***Inflorescence*** axillary, pendulous panicles, many – flowered; pedicel up to 1 – 2 mm long, glabrous; peduncles 2 – 3cm; bracts linear, 3 – 4 mm, pubescent; bracteoles linear**.** ***Calyx*** reddish, tubular – shaped, 5-lobed, ca. 1 mm long, apex obtuse, glabrous. ***Corolla*** tubular – campanulate; tube 1 – 1.5 cm by 1 cm, 5-lobed, white coloured; lobes spreading, ovate, ca. 4 mm by 2 mm, apex rounded, margin entire, glabrous. ***Stamen*** 5, anthers 2 mm long, versatile; filaments very short inserted in upper part of the tube, 1 – 2 mm long. ***Ovary*** superior; stigma capitates. ***Drupes*** ellipsoid, purplish black, 5 mm by 2 mm. ***Pyrenes*** compressed, obovoid, ca. 9 mm by 4 mm with 1 broad and deep ventral groove, apex rounded.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – Bhutan, Myanmar, China, India, Nepal, Vietnam

Ecology –Found in moist broad-leaved forest and in the degraded areas. Altitude 1,400 – 3,500 m asl. Flowering in April – May

Specimen Examined – T.Tob 057 (THIM)

APIACEAE

Hydrocotyle himalaica P. K. Mukh., Indian Forester. 95: 470. 1969; M.F. Watson in Fl. Bhutan 2(2): 443. 1999; S.Menglan et al. in Fl. China 14: 17. 2005. – *Hydrocotyle javanica* var. *podantha* (Molk.) C.B. Clarke, Fl. Brit. India 2(6): 668. 1879. (**Plate 2 D-E).**

Prostrate herb, up to 20 – 30 cm. ***Stems*** sparsely brown pubescent, rooting at nodes. ***Leaves*** simple, leaf blades orbicular, 20 mm by 5 mm, 5 – 7 lobed; lobes rounded; apex rounded, base deeply cordate, margins crenate, sparesly strignose on both surfaces; petiole 5 – 10 cm long, densely pubescent on the apex. ***Inflorescence*** umbel, solitary in leaf axils, many – flowered; 3 – 7 cm long, usually longer than the petiole; pedicels 2 – 3 mm in flower and 4 – 5 mm in fruits. ***Calyx-*** teeth obsolete. ***Petals*** narrowly triangular, greenish, apex slightly incurved. ***Stamen*** 5, filaments slender, anther bilobed, dorsifixed. ***Ovary*** inferior, style, ca. 1 mm long, spreading. ***Capsule*** brown or purplish red, globose, ca. 1 – 2 mm.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar districts

Distribution – Myanmar , China, India, Nepal

Ecology – Found mostly in shaddy moist grassy places, along the roadsides. Altitude 1,500 – 2,400 m asl. Flowering in April – September.

Specimen examined – T Tob 094 (THIM)

ARISTOLOCHIACEAE

Aristolochia griffithii Hook. f. & Thomson ex Duch., Prodr.15: 437. 1864; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(2): 353. 1984; H. Shumei et al. in Fl. China 5: 262. 2003. – *Aristolochia yunnanensis* Franch., J. Bot. (Morot) 12(19–20): 313–314. 1898. – *A. yunnanensis* var. *meionantha* Hand.-Mazz., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 161: 163. 1879. (**Plate 3 A-B).**

Scandent. ***Stems*** covered by densely reddish brown villous, terete and striate. ***Leaves*** simple, ovate, 11 cm by 9 cm, apex acuminate, base cordate to auriculate, margin ciliated; lower surface of leaf with densely red-brown or white villous; upper surface sparsely pubescent; mid-rib distinct on both surfaces; veins palmate with 2 – 4 pairs from base, conspicuous on both surfaces. ***Flowers*** solitary; peduncles pendulous, 5 – 10 cm long, densely pubescent; bracteoles, small and leaf – like, ovate, 2 cm by 1.5 cm; pedicels 2-3 cm long, pubescent. ***Perianth*** S-shaped; folded tube 4 – 5 cm, green with purple veins, strongly inflated at band, 3 – 5 cm broad, sparsely pubescent; limb funnel-shaped, rhombic – orbicular, 7 – 8 cm in diam., shallowly 3 – lobed; lobes broadly deltoid bearing 12 anthers. ***Anthers*** oblong 3-4 mm. ***Ovary*** cylindrical 3 – 4 cm, dehisycing basipetally. ***Capsule*** oblong, 12 cm by 3 cm. ***Seeds*** ovoid, ca. 4 mm by 2 mm.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Nepal

Ecology – Found in broad leaved-forest at an altitude of 1,800 – 3,000 m asl. Flowering in April – May

Specimen Examined – T. Tob 064 (THIM)

ASTERACEAE

Ainsliaea latifolia (D. Don) Sch. Bip., Jahresber. Pollichia. 18–19: 169, 190. 1861; A.J.C. Grierson and L.S. Springate in Fl. Bhutan 2(3): 1418. 2001; G. Tiangang et al. in Fl. China 20-21: 22. 2011. – *Ainsliaea heterantha* Hand.- Mazz.,Oesterr. Bot. Z. 87: 128. 1938. – *A. hypoleuca* Diels, Repert. Spec. Nov. Regni Veg. Beih. 12: 514. 1922. – *A. latifolia* var. *ramifera* H. Chuang, Fl. Yunnan. 13: 835, 652. 2004. – *A. petelotii* Merr.,J. Arnold Arbor. 21(3): 388–389. 1940[1940]. – *A. pteropoda* D C., Prodr.7: 14. 1838. – *A. silhetensis* (DC.) C.B. Clarke, J. Linn. Soc., Bot. 14(78): 411–412. 1875. – *A. triflora* (Buch.-Ham. ex D. Don) Druce, Rep. Bot. Exch. Cl. Brit. Isles 1913. 4: 603. 1916. – *Liatris latifolia* D. Don, Prodr. Fl. Nepal. 169. 1825. – *Perdicium triflorum* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.169. 1825. (**Plate 3 C).**

Herbs, up to 40-50 cm tall. ***Stem*** erect. ***Leaves*** in a basal rosette, simple; blade ovate to elliptic, 5 – 6 cm by 2 cm, apex acuminate, rounded to tapering at the base, sparsely pubescent on both surface; margin weakly crenate; petiole winged throughout, 3 – 4 cm long; mid-rib prominent on lower surface; lateral veins 3- paired, palmate – pinnate veined. ***Inflorescence*** homogamous capitulum; capitulum subsessile of shortly pedenculate, ca. 2 mm long, clustered, arranged in spikes or panicles, 2-3 flowered; involucres cylindric, 2-3 mm. ***Phyllaries*** 5 – seriate; outer phyllary ovate, 1 mm long, apex acute, base rounded, margin entire, glabrous; inner phyllary linear to lanceolate, 5 – 6 mm long, apex acute, base rounded, margin entire. ***Florets*** cleistogamous, fertile. ***Corolla*** tubular, tube, 7 – 8 mm long, white, 6 – lobed; lobes linear – lanceolate, apex acute, margin entire, glabrous. ***Stamens*** 5 anthers appendages, rounded; style very short ca. 1 mm. ***Ovary*** inferior, ca. 1mm long, glabrous. ***Achenes*** subfusiform, ca. 5 mm long. ***Pappus*** 7 – 8 mm long, brown, bristles numerous, plumose.

Bhutan – Chukha, Haa, Mongar, Sarpang, Punakha, Thimphu districts

Distribution – Bangladesh, Myanmar, China, India, Indonesia, Nepal, Thailand, Vietnam

Ecology –Found in open forests, along roadsides, dry and open places at an altitude of 2,563 m asl. Flowering in March –June.
Specimen Examined – T.Tob 071 (THIM)

Dichrocephala integrifolia (L. f.) Kuntze, Revis. Gen. Pl.1: 333. 1891; A.J.C. Grierson and L.S Springate in Fl. Bhutan 2(3):1526. 2001; C. Yousheng and D.J.N. Hind in Fl. China 20 – 21:550, 551. 2011. – *Cotula bicolor* Roth, Catal. Bot.1: 116. 1800. - *Dichrocephala auriculata* (Thunb.) Druce, Rep. Bot. Soc. Exch. Club Brit. Isles 4: 619. 1917. – *D. bicolor* (Roth) Schltdl., Linnaea 25: 209–211. 1852. – *Ethulia auriculata* Thunb., Prodr. Pl. Cap.141. 1794. – *Hippia integrifolia* L. f., Suppl. Pl.389. 1781. (**Plate 3 D).**

Herbs, 10 – 15 cm tall. ***Stem*** erect, simple and branched at the base, covered with white villous or pubescent. ***Leaves*** alternate, lyrate, blade ovate or elliptic, 5 – 6 cm by 2 – 3 cm, apex acute, base attenuate, usually petiolate, margin serrate; lyrately pinnatilobate; terminal lobe elliptic, 3.5 cm by 2 cm; lateral lobes 2 – paired; mid-rib visible on both the surfaces; lateral veins conspicuous, 4 – 5 paired; petiole 1 – 2 cm long, narrowly winged; surfaces sparsely to moderately strigose. ***Inflorescence*** a panicle, globular heads or capitula; capitulam small, 3 – 4 mm in diam., in terminal paniculiform synflorescences. ***Phyllaries*** 2-seriate, oblanceolate to oblong, ca. 1 mm by 0.4 mm, margin hyaline, lacerate; receptacle sub-globose with a flat apex. ***Ray florets*** 4- 8 seriate, pistillate. ***Pappus bristles*** absent. ***Corolla*** tube ca. 0.5 mm long, whitish, not appressed to style, 2-3 toothed. ***Disk florets*** numerous. ***Pappus bristles*** 2-3. ***Corolla*** tube ca. 0.3 – 0 .4 mm long, limb narrowly campanulate to funnel-form with 4 – 5 lobes, sessile glandular. ***Achene*** ovoid, ca. 1 mm long.

Bhutan – Chukha, Mongar, Punakha, Trongsa, Thimphu districts
Distribution – Myanmar, Cambodia, China, Laos, Philippine, Vietnam

Ecology – Found in the open ground, waste land at an altitude of 2,500 m asl.
Flowering in March – July
Specimen Examined – T Tob 091 (THIM)

Galinsoga parviflora Cav., Icon. 3: 41. 1795; A.J.C. Grierson and L.S Springate in Fl. Bhutan 2(3):1610. 2001; C. Yousheng and D.J.N. Hind in Fl. China 20-21:864, 865. 2011. – *Adventina parviflora* Raf., New Fl.1: 67. 1836. – *Galinsoga parviflora* var. *semicalva* A. Gray, Smithsonian Contr. Know l.5 (6): 98. 1853. – *G. quinqueradiata* Ruiz & Pav., Syst. Veg. Fl. Peruv. Chil. 1: 198. 1798. – *G. semicalva* (A. Gray) H. St. John & D. White, Rhodora 22 (258): 100. 1920. – *Sabazia microglossa* DC., Prodr.5: 497. 1836. – *Stemmatella sodiroi* Hieron., Bot. Jahrb. Syst.28(5): 601. 1901. – *Wiborgia acmella* Roth, Catalect. Bot.2: 112. 1800. – *W. parviflora* (Cav.) Kunth, Nov. Gen. Sp. (folio ed.) 4: 201. 1820. (**Plate 3 E).**

Herbs, up to 10 – 30 cm tall. ***Stem*** erect, branched, pubescent above. ***Leaves*** simple, opposite, 3-veined at the base, ovate – lanceolate, 4 cm by 2 cm, apex acute or short acuminate, base rounded or attenuate, margin shallowly serrate, sparsely pilose on both the surfaces; distinct mid-rib on both the surfaces; petiole ca. 1 cm or upper leaves ± sessile. ***Inflorescence*** terminal, cymose with 3 – 4 capitula in cluster; capitula with florets; peduncles slender, pubescent, short, 2-3 mm; involucre campanulate, ca. 3 mm in diam. ***Phyllaries*** ovate, green, 2-seriate; outer phyllaries 2-3 mm; inner phyllaries 3-4 mm; paleae free, trifid; outer paleae oblong-elliptic, 3 – 4 mm; inner paleae oblanceolate, 2-3 mm, apex acute. ***Ray florets*** 5, ca. 1-1.5 mm. ***Pappus bristles*** absent. ***Corolla*** white; lamina 2.5 mm by 1.5 mm. ***Achenes*** 1 – 2 mm. ***Disk florets*** numerous, 1 – 2 mm, glabrous. ***Pappus*** scales 0.5-1mm. ***Achenes*** ca. 1 mm.

Bhutan – Chukha, Mongar, Punakha, Samchi, Tashigang, Thimphu districts
Distribution – China, India, Nepal

Ecology – Found in open ground, waste places an altitude above 900 – 2450 m asl. Flowering in July – October

Specimen Examined – T Tob 098 (THIM)

Parthenium hysterophorus L., Sp. Pl.2: 988. 1753; A.J.C. Grierson and L.S. Springate in Fl. Bhutan 2(3): 1622. 2001; C. Yousheng and D.J.N. Hind in Fl. China 20-21: 877. 2011. – *Argyrochaeta bipinnatifida* Cav., Icon. 54–55, t. 378. 1797. – *Echetrosis pentasperma* Phil., Anales Univ. Chile43: 504–505. 1873. – *Parthenium glomeratum* Rollins, Contr. Gray Herb.172: 59. 1950. – *P. lobatum* Buckley, Proc. Acad. Nat. Sci. Philadelphia 13(12): 457. 1861. – *Villanova bipinnatifida* Ortega, Nov. Pl. Descr. Dec.4: 48, t. 6. 1797. (**Plate 3 F).**

Herbs, about 50 – 100 cm tall. ***Stem*** branched, erect, stiffly appressed white puberulous. ***Leaves*** alternate, leaf blade ovate – lanceolate, 15 – 18 cm by 5 – 6 cm, pinnately 1 – 2 lobed, sparsely white pubescent on both the surfaces; mid-rib distinct; lateral veins conspicuous, often pilose; basal leaves ovate, 8 cm by 3 cm, segments irregularly and coarsely rounded – dentate, long petiolate, 2 – 3 cm long; cauline leaves, finely cut, short petiolate; upper leaves smaller, narrower and ± sessile. ***Inflorescence*** terminal, often panicles with many small capitula; capitula obscurely radiate; peduncles 8 – 10 mm long, pubescent; pedicels 1 – 9 mm long. ***Phyllaries*** scarious, 2-seriate; outer phyllaries 5, elliptic to lanceolate, 2 mm by 1.5 mm, apex acute, margin ciliated, 2-3 veined; inner phyllaries 5, ovate – orbicular, ca. 4 mm by 4 mm, apex rounded, margin entire or finely ciliate, glabrous. ***Ray florets*** 5, pistillate. ***Pappus*** absent, pappus like appendages on top of ovary, appendage lanceolate, white. ***Corolla*** orbicular to oblong, 0.3 -1 mm, white. ***Stamen*** absent. ***Ovary*** inferior, ovate, whitish, glabrous. ***Disk florets*** 20-30, ca. 1 mm long. ***Pappus*** absent. ***Corolla*** tube ca. 2.5 mm long, 4-lobed, creamy white. ***Stamens*** 4, fused near base; filaments ca. 0.3 mm long, anthers basifixed. ***Ovary*** inferior, diminutive; style ca. 1 mm long, reddish. ***Achenes*** ovoid 1 – 1.5 mm.

Bhutan – Mongar, Punakha, Tashigang, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found in the open ground, waste places and roadsides at an altitude above 1,000 m asl. Flowering in April – August.

Specimen Examined – T Tob 116 (THIM)

Pseudognaphalium affine (D. Don) Anderb., Opera Bot.104: 146. 1991; A.J.C. Grierson and L.S. Springate in Fl. Bhutan 2(3): 1522. 2001; C. Yousheng et al. in Fl. China 20 - 21: 816. 2011. – *Gnaphalium affine* D. Don, Prodr. Fl. Nepal.173. 1825. – *G. confusum* DC., Prodr.6: 222. 1837. – *G. javanum* DC., Prodr.6: 222. 1837. – *G. luteoalbum* subsp. *affine* (D. Don) J. Kost., Blumea 4(3): 484–485. 1941. – *G. luteoalbum* var. *multiceps* (Wall. ex DC.) Hook. f., Fl. Brit. India 3(8): 288. 1881. – *G. multiceps* Wall. ex DC., Prodr.6: 222. 1837. – *G. ramigerum* DC., Prodr.6: 222. 1837. – *Laphangium affine* (D. Don) Tzvelev, Byull. Moskovsk. Obshch. Isp. Prir. Otd. Biol. 98(6): 105. 1993. – *Pseudognaphalium luteoalbum* subsp. *affine* (D. Don) Hilliard & B.L. Burtt, Bot. J. Linn. Soc. 82(3): 206. 1981. (**Plate 4 A).**

Herbs, up to 10 – 30 cm tall. ***Stem*** erect, often branched at the base, densely white tomentose. ***Leaves*** simple, alternate, blades lanceolate – oblanceolate, 4.5 cm by 0.5 cm, apex obtuse or shotly acuminate, base angular, sessile, margin entire or ciliated, both the surfaces with dense white lanate; mid-rib and veins inconspicuous. ***Inflorescence*** terminal or axillary; capitula numerous, 1 – 3 mm in diam., densely aggregated in termimal corymbs; involucre globose 3 cm by 2.5 mm. ***Phyllaries*** 3 – 4 seriate, pale yellow; outer phyllaries broadly ovate, ca. 1.5 mm by 0.5 mm, apex acute, margin, entire, glabrous; inner phyllaries oblong, 2 mm by 0.5 mm, apex obtuse, glabrous. ***Florets*** 2***;*** outer numerous, ca. 1.5 mm; central 5-10.ca. 2 mm. ***Corolla*** yellow, ca. 2 mm. ***Achenes*** oblong, compressed, ca. 0.5 mm, papillose. ***Pappus*** white, ca. 2 mm.

Bhutan – Chukha, Mongar, Samdrup Jongkhar, Sarpang, Trongsa, Thimphu districts
Distribution –Myanmar , China, India, Indonesia, Japan, Nepal, Vietnam
Ecology –Found in open ground, roadsides, dry and open places at an altitude of 1,000 – 4,900 m asl. Flowering in March – December
Specimen Examined – T.Tob 041 (THIM)

Sonchus oleraceus L., Sp. Pl. 2: 794. 1753; A.J.C. Grierson and L.S. Springate in Fl. Bhutan 2(3): 1480. 2001. – *Sonchus ciliatus* Lam., Fl. Franc 2: 87. 1778. – *S. gracilis* Phil., Anales Univ. Chile 87: 325. 1894. – *S. mairei* H. Lév., Repert. Spec. Nov. Regni Veg. 12(325–330): 284. 1913. – *S. maritimus* Sessé & Moc., Fl. Mexic. (ed. 2) 177. 1894. – *S. maritimus* Sessé & Moc., 177. 1894. – *S. plumieri* Sessé & Moc., Fl. Mexic. (ed. 2)178. 1894. (**Plate 4 B-C).**

Herbs, 50 – 90 cm tall. ***Stem*** erect, branched, papillose, often hollow. ***Leaves*** simple, oblanceolate, 10 – 15 cm by 4 – 5 cm, apex acute, base hastate, sessile; margin ± coarsely spinulosely dentate**.** ***Inflorescence*** terminal corymb with few to several capitula; capitula with many florets; peduncle up to 4 – 5 cm long, slender, papillose; involucre campanulate, 1 – 1.2 cm. ***Phyllaries*** glabrous or with few glandular hairs; apex ± obtuse; outer phyllaries lanceolate, 7-8 mm long, margins entire, imbricate; inner phyllaries lanceolate, 8-11 mm long, margin entire. ***Ligulate flower*** bisexual, 0.5 mm across. ***Pappus bristle*** numerous, 5-6 mm long, white. ***Corolla*** tube 5-6 mm long, narrowly cylindric, minutely 5-toothed. ***Stamens*** 5, fused to the corolla at top of tube; filaments ca. 0.5 mm long, anther basifixed. ***Ovary*** inferior, obovoid; style exserted, ca. 5 mm long. ***Achenes*** narrowly obovoid, 2.5 -3 mm, 2-grooved on each face with obscure ribs.

Bhutan – Mongar, Punakha, Tashigang, Thimphu
Distribution – Bhutan, China, India, Nepal

Ecology – Mostly found along the roadsides and sometimes in an open ground above 1,900 – 2,450 m asl. Flowering in March – November.
Specimen Examined – T.Tob 022 (THIM)

BALSAMINACEAE

Impatiens spirifer Hook. f. & Thomson, J. Proc. Linn. Soc., Bot. 4: 135. 1859; C. Grey-Wilson in Fl. Bhutan 2(1): 94. 1991. (**Plate D-E).**

Herbs, up to 50 – 60 cm tall. ***Stem*** erect, glabrous. ***Leaves*** simple, alternate, elliptic, 4.5 – 5 cm by 1 – 2 cm, glabrous, slightly pubescent along the veins beneath; margin serrate or dentate; apex acuminate; base cuneate; mid-rib distinct on both sides; lateral vein 5 – paired. ***Inflorescence*** simple cyme, terminal, epedunculate. ***Flowers*** pale pink with a yellowish – orange spur; pedicel 1.5 – 1.7 cm long; bract linear-lanceolate, 4 mm by 1mm; margin entire; lateral sepal bucciniform, 15 – 20 mm long, 13 – 18 mm deep, ± gradually constricted into an incurved; spiraled spur; dorsal petal cucullate, ca. 15 – 16 mm by 16 – 18 mm when flattened; lateral united petal 30 – 34 mm, slightly emerginate; upper lateral petal suborbicular, 10 – 13 by 9 – 10 mm; lower lateral petal asymmetrically elliptic, 20 – 25 by 8 – 10 mm. ***Stamens*** 5, filaments 2-3 mm long; anthers basifixed. ***Ovary*** superior, elliposoid, ca. 2 mm long, glabrous; style 1mm long, glabrous; stigma reduced. ***Capsule*** sub-fusiform, 20 - 21 by 3 – 4 m, glabrous.

Bhutan – Mongar, Punakha, Tashigang, Thimphu, Wangduephodrang districts
Distribution – China, India, Nepal
Ecology – Mostly found along the pathways, montane forest at the altitude 1,500 – 3,000 m asl. Flowering in July – October.
Specimen Examined – T.Tob 115 (THIM)

I. stenantha Hook. f., Fl. Brit. India. 1(3): 478–479. 1875; C. Grey-Wilson in Fl. Bhutan 2(1): 98. 1991; C. Yilin., S. Akiyama and H. Ohba in Fl. China 12: 69. 2007. – *Impatiens angustiflora* Hook. f., Fl. Brit. India1(3): 480–481. 1875. (**Plate 4 F).**

Herbs, up to 70 – 80 cm tall. ***Stem*** erect, branched, glabrous or glandular. ***Leaves*** simple, alternate; leaf blade elliptic to oblanceolate, 9.5 – 10 cm by 3 – 3.5 cm, both the surface glabrous, margin crenate, setose between the teeth; mid-rid distinct; lateral veins conspicuous on both the surfaces, 7 – 8 paired, apex acute or acuminate, base cuneate, attenuate in to petiole; petioles 1 – 2 cm long, glabrous. ***Inflorescence*** simple, cyme, axillury or terminal, 4 – 5 flowered, peduncles usually shorter than leaves, 4 – 5 cm long; pedicel slender, sparsely glabrous; bracts often caduceus; ovate to lanceolate, 8 mm by 3 mm. ***Flowers*** yellow with a red-crimson spots merging into blotches along spur; lateral sepals 2, oblong – lanceolate, small, ca. 3-4 mm long, apex acuminate; lower sepal funnelform, narrowed into slightly curved, slender spur, mouth oblique; lateral united petals ovate – oblong, 15- 22 mm, not clawed; upper lateral petal oval-reniform, 5 mm by 3 mm; lower lateral petal linear-lanceolate, 15 mm by 4 mm. ***Stamen*** 5, filaments 1-2 mm long; anther obtuse, basifixed. ***Ovary*** fusiform, glabrous. ***Capsule*** not seen.

Bhutan – Mongar, Punakha, Tashigang, Wangduephodrang
Distribution – China, India, Nepal
Ecology –Found in the broad-leaved forest ground floor and thickets at an altitude of 1,500 – 2,000 m asl. Flowering in June – October.
Specimen Examined – T.Tob 104 (THIM)

BERBERIDACEAE

Berberis griffithiana C.K. Schneid., Bull. Herb. Boissier, sér. 2. 5: 403. 1905; A.J.C. Grierson in Fl. Bhutan 1(2): 324. 1984; Y.Junshen et al.in Fl. China 19: 738. 2011. – *Berberis subpteroclada* Ahrendt, J. Bot. 79: 21. 1941. – *B. subpteroclada* var. *impar* Ahrendt, J. Bot. 79: 21. 1941. (**Plate 5 A-B).**

Shrubs, about 1 – 3 m tall. ***Stem*** erect, grooved, puberlent with spinous nodes; spines 1 – 1.5 cm long; internodes 1 – 2 cm long. ***Leaves*** sessile, whorled; leaf blade linear-lanceolate, 4 – 4.5 cm by 1 – 1.2 cm, margin 4 – 5 spinulose-serrulate on each side, apex acute, base attenuate, ± glabrous on both surface; mid-vein prominent beneath; lateral veins inconspicuous. ***Inflorescence*** axillary; 3 – flowered in fascicles; pedicels 1 – 1 .5 cm long, glabrous; bracts ovate, 1 – 2 mm long, apex acuminate. ***Calyx*** in 2 whorls; outer sepals ovate, 5 mm by 2 mm, apex acute, margin entire, glabrous; inner sepals oblong – obovate, 1 cm by 0.5 cm, apex rounded. ***Corolla*** yellow; petal-6, imbricate; lobes obovate, ca. 1.4 cm by 1 cm, apex emarginated, base clawed. ***Stamens*** 5; filament slender, 4 – 5 mm long, glabrous; anthers connective prolonged, apiculate. ***Ovary*** superior; ca. 2 mm long; ovules 2 – 3; style persistent. ***Berries*** obovoid, 8-9 mm by 3 mm, reddish.

Bhutan – Bumthang, Haa, Mongar, Tashigang, Trongsa districts
Distribution – China, India, Nepal
Ecology – Found at the forest margins and roadsides at an altitude of 2,500 m asl. Flowering in April – May.
Specimen Examined – T.Tob 026(THIM)

BORAGINACEAE

Cynoglossum furcatum Wall., Fl. Ind., ed. 1820. 2: 6–7. 1824; Z. Ge-ling., H. Riedl and R. Kamelin in Fl. China 16: 423. 1995; R.R. Mill in Fl. Bhutan 2(2): 908. 1999. (**Plate 5 C-D).**

Herbs, up to 50-60 cm tall. ***Stem*** erect, single or several, densely pubescent, branched mostly in inflorescence. **Leaves** simple; cauline leaves numerous, alternate, leaf blade lanceolate, 6 cm by 2 cm; sessile and ± clasping stem; margin finely ciliate; apex acute; base attenuate; both the surface with appressed pubescent; mid-rib prominently raised beneath, dense appressed pubescent; lateral veins prominent, 4 – 5 paired.

Inflorescence terminal to axillary, much branched, furcate, ultimate branches 5 – 6 cm long; upper branches highly villous; pedicels ca. 1 mm long, shorter than calyx in fruit, densely strigose. ***Calyx*** 5-lobed; lobes ovates – lanceolate, 1 – 3 mm long, apex acute; margin finely ciliate. ***Corolla*** funnelform, blue, 5 – lobed; lobes oblong, 2 mm by 1 mm, glabrous; apex rounded. ***Stamens*** 5, ca. 1 mm long, inserted on corolla tube; very short filament, ca. 0.5 mm; anthers oblong, 1 – 2 by 1 – 1.5 mm, dorsifixed. ***Ovary*** superior, deeply 4-lobed, globose; style conical, ca. 1 mm long. ***Nutlets*** ovate, 2-2.5 mm, immarginate, evenly glochidiate; glochids ca. 0.5 mm.

Bhutan – Haa, Mongar, Punakha, Thimphu, Tashigang, Trongsa districts
Distribution – China, India, Japan, Pakistan, Phillipines, Thailand, Vietnam
Ecology – Mostly found at the forest meadows, sunny slopes at an altitude of 1,200 – 2,500 m asl. Flowering in April – October
Specimen Examined – T.Tob 0124 (THIM)

BRASSICACEAE

Nasturtium officinale W.T. Aiton, Hort. Kew. (ed. 2)4: 110. 1812; A.J.C. Grierson in Fl. Bhutan 1(2): 436. 1984; Z. Taiyan et al. in Fl. China 8: 136. 2001. –*Baeumerta nasturtium* (Moench) G. Gaertn., B. Mey. & Scherb., Oekon. Fl. Wetterau2: 467. 1800. – *B. nasturtium-aquaticum* (L.) Hayek, Fl. Steiermark1: 498. 1909. – *Cardamine nasturtium* (Moench) Kuntze, Revis. Gen. Pl.1: 22. 1891. – *C. nasturtium-aquaticum* (L.) Borbás, A Balat. Florája390. 1900. – *C. nasturtium* Moench, Methodus262. 1794. – *Nasturtium fontanum* Asch., Fl. Brandenburg1: 32. 1864. (**Plate 5 E).**

Herbs, up to 10 – 40 cm tall, rhizomatous, aquatic. ***Stem*** erect, or spreading, copiously rooting at the nodes, glabrous. ***Leaves*** pinnate, alternate; leaflets sessile, ovate, 2 cm by 1 cm, apex obtuse, base cuneate or subcordate, margin entire; mid-rib distinct on both the surfaces, glabrous. ***Inflorescence*** terminal with short racemes; many-flowered; flowers white; pedicel 7 – 8 cm long, sparsely pubescent. ***Calyx*** sepals 5;

lobes oblong, 2 mm by 1 mm, apex acute, margin entire. ***Corolla*** white; petals 4, polypetalous, lobes obovate, 3 mm by 1.5 mm, apex rounded, margin entire, glabrous. ***Stamens*** 5, unequal; filaments 1 – 2 mm long, slender, pubescent; anthers bilobed, dorsifixed. ***Ovary*** ovoid; style 1 – 2 mm long; stigma capitate. ***Capsule*** oblong, 1-2 cm. ***Seeds*** 0.5-1 mm.

Bhutan – Mongar, Punakha, Thimphu, Trongsa districts
Distribution – China, India, Nepal, Japan, Vietnam
Ecology – Found in small pond, marshes at an altitude 1,000 – 1,500 m asl. Flowering in June
Specimen Examined – T.Tob 086 (THIM)

CAMPUNULACEAE

Lobelia pyramidalis Wall., Asiat. Res.13: 376. 1820; R.A. Clement in Fl. Bhutan 2(3): 1395. 2001; H. Deyuan et al. in Fl. China 19: 555. 2011. – *Dortmannia pyramidalis* (Wall.) Kuntze, Revis. Gen. Pl. 2: 380. 1891. – *Lobelia pyramidalis* var. *wallichiana* (C. Presl) Steud., Nomencl Bot. 2: 62. 1841. – *L. seguinii* var. *arakana* E. Wimm., Ann. Naturhist. Mus. Wien 56: 367. 1948. – *L. wallichiana* (C. Presl) Hook. f. & Thomson, J. Proc. Linn. Soc., Bot. 2: 29. 1858. – *Rapuntium pyramidale* (Wall.) C. Presl, Prodr. Monogr. Lobel. 23, 24. 1836. – *R. wallichianum* C. Presl, Prodr. Monogr. Lobel. 23, 24. 1836. (**Plate 6 A).**

Large herbs, 0.7 – 2 m tall. ***Stem*** single, hollow, glabrous, profusely branched towards apex forming a pyramidal inflorescence. ***Leaves*** sessile, alternate, linear – lanceolate, 5 – 6 cm by 2 – 3 cm, apex acute – acuminate, margin serrulate, base attenuate, both the surfaces glabrous; mid-rib distinct on both the surfaces. ***Inflorescence*** raceme; flowers dense; bracts longer or shorter than flower, 15 mm by 2 mm, linear-lanceolate, apex acuminate, margin entire, glabrous; pedicals 1 – 2 cm long, glabrous. ***Calyx*** cup-shaped; tube 4 mm long, glabrous; 5 – lobed; lobes linear, 1.5 cm by 2 cm;

apex acute; margin entire; glabrous. ***Corolla*** white, 1 – 2 cm long, outside glabrous, inside densely villous. ***Stamens*** 5, connate into tube above base; filament tube glabrous; anthers 4 mm long, densely villous along sutures; stigma bifid. ***Capsule*** broadly ovoid, 3.5 – 6.5 mm in diam., glabrous. ***Seeds*** elliptic, 0.6 mm.

Bhutan – Mongar, Punakha, Samdrup Jongkhar, Thimphu, Trongsa districts.
Distribution – China, India, Laos, Myanmar, Nepal, Thailand, Vietnam
Ecology – Found along the roadsides. Altitude 1,600 – 2,100 m asl. Flowering in March – June.
Specimen Examined – T.Tob 021 (THIM)

CANNABACEAE

Cannabis sativa L., Sp. Pl. 2: 1027. 1753; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 134. 1983; Z. Zhekun and B. Bartholomewin Fl. China 5: 75. 2003. – *Cannabis indica* Lam., Encycl.1 (2): 695. 1785. – *C. sativa* var. *indica* (Lam.) E. Small & Cronquist, Taxon 25(4): 426. 1976. (**Plate 6 B).**

Herbs, up to 1 – 2 m tall. ***Stem*** erect, branched, branchlets densely white pubescent. ***Leaves*** alternate; leaf blade abaxially whitish green, strignose; leaflets narrowly elliptic or lanceolate, 11 by 1 cm, apex narrowly acuminate, base attenuate, margin serrate, minutely scabrib above; petiole 2-7 cm, pubescent. ***Male inflorescence*** axillary or terminal panicles. ***Tepals*** 5, free, finely pubescent, 3-4 mm long. ***Stamens*** 5; filaments slender; anther basifixed. ***Female inflorescence*** solitary, axillary or terminal, spikes; dark green bract with glandular hairs. ***Perianth*** absent. ***Ovary*** globose, 1 –locular; style short and divided into 2 stigmatic arms. ***Achenes*** ovoid, 3 – 3.5 mm, greenish – brown, reticulate with pale lines.

Bhutan – Chukha, Gelephug, Thimphu, Trongsa, Mongar and Tashigang districts.
Distribution – India, China, Nepal

Ecology –Found in waste ground at an altitude of 1,000 -1,500m asl. Flowering in June - August.

Specimen Examined – T Tob 125 (THIM)

CAPRIFOLIACEAE

Leycesteria formosa Wall., Fl. Ind. 2: 182. 1824; R.A. Kingin Fl. Bhutan 2(3): 1355. 2001; Y. Qiner et al. in Fl. China 19: 619. 2011. (**Plate 6 C).**

Climber, ***Stem*** arching, hollow, sparsely pubescent. ***Leaves*** simple, opposite; leaf blade ovate, ca. 13 cm by 5 cm, both surfaces glabrescent or sparsely depressed pubescent, apex acuminate, base rounded or cordate, margin entire; petiole 1.5 cm, glabrous; mid-rid prominent, densely pubescent at the lower parts; lateral veins 5-paired; stipule absent. ***Inflorescence*** terminal or axillary, cyme; whorls 1 – 5, whorl composed of 2 opposite sessile, 3 – flowered, purplish, or purple-red, leaf like involucral bracts and bracts; bracts ovate – acuminate; 1 – 2 cm, margin ± entire; apex acuminate. ***Calyx*** synsepalou***s,*** fused at the base; 5 – lobed, lobes unequal, lobes linear – lanceolate, 2 – 5 mm long, densely glandular hairy. ***Corolla*** funnel-shaped, white or pink, 1.5 cm long, pubescent outside; 5-lobed; lobes orbicular – ovate, ca. 3 mm long. ***Stamens*** 4, anthers bi-lobed, dorsifixed, filaments, 3 – 4 mm long, glabrous. ***Ovary*** ovoid or subglobose; style slender, 3-4 mm long, glabrous. ***Capsule*** not seen.

Bhutan – Bumthang, Mongar, Punakha, Tashigang, Thimphu districts

Distribution – Myanmar, China, India, Nepal, Pakistan

Ecology – Mostly found at forest margins, scrub at an altitude 1,500 – 3,600 m asl. Flowering in June – August

Specimen Examined – T Tob 132 (THIM)

CARYOPHYLLACEAE

Stellaria media (L.) Vill., Hist. Pl. Dauphine 3(2): 615. 1789; A.J.C. Grierson in Fl. Bhutan 1(2): 207. 1984; – *Alsine media* L., Sp. Pl.1: 272. 1753. – *Stellaria apetala* Ucria ex Roem. Pl. Linn. Op.I (1): 68. 1796. – *S. hiemalis* Raunk., Bot. Studier1: 13, 19. 1934. – *S. media* (L.) J.C. Sowerby & Sm., Engl. Bot.8: t. 537. 1799. – *S. media* var. *procera* Klatt & Richt., Fl. Leipzig 382. 1830. – *S. vulgaris* Raunk., Bot. Studier 13, 22. 1934. (**Plate 6 D).**

Herbs, up to 20 – 25 cm tall. ***Stem*** decumbent or creeping or stoloniferous, pilose throughout. ***Leaves*** simple, opposite, ovate, 2 cm by 1cm, sessile, margin entire, apex acute, base obtuse; mid-rib visible on both surfaces, slightly raised underneath; venation indistinct, glabrous or few ciliate hairs at the base. ***Inflorescence*** axillary or terminal, leafy cyme, few or many-flowered; pedicels up to 1 cm long, densely pilose; bract ovate to lanceolate, 10 mm by 4 mm, ciliate, margin entire, apex acute. ***Calyx*** sepals 4, green, lanceolate, 4 mm by 1 mm, apex acute, margin entire, pilose. ***Corolla*** petals 10, lobes lanceolate, 3 mm by 1 mm, apex acute, margin entire, glabrous. ***Stamens*** 8; filaments slender 1 mm; anthers basifixed. ***Ovary*** superior, ovoid, 0.5 – 1 mm long, green; styles 3, recurved, ca. 0.5 mm long. ***Capsule*** ovoid, 2-3 mm. ***Seeds*** numerous, red brown, ca. 1 mm diam.

Bhutan – Chukha, Mongar, Punakha, Samchi, Thimphu districts
Distribution – Afghanistan, China, Pakistan
Ecology – Found in the open ground, forest margin at an altitude of 2,352 m asl.
Flowering in February – November
Specimen Examined – T Tob 065 (THIM)

ERICACEAE

Agapetes incurvata (Griffith) Sleumer, Bot. Jahrb. Syst. 70: 105. 1939; D.G. Long in Fl. Bhutan 2(1): 402. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 509. 2005. –

Gaylussacia incurvata Griff., Icon. Pl. Asiat. 4: pl. 506. 1854. – *Pentapterygium rugosum* (Hook. & Thomson) Hook., Bot. Mag.64: , pl. 5198. 1860. – *Vaccinium rugosum* Hook. & Thomson, Bot. Mag.82: sub pl. 4910. 1856. (**Plate 6 E).**

Shrubs, up to 2 – 3 m tall. ***Leaves*** simple, alternate, rigidly coriaceous; leaf blade elliptic – lanceolate, 8 cm by 3 cm, glabrous, sessile, apex acuminate, base cuneate, margin serrate; mid-rib distinct, finely pubescent, prominently raised beneath; lateral veins 6 – 7 paired. ***Inflorescence*** corymbose; flowers 3 – 8, pendulose; pedicels 2 – 3 cm long, glabrous. ***Calyx*** greenish; sepal 5, ovate, 6 mm by 4 mm, apex obtuse, margin entire, glabrous. ***Corolla*** tubular, tube 1 – 1.5 cm long, white, with darker red zig zag bands; 5-lobed; lobes yellow, small, ca. 2 mm long, apex acute, finely pubescent. ***Stamens*** 8, unequal; filaments 1 – 1.5 cm long, puberulous, anther 5 mm; tubular tips 10 mm, spur dorsally. ***Ovary*** inferior, conic, 1.5 – 2 mm in diam. ***Fruit*** not seen.

Bhutan – Mongar, Samdrupjongkhar, Tashigang districts
Distribution – Bangladesh, China, India, Nepal
Ecology –Found along roadsides at an altitude above 1,800 m asl. Flowering in June – October.
Specimen Examined – T Tob 131 (THIM)

Gaultheria fragrantissima Wallich, Asiat. Res. 13: 397. 1820; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 388. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 472. 2005. – *Gaultheria forrestii* Diels, Notes Roy. Bot. Gard. Edinburgh 5(25): 210–211. 1912. – *G. fragrantissima* var. *hirsuta* Franch., Pl. David. 2: 82. 1887. (**Plate 6 F).**

Shrubs, up to 2-3 m tall. ***Stem*** erect, branched; branchlets terete, glabrous. ***Leaves*** simple, alternate; leaf blade ovate – lanceolate, 5 – 10 cm by 2.5 – 4 cm, glabrous, apex attenuate, base cuneate, margin distantly and bluntly serrulate; mid-rib distinct,

prominently raised beneath; lateral veins conspicuous, 3-paired; petiole 3 – 4 mm long, glabrous. ***Inflorescence*** axillary, racemes, many – flowered; pendulose; pedicel 2 – 3 mm long, finely pubescent throughout. ***Calyx*** light green, sepal 5, fused at the base, lobes triangular, 2 mm by 1 mm, apex acute, margin ciliolate, finely pubescent; minute bract, triangular, 1 mm by 0.5 mm, apex acute, margin ciliolate. ***Corolla*** white, barrel-shaped, usually constricted towards apex, 3 – 4 mm long, 5 – lobed, lobes small 2 mm long, apex acute, glabrous. ***Stamens*** 10, equal; anthers with 4 spurs, 1 mm; dorsifixed; filaments short, 0.5 – 1 mm long, puberlous. ***Ovary*** inferior, conic, 1.5 – 2 mm in diam., pubescent. ***Capsule*** globose, 4 – 6 mm in diam., surrounded by enlarged fleshy calyx. ***Seeds*** not seen.

Bhutan – Mongar, Punakha, Sapang, Samdrupjongkhar, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Nepal, Sri Lanka, Vietnam
Ecology –Found at forest margins, dry slopes at an altitude above 1,700 – 2,500 m asl. Flowering in March –June
Specimen Examined – T Tob 045 (THIM)

G. griffithiana Wight, Calcutta J. Nat. Hist. 8: 176. 1847; D.G. Long and S.J. Rae in Fl. Bhutan 2(1):390. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 472. 2005. (**Plate 7 A).**

Shrubs, up to 2-3 m tall. ***Stem*** erect, branchlets terete, glabrous. ***Leaves*** simple, alternate; leafblade elliptic – oblong, 10 – 15 cm by 2 – 3.5cm, apex acuminate, base rounded, margin closely and sharply serrulate; mid-rib distinct, prominently raised beneath; lateral veins visible on both the surfaces, 4 – paired; glabrous; petiole grooved, 4 – 5 mm long, glabrous. ***Inflorescence*** axillary, racemes; flower numerous pendulose; pedicels 1 – 1.5 mm long, finely pubescent throughout. ***Calyx*** light green, 5- sepals, fuse at the base, lobes ovate, 2 mm by 1 mm, finely pubescent, apex acute, margin ciliolate; bracts triangular, 2mm by 1mm, apex acute, margin ciliolate.

Corolla white, open-campanulate, 3 – 4 mm long, white, 5-lobed; lobes 2 mm long, apex acute, glabrous. ***Stamens*** 10, anthers with 4 spurs, 1 mm, dorsifixed; filaments short, 0.5 – 1 mm long, puberlous. ***Ovary*** inferior, conic, 1.5 – 2 mm in diam., pubescent. ***Capsule*** globose, 2 – 3 mm in diam., surrounded by enlarged fleshy calyx.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Nepal, Vietnam
Ecology –Found in forest margins, thickets on dry slopes at an altitude above 2,000 – 3,000 m asl. Flowering in April – June
Specimen Examined – T Tob 038 (THIM)

Lyonia ovalifolia **(Wall.) Drude,** Nat. Pflanzenfam. 4(1): 44. 1889; S. B. Rajabhandari et al. in Fl. Kathmandu 11: 441. 1986; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 395. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 461. 2005. – *Andromeda ovalifolia* Wall., Asiat. Res.12: 391. 1820. – *Pieris ovalifolia* (Wall.) D. Don, Edinburgh New Philos. J.17: 159. 1834. (**Plate 6 B).**

Shrubs, up to 6 – 7 m tall. ***Stem*** higly branched; branchlets glabrous. ***Leaves*** simple, alternate; leaf blade ovate to broadly elliptic; 6 cm by 4 cm; apex shortly acuminate, base rounded-cordate, margin entire; mid-rib distinct, finely pubescent, prominently raised beneath; pinnately veined; lateral veins 9 – 10 paired, inconpicious in the upper surface; petiole 3 – 4 mm long, glabrous. ***Inflorescence*** racemes, 30 – 40 flowered; pedicel 2 – 3 mm long, pubescent. ***Calyx*** cup-shaped, yellowish green, 5 – lobed; lobes 2 mm long, triangular, apex acute, margin entire, pubescent. ***Corolla*** white, cylindric, 10 mm by 5 mm, 5-lobed; lobes small, 2 mm long, apex acute, abaxially densely pubescent. ***Stamens*** 10, equal; anther bilobed, dorsifixed; filaments 6 – 7 mm long, pilose with 2 spurs at apex. ***Ovary*** superior, conic, 1.5 – 2 mm in diam., glabrous. ***Capsule*** globose, ca. 3 mm by 5 mm. ***Seeds*** ca.1 mm.

Bhutan – Chukha, Thimphu, Punakha, Tashigang and Mongar districts
Distribution – Bangladesh, Cambodia, India, Nepal, Pakistan, Thailand, Vietnam
Ecology – Found mostly in forest margins, open and dry slopes at an altitude above 1,500 – 2,600 m asl. Flowering in May - August.
Specimen Examined – T Tob. 134 (THIM)

Rhododendron arboreum Sm., Exot. Bot. 1: 9. 1805; D.G. Long and S.J. Raein Fl. Bhutan 2(1): 372. 1991; F. Mingyuan et al. in Fl. China 14: 375. 2005. – *Wiborgia parviflora* Benth., London J. Bot. 3: 364. 1844. (**Plate 7 C).**

Trees, usually evergreen, up to 7 – 8 m tall. Trunk well defined, bark brownish, exfoliating in flakes. ***Leaves*** opposite or whorled, leaf blade elliptic or lanceolate, 10 – 20 cm by 3 – 5.5 cm; petiole 1.5 – 2 cm long, apex acute, base cuneate, margin entire; upper surface glabrous; lower surface densely matted white tomentose; mid-rib prominently raised underneath, tomentose; lateral veins visible on lower surface, 15 – 20 paired. ***Inflorescence*** terminal, racemes, compact, 10 – 20 flowered; perulae ovate, apex acute, glabrous; pedicel 7 - 9 mm long, glandular hairy. ***Calyx*** 1 – 2 mm long, shortly 5 – lobed, glabrous or glandular. ***Corolla*** tubular campanulate, 4 – 5 cm long, 5 – lobed, red with darker spots and nectar pouches; lobes emarginate, 1.5 by 1 cm. ***Stamens*** 10, unequal, 1 – 2 cm long; filaments glabrous; anthers 1.5 mm long, dorsifixed. ***Ovary*** superior, conoid, densely white tomentose, 4 mm long, 8 – locular; style 2.5 cm long, glabrous; stigma slightly swollen. ***Capsule*** slightly curved, ca. 2.5 cm by 1 cm.

Bhutan – Chukha, Bumthang, Mongar, Punakha, Thimphu, Trongsa districts
Distribution – China, India, Nepal, Sri Lanka, Thailand, Vietnam
Ecology – Found in open slopes at an altitude of 2,096 m asl. Flowering in March – June
Specimen Examined – T Tob 018(THIM)

R. falconeri Hook. f., Rhododendron Sikkim Himalaya t.10. 1849; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 370. 1991. (**Plate 7 D).**

Trees, up to 5 – 10 m tall, bark rough and flaking; branchlet finely tomentose. ***Leaves*** broadly obovate, 15 – 25 cm by 10 – 18 cm, whorled; petiole 3 – 4 cm long, tomentose, apex obtuse-rounded, base rounded, dark green and rugose above, dense red-brown tomentose beneath; mid-rib prominently raised beneath, tomentose; lateral veins 10 – 12 paired, visible on both the surfaces, weakly prominent beneath and finely tomentose; margin entire. ***Inflorescence*** terminal, racemes, subglobose, 10 – 15 flowered; pedicels 3-4 cm long, glandular. ***Calyx*** a minute 1 – 2 mm, glabrous or glandular. ***Corolla*** fleshy, obliquely campanulate, 4 – 5 cm long, 8 – 10 lobed, white, purple blotch at the base. ***Stamens*** 12 – 16. ***Ovary*** densely glandular; style stout, longer than stamens; stigma disk-like. ***Capsule*** straight, ca. 3 cm by 1 cm.

Bhutan – Bumthang, Mongar, Punakha, Tashigang, Trashi Yangtse, Thimphu and Trongsa districts
Distribution – China, India, Nepal
Ecology – Found in broad-leaved forest at an altitude above 2,500 – 3,200 m asl. Flowering in April – May
Specimen Examined – T Tob 034 (THIM)

R. maddenii Hook. f., Rhododendron Sikkim Himalaya2: pl. 18. 1851; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 379. 1991. (**Plate 7 E-F).**

Shrubs or small trees, up to 4 – 6 m tall, branches many, branchlet scaly; bark rusty scaly and papery. ***Leaves*** simple, ± whorled; leaf blade elliptic to oblanceolate, 8 – 12 by 5 – 6 cm, apex acute, base cuneate, margin entire; abaxially reddidh brown scales; adaxially ± glabrous; mid-rib distinct on both the surfaces; lateral veins 9 – 10 paired; petiole grooved 1 – 1.5 cm long, glabrous. ***Inflorescence*** racemes umbel-liked, 3 – 4

flowered, flowers fragrant, pedicel 1 – 1.5 cm long. ***Calyx*** cup-shaped, 5 rounded fimbriate lobes, 3 – 4 mm, scaly. ***Corolla*** funnel-campanulate, 8-10 cm long; 5 – lobed, white, with a yellow blotch at the base of tube, tube scaly outside. ***Stamens*** 15 – 20; filaments glabrous, 4.5 – 5 cm long; anther dorsifixed, bilobed, 2 mm by 1 mm; ***Ovary*** 10 – 12 locular; dense scale, tapering in to style; stigma large, discoid. ***Capsule*** cylindric, ca. 1.5 cm by 2.5 cm.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Thimphu, Trongsa districts
Distribution – Myanmar, China, India, Thailand, Vietnam
Ecology – Found on rocks, cliff in evergreen oak forest at an altitude above 1,800 – 3,000 m asl. Flowering in May – July.
Specimen Examined – T Tob 050 (THIM)

Vaccinium retusum (Griffith) J. D. Hooker ex C. B. Clarke in J. D. Hooker, Fl. Brit. India. 3: 451. 1882; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 397. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 501. 2005. – *Thibaudia retusa* Griff., Fl. Brit. India 3(9): 451. 1882. (**Plate 8 A).**

Shrubs, up to 0.5 – 1 m tall. ***Stem*** erect, branched, young branchlets pubescent. ***Leaves*** simple, alternate, leaf blade obovate, 2.5 cm by 1 cm, apex retuse, base attenuate, margin entire and finely puberulous at the lower end, both the surface glabrous; petiole very short 1 – 2 mm long; mid-rib distinct; lateral veins ascending, slightly raised abaxially, inconspicuous adaxially, 2 – paired. ***Inflorescence*** terminal, racemes, 10 – 15 flowered; pedicels very short, 1 – 2 mm; bracts minute, elliptic, 1 mm by 0.5 mm, apex acute, margin entire. ***Calyx*** cup-shaped, hypanthium 1 – 2 mm long; 5- lobed; lobes ovate, 1 mm by 0.5 mm, apex acute, margin entire. ***Corolla*** pink, urceolate; 5- lobed; lobes small 1 mm, white with rounded apex, glabrous. ***Stamens*** 10, equal; filaments ca. 0.5 mm long; anthers 3 mm with 2 erect spurs; tubules as long as thecae. ***Ovary*** superior, 0.5 – 1 mm in diam., glabrous. ***Fruit*** not seen.

Bhutan – Mongar, Trongsa districts

Distribution – Myanmar, China, India, Nepal

Ecology –Found as an epiphytes on rocks. Altitude above 2,000 – 3,000 m asl. Flowering in April – June

Specimen examined – T Tob 027 (THIM)

V. vacciniaceum (Roxburgh) Sleumer, Bot. Jahrb. Syst. 71: 479. 1941; D.G. Long and S.J. Rae in Fl. Bhutan 2(1): 399. 1991; M. Tianlu and A. Anderberg in Fl. China 14: 494. 2005. (**Plate 8 B).**

Shrubs, epiphytes, up to 1 – 2 m. ***Stem*** erect, branched, twigs rounded, young shoot glabrous. ***Leaves*** whorled, 5 – 10 leaves; leaf blade elliptic, 3 – 6 cm by 1 – 1.5 cm, glabrous, apex acute, base cuneate, margin serrulate; mid-rib distinct, prominently raised beneath; lateral veins 10 – paired; petiole short 1-1.5 mm long. ***Inflorescence*** terminal, racemes, 8 – 10 flowered; pedicels 1.5 – 2 cm long, glabrous. ***Calyx*** 5-sepals, fuse at the base, lobes triangular, 2 mm by 1 mm, glabrous, apex acute, margin entire; bract, minute, triangular, 1 mm by 0.5 mm, apex acute. ***Corolla*** urn-shaped, 1 cm long, greenish white; lobes small, 2 mm long, apex acute, glabrous. ***Stamens*** 10, equal; anthers basifixed; filaments 2 – 3 mm long without spurs, pilose. ***Ovary*** inferior, 0.5 – 1 mm in diam. ***Capsule*** not seen.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Nepal

Ecology –Found in evergreen forest, sometimes epiphytic on tree at an altitude of 1,200 – 2,100 m asl. Flowering in March – May

Specimen Examined – T Tob 039 (THIM)

FABACEAE

Albizia sherriffii E. G. Baker, London J. Bot. 76: 20. 1938; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 646. 1987; X. Langran in Fl. China 10: 62-65. 2010. (**Plate 8 C).**

Trees, up to 5 – 10 m tall. Branchlets brown tomentose. ***Leaves*** bipinnate; petiole 2 – 3 cm, pubescent, gland at the base of petiole and near the apex, 0.5 – 1 mm; leaf rachises, 10 – 15 cm long, brown tomentose; pinnae 9 – 11 pairs, opposite; leaflets 8 – 23 pairs, sessile, oblong, 5 mm by 2 mm, apex acute, base truncate, margin finely ciliate, abaxially pubescent, adaxially glabrous; mid-rib distinct on the lower surface, densely ciliated, inconspicuous in upper surface. ***Inflorescence*** axillary or terminal; heads 20 – 25 flowered; peduncle 9 – 10 cm long, peduncles in axillary cluster or in terminal panicles, densely brown tomentose. C***alyx*** tubular, densely pubescent; sepals 5-lobed, lobes 2 mm by 1 mm, apex acute, margin ciliated. ***Corolla*** yellow – white, 10 – 12 mm, 4-lobed; lobes finely pubescent, ± glabrous. S***tamens*** numerous, 3 – 3.5 cm long, marginally white, centrally golden yellow. ***Ovary*** linear, sessile. ***Pod*** thinly coriaceous, 15 – 20 seeded.

Bhutan – Chukha, Mongar, Sarpang, Trongsa districts
Distribution –Myanmar, China, India, Nepal
Ecology – Found in a dense forest at an altitude above 1,000 – 2,000 m asl. Flowering in April – June.
Specimen Examined – T Tob 055 (THIM)

Desmodium confertum DC., Ann. Sci. Nat. (Paris) 4: 101. 1825; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 677. 1987. (**Plate 8 D).**

Shrubs, up to 2 – 3 m tall. ***Stem*** erect, branched, sparsely pubescent. ***Leaves*** coriacous, 3 – foliate, leaflets obovate, 5 – 7 cm by 2 – 4 cm, apex acute or obtuse,

base rounded, margin undulate; distinct mid-rib on both the surfaces; lateral veins visible on both the surfaces; appressed pubescent on lower surface; petioles ca. 1 – 3 cm long; stipels linear 2 – 3 mm; stipules ovate – lanceolate, 4 mm by 2 mm. ***Inflorescence*** axillary or terminal, racemes; rachis 10 – 15 cm long, many – flowered; flowers purple; bracts ovate, 7 mm by 3 mm; pedicels 4 – 5 mm long, pubescent. ***Calyx*** cup–shaped, 5 – lobed, lobes unequal, ovate, 2 – 3 mm, apex acute, margin ciliate. ***Corolla*** purplish, standard broadly ovate; wings obvate or narrowly elliptic, shorlty auriculate; keel slightly curved, shorlty clawed. ***Stamens*** diadelphous; anthers basifixed. ***Ovary*** adpressed pubescent. ***Pods*** densely pale spreading hirsute, dividing into 4 – 6 elliptic segments; segments 4 mm by 2 mm.

Bhutan – Chukha, Mongar, Samtse, Tashigang districts
Distribution – China, India, Nepal
Ecology – Found in scrubs at an altitude above 800 – 1,500 m asl. Flowering in August – November
Specimen Examined – T Tob 29 (THIM)

Indigofera heterantha Wall. ex Brandis, For. Fl. N.-W. Centr. Ind., 135. 1874; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 665. 1987; X. Langran et al. in Fl. China 10: 140, 141, 161,162. 2010. – *Indigofera gerardiana* Graham ex Baker in Hook. f., Fl. Brit. India 2(4): 100. 1876. – *I. gerardiana* var. *heterantha* (Wall. ex Brandis) Baker, Fl. Brit. India 2(4): 100. 1876. – *I. heterantha* var. *gerardiana* (Graham ex Baker in Hook. f.) Ali, in Fl. W. Pakistan100: 83. 1977. – *I. mairei* Pamp., Nuovo Giorn. Bot. Ital., n.s. 16–17, f. 5. 1910. (**Plate 8 E).**
Shrubs, up to 2 – 3 m tall. ***Stem*** erect, branched, terrete with rounded lenticels, densely pubescent; stipules linear, 2 mm, caducous with appressed brown trichomes. ***Leaves*** simple, 10 – 20 foliolate; leaflet blades opposite, obovate, 11 – 12 cm by 5 mm, apex mucronate, base rounded or broadly cuneate, margin ciliated, both surfaces with appressed white medifixed trichomes; mid-rib distinct on both the surfaces,

abaxially prominent and adaxially flat; secondary veins inconspicuous; petiole 1 – 2 mm long and petiolules 0.5 mm; rachis 4 – 5 mm long, densely pubescent. ***Inflorescence*** terminal or axillary, racemes 5 – 7 cm; peduncle 2 – 3 cm long bearing the flowers to the base of rachis; rachis with dense appressed medifixed trichomes; minute bracts, narrowly lanceolate, 1 – 1.5 mm by 0.5 mm; pedicels 1 – 2 mm long, hairy.***Calyx*** cup-shaped, 2 mm, divided in to narrowly lanceolate 5 teeth, teeth 1 – 1.5 mm long, covered by appressed midifixed trichomes. ***Corolla*** purple; standard broadly obovate, 6 mm by 4 mm, apex rounded, base truncate, margin finely ciliate; wings 7 cm long, glabrous, margin ciliated; keel 5 – 7 mm, apically hairy outside, margin ciliate; spur ca. 1 mm. ***Stamens*** 8; anthers ovoid, 1 mm, basifixed. ***Ovary*** hairy; stigma capitate. ***Legume*** brown, linear 10 – 20 mm by 2.5 mm, appressed pubescent. ***Seeds*** 5-10 per legume, oblong, ca. 2.5 mm.

Bhutan – Chukha, Mongar, Samtse, Tashigang, Thimphu, Trongsa districts
Distribution – Afghanistan, China, India, Nepal, Pakistan, Sri Lanka
Ecology – Found in open ground, roadsides and forest edges. Altitude 3,050 m asl. Flowering in April – August
Specimen Examined – T Tob 068 (THIM)

I. tinctoria L.Sp. Pl.2: 751. 1753; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 665. 1987; X. Langran et al. in Fl. China 10: 140, 150, 151. 2010. –*Anila tinctoria* (L.) Kuntze, Revis. Gen. Pl.1: 160. 1891. – *A. tinctoria* var. *normalis* Kuntze, Revis. Gen. Pl.1: 160. 1891. – *Indigofera indica* Lam., Encycl. 3(1): 245. 1789. – *I. sumatrana* Gaertn., Fruct. Sem. Pl.2: 317, pl. 148. 1791. (**Plate 8 F).**
Shrubs, up to 1 – 2 m tall. ***Stem*** branched, sparsely appressed pubescent. ***Leaves*** simple, 9 – 10 foliolate, 3 – 7 cm; petiole and rachis adaxially grooved; petiole 1 – 2.5 cm long; leaflets blades in opposite, obovate, 5 mm by 2 mm, apex rounded to emginate, base cuneate, margin ciliated, both the surface with appressed medifixed trichomes; mid-rib visible on both the surfaces; lateral veins inconspicuous.

Inflorescence terminal or axillary, racemes, 3 – 8 cm, many-flowered, peduncle absent; bracts bristle-like ca. 1 mm long, pubescent. ***Calyx*** 1.5 mm, covered by appressed medifixed trichomes, teeth-5, triangular 1 mm by 0.5 mm; ***Corolla*** pink, standard broadly obovate, 3 – 5 mm; wings 4 mm; keel as long as wings, outside densely covered by brown trichomes. ***Stamens*** diadelphous; filaments 1 – 2 mm long; anthers cordate, basifixed. ***Ovary*** superior, glabrous; style 3 – 4 mm long; stigma capitate. ***Legume*** linear, deflexed but scarcely upcurved, sparsely pubescent. ***Seeds*** 7-10 per legume, ca. 1.5 mm.

Bhutan –Mongar, Samtse, Tashigang districts
Distribution – China, India, Malaysia, Nepal
Ecology – Found in open areas, broad leaved forest. Altitude 2,500 m asl. Flowering in May – July
Specimen Examined – T Tob 136 (THIM)

Parochetus communis Buchanan-Hamilton ex D. Don, Prodr. Fl. Nepal. 240. 1825; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 728. 1987; Hook.f. in Fl. Brit. India 2: 86. 1879. – *Cosmiusa repens* Alef., Bot. Zeitung (Berlin) 24: 146. 1866. – *Parochetus maculata* Bennett, Pl. Jav. Rar. 1: 162. 1840. – *P. major* Buch. –Ham. Ex D.Don, Prodr. Fl. Nepal. 241. 1825. – *P. oxalidifolius* Royle, I11. Bot. Himal. Mts. [Royle] 201. t. 35. f. 1. (**Plate 9 A).**

Herbs, ascending, roots at nodes. ***Leaves*** digitately 3-foliate; petiole slender, sparsely pilose; stipule entire; base adnate to petiole; leaflets obcordate, 1.6 by 1.6 cm;
petiolule 0.5 mm long, margin entire, apex emarginate, base cuneate; both the surface of leave lepidote, pilose; mid-rib distinct on both sides; lateral veins 3 – 5 paired. ***Inflorescence*** terminal, simple cyme, 1 – 3 flowered; usually long peduncle, 8 – 10 cm, sparsely pilose. ***Calyx*** ca. 3.5 mm long, pilose. 5-lobed; anterior and lateral lobes narrowly triangular to ovate; posterior 2 lobes, triangular, reduced and shorter than

anterior lobes. ***Corolla*** blue, papilionaceous; petals 5; standard ovate, ca. 1 by 0.6 cm including claw, glabrous, emarginate, margin ciliate; wings obovate, ca. 1.4 cm by 0.5 cm, base auriculate, glabrous; keel falcate, monodelphpous with membranous staminal tube; filaments ca. 1.3 cm long, winged; anther pubescent, dorsifixed. ***Ovary*** superior, glabrous, 5 mm long; style subulate, 5 mm long, glabrous; stigma reduced. ***Legume*** 15-18 mm by 2-3 mm. ***Seeds*** rounded, ca. 1 mm in diam., black.

Bhutan – Chukha, Mongar, Samdrupjongkar, Tashigang, Thimphu districts
Distribution – Myanmar, China, India, Malaysia, Nepal, Sri Lanka, Thailand, Vietnam
Ecology –Found in woodland margins and along the roadsides at an altitude above 1,900 – 3,000 m asl. Flowering in March – September
Specimen Examined – T Tob 128 (THIM)

Trifolium repens L., Sp. Pl.2: 767. 1753; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 731. 1987; X. Langran in Fl. China 10: 549-550. 2010. – *Amoria repens* C. Presl, Symb. Bot. 1(3): 47. 1830. – *Lotodes repens* (L.) Kuntze, Revis. Gen. Pl.1: 194. 1891. – *Trifolium limonium* Phil., Linnaea 28: 679. 1856. – *T. repens* fo. *riparia* Hauman, Anales Mus. Nac. Hist. Nat. Buenos Aires 24: 395. 1913. – *T. repens* subsp. *giganteum* (Lagr.-Fossat) Ponert, Feddes Repert. 83(9–10): 636. 1972[1973]. – *T. repens* var. *giganteum* Lagr.-Fossat, Fl. Tarn. Garonne 95. 1847. – *T. stipitatum* Clos, Fl. Chil. 2(1): 71–72. 1846. (**Plate 9 B).**

Herbs, stoloniferous, rooting at nodes, glabrous. ***Stem*** 10 – 20 cm long. ***Leaves*** long petiolate, digitately 3-foliate; leaflets obovate, 1 – 2 by 1 cm, margin denticulate, apex rounded or emarginated, base cuneate, glabrous, whitish V-shape marking on the upper surface; petiole 5 – 6 cm long; mid-rib distinct on the both sides; lateral veins visible on both the sides, 13 – 14 paired. ***Inflorescence*** terminal, globose umbels, many-flowered, 1 – 1.5 cm in diam., long peduncle, 5 – 20 cm, glabrous; pedicel 2 cm

long. ***Calyx*** tube 2 – 3 mm long; 5-lobed, glabrous, unequal; lobes lanceolate, apex attenuate, margin entire. ***Corolla*** white, free, papilionaceous, petals 4; standard widely ovate, ca. 2 cm by 1 cm including claw, glabrous, apex rounded, base ± rounded; wings obovate; keel fulcate ca. 1 by 0.5 cm, apex acute. ***Stamens*** 10, monodelphous with membranous staminous tube; filaments 1 – 4 mm long; anthers dorsifixed. ***Ovary*** sessile; ovules 3 or 4. ***Legume*** linear-ovate, 15-20 mm by 3-4. ***Seeds*** 8-12, ca. 1 mm, ovoid.

Bhutan – Mongar, Bumthang, Trongsa districts

Distribution – China, India, Nepal

Ecology –Found in a grassy slopes and along the road sides. Altitude above 2,000 – 2,700 m asl. Flowering in April – June.

Specimen examined – T Tob 049 (THIM)

FAGACEAE

Castanopsis indica (J. Roxb. ex Lindl.) A. DC., J. Bot.1: 182. 1863; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 81. 1983; H.Chenjiu et al. in Fl. China 4: 323. 1999. – *Castanea indica* J. Roxb. ex Lindl., Pl. Asiat. Rar.2: 5. 1830. – *Castanopsis macrostachya* H.H. Hu, Acta Phytotax. Sin. 1(1): 105. 1951. – *C. sinensis* A. Chev., Bull. Econ. Indochine 20: 875. 1918. – *C. subacuminata* Hayata, Icon. Pl. Formosan.3: 189–190. 1913. – *Quercus indica* (J. Roxb. ex Lindl.) Drake, J. Bot. (Morot) 4(8): 153. 1890. (**Plate 9 C-D).**

Trees, up to 10 – 30 m tall, evergreen. ***Terminal buds*** ovoid, ca. 6 cm by 4 cm, branchlets tomentose. ***Leaves*** simple, alternate; leaf blade oblong – elliptic, 18 cm by 4 – 5 cm, apex acuminate, base cuneate, margin distantly serrate and basally entire, glabrous above, finely brownish pubescent; mid – rib distinct on both the surfaces; prominent; lateral veins conspicuous on both the surfaces, 12 – 13 paired; petiole 0.5 – 1 cm long, glabrous. ***Inflorescence*** terminal or axillary, often paniculate. ***Male inflorescence*** branched; spikes; 10 – 15 cm long; bracts and bracteoles triangular,

pubescent outside; flower white, 2-3 in clustered. ***Calyx*** 6-lobed, lobes obovate, ca. 1 mm by 0.5 mm, pubescent. ***Stamens*** 10, ca. 1.5 mm long, glabrous. ***Ovary*** globose, ca. 1 mm in diam., hirsute. ***Female inflorescence*** spike, 10-20 cm long; flower solitary. ***Calyx*** 6 –lobed, lobes obovate, ca. 1 mm by 0.5 mm. ***Stamens*** 8, ca. 1 mm long, glabrous***. Ovary*** globose; style 3, divergent, pilose at the base; stigma pointed. ***Fruits*** sessile, ovoid 2-4 cm in diam. (including cupule), clustered in a group of 2-3 by their spines on an erect infructescence, ca. 10 -20 cm long. ***Cupule*** completely enclosing the nut, tufted, erect spines; nut 1 per cupule, conical or ovoid, ca. 1.5 cm by 1 cm.

Bhutan – Mongar, Samchi, Samdrup Jongkar, Trongsa districts
Distribution – Bangladesh, Myanmar, China, India, Nepal, Thailand, Vietnam
Ecology –Found in broad-leaved forests. Altitude above 100 – 1,500 m asl. Flowering in March – May
Specimen examined – T Tob 054 (THIM)

Quercus oxyodon Miq., Ann. Mus. Bot. Lugduno-Batavi1: 114. 1863; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 76. 1983. (**Plate 9 E-F).**

Trees, up to 20-25 m tall, branchlets pubescent, lenticellate, blaskish when dry. ***Leaves*** simple, alternative; leaf blade ovate – oblong, 6 – 9 cm by 2 – 3 cm, apex acuminate, base cuneate, margin serrate, entire towards the base, silky hairy on both surfaces, greyish appressed pubescent beneath; mid-rib abaxially prominent, adaxially impressed; lateral veins conspicuous on both the surfaces; 15 – 21 paired; petiole 1 – 1.5 cm long, densely tomentose. ***Inflorescence*** spike, often paniculate. ***Male inflorescence*** 2-3 tufted, pendulous catkins; axillary; bracts and bracteoles lanceolate, ca. 4 mm by 2 mm, pubescent outside. ***Perianth*** campanulate, 6-lobed; lobes oblong, glabrous. ***Stamens*** 6, ca. 1-2 mm long, glabrous. ***Female inflorescence*** axillary or terminal, spikes, 8-10 flowered. ***Flowers*** free or in cluster. ***Stamen*** 6, ca. 1-2 mm

long; style 3, hairy near base; stigma elongate, spathulate. ***Acorns*** sessile, ovoid, 3 cm by 1.5 cm (including cupule). ***Cupule*** sacucer-shaped, enclosing only the base; walls comprising greenish hairs or scales. ***Nut*** 1, conical, conical, ca. 2.5 cm by 2 cm, brown.

Bhutan – Mongar, Punakha, Thimphu, Trongsa districts
Distribution – Myanmar, China, India, Nepal
Ecology –Found in evergreen oak forest at an altitude of 1,500 m asl. Flowering in June
Specimen examined – T Tob 058 (THIM)

GENTIANACEAE

Swertia bimaculata (Siebold & Zuccarini) J. D. Hooker & Thomson ex C. B. Clarke, J. Linn. Soc., Bot. 14: 449. 1875; H. Ting-nung and J.S. Pringle in Fl. China 16: 115. 1996; E. Aitken in Fl. Bhutan 2(2): 624. 1999. – *Ophelia bimaculata* Siebold & Zucc., Abh. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. 4(3): 159. 1846. – *Silene esquirolii* H. Lév., Fl. Kouy-Tcheou 174. 1914. – *Swertia bimaculata* var. *macrocarpa* Nakai, Bot. Mag. (Tokyo) 47(556): 262. 1933. – *S. platyphylla* Merr., Lingnan Sci. J.15(3): 424–425, f. 1. 1936. (**Plate 10 A-B).**

Herbs, up to 20 – 50 cm tall, annuals or binnials. ***Stem*** erect, glabrous, branched, quadrangular. ***Leaves*** opposite, simple, leaflets broadly elliptic or ovate, ca. 6 – 7 cm by 2 – 3 cm, apex acuminate, base narrowly tapered, margin entire, palmately veined; mid-rib distinct on both the surface, glabrous; sessile. ***Inflorescence*** terminal or axillary, corymbs 3 – 7 flowered with a long peduncle, 3 – 6 cm long; pedicel 1 – 2 cm long; bracts 10 mm by 2 – 3 mm. ***Calyx*** tube 1 – 2 mm long; sepal 5; lobes unequal, spathulate, 7 mm by 1 mm, apex acute, margin entire, glabrous. ***Corolla*** 4 – lobed, lobes white or greenish yellow, spotted with dark purple or black, obovate, 5 mm by 3 mm, apex acute, base narrowed, margin entire, glabrous; glands 2 per lobe,

greenish, viscous, orbicular. ***Stamens*** 4, equal; anther ellipsoid, 1.5 – 2 mm long, basifixed, inserted on base of corolla lobe; filaments shorter than anther, ca. 1 mm long, glabrous. ***Ovary*** superior, ovoid; style absent. ***Capsules*** ovoid, 1-2 cm. ***Seeds*** globose, brown, ca. 1 mm, seed coat warty.

Bhutan – Chukha, Mongar, Punakha, Sarpang, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Japan, Nepal, Vietnam
Ecology – Found in open ground at an altitude above 1,500 – 2,000 m asl. Flowering in July – October.
Specimen Examined – T Tob 079 (THIM)

GERANIACEAE

Geranium nepalense Sweet, Geraniaceae. 1: t. 12. 1820; E. J. F. Campbell and D.G. Long in Fl. Bhutan 1(3): 748. 1987; X. Langran and C. Aedo in Fl. China 11: 8. 2008. – *Geranium jinchuanense* Z.M. Tan, Bull. Bot. Res., Harbin 14(3): 232–233, f. 2. 1994. – *G. lavergneanum* H. Lév., Bull. Soc. Agric. Sarthe 39: 319. 1904. – *G. lavergneanum* var. *cinerascens* H. Lév., Bull. Soc. Agric. Sarthe 39: 319. 1904. – *G. nepalense* var. *oliganthum* (C.C. Huang) C.C. Huang & L.R. Xu, Fl. Reipubl. Popularis Sin. 43(1): 35. 1998. – *G. pallidum* Royle ex Ediger, Fl. Brit. India1: 431. 1874. – *G. patens* Royle ex Edgew. & Hook. f., Fl. Brit. India1: 431. 1874. – *G. radicans* DC. Prodr.1: 639. 1824. (**Plate 10 C-D).**

Herbs, up to 10 – 30 cm tall. ***Stem*** sprawling to decumbent. ***Leaves*** opposite, leafblade cordate, 2 – 3 cm across, divided into 3 – 5, ovate - rhombic lobes unequally toothed, pubescent, margin hairy; petiole of basal leaves long, 9 – 10 cm long; upper leaves on short petiole, 3 – 5 cm; stipules linear - lanceolate, 7 mm by 2 mm, apex acuminate. ***Inflorescence*** terminal, cyme, 2 – flowered; peduncle long, slender, hairy, 2 – 7 cm; pedicel eglandular, 1 – 1.5 cm long. ***Calyx*** 5-lobed; lobes ovate-lanceolate, 10 mm by 4 mm, mucronate apiculate, base rounded, margin ciliated, 3-veined.

Corolla 5-petals; lobes white or slightly purple, ovate, 5 mm by 3 mm, apex emarginate, margin ciliate, 3-5 dark purple veins, glabrous. ***Stamens*** 10; whitish filaments, lanceolate with an abruptly narrow apex, pilose, 2 mm long; anther violet, ca. 1 mm, dorsifixed. ***Ovary*** superior, conical, pubescent; stigma reddish. ***Fruit*** not seen.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Samdrup Jongkhar, Sarpang, Tashigang, Trongsa districts

Distribution –Afghanistan, Myanmar , China, India, Nepal, Pakistan, Thailand, Vietnam

Ecology – Found in forest margins, weedy areas at an altitude above 1,400 – 2,000 m asl. Flowering in February – July

Specimen Examined – T Tob 024 (THIM)

GESNERIACEAE

Aeschynanthus parasiticus (Roxb.) Wall., Numer. List 796. 1829; O.M. Hilliard in Fl. Bhutan 2(3): 1302. 2001. (**Plate 10 E-F).**

Shrubs with laxy branched. ***Stem*** slender, pendent, up to 1 m long, rooting at the nodes. ***Leaves*** fleshy, opposite; leafblade elliptic, 10 cm by 3 cm, apex acuminate, base cuneate, margin entire; petiole 8 – 10 mm long, both the surface glabrous; mid-rib distinct in lower surface; inconspicuous in upper surface; lateral veins inconspicuous. ***Inflorescence*** terminal; flowers clustered at the tip of stem; bracts linear to lanceolate; pedicels ca. 7 mm long, pubescent. ***Calyx*** light green, tube 5 mm long, 5-lobed; lobes triangular, 2 mm long; apex acute, margin hairy**.** ***Corolla*** orange-red; tube ca. 3 cm long, curved and inflated in the upper half, slightly constricted at the mouth, 5 -lobed; all lobes projecting forward, glandular pubescent outside the corolla, inside very coarse gland-tipped hairs. ***Stamens*** 4, filaments glandular-puberulous, 2 – 3 cm long; anthers dorsifixed. ***Ovary*** very minutely gland- dotted;

style glandular puberulous. ***Capsule*** linear 25 – 30 cm long. ***Seeds*** ca. 1 mm long with 2 long delicate hairs at both ends.

Bhutan – Chukha, Mongar, Tashigang, Tashi Yangtse districts
Distribution – China, India, Nepal
Ecology – Found as an epiphyte in a big trees and dead wood. Altitude 1,900 – 2,300 m asl. Flowering in July – October.
Specimen Examined – T Tob 126 (THIM)

HYDRANGEACEAE

Dichroa febrifuga Lour**.** Fl. Cochinch. 1: 301. 1790; A.J.C. Grierson in Fl. Bhutan 1(3): 522. 1987; – *Cyanitis sylvatica* Reinw. Bijdr. Fl. Ned. Ind.15. 1826. – *Dichroa sylvatica* (Reinw.) Merr., Contr. Arnold Arbor. 8: 66. 1934. (**Plate 11 A-B).**

Shrubs, up to 1 – 3 m tall. ***Stem*** erect, branched. ***Leaves*** simple, opposite, leafblade elliptic, 12 – 16 cm by 4 – 5 cm, apex acuminate, base cuneate, margin serrate; petioles 1 – 3.5 cm, finely pubescent; mid-rib distinct at both the surfaces, prominently raised beneath; lateral veins 9 – 10 paired; abaxially glabrous or crisped pubescent along veins, adaxially glabrous. ***Inflorescences*** a corymbose panicle, many-flowered, peduncle 4 – 5 cm long, densely pubescent; flower bud obovoid; pedicels 3 – 4 mm long, densely pubescent. ***Calyx*** tube 1 – 2 mm long; 5-lobed; lobes broadly deltoid, apex acute, margin hairy. ***Corolla*** pale blue, 5-lobed; lobes elliptic, 5 – 6 mm by 1.5 – 2.5 mm, apex acute, margin entire, glabrous. ***Stamens*** 10, unequal; filament 1 – 3 mm long; anthers ellipsoid, basifixed. ***Ovary*** inferior; styles 4, clavate, 3 – 4 mm long; stigma oblong. ***Berries*** subglobose, 4-5 mm in diam., intense metallic blue. ***Seeds*** ovoid, minute, ca. 1-2 mm.

Bhutan – Mongar, Punakha, Samchi, Sarpang, Tashigang, Trongsa districts
Distribution – Myanmar, Cambodia, China, India, Nepal, Thailand, Vietnam

Ecology – Found in margin of broadleaved forest, along the roadsides at an altitude above 1,000 – 2,300 m asl. Flowering in May – November.
Specimen Examined – T Tob 077(THIM)

Hydrangea heteromalla D. Don, Prodr. Fl. Nepal. 211. 1825; A.J.C. Grierson in Fl. Bhutan 1(3): 520. 1987; S. Shrestha et al. in Fl. Nepal 3: 273. 2013. – *Hydrangea bretschneideri* Dippel, Handb. Laubholzk.3: 320, f. 171. 1893. – *H. bretschneideri* var. *giraldii* (Diels) Rehder, Pl. Wilson. 1(1): 39. 1911. – *H. bretschneideri* var. *lancifolia* Rehder, Pl. Wilson. 1(1): 28. 1911. – *H. bretschneideri* var. *setchuenensis* (Rehder) Rehder, Pl. Wilson. 1(1): 28. 1911. – *H. dumicola* W.W. Sm., Notes Roy. Bot. Gard. Edinburgh 10(46): 39–40. 1917. (**Plate 11 C-D).**

Shrubs or small trees, up to 3 – 5 m tall. ***Stem*** branched, branchlets brownish, pubescent, few elliptic lenticels. ***Leaves*** broadly ovate, 14 cm by 6 cm, apex acute or shortly acuminate, base obtuse, sparsely pubescent above, densely strignose-pubescent below; mid-rib distinct at both the surfaces; lateral veins 10 – 11 paired; petiole 2 – 4 cm long, sparsely pubescent. ***Inflorescence*** cymes, 10 – 15 cm wide, pudencle pubescent; bracts and bracteoles linear – oblanceolate; pedicels 2-3 mm. ***Sterile flower*** white, 4-sepals, obovate, 11 mm by 11 mm, apex acute or short acuminate, margin entire or sparsely ciliate. ***Fertile flower*** white or yellowish, 5 mm across. ***Calyx*** tube funneliform to campanulate with a triangular teeth; pedicel 2 – 3 mm long. ***Petals*** -5, lobes oblong, 2.5 cm by 1 cm, apex acute or shortly acuminate. ***Stamens*** 10, unequal; filaments 2 – 3 mm long, broader at the base; anthers sub globose, 0.5 mm. ***Ovary*** superior; styles erect, ca. 1.5 mm long; stigma thickened. ***Capsule*** not seen.

Bhutan – Chukha, Bumthang, Mongar, districts
Distribution – Myanmar, China, India, Nepal

Ecology – Found in mixed broad-leaved forest at an altitude above 2,200 – 3,500 m asl. Flowering in June – August

Specimen Examined – T Tob 090

Philadelphus tomentosus Wall. ex G. Don, Gen. Hist.2: 807. 1832; A.J.C. Grierson in Fl. Bhutan 1(3): 527. 1987. – *Philadelphus coronarius* var. *tomentosus* Hook. f. & Thomson, J. Proc. Linn. Soc., Bot.2: 83. 1857. (**Plate 11 E-F).**

Shrubs, up to 3 – 6 m tall. ***Stem*** branched; branchlets glabrous or sparsely villous. ***Leaves*** simple, opposite, ovate, 9 cm by 4 cm, apex acuminate, base rounded, margin minutely and distantly serrate, lower surface of the leaf blade densely pubescent; upper surface glabrous; mid-rib distinct on both the surfaces with a parallel venation; petiole 3 – 5 mm long, densely pubescent. ***Inflorescence*** terminal or axillary, racemes, 5 – 6 flowered; rachis 3 – 4 cm long, glabrous; pedicels 1 cm long, sparsely pubescent. ***Calyx*** cup-shaped, tube 4 – 5 mm; 4-lobed; lobes ovate, 6 mm by 3 mm, apex acuminate, margin entire or sparsely cilate, parallel venation, pubescent on both the surfaces. ***Corolla*** white; petals 5, lobes obovate, 1.5 cm by 1.2 cm, apex emarginated, margin entire, both the surfaces glabrous with dark parallel venation. ***Stamens*** 20 – 25; filaments 5 – 8 mm long, glabrous; anthers 1 mm across, basifixed. ***Ovary*** superior, glabrous; style 6 mm long, sparsely pubescent; stigma clavate, 1 – 2 mm, slightly longer than anther. ***Capsule*** ellipsoid, ca. 1 cm by 0.5 cm. ***Seeds*** ca. 3 mm, shortly tailed.

Bhutan – Chukha, Mongar, Tashigang districts

Distribution – China, India, Nepal

Ecology – Found in mixed broadleaved forest, thickets at an altitude above 2,200 – 3,000 m asl. Flowering in May – July

Specimen Examined – T Tob 088(THIM)

HYPERICACEAE

Hypericum choisyanum Wallich ex N. Robson in Nasir & Ali, Fl. W. Pakistan. 32: 6. 1973; N.K.B. Robson and D.G. Long in Fl. Bhutan 1(2): 374. 1984. (**Plate 12 A).**

Shrubs, up to 1-3 m tall. ***Stem*** branched, branchlets erect to arching, glabrous. ***Leaves*** opposite, lanceolate, 5 – 6 cm by 1.5 – 2 cm, apex subacute or bluntly apiculate apex, base broadly cuneate, both the surface glabrous; pellucid lines and dots on the lower surface; distinct mid-rib on the both surface; lateral veins 3 – 4 paired; petiole very short 1 – 2 mm long, ± sessile. ***Inflorescence*** terminal, compound cyme, 3 – 4 flowered; peduncle, 3 – 4 mm long, glabrous; pedicels, 2 – 3 mm long; bracts, lanceolate, 10 mm by 3 mm, apex acute, margin entire, glabrous. ***Calyx*** greenish**,** sepal 5, lobes obovate, 7 mm by 3 mm, apex rounded, margin entire, glabrous. ***Corolla*** yellow, free, petals 5, lobes broadly obovate-circular, 19 mm by 10 mm, apex rounded, margin entire, glabrous. ***Stamens*** numerous; filaments slender, 4 – 5 mm long, glabrous; anthers 0.5 – 1 mm in size, dorsifixed. ***Ovary*** superior, broadly ovoid, 4 mm by 3 mm; style 3 – 4 mm long, free, outcurved near apex. ***Capsule*** ovoid, ca. 1.5 cm. ***Seeds*** dark brown ca. 1 mm, shallowly winged.

Bhutan – Bumthang, Mongar, Paro, Thimphu districts
Distribution – Myanmar, China, India, Nepal, Pakistan
Ecology – Found in grassy or rocky slopes and cliffs. Altitude above 2,400 – 3,000 m asl. Flowering in June – July
Specimen Examined – T Tob 0135 (THIM)

LAMIACEAE

Callicarpa arborea Roxb., Fl. Ind. 1: 405. 1820; S.J. Rae in Fl. Bhutan 2(2): 919. 1999. (**Plate 12 B).**

Trees, up to 5 – 10 m tall. ***Branchlets*** yellowish with stellate tomentose. ***Leaves*** opposite, coriacous, ovate – elliptic, 25 cm by 15 cm, apex acuminate, base cuneate, margin distantly serrate or entire, densely yellowish stellate tomentose beneath; distinct mid-rib on both the surface; prominently raised beneath; lateral veins 7 – 8 paired, densely tomentose; petiole, 4 – 5 cm long. ***Inflorescence*** axillary, rounded cyme, many – flowered; peduncle, 3 – 4 cm long, thickly tomentose; pedicels very short, 0.5 – 1 mm long, tomentose; bracts hairy, linear, 5 mm by 1 mm, apex acute, margin hairy. ***Calyx*** cup-shaped, 5 lobed; tube very short, 0.5 mm long, densely gray stellate tomentose. ***Corolla*** purple or pinkish; tube, 1 – 1.5 mm long, 4-lobed; lobes, 0.5 - 1 mm long, ovate, apex rounded, margin entire. ***Stamens*** 4, longer than corolla; filaments slender, 3 – 4 mm long***. Ovary*** densely stellate tomentose. ***Drupe*** ca. 2-3 mm in diam., succulent, dark purple when ripe.

Bhutan – Chukha, Mongar, Tashigang districts
Distribution – Bangladesh, Myanmar, Cambodia, China, India, Nepal, Thailand Vietnam
Ecology –Found in mixed forest and mountain slopes. Altitude 1,520 m asl. Flowering in April – June.
Specimen Examined – T Tob 110 (THIM)

Leucas aspera (Willd.) Link, Enum. Hort. Berol. Alt. 2: 113. 1822; L. His-wen and I.C. Hedge in Fl. China 17: 143. 1994; R.A. Clement in Fl. Bhutan 2(2): 963. 1999.– *Leucas plukenetii* (Roth) Spreng., Syst. Veg. [Sprengel] 2: 743. 1825. *Phlomis aspera* Willd., Enum. Pl. 2: 621. 1809. – *Phlomis plukenetii* Roth, Nov. Sp. 261. 1821. (**Plate 12 C).**

Herbs, up to 50 – 60 cm tall. ***Stem*** erect, hispid. ***Leaves*** whorled, linear –lanceolate, 7 cm by 1.5 cm, apex acute, base cuneate, margin distantly serrate; distinct mid-rib, visible on both surfaces, hairy; lateral veins 2 – 3 paired, densely pubescent; petiole

very short ca. 1 mm long. ***Inflorescence*** axillary, verticillaster, globose, 2 – 3 on branches, many – flowered, densely hispid; bracts narrowly linear, 10 mm by 1 mm, margin hispid ciliate. ***Calyx*** tubular, 8 – 10 mm long, slightly constricted at the apex, slightly glabrous at the base of tube; mouth oblique, 10-11 straight teeth, narrowly linear, 3 – 4 mm long, hispid. ***Corolla*** white, bilabiate; tube, 9 mm long; upper lip 2 mm long; lower lip spreading, 2 mm long; large middle lobe 5 mm by 3 mm. ***Stamens*** 4; style ca. 8 mm long. ***Ovary*** not seen. ***Nutlets*** 4, oblong, trigonous, ca. 2 mm long.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – China, India, Philippines, Thailand
Ecology – Found in open wet areas, grassland at an altitude above 915 – 1,220 m asl. Flowering in May – August.
Specimen Examined – T Tob 123 (THIM)

Prunella vulgaris L., Sp. Pl.2: 600. 1753; L.H. Wen and I.C. Hedge in Fl. China 17: 134. 1994; R.A. Clement in Fl. Bhutan 2(2): 955. 1999. (**Plate 12 D).**

Herbs, up to 15 – 20 cm tall. ***Stem*** erect, slender, pilose. ***Leaves*** simple, opposite, ovate – oblong, 2.5 by 1 cm, apex acute, base obtuse or cuneate, margin shallowly dentate or undulate, ciliate; lower surface pilose; upper surface shinny white pilose; mid-rib visible on both sides; lateral viens conspicuous; 3 – 4 paired; petiole, 5 – 6 mm long, densely pilose. ***Inflorescence*** terminal, cylindrical spike; many – flowered; pedicels, 2.5 mm long; pilose; bract widely ovate, 12 mm by 12 mm, apex acuminate, base rounded, margin ciliated. ***Calyx*** tubular campanulate, bilabiate; tube, 2 – 3 mm long, pilose; upper lip truncate with 3 short mucronate teeth, pilose; veins reticulate; lower lip divided into two triangular lobes; lobes, ca. 2 mm long. ***Corolla*** blue; tube 8 mm long, bilabiate; upper lip, semicircular, ca. 4 mm long, margin entire, pilose; lower lip 3-lobes, recurved; middle lobe irregular, dentate, highly reduced 2 lateral

lobes. ***Stamens*** 4, unequal, short 2, long 2; filaments slender with apical spur, 4 – 7 mm long, glabrous; anthers basifixed, glabrous. ***Ovary*** globose, 4 – lobed, glabrous; style slender, 5 – 6 mm long; stigma bifid. ***Nutlets*** oblong-ovoid, ca. 1 mm by 0.5 mm.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Thimphu, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Japan, Nepal

Ecology –Found in open slopes, grassland, disturbed sites and roadsides. Altitude above 1,300 m asl. Flowering in May-August.

Specimen Examined – T Tob 121 (THIM)

MAZACEAE

Mazus surculosus D. Don, Prodr. Fl. Nepal. 87. 1825; H. Deyuan et al. in Fl. China 18: 46. 1998; R.R. Mill in Fl. Bhutan 2(3): 1101. 2001. (**Plate 12 E-F).**

Herbs, up to 5 – 6 cm tall. ***Stem*** short with arching arial stolons; stolons slender, internodes 3 – 4 cm, flowering stems decumbent to suberect, 5 – 10 cm long. ***Basal leaves*** rosulate; leaf blade obovate, 3 cm by 0.5 cm, apex rounded, base often pinnately pendurate, margin irregularly crenate; mid-rib distinct on the upper surface and inconspicuous in lower surface; lateral veins 3 – 4 paired, inconspicuous on lower surface, both the surfaces thinly eglandular – pilose and with sessile glands; leaves opposite to the stolons are with short petiolate; leaf blade obovate 2 cm by 0.5 cm, smaller than the basal leaves. ***Inflorescence*** up to 7 – 8 flowered, scape longer than leaves, 3 – 4 cm long, densely pubescent, racemes with the flowers almost from the base; pedicels 2 – 2.5 cm long in flower and 7 – 8 mm in fruit, sparsely hairy; bracts linear, 5 mm by 1 mm, apex acute, margin entire or finely ciliate. ***Calyx*** infundibular – campanulate, tube 8 – 9 mm long, hairy, 5 – lobed; lobes ovate, 4 mm by 2 mm, apex acute, margin entire. ***Corolla*** light purple, 7 – 11 mm long; upper lip mauve,

erect and short, lobes suborbicular; lower lip white with two orange or yellow ridges. ***Stamens*** 4, didynamous, inserted in corolla tube; anthers 2 – celled. ***Ovary*** not seen. ***Capsule*** ovoid to subglobose, ca. 4 mm by 3 mm. ***Seeds*** lenticular, tiny, light brown, each end with tiny projection.

Bhutan – Chukha, Mongar, Punakha, Thimphu, Trongsa districts
Distribution – China, India, Nepal
Ecology – Found in open hill sides. Altitude above 1,400 – 2,500 m asl. Flowering in May – July
Specimen Examined – T Tob 068 (THIM)

MELASTOMATACEAE
Melastoma normale D. Don, Prodr. Fl. Nepal. 220. 1825; R.A. Clement in Fl. Bhutan 2(1): 296. 1991. (**Plate 13 A).**

Shrubs, up to 4 – 5 m tall. ***Stem*** erect, densely appressed – hairy, branched. ***Leaves*** opposite, elliptic – lanceolate, 11.5 – 12 cm by 2 – 3 cm, apex attenuate, base cuneate or obtuse, fimbriate-margined, pubescent on both the surface, hairs on upper surface of leaf longer than the lower surface, 0.5 – 1 mm; petiole up to 0.5 – 1 cm long, densely pubescent; 3 – veined from the base, clearly visible on both the surface, densely hairy. ***Inflorescences*** terminal, umbel – like, 6 – 10 flowered, clustered. ***Calyx*** tubular; tube 3 – 4 mm long, 5-lobed; lobes triangular ca. 1 cm by 0.5 cm, acute apex, margin ciliated. ***Corolla*** purple, 5 – lobed; lobes obovate, ca. 22 mm by 2 mm, apex truncate, margin ciliate, glabrous. ***Stamens*** 10, unequal, 5 long with elongated connective, ca. 2 cm; short 5, ca. 1 cm; anther basifixed; glabrous. ***Ovary*** superior, hairy at the apex; style slender. ***Capsule*** 5-8 mm long, rupturing irregurlary at maturity.

Bhutan – Chukha, Mongar, Samchi, Tashigang, Trongsa districts

Distribution – China, India, Nepal, Vietnam

Ecology – Found mostly along the roadsides, waste places, and forest margins. Altitude above 1,000 m asl. Flowering Feb – August

Specimen Examined – T Tob 047 (THIM)

MYRSINACEAE

Ardisia macrocarpa Wall., Fl. Ind., ed. 1820 2: 277. 1824; D.G. Long and S. J. Rae in Fl. Bhutan 2(2): 513. 1999. (**Plate 13 B).**

Shrubs, up to 1 – 2 m tall. ***Stem*** single, highly branched towards branched apex, glabrous. ***Leaves*** simple, alternate, elliptic or narrowly lanceolate, 12 cm by 3 cm, apex acute, base attenuate, margin undulate, line of raised gland dots along the margin, both the surfaces glabrous; distinct mid-rib on both surfaces, lateral veins 12 – 13 paired; petiole 3 – 9 mm long, glabrous, winged. ***Inflorescence*** terminal or axillary, panicle, each 2 – 5 flowered borne terminally and in the upper axil of the peduncle 2 – 3 cm long, glabrous; pedicels 3 – 6 mm long. ***Calyx*** capular; sepals 5, free, lobes oblong – spathulate, 4 mm by 2 mm, apex obtuse, margin entire, glabrous, dotted glands outside. ***Corolla*** pinkish, petals – 5; lobes united at the base, imbricate, lanceolate, 6 mm by 2 mm, apex acute, margin entire, dotted glands on the surface. ***Stamens*** 4, attached to the base of corolla tube, very short filaments 0.5 – 1 mm; anthers dehiscing longitudinally, 2 mm. ***Ovary*** superior, ovoid, glabrous, 1 mm across; style persistent, 4 mm long; stigma minute, apiculate. ***Drupe*** globose, ca. 1 cm in diam., depressed, bright red, spotted.

Bhutan – Chukha, Mongar, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found as understory shrubs in broad-leaved forests. Altitude above 1,600 – 2,400 m asl. Flowering in the month of May – July

Specimen Examined – T Tob 127(THIM)

OXALIDACEAE

Oxalis corniculata L., Sp. Pl. 1: 435. 1753; D.G. Long in Fl. Bhutan 1(3): 742. 1987. – *Acetosella corniculata* (L.) Kuntze, Revis. Gen. Pl. 1: 90. 1891. – *Oxalis albicans* Kunth, Nov. Gen. Sp. (quarto ed.) 5: 244. 1821[1822]. – *O. bradei* R. Knuth, Repert. Spec. Nov. Regni Veg. 23(648/655): 276. 1927. –*O. corniculata* subsp. *albicans* (Kunth) Lourteig, Phytologia 42(2): 137. 1979. – *O. corniculata* subsp. *repens* (Thunb.) Masam., Mem. Fac. Sci. Taihoku Imp. Univ. 11: 257. 1934. – *O. corniculata* var. *atropurpurea* Planch., J. Gén. Hort. 12: 47–48, pl. 1205. 1857. (**Plate 13 C-D).**

Herbs, with a prostate stem up to 10 – 15 cm, freely rooting at nodes, erect leafy branches, pilose, bulbs absent. ***Leaves*** alternate or clustered, 3 – foliate; leaflets obcordate, 5 – 9 mm by 3 – 4 mm, apex emarginate, base cuneate – obtuse, margin densely pilose; mid-rib inconspicuous on both the surfaces; petiole 2 – 4 cm long. ***Inflorescence*** umbellate, 2 – 3 flowered; peduncles slightly longer than petioles 3 – 5 cm long; bracts linear – lanceolate, 2 mm by 1 mm; pedicels 3 – 5 mm long, deflexed, densely strignose. ***Calyx*** greenish yellow, 5 – sepals; lobes lanceolate, 5 mm by 2 mm, apex retuse, margin sparsely pilose. ***Corolla*** yellow, 5-lobed; lobes broadly obovate, 7 mm by 3 mm, apex irregularly toothed or truncate, margin entire. ***Stamens*** 10, unequal, shorter stamens, 2 mm; longer stamens ca.4 mm long; filaments filiform, glabrous; anthers dorsifixed. ***Ovary*** superior, ovoid, 2 mm; style 2 mm long, pilose, stigma trifid. ***Capsule*** cylindric, 2 – 3 cm long, strigose with abundant simple hairs. ***Seeds*** ca.1.5 mm long, brown, transversely ribbed.

Bhutan – Chukha, Mongar, Samchi, Samdrup Jongkhar, Tashigang, Trongsa districts
Distribution – India, China, Nepal, Pakistan
Ecology – Found in disturbs sites along the road sides at an altitude 2,400 m asl. Flowering in the month of February – August.
Specimen Examined – T Tob 093 (THIM)

Oxalis griffithii Edgeworth & J. D. Hooker. f., Fl. Brit. India. 1: 436. 1874; D.G. Long in Fl. Bhutan 1(3): 742. 1987; L. Quanru and M.F. Watson in Fl. China 11: 3,5,6. 2008. – *Acetosella griffithii* (Edgew. & Hook. f.) Kuntze, Revis. Gen. Pl.1: 91. 1891. – *Oxalis acetosella* fo. *rubriflora* Makino, Bot. Mag. (Tokyo) 22: 171. 1908. – *O. acetosella* subsp. *formosana* Terao, Acta Phytotax. Geobot. 30(1–3): 61. 1979. – *O. acetosella* subsp. *griffithii* (Edgew. & Hook. f.) Hara, J. Jap. Bot. 30(1): 22. 1955. – *O. acetosella* subsp. *japonica* (Franch. & Sav.) H. Hara, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.6: 82. 1952. (**Plate 13 E-F).**

Herbs, stem less with the creeping underground rhizome, 5 – 10 cm tall. ***Leaves*** 3 – foliate; leaflets obcordate, 3 cm by 1.5 cm, apex emarginate, base cuneate-obtuse, margin sparsely pilose, distinct mid-rib on both the surface; lateral veins 4 – 5 paired, insconspicious on both the surfaces; petiole very long, slender, 10 – 15 cm long. ***Flowers*** solitary, peduncle 10 – 15 cm long, pilose and thick tomentose below the flower; bracts 2, ovate. ***Calyx*** greenish yellow, 5 – sepals; lobes elliptic, 6 mm by 2 mm, apex retuse, margin sparsely pilose. ***Corolla*** white, 5 – lobed; lobes broadly obovate, 15 mm by 6 mm, apex irregularly toothed or truncate, margin entire. ***Stamens*** 10, unequal, 5 short and 5 long; shorter stamens ca. 4 mm; longer stamens ca.6 mm long; filaments filiform, glabrous; anthers dorsifixed. ***Ovary*** superior, ovoid, ca. 2 mm; style 5, filiform, 5 – 6 mm long; stigma slightly swollen. ***Capsule*** oblong-conic, 10 mm by 5 mm. ***Seeds*** ovoid, 1-2 mm.

Bhutan – Bumthang, Chukha, Mongar, Tashigang, Trongsa districts
Distribution– China, India, Nepal, Pakistan
Ecology – Found in the moist and shady areas of broadleaved forests from 2,000 m asl. Flowering in the month of March – May
Specimen Examined – T Tob 032 (THIM)

PHYTOLACCACEAE

Phytolacca acinosa Roxb., Fl. Ind., ed. 1832. 2: 458. 1832; A.J.C. Grierson and D.J. Long in Fl. Bhutan 1(2): 191. 1984; L. Dequan and K. Larsen in Fl. China 5: 435. 2003. – *Phytolacca esculenta* Van Houtte, Fl. Serres Jard. Eur. 4: 398 B. 1848. – *P. pekinensis* Hance, Jour. Bot. 7: 166. 1869. (**Plate 14 A-B).**

Herbs, up to 50 – 125 cm tall. ***Stem*** erect, fleshy branched, often purplish, terete, longitudinally grooved. ***Leaves*** elliptic, 17 – 18 cm by 5 – 7 cm, margin entire throughout, apex acute, base attenuate; distinct mid-rib, visible on both surface; lateral veins 15 – 16 paired; petiole 1 – 2 cm long, glabrous. ***Inflorescences*** axillary, densely racemes, many – flowered; peduncle 1 – 2 cm long, glabrous; pedicels 6 – 8 mm long; bracts linear, 2 mm long. ***Tepals*** 5, pinkish, elliptic, 3 – 4 mm by 2 mm. ***Stamens*** 8 – 10, ca. as long as tepals; filaments persistent, white, subulate, base broad; anthers pink. ***Carpels*** 8, distinct; styles erect, short, apex curved. ***Berries*** oblate, ca. 5 mm in diam., purplish black when mature. ***Seeds*** 3-angulate, ca. 3 mm.

Bhutan –Chukkha, Thimphu, Trongsa, Bumthang, Tashigang and Mongar districts
Distribution – Myanmar, China, India, Janpan, Nepal, Vietnam
Ecology –Found in roadsides, forest understories, moist fertile land at an altitude above 900 – 2,500 m asl. Flowering in April – September.
Specimen Examined – T Tob 089 (THIM)

PLANTAGINACEAE

Plantago erosa Wall., Fl. Ind., ed. 1: 423. 1820; L.S. Springate in Fl. Bhutan 2(3): 1342. 2001. (**Plate 14 C).**

Herbs***. Leaves*** simple; blade elliptic, 6 cm by 2.5 cm, apex sub-acute, base attenuate, margin distantly serrate or ± entire, 3 – parralled veins conspicuous on both the surfaces, both the surface glabrous; petiole 2 – 3.5 cm long, winged. ***Inflorescence*** spike, many – flowered; peduncle slender, 8 – 10 cm long, ribbed; flowering head 10

– 20 cm up to late anthesis; flowers sub – sessile; bracts suborbicular or ovate, 1 – 2 mm, apex acute. ***Calyx*** sepals – 4, broadly obovate (outer 2), oblong – elliptic (inner 2), with keel briefly projecting as obtuse cusp; lobes ca. 4 mm by 2 mm, apex sub-acute, margin entire. ***Corolla*** white; tube 2 – 3 mm long, ovate, 0.5 mm by 0.2 mm, apex acute, glabrous. ***Stamens*** 4, anthers ca. 1 mm, dorsifixed, filaments ca. 2 mm long. ***Ovary*** superior, ca. 1 mm across; style 1 – 2 mm long; stigma capitate. ***Capsule*** ovoid, 2-3 mm. ***Seeds***1-2 mm, brown.

Bhutan –Chukha, Samdrup Jongkhar, Sarpang, Thimphu, Trongsa, Tashigang, Mongar districts.

Distribution – Bhutan, China, Vietnam

Ecology –Found in waste ground, cleared areas, grass lands at an altitude above 600 – 2,500 m asl. Flowering in March – August.

Specimen Examined – T Tob 084 (THIM)

POLYGALACEAE

Polygala arillata Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.199. 1825; K. Tan in Fl. Bhutan 2(1): 42. 1991; C. Shukun et al. in Fl China 11: 143,145,146. 2008. –*polygala arillata* var. *ovata* Gagnep. Fl. Indo-Chine1: 231. 1939. (**Plate 14 D).**

Shrubs or small tree, up to 5 m tall. ***Stem*** branched, young twigs densely fulvous – tomentose or pubescent, terminal bud densely yellow brown felted – hairy. ***Leaves*** simple, alternate; lamina oblong – lanceolate, 5 – 15 cm by 2 – 3 cm, apex acuminate, base cuneate, margin entire or thinly pilose; mid-rib distinct on both the surfaces, prominently raised on lower surface; lateral veins conspicuous, 5 – 6 paired; petiole 5 – 6 mm long. ***Inflorescence*** terminal or axillary, racemes, many – flowered; bracts and bracteoles linear – lanceolate, caduceous; rachis 10 – 15 cm long, densely pubescent; pedicels 5 mm long, pubescent; flowers yellow or deep orange, purple at the tip.***Calyx*** sepals 5, unequal, ciliate, outer sepals 3, small, 7-8 mm, upper one

deeply culcullate; lateral sepals ovate, 4 mm by 2 mm, apex rounded; inner sepals 2; petaloid oblong – ovate, 1.5 – 1.8 cm. ***Corolla*** petals 3; outer solitary boat – shaped, yellow, slightly fleshy; keel petal 10 – 20 mm, longer than lateral petals, apex with multifid appendages. ***Stamens*** 8; filaments ca. 1.5 cm long, lower 2/3 united, forming an open staminal sheath, adnate with petals; anthers ovoid. ***Ovary*** compressed, globose, ca. 3 mm in diam., narrowly winged, ciliate; style 10 – 12 mm long, curved towards apex; apex 2 – lobed, stigma on lower lobes. ***Capsule*** oblong – elliptic ca. 10 mm by 5 mm, pubescent, dark reddish purple, conspicuously ribbed at maturity. ***Seeds*** black, globose, ca. 4 mm in diam.

Bhutan –Chukkha, Samdrup Jongkhar, Punakha, Sarpang, Thimphu, Trongsa, Tashigang, Mongar districts

Distribution – Myanmar, Cambodia, China, India, Nepal, Sri Lanka, Thailand, Vietnam

Ecology – Found in forest margins of mixed broadleaved forest at an altitude above 1,000 – 2,500 m asl. Flowering in May – August

Specimen Examined – T Tob 0137 (THIM)

POLYGONACEAE

Aconogonum molle (D. Don) H. Hara, A.J.C. Grierson and D.J. Long in Fl. Bhutan 1(1): 156. 1983; L. Anjen et al. in Fl. China 5: 315. 2003. (**Plate 14 E).**

Shrubs, up to 1 – 2.5 m tall. ***Stem*** erect, branched, hirsute. ***Leaves*** alternate; leaf blade, pubescent, broadly elliptic, 13 – 14 cm by 6 – 7 cm, apex acuminate, base cuneate, margin hirsute; mid-rib visible on both the surfaces; lateral veins 19 to 20-paired; petiole 1 – 1.5 cm long, densely pubescent. ***Ocreae*** brown, tubular, 1 – 2 cm, membranous, oblique, pubescent. ***Inflorescence*** terminal or axillary, tomentose panicle, many – flowered; peduncle 2 – 3 cm long, densely pubescent; pedicels 1-1.5 mm long; bracts brown, ovate. ***Perianth*** white, segments oblong-elliptic, 2 mm by 1 mm, apex rounded, 3-veined. ***Stamens*** 8; style ca. 1 mm long; anther basifixed. ***Ovary***

superior, ovoid; stigma capitate. ***Achene*** ca. 2 mm enclosed in blackish fleshy perianth.

Bhutan – Phuntsholing, Chukha, Deothang, Mongar, Haa districts
Distribution – India, China, Nepal
Ecology – Found in the cleared forest areas 1,500 – 2,500 m asl. Flowering in Aug – Sept
Specimen Examined – T Tob 133 (THIM)

Fagopyrum dibotrys (D. Don) H. Hara, Fl. E. Himal. 69. 1966; A.J.C. Grierson and D.J. Long in Fl. Bhutan 1(1): 171. 1983; L. Anjen et al. in Fl. China 5: 321. 2003. – *Fagopyrum cymosum* (Trevir.) Meisn., Pl. Asiat. Rar.3: 63. 1832. – *F. megaspartanium* Q.F. Chen, Bot. J. Linn. Soc.130: 62. 1999. – *F. pilus* Q.F. Chen, Bot. J. Linn. Soc.130: 62. 1999. – *Polygonum cymosum* Trevir., Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur.13: 177. 1826. (**Plate 14 F).**

Herbs, up to 1 – 3 m tall. ***Stem*** erect, branched, striate, glabrous. **Leaves** alternate, leaf blade traingular, 8.5 by 9 cm, apex acuminate, base hastate, margin entire; petiole 6 – 7 cm long, densely pubescent; mid - rib distinct on both surfaces, hairy. ***Ocrea***e brown, broadly ovate, ca. 2 cm by 1, pilose, apex acute, margin entire. ***Inflorescence*** terminal or axillary, corymbose, flower 4; peduncle 10 – 12 cm long; pedicels very short, ca. 1 mm; bracts ovate – lanceolate, 3 mm by 1 mm, apex acuminate, margin membranous. ***Perianth*** white; tapels elliptic, 2 mm. ***Stamens*** 8, anthers dorsifixed; filaments 1 mm long. ***Ovary*** superior; style ca. 1 mm long. ***Achenes*** ovoid, ca. 5-6 mm, trigonous with flat surfaces.

Bhutan – Chukha, Mongar, Haa districts
Distribution – Myanmar, China, India, Nepal, Vietnam

Ecology –Mostly found along the roadsides ditches. Altitude above 1,400 m asl. Flowering in June – September.
Specimen Examined – T Tob 117 (THIM)

Persicaria capitata (Buch.-Ham. ex D. Don) H. Gross, Bot. Jahrb. Syst.49(2): 277. 1913; A.J.C. Grierson and D.J. Long in Fl. Bhutan 1(1): 165. 1983; L. Anjen et al. in Fl. China 5: 301. 2003. –*Polygonum capitatum* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.73. 1825. (**Plate 15 A-B).**

Herbs, up to 10 - 20 cm tall**.** ***Stem*** creeping, decumbent, densely leafy, rooting from the nodes, internodes shorter than the leaf blade, pubescent. ***Leaves*** simple, alternate; leaf blade ovate – elliptic with a large blackish spot adaxially, 1.5 cm by 1 cm, apex acute, base rounded or cuneate, margin ciliated; distinct mid-rib on both the surfaces; lateral veins 4 – 6 paired, inconspicuous on lower surface; petiole very short, 1 – 2 mm. ***Ocreae*** tubular, membranous, sparsely glandular hairy, apex truncate. ***Inflorescence*** terminal or axillary, solitary; flowers pinkish, globose head; bracts membranous, elliptic, 5 mm by 2 mm, apex acute, margin ciliated; peduncle glandular, 4 – 5 mm long; pedicels very short ca. 0.2 mm. ***Perianth*** 5, pinkish, tepals elliptic, 2 – 3 mm. ***Stamens*** 8; filaments 0.5 – 1 mm long. ***Ovary*** superior, ovoid, ca. 1 mm; stigma discoid; style ca. 1 mm long. ***Achenes*** reddish brown to brownish black, 3-gonous ca. 2 mm by 1.5 mm, smooth.

Bhutan – Mongar, Samchi, Sarpang, Tashigang districts
Distribution – Bhutan, China, India, Nepal
Ecology – Found along roadsides, open ground an altitude above 1,200 – 2,500 m asl. Flowering in March – September
Specimen Examined – T Tob 114 (THIM)

Rumex nepalensis Spreng., Syst. Veg. 2: 159. 1825; A.J.C. Grierson and D.J. Long in Fl. Bhutan 1(1): 173. 1983; A.J. Li et al. in Fl. China 5: 339. 2003; Hook.f. in Fl. Brit.

India 5: 60. 1884. – *Rumex bequaertii* De Wild., Pl. Bequaert. 5: 2. 1929. – *R. bequaertii* var. *quarrei* (De Wild.) Robyns, Fl. Spermat. Parc Natl. Albert 1: 117. 1984. – *R. camptodon* Rech. f., Beih. Bot. Centralbl. 49: 76. 1932. – *R. peregrinus* Boiss., Diagn. Pl. Orient., ser. 1 1(5): 46. 1844. – *R. quarrei* DeWild., Pl. Bequaert. 5:3. 1929. (**Plate 15 C).**

Herbs, up to 0.5 – 1 m tall. ***Stem*** erect, branched, glabrous. ***Leaves*** simple, alternate, ovate – oblong, 7 – 8 cm by 4 – 5 cm, apex acute, base rounded or slightly cordate, margin partially dentate throughout, both the surface glabrous and ± lepidote; mid – rib prominent on both surface; lateral veins 4 – 5 pairs, anastomosing. ***Ocrea*** membranous, fugaceous, brown and glabrous when dried. ***Inflorescence*** terminal or axillary; flowers in fascicles, numerous; pedicel very short 0.5 – 1 mm long, glabrous. ***Tapels*** 6 – lobed; outer 3 lobes ca. 2 mm by 1 mm, apex rounded, margin entire, glabrous; inner 3 lobes larger, oblong, 4 mm by 2 mm, margin usually teethed in the lower half and hooked at the apex, apex rounded***. Stamens*** 6, 0.5 – 1 mm; filaments slender, glabrous; anther basifixed. ***Ovary*** superior, 1 – 2 mm diam., glabrous; style 3, reclinate; stigma branching and spreading. ***Achenes*** ovoid, ca. 3-4 mm by 2 mm, brown.

Bhutan – Chukha, Mongar, Thimphu, Tashigang, Trongsa districts
Distribution – Afghanistan, Myanmar, China, India, Japan, Nepal, Pakistan, Vietnam
Ecology – Abundant in the grazed ground, marshy places above 1,000 m asl. Flowering in June – August.
Specimen Examined – T Tob 080 (THIM)

PRIMULACEAE

Lysimachia japonica Thunb., Syst. Veg. (ed. 14)196. 1784; H. Chi-Ming and S. Kelso in Fl. China 15: 60. 1996; E. Aitken in Fl. Bhutan 2(2): 564. 1999. (**Plate 15 D).**

Herbs, up to 30 – 40 cm tall. ***Stem*** prostrate to decumbent, branched from the base, densely covered by grayish multicellular hairs. ***Leaves*** opposite, simple, leaf blade ovate, 3 – 3.5 cm by 2 cm, apex acute, base rounded to subtruancate, margins entire, thinly puberulous on both the surfaces, scattered glandular dots; mid – rib and lateral veins prominent on both the surfaces; lateral veins 3 – 4 paired; petiole 5 – 10 mm long, narrowly winged, densely pubescent. ***Inflorescence*** terminal, 2 – 3 flowered; pedicels short, 2 – 3 mm, densely pubescent. ***Calyx*** cup-shaped, tube 1-2 mm long, densely cilitated, 5 – lobed; lobes linear – lanceolate, 7 mm by 2 mm, apex narrowly acute, margin ciliated. C***orolla*** yellow, deeply parted, lobes ovate, ca. 9 mm by 5 mm, apex acute, margin entire, dotted glands on the surfaces. ***Stamens*** 5, monadelphous, filaments 3 mm long, pubescent; anthers bilobed, 2 mm by 1 mm, dorsifixed. ***Ovary*** superior, densely pubescent; style 5 mm long, glabrous; stigma capititate, pilose. ***Capsule*** subglobose, 3 – 4 mm in diam., pubescent at the apex. ***Seeds*** many, small.

Bhutan – Mongar, Chukha, Sarpang districts

Distribution –China, India, Japan, Nepal

Ecology – Found in the damp places. At an altitude above 1,000 – 2,100 m asl. Flowering in June – August

Specimen Examined – T Tob 109 (THIM)

ROSACEAE

Duchesneaindica (Andrews) Focke in Engler & Prantl, Nat. Pflanzenfam. 3(3): 33. 1888; A.J.C. Long in Fl. Bhutan 1(3): 579. 1987; L. Lingdi et al. in Fl. China 9: 338. 2003. – *Duchesnea fragiformis* G. Don, Prodr. Fl. Nepal.233. 1825. – *Fragaria indica* Andrews, Bot. Repos.7: pl. 479. 1807. – *Potentilla durandii* Torr. & A. Gray, Fl. N. Amer.1(3): 444. 1840. – *P. indica* (Andrews) Th. Wolf, Syn. Mitteleur. Fl.6(1[34,35]): 661. 1904. – *P. indica* var. *major* Makino, Bot. Mag. (Tokyo)28: 184. 1914. (**Plate 15 E).**

Herbs, about 30 cm tall, rootstock stout with several prostrate stolons. ***Leaves*** 3 – foliate, petiolutate, ovate, 4 cm by 2 cm, apex rounded, base cuneate, margin serrate, 7 – 8 teeth on each side, both the surface hairy; stipules narrowly ovate – lanceolate, 4 – 7 mm; petiole 1 – 5 cm long, pilose**.** ***Inflorescence*** axillary, compound cyme, sometimes solitary flower; pedicel spreading hairy or densely villous, ca. 1 cm long, white sericeous. ***Calyx*** saucer-shaped, 5 – lobed; lobes ovate, 4 mm by 2 mm, apex acute, margin entire, white sericeous. ***Epicalyx*** segment 5, elliptic, 2 mm by 1 mm, margin entire, ciliate. ***Corolla*** yellow, 4 - lobed; lobes obovate, 5 – 7 mm by 4 – 5 mm, apex slightly emarginate. ***Stamens*** 20 - 30, 2 – 3 mm long; filaments narrowly triangular, glabrous; anthers flattened ovoid. ***Carpel***s numerous, free. ***Fruit*** not seen.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – Afghanistan, Myanmar, China, India, Nepal, Pakistan
Ecology – Found along the forest margin, roadside from 1,060 – 3,500 m asl. Flowering in February – June.
Specimen examined – T Tob 023 (THIM)

Fragaria nubicola (Hook. f.) Lindl. ex Lacaita, J.Linn. Soc., Bot. 43(293): 467 – 468. 1916; D.G. Long in Fl. Bhutan 1(3): 577.1987. – *Fragaria vesca* var. *nubicola* Hook. f., Fl. Brit. India 2(5): 344.1878. (**Plate 16 A-B).**

Herbs, 4 – 5 cm tall. ***Stem*** prostrate. ***Leaves*** 3 – foliate, bearing 2 additional minor leaflets; leaflets sessile, ovate, 2.5 cm by 1.5 cm, apex rounded, base cuneate, margin incised serrate, 5-12 teeth on each side, upper surface sparsely white appressed hairy, lower surface hairy on the mid-rib and viens; mid-rib distinct on the lower surface; lateral veins distinct on the lower surface, 5 – 7 paired; petiole 1.5 cm long, pilose**.** ***Inflorescence*** axillary, compound cyme, sometimes solitary flower; pedicel ca. 1 cm long, white sericeous. ***Calyx*** saucer – shaped, 5 – lobed; lobes ovate, ca. 4 mm by 2 mm, apex acute, margin entire. ***Epicalyx*** segment 5, elliptic, ca. 2 mm by 1 mm,

margin entire, ciliate. ***Corolla*** white, 5 – lobed; lobes orbicular, 6 – 7 mm by 4 – 5 mm, apex rounded. ***Stamens*** 20 – 25, 2 – 3 mm long; filaments narrowly triangular, glabrous; anthers flattened ovoid, ca. 1 mm. ***Ovary*** oblong, sparsely hairy or glabrous; style ca. 1 cm long, base constricted; stigma dilated***. Fruiting receptacle*** subglobose, ca. 1 -1.3 cm in diam., red; persistent sepals' appressed to aggregate fruit. ***Achenes*** ovoid, ca. 1 mm by 0.5, glabrous.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – Afghanistan, Myanmar, China, India, Nepal, Pakistan
Ecology – Found along the forest margin, roadside from 2,500 – 3,500 m asl. Flowering in May – July.
Specimen examined – T Tob 015 (THIM)

Neillia rubiflora D. Don, Prodr. Fl. Nepal. 228–229. 1825; A.J.C. Grierson in Fl. Bhutan 1(3): 537. 1987; L. Lingdi et al. in Fl. China 9: 78. 2003. – *Spiraea rubiacea* Wall., Numer. List n. 697. 1829. (**Plate 15 F).**

Shrubs, up to 2 – 3 m tall***. Stem*** branched, branchlets red-purples, glabrescent. ***Leaves*** simple, alternate; leaf blade 8 cm by 5 cm, deeply 3 – lobed; lobes ovate – elliptic, apex acuminate, base cordate, margin sharply doubly serate; mid-rib conpicious on both the surfaces; lateral veins visible on both the surfaces, 5 – 6 paired; petiole 1 cm long, pubescent. ***Inflorescence*** terminal, a narrow racemes or compact panicle, many-flowered; peduncle 2 – 3 cm long, pubescent; pedicels very short, ca. 1 mm long, pubescent; bracts greenish, ovate – lanceolate, 4 mm by 1.5 mm, apex shortly acuminate, margin entire or distantly serate at the base. ***Calyx*** cup – shaped; hypanthium 3 – 4 mm long, pubescent, 5 – lobed; lobes triangular, 2 – 3 mm by 1 mm, apex acuminate, margin entire. ***Corolla*** white, obovate, 2 mm by 1 mm, apex ± rounded, margin entire. ***Stamens*** 10 – 15, filaments exsert on the base of calx lobes; 1 – 2 mm long; anthers bilobed, dorsifixed. ***Ovary*** superior, ovoid, ca. 2 mm by 1 mm,

glabrous or slightly hairy at the apex; style 1 mm long; stigma capitate.***Capsule*** ovoid, ca. 5 mm, glabrous, enclosed by hypanthium with glandular hairs.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found in grassy slopes of mixed forest and along the roadsides. At an altitude above 2,100 – 3,300 m asl. Flowering in May-July.

Specimen examined – T Tob 130 (THIM)

Potentilla sundaica (Blume) W. Theob., Myanmar h [Mason], ed. 3. 2: 490. 1883; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 567. 1987. – *Potentilla wallichiana* Ser., Prodr. 2: 574. 1825. – *P. kleiniana* Wight & Arn., 1: 300. 1834. (**Plate 16 C).**

Herbs with spreading prostrate stem, up to 30 – 40 cm. ***Stem*** decumbent at the base, densely pubescent; root stocks thin and slender. ***Leaves*** palmately 3 – 5 foliate; leaflets obovate, 6 mm by 3 mm, apex rounded, base cuneate, margin serate, adaxially ± glabrous, abaxially appressed pubescent; petiole 1 – 2 cm long, densely pubescent; stipules: basal stipules usually membranous with lanceolate auricles and upper stipules are ovate, leafy. ***Inflorescence*** terminal, cyme, 2 – 5 flowered. 5 – 7 mm in diam. ***Calyx*** light green, 8 – 10 lobes, lobes lanceolate 5 mm by 2 mm, apex acute, margin ciliate. ***Corolla*** yellow; lobes obovate, 5 mm by 2 mm; apex rounded or sub-emarginate, margin entire, glabrous. ***Stamens*** more than 20. ***Carpels*** numerous, attached to the swollen receptacle; styles subterminal 0.5 – 0.6 mm. ***Achenes*** ellipsoid ca. 1 mm, glabrous.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Thimphu, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found along the roadsides at an altitude 1,300 m asl. Flowering in March – July.

Specimen examined – T Tob 48 (THIM)

Prunus nepaulensis (Ser.) Steud., Nomencl. Bot., ed. 2, 2(3): 403 (1841); A.J.C. Grierson in Fl. Bhutan 1(3): 540. 1987; J.C.M. Alexander and N. Joshi in Fl. Nepal 3: 391. 2013. (**Plate 16 D).**

Trees, up to 20 m tall. ***Branchlets*** reddish brown, glabrous. ***Leaves*** alternate, elliptic to lanceolate, 9 cm by 2 cm, apex acute to shortly acuminate, base cuneate, margin serrate; mid-rib distinct on both surfaces, prominently raised beneath; lateral veins visible on both surfaces, 10 – 15 paired; upper surface dark green, glabrous; lower surface pale green, glabrous or sparsely hairy; petiole 1 – 1.5 cm long. ***Inflorescence*** axillary, racemes, 10 – 15 cm; rachis densely pubescent, 2 – 3 mm long; pedicel 4 – 5 mm long, pubescent. ***Calyx*** cup-shaped, highly pubescent, short 5 – lobed, 1 mm, apex rounded. ***Corolla*** white; petals 5, ovate, 6 mm by 5 mm, apex rounded, margin entire. ***Stamens*** numerous; filaments flattened, 2 – 5 mm long, glabrous; anthers bi-lobed, dorsifixed. ***Ovary*** superior, ovoid, glabrous; style 5 mm long; stigma disc-shaped. ***Fruit*** not seen.

Bhutan – Bumthang, Chukha, Haa, Mongar, Samchi, Samdrup Jongkhar, Sarpang, Tashigang, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found in evergreen broad – leaved forest at an altitude 1,600 – 2,100 m asl. Flowering in April – May

Specimen examined – T Tob 044 (THIM)

Prunus sp. (**Plate 17 A).**

Trees, up to 10 m tall. Branchlets with sharp spines, glabrous. ***Leaves*** simple, 4 – 5 leaves clustered at nodes; leaf blade lanceolate, 6 cm by 2 cm, apex acute, base cuneate, margin minute sharp serrate towards apex, glabrous; mid-rib distinct on both the surface, impressed on the above, prominently raised beneath; lateral veins 4 – 5 paired, conspicuous; petiole 1 – 2 mm long or sub-sessile. ***Inflorescence*** terminal, simple umbel, 3 - 4 flowered; peduncle 1 – 2 cm long; pedicels 3 – 4 mm long, glabrous. ***Calyx*** cup – shaped, 5-lobes, tube ca. 7 – 8 mm long; lobes obovate, ca. 5 mm by 3 mm, apex rounded, margin ciliated, glabrous. ***Corolla*** white or pinkish at the tip of lobes, 5 - lobed; lobes orbicular, ca. 15 mm by 15 mm, apex rounded, base sub-cordate, veined. ***Stamens*** numerous, filaments 7 – 13 mm long, glabrous; anthers ca. 2 mm in across, versatile. ***Ovary*** inconspicuous; style 3 – 5 mm long; stigma capitate. ***Fruit*** not seen.

Bhutan – Mongar
Distribution –
Ecology – Found in montane heath forest at an altitude 1,500 m asl. Flowering in April – May
Specimen examined – T Tob 013

Rubus ellipticus Smith in Rees, Cycl. 30: Rubus no. 16. 1819; A. J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 557. 1987; L. Lingdi et al. in Fl. China 9: 2012. 2003; D.E. Boufford et al. in Fl. Nepal 3: 330. 2013. – *Rubus flavus* D. Don, Prodr. Fl. Nepal. 234. 1825. (**Plate 16 E-F).**
Scandent, 1 – 3 m tall. ***Branchlets*** brown or brownish, hispid, with a curved prickle and dense brown bristles or glandular hairs. ***Stipules*** linear, 5 – 10 mm long, pubescent. ***Leaves*** 3 – foliolet, leaflets elliptic – ovate; terminal leaflet 6.5 cm by 4 cm, apex acute, base rounded, margin unevenly minute sharply serrate, pubescent,

distinct mid-rib on both surface; petiole 1 – 2 cm long, densely purplish red hispid; lateral leaflets subsessile, 3.5 cm by 2 cm; petiolule and rachis purplish red hispid, pubescent with minute prickles. ***Inflorescence*** terminal, dense glomerate racemes, many – flowered in cluster; bracts linear, 5 – 9 mm, pubescent; pedicel 3 – 4 mm long, densely pubescent. ***Calyx*** cup bristly; 5-lobed; lobes ovate, 4 mm by 3 mm, apex acute, margin pilose, densely yellowish tomentose. ***Corolla*** white, polypetalous, 5 - petals; lobes obovate, 5 mm by 2.5 mm, apex rounded, margin entire. ***Stamens*** numerous; filaments 2 – 2 .5 mm long; anthers 0.5 mm, dorsifixed. ***Ovary*** pubescent; style glabrous, slightly longer than stamens, ca.3 mm long. ***Aggregate fruit,*** golden yellow, subglobose, ca. 1 cm diam., druplets pubescent at the apex. ***Pyrenes*** triangular-ovoid, densely rugulose.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Samchi, Sarpang, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam

Ecology – Found along the roadside, forest scrubs from 1,200 – 1,900 m asl. Flowering in February – April

Specimen examined – T Tob 017 (THIM)

R. rosifolius Sm., Pl. Icon. Ined. 3: 60. 1791; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(3): 562. 1987; L. Lingdi et al. in Fl. China 9: 227. 2003; D.E. Boufford et al. in Fl. Nepal 3: 336. 2013. –*Rubus pinnatus* Willd., Sp. Pl.2(2): 1081. 1799. – *R. coronarius* (Sims) Sweet, Hort. Brit.1: 144. 1826. (**Plate 17 C-D).**

Shrubs, up to 2 – 3 m tall with long slender branches with numerous curved throns; leafy branchlets short, thinly pilose and with slender hooked throns, eglandular. ***Stipules*** ovate – lanceolate, 6 mm by 3 mm, sparsely soft hairy. ***Leaves*** pinnately 3 – 7 foliate; leaf blade upper surface pilose with a glands; lower surface pilose to

subglabrascent, sparse minute prickles along the mid-vein, ovate – elliptic, 6 cm by 2.5 cm, apex acuminate, base rounded, margin sharply incised doubly serrate; mid-rib distinct on both the surface; lateral veins visible on both surface, 6-paired; petiole 2 – 3 cm, softly hairy with minute prickles; petiolule of terminal leaflet 1-1.5 cm long; lateral leaflet subsessile, petiolule and rachis softly hairy, sparse minute prickles. ***Inflorescence*** terminal or axillary, 1 – 2 flowered; bracts linear, 5 – 6 mm long; pedicels 1.5 – 2 cm long, sparsely hairy, minute prickles. ***Calyx*** softly hairy and glandular, 5 - sepals; lobes ovate – lanceolate, 20 mm by 5 mm, apex long caudate, pilose. ***Corolla*** white, 5 – petals; lobes obovate or orbicular, 10 mm by 9 mm, glabrous, margin entire. ***Stamens*** numerous; filaments flat, 5 mm long; anthers bi-lobed, 0.5 – 1 mm, dorsifixd. ***Carpel*** numerous; style slender, 5 – 6 mm long, glabrous; stigma capitate. ***Aggregate fruit*** red, ovoid – globose, narrowly ovoid – oblong, glandular. ***Pyrenes*** deeply foveolate.

Bhutan – Mongar, Samchi, Samdrup Jongkhar, Sarpang, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Japan, Nepal, Thailand, Vietnam
Ecology – Found along the roadside, mixed forest, grassy slopes from 1,600 – 2,100 m asl. Flowering in February – May
Specimen examined – T Tob 035 (THIM)

Spiraea micrantha Hook.F., Fl. Brit. Ind. 2[5]:325. 1878; A.J.C. Grierson in Fl. Bhutan 1(3): 534. 1987; J.C.M. Alexander and N. Joshi in Fl. Nepal 3: 290. 2013. (**Plate 17 B).**

Shrubs, up to 2 – 2.5 m tall. ***Stems*** branched, reddish brown, finely ridged, pubescent. ***Leaves*** simple, alternate, ovate-elliptic, 5 cm by 1.5 cm, apex attenuate, base cunate, margin doubly serrate; mid-rib distinct on both the surfaces, prominently raised beneath, pubescent; lateral veins visible on both the surfaces, 4 – 5 paired; petiole 2 – 3 mm long, densely pubescent. ***Inflorescence*** terminal, corymb, much - branched,

many – flowered; peduncles 2 – 4 cm long, pubescent; pedicel 4 – 5 mm long, hairy. ***Calyx*** cup – shaped, 5 – lobed; lobes triangular, 1 mm, pubescent outside. ***Corolla*** white; petals 5, polypetalous; blades orbicular, 2 mm by 1.5 mm, apex rounded, margin entire, glabrous, veined. ***Stamens*** 20; filaments slender, 2 – 3 mm long; anther dorsifixed; disk 10 – lobed. ***Carpels*** apocarpus, hairy. ***Fruit*** not seen.

Bhutan – Bumthang, Chukha, Mongar, Samchi, Samdrup Jongkhar, Tashigang, Trongsa districts
Distribution – China, India, Nepal
Ecology – Found in cleared areas and forest margin at an altitude altitude of 2200 m asl. Flowering in June – August
Specimen examined – T Tob 129 (THIM)

RUBIACEAE
Mussaenda roxburghii Hook.f., Fl. Brit. India 3: 87. 1880; J.R.I. Wood in Fl. Bhutan 2(2): 782. 1999. (**Plate 17 E-F).**

Shrubs up to 1-4 m tall. ***Stems*** branched, sparsely or densely pilose**.** ***Leaves*** simple, opposite, petiolate, leaf blade broadly elliptic or ovate, 13 cm by 7 – 8 cm, apex shortly acuminate, base cuneate, margin entire, sparsely pilose on both the surface; mid-rib distinct on both surfaces, hairy; lateral veins conspicuous on both surfaces, pilose, 7 – paired; petiole 1 – 3 cm long; stipules triangular. ***Inflorescence*** terminal, 3 – branched from base, many – flowered, peduncle 1 – 2 cm long, pubescent; pedicels 1 – 2 mm long, hairy. ***Calyx*** tubular, tube 5 mm long, pubescent; 5-lobed; lobes filliform, tapering from the base, 1 – 2 mm long, densely covered by long silky hairs. ***Corolla*** tube 2 – 2.5 cm long, dense long yellow silky hair on the inner surface of the tube; 5-lobed; lobes ovate, 2 – 3 mm by 2 mm; apex acuminate, margin entire. ***Stamens*** 5, filaments slender, 3 cm long, anther ca. 2 cm, versatile. ***Carpel*** style slender, 2 cm long. ***Berries*** oval, ca. 0.5 cm in diam., glabrous.

Bhutan – Chukha, Mongar, Samchi, Samdrup Jongkhar, Tashigang, Trongsa districts
Distribution – India, Nepal, Thailand
Ecology – Found in secondary scrub and forest margins at an altitude of 1,200 m asl. Flowering in May – August.
Specimen examined – T Tob 129 (THIM)

Wendlandia grandis (J. D. Hooker) Cowan, Notes Roy. Bot. Gard. Edinburgh. 16: 261. 1932; J.R.I. Wood in Fl. Bhutan 2(2): 754. 1999; C. Tao et al. in Fl. China 19: 355, 356, 359. 2011. – *Wendlandia tinctoria* var. *grandis* Hook. f., Fl. Brit. India 3(7): 38. 1880. (**Plate 18 A).**

Small trees. ***Stem*** erect, branched, branchlets brown, sparsely pubescent, fissured. ***Leaves*** opposite pairs, broadly elliptic, 12 cm by 5 cm, apex acute or shortly acuminate, base cuneate, margin entire; mid-rib distinct at both the surfaces, strignose; lateral veins conpicious, 7 – 8 paired, petiole 1 – 2 cm long, densely pubescent; stipules persistent, triangular to ovate, 8 – 10 mm, strigillose with erect apex; ligulate 4 – 5 mm and often longitudinally folded. ***Inflorescence*** terminal, paniculate, many – flowered, flowers usually congested on the secondary branches; bracts lanceolate, 3 mm; flowers sessile. ***Calyx*** densely brown hirtellous, hypanthium 1 mm long; deeply 5 – lobed, lobes acute or obtuse, ca. 0.5 mm. ***Corolla*** white, funnel-shaped; tube 2 – 3 mm long, hirsute inside; lobes triangular, 0.5 – 1 mm. ***Stamen*** 4; filament very short and are partially exserted, 1 mm; anthers elliptic, ca. 1 mm, dorsifixed. ***Ovary*** 2-celled; style filliform, ca. 1 mm long; stigma bifid. ***Capsule*** subglobose, 1 – 2 mm in diam., pubescent. ***Seeds*** numerous, small, compressed.

Bhutan – Mongar, Samchi, Samdrup Jongkhar, Trongsa districts
Distribution – Bangladesh, Myanmar, China, India, Nepal
Ecology – Found in ever green broad-leaved forest and secondary forests at an altitude of 1,200 m asl. Flowering in February – April

Specimen examined – T Tob 112 (THIM)

RUTACEAE

Murraya koenigii (L.) Spreng., Syst. Veg. (ed. 15 bis)2: 315. 1817; A.J.C. Grierson in Fl. Bhutan 2(1): 17. 1991. – *Bergera koenigii* L., Mant. Pl.2: 555, 563. 1771. – *Chalcas koenigii* (L.) Kurz, J. Asiat. Soc. Benga l44(2): 132. 1875. (**Plate 18 B).**

Small trees, up to 4 – 5 m tall. ***Stem*** branched, glabrous. ***Leaves*** 10 – 15 cm long, imparipinnate; leaflets ovate – elliptic, 4 cm by 2 cm, apex shortly acuminate, base cuneate, margin minutely crenate, both the surfaces sparsely pubescent or glabrous; mid-rib distint and visible on both the surfaces; lateral veins inconpicous in upper surface, 5 – 6 paired; petiole 1 – 2 mm long, sparsely pubescent. ***Inflorescence*** terminal, corymbs with numerous flower; peduncle 1 – 2 cm long, pubescent; pedicels 5 – 6 mm long, pubescent. ***Calyx*** cup – shaped, 5 – lobed; lobes ovate, 1 mm by 0.5 mm, apex acute, margin entire, glabrous. ***Corolla*** white, petal 5, oblanceolate, 7 mm by 2 mm, apex sub – acute, margin entire, dotted spot on the surface. ***Stamens*** 10, unequal length, 5 stamens short and 5 stamens long; short stamens ca. 6 mm; longer stamens ca. 10 mm long; filaments glabrous, broaden at the base; anther dorsifixed. ***Ovary*** superior, ovoid, ca. 1 mm in diam.; style 5 mm long, glabrous; stigma capitate. ***Berries*** ovoid, 7 mm by 6 mm. ***Seeds*** with membranous or fleshy seed coat.

Bhutan – Chukha, Mongar, Samchi, Samdrup Jongkhar districts

Distribution – China, India, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam

Ecology – Found in forest slopes at an altitude of 1,250 m asl. Flowering in February – March

Specimen examined – T Tob 028 (THIM)

SAURURACEAE

Houttuynia cordata Thunb., Kongl. Vetensk. Acad. Nya Handl. 4: 149. 1783; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(2): 341. 1984; K. Larsen in Fl. Thailand 7(2): 344. 2000. – *Polypara cochinchinensis* Lour., Fl. Cochinch. 61. 1790. *P.* Kuntze, Revis. Gen. Pl. 2: 565. 1891. (**Plate 18 C).**

Herbs, up to 30 – 35 cm tall. ***Rhizomes*** creeping, thin, basal parts of stems creeping, terete, glabrous**.** ***Leaves*** simple, alternate; lamina broadly ovate, 7 cm by 5.5 cm, apex shortly acuminate, base cordate, margin entire; 5 – 7 nerved; stipular sheaths at the base of petiole, lanceolate, 10 – 15 mm. ***Inflorescence*** terminal, solitary; peduncle 1 – 3 cm long, glabrous; involucral bracts oblong or obovate, 5 mm by 3 mm, apex rounded. ***Petaloid*** bracts 4, white, obovate, 10 mm by 5 mm, apex rounded, margin entire, glabrous. ***Stamens*** numerous; filaments 1 – 2 mm long; anthers ca. 1 mm. ***Ovary*** 3-lobed with 3 divergent styles. ***Capsule*** urceolate, 1 – 2 mm. ***Seeds*** ovoid, ca. 1 mm.

Bhutan – Chukha, Mongar, Samchi, Samdrup Jongkhar, Tashigang, Trongsa districts
Distribution – China, India, Japan, Nepal, China, Japan, Thailand, Vietnam
Ecology – Found in wet meadows, field margins. Altitude above 1,000 – 2,400 m asl. Flowering in June – August.
Specimen examined – T Tob 107 (THIM)

SOLANACEAE

Solanum viarum Dunal, Prodr. 13(1): 240. 1852; R.R. Mill in Fl. Bhutan 2(3): 1057. 2001. – *Solanum chloranthum* DC., Pl. Rar. Jard. Genèvet. 13. 1826. –*Solanum viridiflorum* Ruiz & Pav., Fl. Peruv.2: 38, t. 173, f. b. 1799. (**Plate 18 D).**

Herbs or undershrub, annuals, 50 – 100 cm tall. ***Stem*** branched, terete, densely patent – villous whitish gray, thin, simple viscid – glandular hairs; sharp prickles, 5 – 15 mm

long. ***Leaves*** alternate, broadly ovate, 13 cm by 10 cm, shallowly or deeply 4 – 5 lobes; lobes apex acute, margin ciliate, base sub-cordate; mid-rib distinct on both surfaces; densely patent – villous; lateral veins 7 – 8 paired. ***Inflorescence*** axillary, 1 – 3 flowered racemes; peduncle short; pedicels 1 – 1.3 cm long with villous and few short slender prickles. ***Calyx*** 5 – sepals, hairy; lobes oblong – lanceolate, 4 mm by 1 mm, apex acute, base cuneate, margin ciliated. ***Corolla*** white, ovate – lanceolate, 11 mm by 4 mm, apex acute, sparsely villous outside towards apex. ***Stamens*** 5; filaments flattened, broader at the base 1 – 2 mm long, pubescent; anthers narrowly flask – shaped, 5 – 6 mm, glabrous. ***Ovary*** puberulent; style 6 – 7 mm long, glabrous. ***Berry*** pale yellow, globose, 2 – 3 cm in diam***. Seed*** brown, discoid.

Bhutan – Chukha, Mongar, Samchi, Samdrup Jongkhar, Tashigang, Trongsa districts
Distribution – China, India, Japan, Nepal, Thailand, Vietnam
Ecology – Found along the roadside. Altitude 2,100 m asl. Flowering in June - August
Specimen examined – T Tob 122 (THIM)

SYMPLOCACEAE

Symplocos dryophila C.B. Clarke, Fl. Brit. India 3(9): 578. 1882; D.G. Long in Fl. Bhutan 2(2): 583. 1999. *–Dicalix delavayi* (Brand) Migo, Bull. Shanghai Sci. Inst. 13(3): 200. 1943. *–D. forrestii* (W.W. Sm.) Migo, Bull. Shanghai Sci. Inst. 13(3): 201. 1943. – *D. shunningensis* Migo, Bull. Shanghai Sci. Inst. 13(3): 205. 1943. – *Symplocos delavayi* Brand, Repert. Spec. Nov. Regni Veg. 3(40–41): 218. 1906. – *S. forrestii* W.W. Sm., Notes Roy. Bot. Gard. Edinburgh 13(63–64): 185–186. 1921. – *S. longipetiolata* Rehder, Pl. Wilson. 2(3): 599. 1916. (**Plate 18 E).**

Trees, up to 5 – 10 m tall. ***Stem*** erect, branched; branchlets stout, glabrous; terminal buds large, 1 – 2 cm, glabrous outside. ***Leaves*** simple, alternate, coriaceous, oblanceolate – elliptic, 10 – 13 cm by 4 – 5 cm, apex acuminate, base cuneate, margin

entire, both the surface glabrous; mid – rib distinct on both the surfaces, prominently raised beneath, impressed on the upper surface; lateral veins visible on both the surfaces, 6 – 9 paired; petiole 1 – 1.5 cm long, pubescent, stout. ***Inflorescence*** terminal, simple racemes 5 – 10 cm; many – flowered, white or creamy; bracts linear – elliptic, 5 mm by 1 mm, apex acute, margin cilated; peduncles appressed hairy; pedicels 1 – 2 mm long, densely pubescent. ***Calyx*** cup – shaped, 5 – lobeed; lobes triangular, 1.5 mm by 1 mm, margin entire, glabrous. ***Corolla*** petals – 5; lobes oblong, 10 mm by 5 mm, apex rounded, margin entire, glabrous. ***Stamens*** numerous; filaments slender, 1 – 10 mm long, glabrous; anthers ca. 1 mm, basifixed. ***Disc*** inconspicuous; style base conic, sparsely pubescent, 3 – 7 mm long; stigma capitate. ***Drupes*** ellipsoid, 5 – 8 mm by 4 – 5 mm, 1 – seeded, glabrous, apex with persistent erect calyx lobes.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – Myanmar, India, China, Nepal, Thailand, Vietnam
Ecology – Found as a major components of broad leaved forest an altitude above 1,600 – 2,500 m asl. Flowering in May – July
Specimen examined – T Tob 037 (THIM)

S. glomerata King ex C.B. Clarke, Fl. Brit. India 3(9): 577. 1882; W. Rong-fen and H.P. Nooteboom in Fl. China 15: 249. 1996; D.G. Long in Fl. Bhutan 2(2): 582. 1999. – *Dicalix glomeratus* (King ex C.B. Clarke) Migo, Bull. Shanghai Sci. Inst. 13(3): 201. 1943. – *Symplocos wenshanensis* Huang & Y. F. Wu in Y. F. Wu, Acta Phytotax. Sin. 24(3): 199–200, pl. 8. 1986. – *S. yizhangensis* Y.F. Wu, Acta Phytotax. Sin. 24(3): 200–202, pl. 9. 1986. (**Plate 18 F).**

Trees up to 5-10 m tall. ***Stem*** branched, branchlets glabrous or tomentous, terminal buds small. ***Leaves*** simple, alternate; leaf blade oblong – elliptic, 12 cm by 3 cm, both the surfaces glabrous, apex acuminate, base cuneate, margin serrulate; mid-rib distinct

on both the surfaces, impressed above; lateral vein 7 – 8 paired, visible on both the surface; petiole 1 cm long, glabrous. ***Inflorescence*** axillary, raceme, flowers white, many – flowered; peduncle 4 – 5 mm long, finely pubescent; rachis 3 – 4 cm; pedicels 2 mm long. ***Calyx*** cup – shaped, sparsely pubescent; 5 – lobed; lobes suborbicular, 1 mm by 0.5 mm, apex acute, margin ciliate. ***Corolla*** white; petal 5; lobes sub-orbicular 3 mm by 2 mm, apex rounded, margin entire. ***Stamens*** numerous; filaments slender, 1 – 3 mm long; anthers dorsifixed. ***Ovary*** superior, ovoid; style 4 mm long, glabrous; stigma capitate. ***Drupes*** cylindrical, 5-6 mm by 2-3 mm. ***Seed*** 1, straight.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – China, India
Ecology – Found at broadleaved forest. Altitude above 1,800 m asl. Flowering in March – May.
Specimen examined – T Tob 073 (THIM)

S. sumuntia Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 145. 1825; W. Rong-fen and H.P. Nooteboom in Fl. China 15: 243. 1996; D.G. Long in Fl. Bhutan 2(2): 583. 1999; H.P. Noteboom in Fl. Thailand 2(4): 463. 1981. –*Bobua austrosinensis* Migo, Bot. Mag. (Tokyo) 56(666): 267–268. 1942. – *Dicalix austrosinensis* (Migo) Migo, Bull. Shanghai Sci. Inst. 13(3): 198. 1943. – *D. botryanthus* (Franch.) Migo, Bull. Shanghai Sci. Inst. 13(3): 199. 1943. – *D. decorus* (Hance) Migo, J. Shanghai Sci. Inst. 13(3): 200. 1943. – *D. swinhoeanus* (Hance) Migo, Bull. Shanghai Sci. Inst. 13(3): 206. 1943. – *D. urceolaris* (Hance) Migo, J. Shanghai Sci. Inst. 13(3): 207. 1943. (**Plate 19 A-B).**

Trees, up to 5 – 10 m tall. Branched, branchlets brown and stout, glabrous; terminal buds small, 4 – 5 mm, glabrous outside. ***Leaves*** simple, alternate; blades elliptic, 6 – 11 cm by 2.5 – 3 cm, apex shortly acuminate, base cuneate, margin distantly serrate, glabrous, mid-rib distinct on both the surface; lateral veins 5 – 6 paired, inconspicuous in upper surface; petiole 1 – 1.5 cm long, glabrous. ***Inflorescence***

terminal or axillary, racemes, many – flowered; pedicel 2 mm long, pubescent; bracts at the base of pedicel, appressed hairy; bracteoles under the flower, 1 – 2 mm, caducous. ***Calyx*** cup-shaped, tube ca. 1 – 1.5 mm long, 5-lobed; lobes Ovate – lanceolate, 2 mm by 1 mm, apex obtuse, margin entire, sparsely pubescent. ***Corolla*** white, petals - 5, lobes ovate, 5 mm by 2 mm; apex rounded, margin entire. ***Stamens*** numerous, unequal; filaments 2 – 3 mm long; anthers basifixed. ***Ovary*** ovoid, 1 – 2 mm; style ca. 4 mm long; stigma disk-shaped, glabrous. ***Capsule*** not seen.

Bhutan – Chukha, Mongar, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Japan, Nepal, Thailand, Vietnam
Ecology – Found in evergreen broadleaved forest. Altitude 2,200 m asl. Flowering in April
Specimen examined – T Tob 020 (THIM)

THEACEAE

Schima wallichii (DC.) Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot. 143. 1842; A.J.C. Grierson in Fl. Bhutan 1(2): 365. 1984; M. Tianlu and B. Barthomew in Fl. China 12: 420,422. 2007; – *Gordonia wallichii* DC., Prodr. 1: 528. 1824. (**Plate 19 C).**

Trees, up to 30 m tall. ***Branchlets*** grayish brown, densely white lenticellate; longitudinally ribbed; terminal buds white velutinous. ***Leaves*** simple, alternate; leaf blade ovate – elliptic, 17 cm by 6 cm, apex acute, base cuneate, margin entire; upper surface glabrous; lower surface sparsely pubescent; mid-rib distinct at both the surface; spreading villous along mid-vein on the lower surface; lateral vein 11 – 12 paired; petiole 2 cm long, glabrous. ***Inflorescence*** axillary; flowers 3 – 4 in cluster, white, 3 – 4 cm across; pedicel 2 – 2.5 cm long, gray pubescent, white lenticellate; bracteoles oblong, 4 mm by 2 mm. ***Calyx*** sepal 5, orbicular, 4 mm by 3 mm, apex rounded, margin ciliate. ***Corolla*** white, petal 5, broadly obovate, 2 cm by 1.5 cm, apex rounded, margin ciliate, minutely pubescent externally at the base. ***Stamens***

numerous, yellow; filaments free, basally adnate with petals, 2 – 3 mm long; anthers dorsifixed. ***Ovary*** globose yellowish tomentose but apically glabrous, 2 – 3 cm in diam.; style 5 – 6 mm long; stigma capitate. ***Capsule*** subglobose, 1 – 2 cm diam., woody, brown.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Nepal, Thailand, Vietnam
Ecology – Found in broadleaved forest. Altitude above 300 – 2,000 m asl. Flowering in May – July.
Specimen examined – T Tob 074 (THIM)

THYMELAEACEAE

Daphne bholua Buch.-Ham. ex D. Don Prodr. Fl. Nepal. 68–69. 1825; S.J. Rae in Fl. Bhutan 2(1): 212. 1991; W. Yinzheng et al. in Fl. China 13: 232, 244, 245. 2007. (**Plate 19 D).**

Shrubs, up to 2 – 3 tall. ***Stem*** branched, erect, brownish, glabrous. ***Leaves*** simple, alternate, clustered at the stem apex; leaf blade lanceolate, 15 cm by 3 cm, apex acute, base cuneate, margin entire, both the surface glabrous; mid-rib prominently raised beneath; visible on both the surface; petiole very short ca. 2 mm, ± sessile. ***Inflorescence*** terminal, simple umbel, many-flowered in clusters; bracts paired, caducous, broadly lanceolate or oblong – ovate, 13 mm by 3 mm, densely sericeous, apex caudate; pedicel 2 – 3 mm long, densely sericeous. ***Calyx*** purplish red, tube cylindric, ca. 1 cm long; 4 – lobed; lobes white, ovate, 10 mm by 5 mm, apex slightly retuse or sub – acute. ***Stamens*** 8, lower whorl inserted to middle of calyx tube, upper whorl reaching the mouth; filaments very short, ca. 0.5 mm; anthers 2 mm. ***Ovary*** superior, ovoid 10 mm by 5 mm; style very short 0.1 – 0.2 mm; stigma capitate. ***Drupes*** ovoid, ca. 7 mm by 4 mm, black.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – Bangladesh, Myanmar, China, India, Nepal, Vietnam

Ecology – Found in broadleaved forest. Altitude above 1,980 – 3,400 m asl. Flowering in February – May

Specimen examined – T Tob 014 (THIM)

URTICACEAE

Elatostema lineolatum Wight, Icon. Pl. Ind. Orient. 6: 11, pl. 1984. 1853; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 119. 1983; C. Jiarui et al. in Fl. China 5: 137. 2005. – *Elatostema lineolatum* var. *majus* Wedd., Arch. Mus. Hist. Nat. 9(1–2): 312. 1856-1857. (**Plate 19 E).**

Herbs, monoecious or dioecious, 50 – 100 cm tall. ***Stem*** erect, densely strignose. ***Leaves*** alternate, asymmetrically elliptic, 11 cm by 3 cm, apex caudate acuminate, base obliquely cuneate, margin serrate; mid-rib distinct on both the surface; lateral veins conspicuous on both surface; both surface strignose along the veins; petiole very short, ca. 0.5 – 1 mm; stipules lanceolate, 3 – 4 mm, caducous. ***Inflorescence*** axillary; male solitary, simple, 3 mm in diam; pedunculate, receptacle 1 - 2 mm in diam.; bracts connate, bracteoles spatulate. ***Female inflorescence*** solitary, 1 – 2 mm in diam, ± sessile; bracts triangular; bracteoles oblanceolate. ***Achene*** ellipsoid, ca. 0.4 mm long.

Bhutan – Chukha, Mongar, Sarpang, Trongsa districts

Distribution – Myanmar , China, India, Nepal, Sri Lanka, Thailand

Ecology – Found in forest margins and in shady slopes at an altitude of 1,800 m asl. Flowering in May – June

Specimen examined – T Tob 146 (THIM)

E. sessile J.R. Forst. & G. Forst.Char. Gen. Pl. 53. 1775. A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 119. 1983. (**Plate 19 F).**

Herbs, dioeceous, up to 50 – 60 cm tall. ***Stem*** creeping at the base. ***Leaves*** alternate, asymmetrically elliptic, 14 cm by 4.5 cm; apex acuminate, base obliquely cuneate, margins sharply serrate, sparsely appressed pilose; stipules oblong, ca. 1 cm, deciduous, subsessile. ***Inflorescence*** axillary, unisexual flowers substended by free bracts in the staminate and fused in the pistillate fleshy receptacles. ***Staminate*** flower: ***Tepals*** 4, ovate, dorsally appendaged. ***Stamen*** 4. ***Pistillate*** flower: ***Tepals*** 4, dentate. ***Ovary*** 1- celled; stigima penicillate. ***Achenes*** elliposoid, ca. 0.3 mm.

Bhutan – Chukha, Mongar, Sarpang, Tashiyangtse, Trongsa districts
Distribution – China, India, Nepal
Ecology – Found in broad-leaved forest, wet rocks. Altitude of 1,200 – 2,600 m asl. Flowering in May – August
Specimen examined – T Tob 147 (THIM)

Girardinia diversifolia (Link) Friis, Kew Bull. 36: 145. 1981; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 111. 1983; C. Jiarui et al. in Fl. China 5: 91. 2005. – *Girardinia adoensis* (Hochst. ex Steud.) Wedd., Ann. Sci. Nat., Bot., sér. 4, 4 (1): 181. 1854. – *G. condensata* (Hochst. ex Steud.) Wedd., Ann. Sci. Nat., Bot., sér. 4, 4 (1): 181. 1854. – *G. condensata* var. *adoensis* (Hochst. ex Steud.) De Wild., Ann. Mus. Congo Belge, Bot. sér. 4, 1: 173. 1903. – *G. erosa* Decne., Voy. Inde 152. 1844. (**Plate 20 A).**

Herbs, up to 1-2 m tall. ***Stem*** erect, often woody at the base, straight, pubescent and armed with stinging and stigose hairs. ***Stipules*** oblong – ovate, 1 – 2 cm, sparsely strigose abaxially. ***Leaves*** broadly ovate, 15 cm by 5 cm, shallowly or deeply 3 – lobed, apex acute or shortly acuminate, base cordate or subtruncate, margin regularly

serrate or sometimes doubly serrate at the base; 3 – veined, lateral veins 3 – 5 in each sides, abaxially sparsely pubescent and with armed stinging and setulose hairs, adaxially sparsely pubescent with short stinging hairs. ***Male inflorescence*** in the proximal axils, spicate, cymose – racemose, 5 – 8 cm; perianth lobes 4, ovate, apex acute, setulose abaxially; stamen 4; rudimentary ovary copular. ***Female inflorescence*** usually in the distal axils of stem or sometimes in the same axil of male, sometimes solitary, raceme – like or paniculate, 6 – 10 cm, strigose, spreading hirsute; flowers 0.5 mm; perianth lobes unequal, larger lobe cymbiform, ca. 0.4 mm, sparsely strigillose ouside, apex 3 – toothed, smaller lobes linear. ***Achene*** subcordate, 1 – 3 mm in diam., slightly compressed, dark brownish,

Bhutan – Chukha, Mongar, Samdrup Jongkhar, Sarpang, Tashiyangtse, Thimphu, Trongsa districts

Distribution – China, India, Nepal, Sri Lanka

Ecology – Found in forest margins, shaddy moist places, disturbed places usually in cattle grazed areas. Altitude above 1,500 m asl. Flowering in July – September

Specimen examined – T Tob 092 (THIM)

Pilea scripta (Buch.-Ham. ex D. Don) Wedd., Ann. Sci. Nat., Bot., sér. 4. 1: 187. 1854; A.J.C. Grierson and D.G. Long in Fl. Bhutan 1(1): 113. 1983; C. Jiarui et al. in Fl. China 5: 105. 2005. – *Urtica scripta* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal. 59. 1825. (**Plate 20 B).**

Monoecious or dioecious herbs, up to 1 – 1.5 m tall. ***Stem*** erect, branched, succulent, swollen above the nodes, glabrous. ***Leaves*** simple, opposite, elliptic or lanceolate, 15 cm by 4 cm, apex acuminate, base cuneate, margin finely serrate; lateral veins numerous, conspicuous, reticulations interruptedly thickened; petiole 2 – 4 cm long, glabrous; stipules lanceolate, ca. 2 mm. ***Inflorescence*** terminal, solitary, a cymose panicle; male panicle often large and spreading, up to 15 cm in the lower axils; female

panicles ca. 6 cm long in the upper axil. ***Achene*** ovate, ca. 0.5 mm, minute, compressed.

Bhutan – Chukha, Mongar, Punakha, Sarpang, Tashigang, Trongsa districts
Distribution – Myanmar, China, India, Nepal
Ecology – Found in shaded moist places in broad-leaved forest. Altitude above 1,000 – 1900 m asl. Flowering in July – September
Specimen examined – T Tob 105 (THIM)

VIOLACEAE

Viola yunnanfuensis W. Becker, Bull. Misc. Inform. Kew. 1928: 248. 1928; A.J.C. Grierson in Fl. Bhutan 2(1): 222. 1991; C. Yousheng et al. in Fl. China 13: 77,103. 2007. - *Viola bhutanica* H. Hara, - *Viola concordifolia* C.J. Wang, Fl. Reipubl. Popularis Sin. 51: 42, pl. 8, f. 1–6. 1991. – *Viola cordifolia* W. Becker, Bull. Misc. Inform. Kew 1929(6): 201–202. 1929. (**Plate 20 C-D).**

Herbs, acualescent 5 – 6 cm tall. ***Rhizome*** short, robust, 3 – 4 mm in diam., root numerous, whitish, elongated**.** ***Leaves*** simple, arises from the rhizome; blade ovate, ca. 4 cm by 2 cm, apex acute, base cordate, margin serrate – crenate, both the surface sparsely pubescent; mid-rib distinct on both the surfaces; lateral veins conspicuous on both the surface, 3 – 4 paired; petiole, slender, 5 – 6 cm long, sparsely pubescent. ***Flower*** white or violet; pedicel, slender, 7 – 10 cm long, sparsely pubescent; bracteoles linear – lanceolate. ***Sepals*** 5, lanceolate, 3 – 1 mm, apex acute, appendages white puberulous, 1 mm, glabrous or pubescent. ***Petals*** 5-lobed, white or purplish with dark purple streaks. Upper and lateral petals ovate, 10 mm by 4 – 5 mm; anterior petal narrowly obovate, ca. 1 cm, cylindric spur 2 – 3 mm; apex emarginate, ***Ovary*** conic, glabrous, 2 mm across; style 2 mm long. ***Capsule*** ellipsoid, 7 – 8 mm, glabrous.

Bhutan – Bumthang, Punakha, Mongar, Trongsa districts

Distribution – China, India, Nepal

Ecology – Found in wet and moist areas. Altitude above 1,900 – 3,500 m asl. Flowering in April – June.

Specimen examined – T Tob 047 (THIM)

MONOCOTS

ARACEAE

Arisaema nepenthoides (Wall.) Mart. ex Schott & Endl., Melet. Bot. 17. 1831; S.B. Rajabhandari et al. in Fl. Kathmandu 11: 709. 1986; H.J. Noltie in Fl. Bhutan 3(1): 145. 1994; L. Hen et al. in Fl. China 23: 56. 2010. - *Arisaema ochraceum* Schott, J. Linn. Soc., Bot.43: 483. 1916. - *Arum nepenthoides* Wall., Tent. Fl. Napal.1: 26–28. 1824. (**Plate 20 E).**

Dioecious plants up to 30 – 40 cm tall, pseudostem, petioles and peduncles with large blackish chequrred blotches. ***Bulb*** depressed globose, 2 – 5 cm in diam***. Cataphylls*** brownish, with pinkish and dark blotches. ***Leaves*** 2, opposite or subopposite, digitately 5 – foliate, sessile; leaflets oblanceolate, 11 cm by 5 cm, apex acuminate, base cuneate, margin entire, dark green; petiole 9 – 10 cm long; sheaths with conspicuous membranous apical auricles; peduncles longer than leaves. ***Spathe*** greenish with longitudinal white stripes and spots; tube cylindric 3 – 8 cm long, 1 – 2 cm in diam., broadly auriculate at the mouth with a round reflexed lobe; blade triangular – ovate shortly acute, incurved, 8 cm by 3 cm. ***Spadix*** unisexual. ***Female*** cylindrical zone 2.5 cm by 1 cm; ovaries dense, green, obovoid; stigma yellowish. ***Male*** ca. 1 cm; anthers 1 – 3, shortly stipitate; thecae globose, dehiscing by apical pores; appendage, cylindric, obtuse, truncate at the base and stipitate. ***Fruit*** not seen.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashigang, Trongsa districts

Distribution – Myanmar, China, India, Nepal

Ecology – Found in shaddy forest floor above 1,800 – 3,400 m asl. Flowering in February – May

Specimen Examined – T. Tob 033 (THIM)

ASPARAGACEAE

Polygonatum punctatum Royle ex Kunth, Enum. Pl. 5: 142. 1850; H.J. Noltie in Fl. Bhutan 3(1): 41. 1994. – *Disporopsis mairei* H. Lév., Repert. Spec. Nov. Regni Veg. 11(286–290): 303. 1912. – *Polygonatum anomalum* Hua, J. Bot. (Morot) 6(22): 420–421. 1892. – *P. marmoratum* H. Lév., Repert. Spec. Nov. Regni Veg. 7(152–156): 384–385. 1909. – *P. mengtzense* F.T. Wang & T. Tang, Bull. Fan Mem. Inst. Biol., Bot. 7(2): 84–85. 1936. (**Plate 20 F).**

Epiphytic plants up to 20 – 30 cm tall. ***Rhizome*** 0.5 – 1 cm in diam., with dense fleshy roots. ***Stem*** arching, spotted with dark blue, membranous. ***Leaves*** alternate, sub-opposite or in irregular whorls of 3, narrowly elliptic, 6 cm by 2.5 cm, apex blunt acute, base narrowly attuneate, margin entire, glabrous, ± shiny; 3 – 4 parallel veined, prominent; petiole 2 – 3 mm long. ***Inflorescence*** axillary, racemose, 2 – 3 flowered per penducles; peduncles 3 – 4 mm long; pedicels 4 – 5 mm long, glabrous; flowers purplish, urceolate. ***Perianth*** greenish spotted with lilac, ± urceolate, 5-6 mm long; 5-lobed, lobes ovate, apex blunt acute, 1-2 mm by 1 mm. ***Stamens*** 6, filaments ca. 1 – 2 mm long, filiform, smooth to scabrous; anthers bi-lobed, dorsifixed. ***Ovary*** superior, ellipsoid to ovoid, 3 cm by 2 cm; style 1.5 – 2 mm long; stigma slightly dilated. ***Berries*** ca. 5 mm in diam., red. ***Seeds*** 8-10.

Bhutan – Mongar, Tashigang, Tashiyangtse, Trongsa districts

Distribution – Myanmar, China, India, Nepal, Thailand, Vietnam

Ecology – Found as an epiphyte on mossy trees at an altitude above 2,000 – 2,440 m asl. Flowering in April – May

Specimen Examined – T Tob 060 (THIM)

ORCHIDACEAE

Arundina graminifolia (D.Don) Hochr., Bull. New York Bot. Gard. 6: 270. 1910; N. Pearce and P. J. Cribb, Fl. Bhutan 3(3): 319. 2002; C. Xinqi and D. Clayton in Fl. China 25: 315. 2009; H. Æ. Pedersen et al. in T. Santisuk & H. Balslev (eds), Fl. Thai 12(2): 327. 2014. – *Arundina bambusifolia* Lindl., Gen. Sp. Orchid. Pl.125. 1831. – *A. chinensis* Blume, Bijdr. Fl. Ned. Ind.8: 402. 1825. – *A. chinensis* var. *major* S.Y. Hu, Quart. J. Taiwan Mus.25: 54. 1972. – *A. graminifolia* var. *chinensis* (Blume) S.S. Ying, Col. Illustr. Indig. Orch. Taiwan1: 51. 1977. – *A. stenopetala* Gagnep. Bull. Soc. Bot. France79: 32–33. 1932. *Bletia graminifolia* D. Don, Prodr. Fl. Nepal.29. 1825. (**Plate 21 A).**

Terrestrial, up to 3 m tall. ***Stem*** erect, leafy throughout, unbranched or occasionally branched on older stem. ***Leaves*** linear – lanceolate, 20 – 25 cm by 1.5 – 2 cm, apex acuminate, base clasping, sessile. ***Inflorescence*** racemose or paniculate, few to many-flowered; peduncle intermittently sheathed glabrous; rachis 15 – 20 cm long, glabrous; floral bracts lanceolate, 1 cm by 0.5 cm, apex acute; flowers magenta-pinkish white; pedicel and ovary 3 cm long. ***Dorsal sepal*** lanceolate, 33 mm by 77 mm, apex acute, margin entire, glabrous. ***Lateral sepals*** similar dorsal sepal; petals spreading, broadly elliptic, 3.5 cm by 1.5 cm. ***Labellum*** 3 – lobed, 5 cm by 3 cm; lateral lobe semi – ovate enfolding column; mid – lobe recurved, margins crenulate; disc with 3 – 5 parallel keels. ***Column*** slender, erect, angular, 2 cm long. ***Fruit*** long-ellipsoid, ca. 7 cm by 1.5 cm.

Bhutan – Chukha, Mongar, Punakha, Samdrup Jongkhar, Tashiyangtse, Trongsa districts.

Distribution – India, China, Nepal, Myanmar

Ecology – Found at dry roadsides bank, open spaces. Altitude of 2,100 m asl. Flowering in the month of June – November.

Specimen Examined – T Tob 111 (THIM)

Calanthe mannii Hook.f., Fl. Brit. India 5: 850. 1890; N. Pearce and P. J. Cribb, Fl. Bhutan 3(3): 330. 2002; C. Xinqi and D. Clayton in Fl. China 25: 294,303. 2009. – *Alismorkis mannii* (Hook. f.) Kuntze, Revis. Gen. Pl. 2: 650. 1891. – *Calanthe brachychila* Gagnep., Bull. Soc. Bot. France 79: 162. 1932. – *C. pusilla* Finet, Bull. Soc. Bot. France, 46: 436, pl. 10, f. B. 1899. (**Plate 21 B).**

Terrestrial or sympodial orchid up to 30 – 40 cm tall. ***Roots*** fasiculate, thick and fibrous. ***Pseudobulbs*** short, 1 – 2 cm, cylindric. ***Leaves*** 4 to 5, lamina narrowly elliptic – oblong, 20 – 25 cm by 2 – 3 cm, apex acute or sub-acute, base attenuate in to a petiole-like stalk, margin entire, both the surface glabrescent; sheathing at the base, sheaths 2, petiole 7 – 9 cm long. ***Inflorescence*** terminal, 10 – 20 flowered; peduncle 20 – 30 cm long, pubescent, sheathless; rachis 10 – 15 cm long, pubescent; floral bracts lanceolate, 2 mm by 0.5 mm, very small, glabrous, apex acute, margin entire; flowers small, 0.5 – 1 cm across, pale green to dark brown with a golden yellow lip; pedicels 5 – 10 mm long, pubescent. ***Sepals*** ovate – oblong, 7 mm by 3 mm, apex acute, externally pubescent, margin entire, 3 – 5 veined. ***Petals*** obovate – lanceolate, 6 mm by 2 mm, apex acute, margin entire, glabrous. ***Labellum*** adnate to entire length of column wings, 3-lobed, shortly spured; lateral lobes broadly ovate, 2 mm by 1.5 mm, apex truncate, margin entire; mid-lobe deflexed, sub-reniform, apex emarginate, margin entire; disk with 3 lamellae extending from the base of lip to apex of mid-lobe, expanding to semi-lunate swellings, tuberculate; spur pubescent, conical, 1 – 2 mm long. ***Column*** white, short, stout, 1 – 2 mm long. ***Fruit*** fusiform, pendent.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Tashiyangtse, Trongsa districts
Distribution – China, India, Myanmar, Nepal, Vietnam
Ecology – Found in dense forest at an altitude above 600 – 2,100 m asl. Flowering in the month of May – June
Specimen Examined – T Tob 078 (THIM)

C. plantaginea Lindl., Gen. Sp. Orchid. Pl.: 250.1833; N. Pearce & P. J. Cribb, Fl. Bhutan 3(3): 289. 2002; C. Xinqi el al. in Fl. China 25: 294. 2009. (**Plate 21 C).**

Terrestrial. ***Stem*** erect, 30 – 50 cm tall. ***Pseudobulbs*** conical, 2 by 1 cm. ***Leaves*** 3, elliptic – ovate, 30 – 40 cm by 1.5 – 2 cm, apex acute, prominently rigid, petiolate, margin entire; petiole grooved, 10 – 15 cm long. ***Inflorescence*** lateral from pseudobulb, many – flowered; peduncle ridged, pubescent, sheathed, 14 – 18 cm long; sheaths triangular, apex acute, membranous, ca. 6 mm by 2 mm; rachis 9 – 10 cm long, pubescent; floral bracts lanceolate, apex acute, 5 mm by 1 mm. ***Flowers*** pendent; sepals purple or white, lip purple; pedicel (with ovary) 2 – 33 cm long**.** ***Dorsalsepal*** lanceolate – ovate, 1 cm by 0.5 cm, apex acute, 5 – veind; ***lateral sepals*** spreading. ***Petals*** lanceolate, ca. 15 mm by 5 mm, apex acute, 5 – veined. ***Labellum*** 3 – lobed, adenate to column, 9 mm by 11 cm; lateral lobes obovate – fulcate, truncate; mid-lobe spathulate, margin entire; callus 3-ridged, extending to the base; spur long, cylindric 2 – 3 cm long. ***Fruit*** ovoid, ca. 3cm by 1.5 cm; stalk ca. 1.5 cm long.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Samdrupjongkhar, Thimphu, Trongsa districts.
Distribution – China, India, Nepal
Ecology – Found in evergreen forest slopes, damp ground in the shaddy broad-leaved forest at an altitude above 1,400 – 2,600 m asl. Flowering February – April.
Specimen Examined – T Tob 012 (THIM)

Coelogyne corymbosa Lindl., Fol. Orchid. 5: 7.1854; N. Pearce and P. J. Cribb, Fl. Bhutan 3(3): 330. 2002; C. Xinqi and D. Clayton in Fl. China 25: 317. 2009. – *Pleione corymbosa* (Lindl.) Kuntze, Revis. Gen. Pl.2: 680. 1891. (**Plate 21 D-E).**

Epiphytic orchid, 10 – 20 cm tall. ***Rhizome*** stout. ***Pseudobulbs*** clustered, ovoid or oblong, dark brown sheathed at the base, 3 – 4 cm by 1.5 cm. ***Leaves*** 2 in each

pseudobulb, elliptic to lanceolate, 22 cm by 2 cm, apex acute, base narrowly attenuate, margin entire, 5-veined; petiole grooved, 4 – 5 mm long. ***Inflorescence*** synanthous, erect to pendent, 3 – 4 flowered; peduncle long, 10 – 15 cm, sheathed; rachis slender, 3 cm long, glabrous; floral bracts oblong – lanceolate, 20 mm by 4 mm, apex acute. ***Flowers*** white, with 4-yellow eyelike blotches surrounded by reddish orange on lips; pedicel (with ovary) 2 – 3 cm long, glabrous. ***Dorsal sepal*** oblong – lanceolate, 3.5 cm by 1 cm, apex acute, margin entire, 1 – veined, glabrous; ***lateral sepals*** white, lanceolate, 3.5 cm by 0.5 cm, apex acute, margin entire, 1-veined. ***Petals*** narrowly lanceolate, 3 cm by 0.4 cm; apex acute. ***Lip*** 3 – lobed, 2 cm by 1 cm; lateral lobes rounded; mid-lobe ovate, apex acute – acuminate; disc 3 – keeled from the base of lip to base of mid – lobe. ***Column*** ca. 2 cm long, curved, broadly winged, apex 3-lobed. ***Fruit*** not seen.

Bhutan – Bumthang, Chukha, Mongar, Punakha, Thimphu, Trongsa districts
Distribution – China, India, Nepal
Ecology – Found in dense evergreen oak forest, rocky roadsides in the warm broad leaved forest an altitude above 1,300 – 3,800 m asl. Flowering in the month of February – June
Specimen Examined – T Tob 051 (THIM)

Dendrobium candidum Wall. ex Lindl., Edwards's Bot. Reg. 24(Misc.): 36. 1838; N. Pearce and P. J. Cribb, Fl. Bhutan 3(3): 407. 2002. (**Plate 21 F).**

Epiphytic or lithophytic orchid, up to 20 – 30 cm tall. ***Stem*** slender, erect, cylindric, covered by old leaf sheaths, yellow internodes. ***Leaves*** alternate, linear – lanceolate, 8 cm by 0.5 cm, apex obtuse, margin entire, prominently 5 – veined, sessile, glabrous. ***Inflorescence*** terminal or lateral, 1 to 3 – flowered; peduncle slender, sheathed, 7 – 8 mm long; sheath lanceolate, 9 mm by 1 – 2 mm, apex acute, 1 – veined; rachis 9 mm long; floral bracts spathulate, 4 mm by 1 – 2 mm, apex acute, membranous, 1 –

veined. ***Flowers*** 1 – 2.5 cm across; pedicel and ovary slender, 1 – 2 cm long; petals and sepals white; lip with a yellow spot at base. ***Dorsal*** sepal lanceolate, ca. 1.5 cm by 0.3 cm, apex acute, margin entire, 3 – veined, glabrous; ***lateral sepals*** lanceolate ca. 2 cm by 0.5 cm, apex acute, 5 – veined; mentumbroad, rounded. ***Petals*** lanceolate, 1.3 cm by 0.5 cm, apex acute, 3 – veined. ***Labellum*** 3-lobed, oblong – lanceolate, 1.5 cm by 0.5 cm; lateral lobes short, rounded, incurved; disc with an elongate callus extending for 2 – 3 mm form base, expanded at apex; column 4 – 5 mm long, food broad, deeply excavated. ***Fruit*** ovoid, ca. 1.5 cm by 1 cm.

Bhutan – Chukha, Mongar, Punakha, Tashigang, Tashiyangtse, Trongsa districts
Distribution – India, Nepal, Myanmar
Ecology – Found among the moss. altitude above 1,000 m asl. Flowering in the month of February – June
Specimen Examined – T Tob 083 (THIM)

ZINGIBERACEAE

Cautleya gracilis (Sm.) Dandy, J. Bot. 70(12): 328. 1932; R.M. Smith in Fl. Bhutan 3(1): 193.1994; W. Delin and K. Larsen in Fl. China 24: 366. 2000. – *Cautleya lutea* (Royle) Hook. f., Bot. Mag. 114: pl. 6991. 1888. – *Roscoea gracilis* Sm., Trans. Linn. Soc. London 13(2): 460. 1822. – *R. lutea* Royle, Ill. Bot. Himal. Mts. 361, pl. 89, f. 2. 1839. (**Plate 22 A-B).**

Leafy shoots, up to 40 - 50 cm tall, slender, base with a bladeless leaves. ***Leaves*** 4 – 6; leaf blade oblong – lanceolate 20 cm by 4 – 5 cm; apex acuminate, base attenuate, margin entire; adaxially green, abaxially ± brownish, sessile; ligule 2 mm, glabrous. ***Inflorescence*** spikes laxly, 2 – 7 flowered; rachis brown; bracts red, acute, 1 – 2 cm. ***Calyx*** red, unilaterally split, 1 – 1.5 cm; corolla tube slightly exserted from calyx; 1 – 2 cm long; lobes yellow; oblong, 2 – 2.5 cm; lateral staminoides erect, petaloid.

Labellum obovate, ± equal to corolla lobes; filaments curved, 2 cm. ***Ovary*** glabrous. ***Capsule*** red, globose, 6 – 7 mm in diam.

Bhutan – Chukha, Gasa, Punakha, Mongar, Thimphu, Trongsa districts

Distribution – China, India, Nepal, Thailand, Vietnam

Ecology – Epiphytes on a trees. Altitude of 1,500 – 3,000 m asl. Flowering in May – August.

Specimen examined – T Tob 103 (THIM)

PART II: VEGETATION STUDY

The vegetation of Korila lower montane forest

Nine study plots at Korila lower montane forest were classified in to community types using cluster analysis. (Fig. 4). Form the hierarchical cluster analysis at 40% similarity level two main types were recognized (Line A, Fig.4) and at 55% similarity level four types of plant communities were recognized. (Line B, fig.4). Naming the community types were based on physiognomy of dominant species.

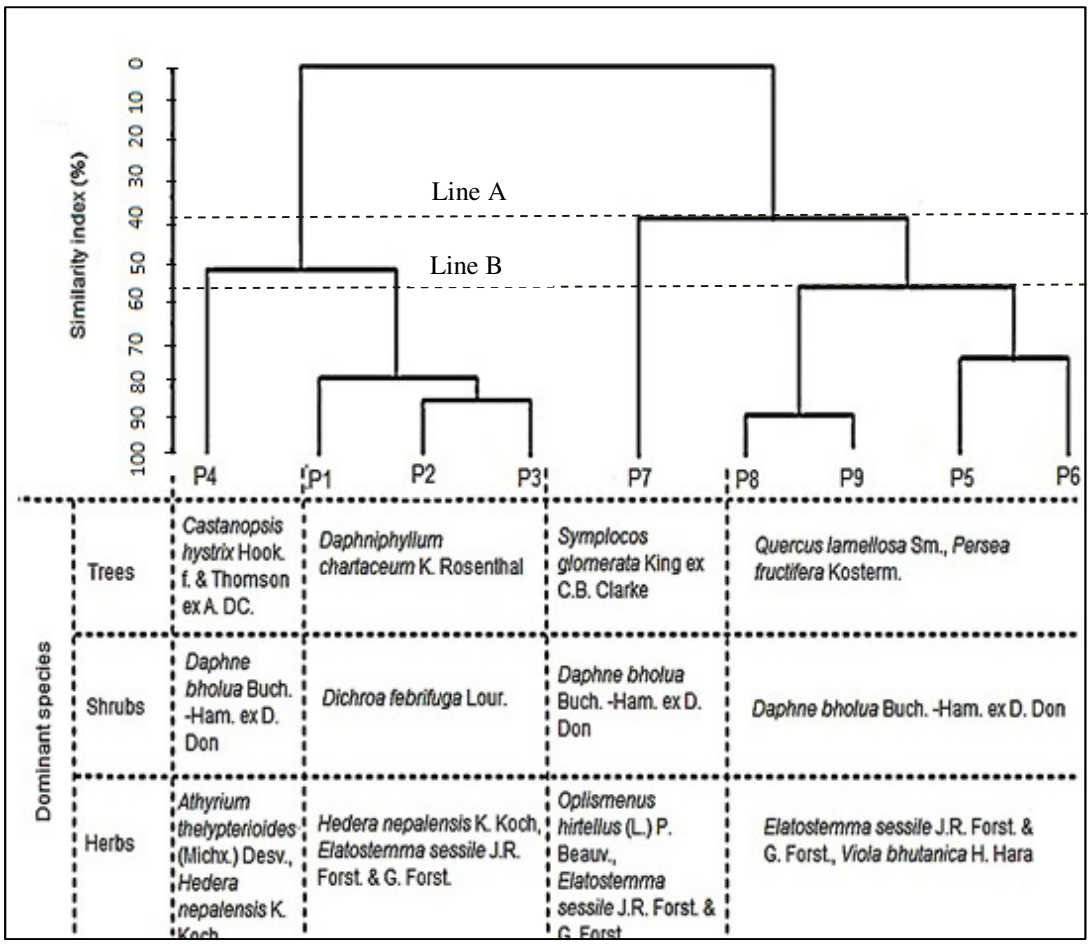

Figure. 4. Dendrogram showing the plant communities and dominant species

The plant communities are recognized as follows:

1. ***Daphniphyllum*** **heath** (Plots 1-3; Table 5, 6,7 ; Fig. 4 and Plate 24)

The community has been dominated by a shrubby/small tree species: *Daphniphyllum chartaceum* K. Rosenthal, which has rather unique low/cylindrical to cone-shaped canopies. In the study area, such vegetation occurred from place to place in the patches of the lower montane broadleaved vegetation, mostly in the place where disturbances might have taken place in the past, however, the soil in this vegetation type contained rather thick litter than other parts with some bryophytes covered on the ground and with lots of shrubs species, moreover, the canopies of the trees in this community are dense and rather close to the ground (the heath forest?). The majority of the trees in this forest have dbh less than 10 cm and low basal area value.

At Korila, *Daphniphyllum chartaceum* – heath is dominated in the area at an altitude of ca. 1,900 – 2,000 m asl.This community type comprised two strata. The upper one is composed of trees 10-25 (-30) m tall i.e. *Daphniphyllum chartaceum* K. Rosenthal; *Acer campbellii* Hook. f. & Thomson (Aceraceae); *Castanopsis tribuloides* (Sm.) A. DC.; *Schima wallichii* (DC.) Korth. (Theaceae); *Exbucklandia populnea* (R. Br. ex Griff.) R.W. Brown (Hamamelidaceae); *Macaranga denticulata* (Blume) Müll. Arg. (Euphorbiaceae) and *Rhus chinensis* Mill. (Anacardiaceae). The lower stratum is varying from 5-10 m high with trees and shrubs. The *Daphniphyllum chartaceum* K. Rosenthal; *Symplocos glomerata* King ex C.B. Clarke.The dominant shrub species that has characterized the community is *Dichroa febrifuga* Lour. then followed by: *Ardisia macrocarpa* Wall. (Primulaceae); *Daphne bholua* Buch.–Ham. ex D. Don.; *Rubus ellipticus* sm.; *Viburnum erubescens* Wall. Whilst in the areas with relatively open canopy, ground covers have been dominated by some selected herbs e.g. *Hedera nepalensis* K. Koch; *Hydrocotyle himalaica* P.K. Mukh; *Impatiens stenantha* Hook. f. (Balsaminaceae); *Oplismenus hirtellus* (L.) P. Beauv.; *Persicaria nepalensis* (Meisn.) H. Gross (Polygonaceae); *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita (Rosaceae);

Table 5. The number of all tree species in every dbh (cm) class and basal area of Plot 1

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Castenopsis tribuloides* (Sm.) A. DC.		1					1					2	22.62	0.5
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal	15	12	7	3	3							40	57.91	1.28
Anacardiaceae	*Rhus chinensis* Mill.		1										1	0.45	0.01
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	9			1								10	16.7	0.37
Symplocaceae	*Symplocos* sp.		1										1	2.26	0.05
	Total	24	15	7	4	3	0	1	0	0	0	0	54	100	2.21

Table 6. The number of all tree species in every dbh (cm) class and basal area of Plot 2

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Aceraceae	*Acer campbellii* Hook. f. & Thomson			1									1	3.9	0.1
Anacardiaceae	*Rhus chinensis* Mill.		1										1	3.9	0.1
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal	15	5	5	4	2							31	56.7	1.4
Euphorbiaceae	*Macaranga denticulata* (Blume) Müll. Arg.				1								1	3.9	0.1
Fagaceae	*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.						1						1	10.2	0.3
	C. tribuloides (Sm.) A. DC.		1					1					2	10.2	0.3
Hamamelidaceae	*Exbucklandia populnea* (R. Br. ex Griff.) R.W. Brown		1	1									2	2.0	0.1
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	5	1		1								7	5.1	0.13
Theaceae	*Schima wallichii* (DC.) Korth.				1								1	3.9	0.1
	Total	20	9	7	7	2	1	1	0	0	0	0	47	100	2.5

Table 7. The number of all tree species in every dbh (cm) class and basal area of Plot 3

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Castenopsis tribuloides* (Sm.) A. DC.						1						1	10.9	0.26
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal	2	5	7	5	2	1	1					23	72.4	1.73
Anacardiaceae	*Rhus chinensis* Mill.		1										1	0.42	0.01
Euphorbiaceae	*Macaranga denticulata* (Blume) Müll. Arg.			1			1						2	10.9	0.26
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke		1	3									4	5.4	0.13
	Total	2	6	11	5	3	3	1					31	100	2.39

Elatostemma sessile J.R. Forst. & G. Forst.; *Girardinia diversifolia* (Link) Friis (Urticaceae); and *Viola yunnanfuensis* W. Becker.

2. ***Castanopsis – Elaeocarpus – Quercus* woodland** (Plot 4; Table 8; Fig.5 and Plate 25)

The dominant species in this community is *Castanopsis hystrix* Hook. f. & Thomson ex A. DC. followed by *Elaeocarpus lanceifolius* Roxb. and *Quercus lamellosa* Sm. This is the most diverse plant community in the study areas of Korila forest. And this might due to the fact that such community had situated in the "ecotone" where the elements of the nearby different plant community types met each other. When considering the cluster analysis it is the plant community of the plot 4 only. And such sampling plot had situated in more/less between two different plant community types i.e. *Daphniphyllum chartaceum* heath and *Quercus – Persea* woodland.

The vegetation is composed of two strata the upper stratum contained the tree species of ca. 15-30 m high i.e. *Castanopsis hystrix* Hook. f. & Thomson ex A. DC.; *Elaeocarpus lanceifolius* Roxb. and *Quercus lamellosa* Sm. as the dominant components. And the associated components comprised: *Magnolia champaca* (L.) Baill. ex Pierre (Magnoliaceae); *Toona ciliata* M. Roem.; *Persea chartacea* Kosterm. (Lauraceae) and *Prunus nepalensis* Ser. (Rosaceae). And the lower stratum is composed of tree/shrubby tree/shrub species of 5-15 m high i.e. *Daphniphyllum chartaceum* K. Rosenthal; *Exbucklandia populnea* (R. Br. ex Griff.) R.W. Br.; *Macaranga denticulata* (Blume) Mull. Arg.; *Rhus chinensis* Mil.; *Symplocos glomerata* King ex C.B. Clarke. It is to be noticed also that there are 60% of the tree species with dbh more than 50 cm and the vegetation itself performed higher basal area value than any other types of vegetation classified in the present study.

The ground flora has been dominated by the fern *Athyrium thelypterioides* (Michx.) Desv. and other herbaceous plants e.g. *Hedera nepalensis* K. Koch; *Hydrocotyle himalaica* P.K. Mukh.; *Viola yunnanfuensis* W. Becker.; *Elatostemma lineolatum* Wight (Urticaceae); *E. sessile* J.R. Forst. & G. Forst.; *Girardinia diversifolia* (Link) Friis

Table 8. The number of all tree species in every dbh (cm) class and basal area of Plot 4

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	100	>100	Total	% Cover	BA (m^2)
Anacardiaceae	*Rhus chinensis* Mill.				1								1	1.1	0.07
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal		3		1								4	1.5	0.1
Elaeocarpaceae	*Elaeocarpus lanceifolius* Roxb.								1		1		2	18.7	1.21
Euphorbiaceae	*Macaranga denticulata* (Blume) Müll. Arg.		1										1	1.2	0.08
Fagaceae	*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.							1	1		2		4	34.8	2.25
	Quercus lamellosa Sm.											1	1	14.2	0.92
Hamamelidaceae	*Exbucklandia populnea* (R. Br. ex Griff.) R.W. Br.		1	1									2	0.8	0.05
Lauraceae	*Persea chartacea* Kosterm.							1					1	4.9	0.32
Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre								1				1	7.7	0.5
Meliaceae	*Toona ciliata* M. Roem.											1	1	12.4	0.8
Rosaceae	*Prunus nepalensis* Ser.			1									1	0.6	0.04
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	15	5										20	2.0	0.13
	Total	15	10	2	2	0	0	2	3	0	3	2	39	100	6.47

(Urticaceae); *Arisaema griffithii* Schott; *A. nepenthoides* (Wall.) Mart. ex Schott & Endl.; *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita; *Oxalis griffithii* Edgew. & Hook. f. (Oxalidaceae). There are only three under-canopy shrub species found and with rather low percent of coverage i.e. *Daphne bholua* Buch. -Ham. ex D. Don. (6.6% coverage); *Ardisia macrocarpa* Wall. (5% coverage) and *Rubus ellipticus* Sm. (1.3% coverage).

3. ***Quercus – Persea*** **woodland** (Plots 5, 6, 8, 9; Table 9, 10, 11, 12; Fig.6 and Plate 26 A)

This plant community type performs the characteristic plant community of the lower montane broad-leaf vegetation along the mountain slope of Korila as it occurred consistently along the slope of the Korila areas from ca. 2,200 m onwards to the peak of Korila mountain at around 2,500 m asl. The plant community has been dominated by *Quercus lamellosa* Sm. with large canopy that well raised above the lower storey.

The vegetation is composed of two strata in general the upper stratum of ca. 10-30 m high contained the tree species of *Quercus lamellosa* Sm.; *Persea fructifera* Kosterm.; *Quercus* cf. *lanata* Smith. (Fagaceae); *Persea chartacea* Kosterm. (Lauraceae), and *Magnolia champaca* (L.) Baill. ex Pierre. The lower one of 5-10 m high contained mostly *Symplocos glomerata* King ex C.B. and *Eurya acuminate* DC. (Theaceae); *Rhus chinensis* Mill., and *Macaranga denticulata* (Blume) Müll. Arg. And just only *Daphne bholua* Buch. -Ham. ex D. Don. is a shrub species occurring in this plant community. The ground flora is not much different from other communities occurred in the study areas, that mainly occupied by *Hedera nepalensis* K. Koch, *Hydrocotyle himalaica* P.K. Mukh.; *Impatiens stenantha* Hook. f.; *Oplismenus hirtellus* (L.) P. Beauv.; *Oxalis griffithii* Edgew. & Hook. f.; *Persicaria nepalensis* (Meisn.) H. Gross; *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita; *Elatostemma sessile* J.R. Forst. & G. Forst.; *Girardinia diversifolia* (Link) Friis; *Pilea scripta* (Buch.-Ham. ex D. Don) Wedd. (Urticaceae); *Viola yunnanfuensis* W. Becker. and the fern *Athyrium thelypterioides* (Michx.) Desv.

Table 9. The number of all tree species in every dbh (cm) class and basal area of study Plot 5

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Quercus lamellosa* Sm.				1				1			1	3	23	1.41
Elaeocarpaceae	*Elaeocarpus lanceifolius* Roxb.							1					1	4.9	0.29
Lauraceae	*Persea chartacea* Kosterm.											1	1	15.1	0.89
Euphorbiaceae	*Macaranga denticulata* (Blume) Müll. Arg.		1										1	0.33	0.02
Fagaceae	*Castenopsis tribuloides* (Sm.) A. DC.							1					1	5.3	0.31
Anacardiaceae	*Rhus chinensis* Mill.					1						1	2	2.7	0.16
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	22	6	1		2							31	47	2.83
	Total	22	7	1	1	3	0	2	1	0	0	3	40	100	5.91

Table 10. The number of all tree species in every dbh (cm) class and basal area of Plot 6

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Quercus lamellosa* Sm.				1				1			2	4	67.5	2.49
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal	1	1										2	0.81	0.03
Lauraceae	*Persea chartacea* Kosterm.						1						1	9.21	0.34
Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre						1						1	5.9	0.22
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	39	16	3		1							59	16.5	0.61
	Total	40	17	3		1	2		1			2	67	100	3.69

Table 11. The number of all tree species in every dbh (cm) class and basal area of Plot 8

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Quercus lamellosa* Sm.							1			1		2	30	1.09
Lauraceae	*Persea chartacea* Kosterm.							1	1				2	22	0.82
Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre					1		1					2	13.7	0.5
Fagaceae	*Quercus* sp.										1		1	19	0.72
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	40	12	9	1	1							63	13.7	0.5
	Total	40	12	9	1	2	0	3	1	0	2	0	70	100	3.63

Table. 12. The number of all tree species in every dbh (cm) class and basal area of Plot 9

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Fagaceae	*Quercus lamellosa* Sm.											2	2	62.3	3.9
	Quercus c.f. *lanata* Smith				2								2	5.0	0.31
Lauraceae	*Persea fructifera* Kosterm.							2		1			3	20.1	1.26
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	53	33	1									87	11.0	0.69
Theaceae	*Euryaacuminata* Wall.	2											2	1.6	0.1
Total		55	33	1	2	0	0	2	0	1	0	2	96	100	6.26

Though *Quercus – Persea* woodland might be the characteristic plant community of the broad-leaf lower montane forest of the Himalayan range in this region, it has been under such great impact of human exploitation and disturbance e.g. logging for construction purposes; collection of bark of *Daphne bholua* Buch. -Ham. ex D. Don. for making traditional paper of Bhutan ('De-shoo'). The high percent coverage of *Symplocos glomerata* King ex C.B. had indicated the disturbances and the recovery situation of the vegetation with this mentioned species as a pioneer.

4. *Symplocos glomerata* community (Plot 7; Table 13 and Plate 26 B)

Plant community of the plot 7 had performed different structure and composition from other nearby *Quercus – Persea* community as it has been dominated by only *Symplocos glomerata* King ex C.B. Clarke. Not only that the community is rather uniform in one layer, but also most of the ground floor has been dominated by its seedling and the common shrub *Daphne bholua* Buch. -Ham. ex D. Don. This suggested that *Symplocos glomerata* King ex C.B. Clarke had performed as a pioneer species in this vegetation and also indicated the secondary recovery of the disturbed vegetation. The ground floor in this "pioneer" *Symplocos glomerata* community was mostly exposed to the sunlight due to a less developed canopy structure, and this had supported the well developed of the ground vegetation. The ground floor had been composed of many herbs species, e.g. *Oplismenus hirtellus* (L.) P. Beauv.; *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita; *Elatostemma sessile* J.R. Forst. & G. Forst.; *Athyrium thelypterioides* (Michx.) Desv.; *Rubia manjith* Roxb. ex Fleming (Rubiaceae); *Hydrocotyle himalaica* P.K. Mukh.; *Hedera nepalensis* K. Koch.

Table 13. The number of all tree species in every dbh (cm) class and basal area of Plot 7

Family	Scientific name	DBH Class (cm)													
		<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	>100	Total	(% cover)	BA (m^2)
Symplocaceae	*Symplocos glomerata* King ex C.B. Clarke	22	4	12	5	2							45	95.7	1.4
Daphniphyllaceae	*Daphniphyllum chartaceum* K. Rosenthal					2							2	4.3	0.31
Total		22	4	12	5	4	0	0	0	0	0	0	47	100	1.7

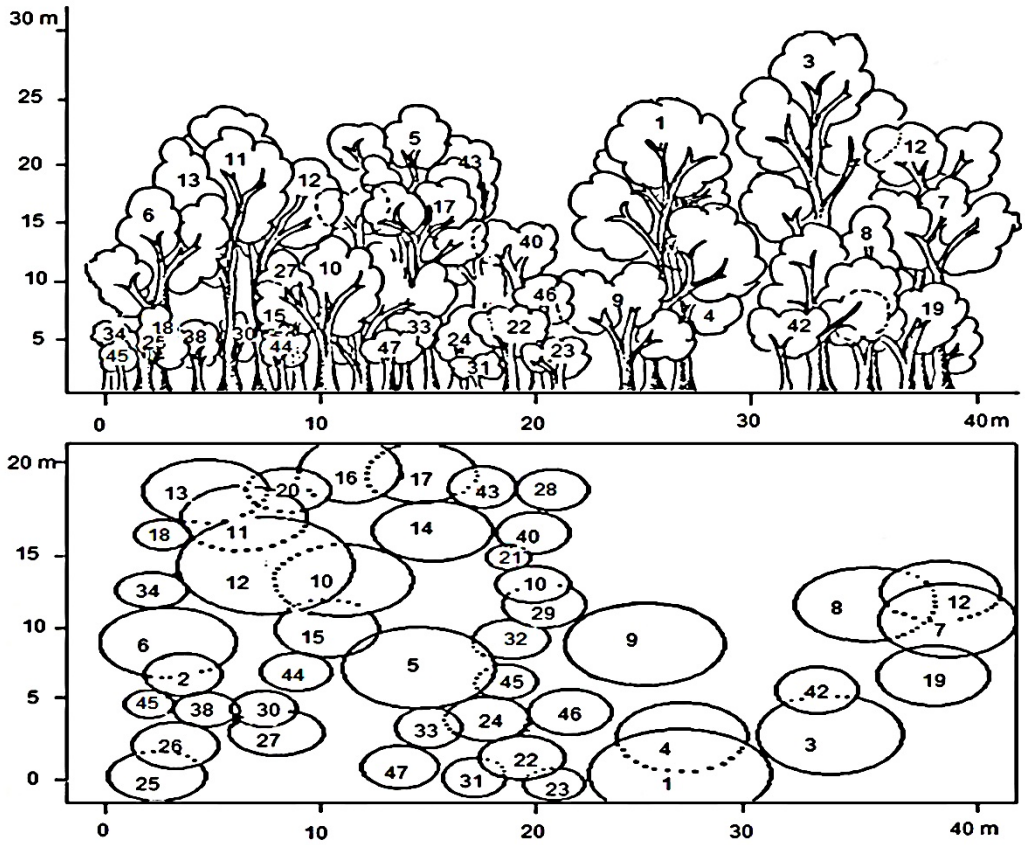

Figure. 5. Profile diagram of *Daphniphyllum* heath (Plot 2):

8 – *Acer campbelllii* Hook.f. & Thomson; 5 –*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.; 1, 3 –*C. tribuloides* (Sm.) A. DC.; 46, 40, –*Exbucklandia populnea* (R. Br. ex Griff.) R.W. Brown; 4, 7, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 29, 32, 33, 34, 35, 36, 37, 38, 39, 41, 43, 44, 45, 47 – *Daphniphyllum chartaceum* K. Rosenthal; 10 – *Macaranga denticulata* (Blume) Müll. Arg.; 42 – *Rhus chinensis* Mill.; 2, 9, 14, 25, 28, 30, 31 – *Symplocos glomerata* King ex C.B. Clarke; 6 – *Schima wallichii* (DC.) Korth.

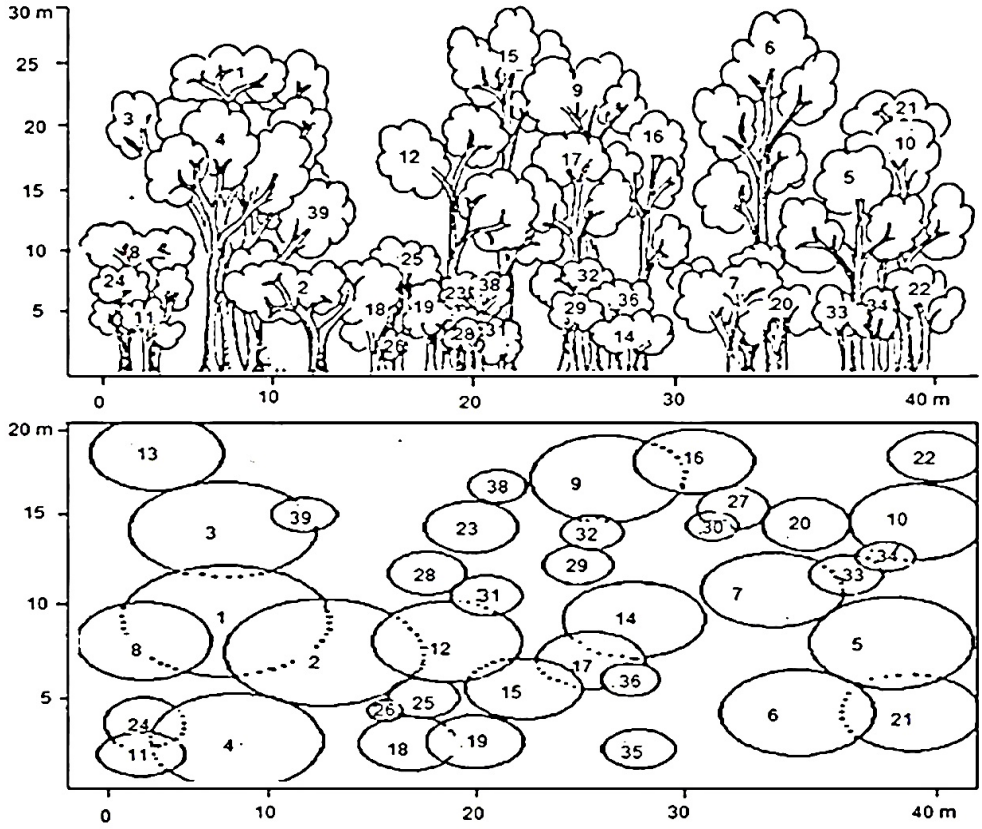

Figure 6. Profile diagram of *Castanopsis – Eleocarpus – Quercus* woodland (Plot 4):

3, 4, 9, 10 –*Castanopsis hystrix* Hook. f. & Thomson ex A. DC.; 7, 18, 27, 31, – *Daphniphyllum chartaceum* K. Rosenthal; 5, 6 –*Elaeocarpus lanceifolius* Roxb.;8, *25 – Exbucklandia populnea* (R. Br. ex Griff.) R.W. Brown; 32 – *Macaranga denticulata* (Blume) Müll. Arg.; 1 – *Magnolia champaca* (L.) Baill. ex Pierre;17 – *Persea chartacea* Kosterm.; 39 –*Prunus nepalensis* Ser.;16 – *Quercus lamellosa* Sm.; 11 – *Rhus chinensis* Mill.; 2, 12, 13, 14, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30, 33, 34, 35, 36, 37, 38 – *Symplocos glomerata* King ex C.B. Clarke; 15 –*Toona ciliata* M. Roem.

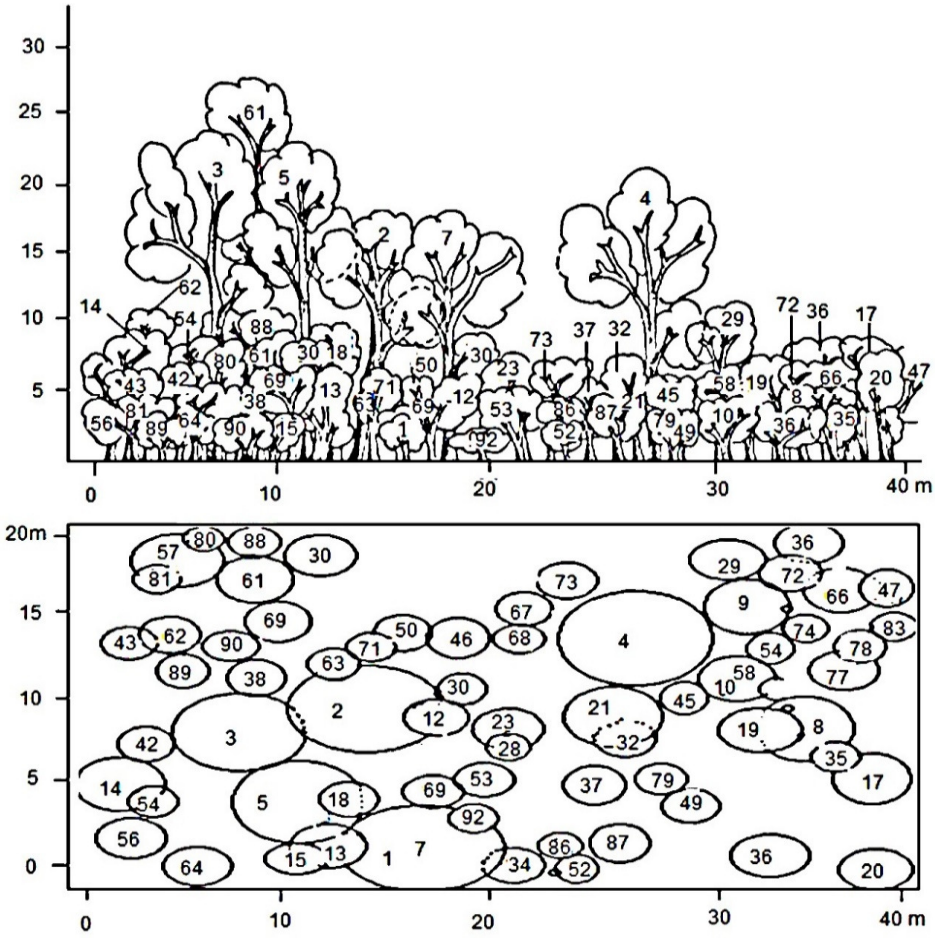

Figure 7. Profile diagram of *Quercus – Persea* woodland (Plot 9):

18, 12 –*Euryaacuminata* DC.; 5, 7, 29 – *Persea fructifera* Kosterm.; 3, 4 – *Quercus lamellosa* Sm.; 2, 61 – *Quercus* c.f. *lanata* Smith 1, 6, 7, 9, 10, 11, 13,14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96 –*Symplocos glomerata* King ex C.B. Clarke

CHAPTER IV
DISCUSSION AND CONCLUSION

Flora and plant diversity of the Korila forest

It is expected that more vascular plants can be recorded from this area although there is no floral study conducted so far in this area. Majority of the plants species are herbs (43.5% of total flora in the study area) followed by trees (23 % of total flora), shrubs (21% of total flora in the study area), small trees (4.8%), ferns (4.8%) and climber (2.4%). Out of 6 fern species *Athyrium thelypteroides* (Michx.) Desv. (Woodsiaceae); *Leucostegia* sp. (Hypodematiaceae) and *Neocheiropteris normalis* (D. Don) Tagawa (Polypodiaceae) were most common species in the shady areas (under canopies) encountered whole over the forest of Korila. These three species were common in the open as well as under canopy with other herbs as the ground cover species.

And when the diversity of plants in each sampling plots were taken into account (Table. 15), the herbs and shrubs reached their peak of diversity in plots 3-7. The most abundant herbaceous species, as mentioned is the fern *Athyrium thelypterioides* (Michx.) Desv. in which the species occurred almost everywhere in the Korila forest, followed by *Hedera nepalensis* K. Koch (Araliaceae); *Hydrocotyle himalaica* P.K. Mukh. (Apiaceae) and *Viola yunnanfuensis* W. Becker (Violaceae) respectively (Table 15). The herbaceous ground-cover species i.e. *Elatostemma sessile* J.R. Forst. & G. Forst. (Urticaceae); *Stellaria media* (L.) Vill. (Caryophyllaceae) and *Swertia bimaculata* (Siebold & Zucc.) Hook. f. & Thomson ex C.B. Clarke (Gentianaceae) occurred only in the plots 4-9 which have been less/no disturbed than the ones in lower altitude (Plots 1-3, ca. 1,900-2,000 m asl.) with more anthropogenic influences. It might due to the fact that the plots 1-3 were situated close to the village and may be disturbed frequently by cattle and some other anthropogenic activities e.g. logging etc. However, the result contradict with the findings of Rawal & Pantey (1994), in which human interference facilitates an introduction and establishment of non-native species increasing the species richness. According to Sean et al., (1999), disturbance increased the availability of resources and leads to increase of species richness and diversity. More shrub species, which have never found in other plots were recorded in plots 1-3 as well i.e. *Dichroa febrifuga* Lour.

(Hydrangeaceae); *Rubus ellipticus* Sm. (Rosaceae) and *Viburnum erubescens* Wall. (Adoxaceae). The dominant tree components in plots 1-3 are *Daphniphyllum chartaceum* K. Rosenthal (Daphniphyllaceae) followed by *Castanopsis hystrix* Hook. f. & Thomson ex A. DC. and *C. tribiloides* (Sm.) A. DC. (Fagaceae).

Regarding plots 4-6 (ca. 2,000 – 2,300 m asl.), rather less/non-disturbed ones, contained less percentage coverage of shrub species than other plots, however, on the other hand, they contained more percentage coverage of the shade-dwelling herbaceous species than any other plots as well. This might lead to the fact that the forest in this zone might experience less anthropogenic disturbances than any other plots, such as cattle grazing, etc. it also indicates that cattle do not graze indiscriminately in the forest and certain parts are left untouched. This could be seen from the more diverse species of plants. Similar, observation by Norbu (2002), seedlings of primary species were prevalent in the protected area pockets (i.e. between fallen tree trunks and stumps) where cattle could not reach them.

The dominant species in this area (± non disturbed) is a "broad-leaf oak tree species" of *Castanopsis hystrix* Hook. f. & Thomson ex A. DC. followed by other broad-leaf species i.e. *Elaeocarpus lanceifolius* Roxb. (Elaeocarpaceae); *Quercus lamellosa* Sm. (Fagaceae); *Toona ciliata* M. Roem. (Meliaceae). In any case, there are many more individuals of *Symplocos glomerata* King ex C.B. Clarke (Symplocaceae) with a small class sizes diameter at breast height ca. >10 to 20 cm, which might indicate some disturbances that may have occurred, *Symplocos glomerata* is going to recover back in the area first before other plant species would, then, take place (pioneer species?).

Considering the plots 7–9, though situated in higher altitude than any other (c. 2,300 – 2,600 m asl.) and in more/less the highest point of the Korila mountain, contained less ground-cover herbs with the noticeable high percent coverage of a shrub species, *Daphne bholua* Buch.-Ham. ex D. Don. (Thymelaeaceae). This might indicate the history of some disturbances in the past and at the same time, the high percentage of this species also point to the recovery process of the vegetation. When the data of tree species in such areas had been taken into account, the dominant tree species in this areas is also broad-leaf oak tree of *Quercus lamellosa* Sm. (62 % coverage), then followed by *Persea fructifera* Kosterm. (Lauraceae) (20 % coverage).

In any case, less number of the dominant tree species and many more individuals of different classes of *Symplocos glomerata* might indicate also the disturbed condition of the areas as well.

Table 14. Plant species diversity; Shanon-weiner Index (H) and Simpson diversity indices (D)

Sampling Plots	1	2	3	4	5	6	7	8	9
Shanon-weiner (H)	2.69	2.9	2.87	2.97	3.04	2.92	2.68	2.73	2.77
Simpson's Index (D)	0.91	0.93	0.92	0.92	0.94	0.93	0.92	0.91	0.91

Table 15. Percentage cover of herbs and Shrubs in nine study plots along the mountain slopes

Family	Scientific name	% Coverage (plots)								
		Plot 1	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**	**Plot 9**
Apiaceae	*Centella asiatica* (L.) Urb.	2.1	2.1	1.6	2.2	2.5	2.5		1.1	
	Hydrocotyle himalaya P.K. Mukh.	5	4.3	8.2	9.9	6.6	6.3	6.2	9.8	6.4
Araceae	*Arisaema griffithii* Schott	0.4	2.1	1.6	3.3	3.3	2.8	1.1	2.5	1.2
	A. nepenthoides (Wall.) Mart. ex Schott & Endl.	0.8	2.1	1.6	2.7	5	3.5	1.4	2.1	1.4
Araliaceae	*Hedera nepalensis* K. Koch	17	12.8	10.5	9.9	7	4.9	3.9	7	4.1
Balsaminaceae	*Impatiens stenantha* Hook. f.	4.6	5.1	3.9	5.5	6.6	7	2.3	4.6	2.3
Caryophyllaceae	*Stellaria media* (L.) Vill.				1.1	2.1				
Commelinaceae	*Cynotis* sp.	0.8		1.2		1.2	1.4	1.4	1.8	1.4
Hypodematiaceae	*Leucostegia* sp.	2.1	3.8	0.8				1.7	1.1	0
Fabaceae	*Trifolium repens* L.				1.1					

Contd. of % composition

Family	Scientific	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Gentianaceae	*Swertia bimaculata* (Siebold & Zucc.) Hook. f. & Thomson ex C.B. Clarke	0.8			2.2	1.7	2.5	1.1	1.4	
Oxalidaceae	*Oxalis griffithii* Edgew. & Hook. f.			1.2	1.6	2.5	3.2	0.3	1.1	0.3
Phrymaceae	*Mazus surculosus* D. Don				0.5	0.8		0.3	0.7	0.3
Plantaginaceae	*Plantago erosa* Wall.		1.7		0.5					
Poaceae	*Oplismenus hirtellus* (L.) P. Beauv.	5.8	6.8	5.1	3.3	1.7	8.1	16.6	4.2	17.1
Polygonaceae	*Rumex nepalensis* Spreng.						1.4			
	Persicaria nepalensis (Meisn.) H. Gross	3.3	3	5.5	2.7	1.7	1.1	2	4.9	2
Polypodiaceae	*Neocheiropteris normalis* (D. Don) Tagawa	3.3	3.8	3.9	3.8	3.3				
Rosaceae	*Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita	15.4	5.1	5.1	1.6		2.1	9.6	3.5	9.9
Rubiaceae	*Rubia manjith* Roxb. ex Fleming	3.7	3	2.7	1.1	3.7	2.5	4.8	4.2	4.9

Contd. of % composition

Family	Scientific	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
Urticaceae	*Boehmeria nivea* (L.) Gaudich.	3.3	6	3.5	3.3	2.5	2.5	2	3.9	2
	Elatostemma lineolatum Wight			3.5	5.5	6.2	3.5			
	E. sessile J.R. Forst. & G. Forst.	9.5	12.4	9	7.1	8.7	8.8	15.8	11.9	16.2
	Girardinia diversifolia (Link) Friis	4.6	6.8	7	7.1	4.5	3.5	5.1	4.6	5.2
	Pilea scripta (Buch.-Ham. ex D. Don) Wedd.	1.7	1.7	2	2.2	8.3	8.4	5.4	9.5	5.5
Violaceae	*Viola yunanfuensis* W. Becker	6.2	9.8	11.3	6	5.4	7.4	13	9.1	13.3
Woodsiaceae	*Athyrium thelypterioides* (Michx.) Desv.	9.5	7.3	9	12.1	11.2	13.3	4.5	9.1	4.6
Adoxaceae	*Viburnum erubescens* Wall.	20	25	14						
Hydrangeaceae	*Dichroa febrifuga* Lour.	55.9	42	53.7						
Primulaceae	*Ardisia macrocarpa* Wall.	3.5	6.7	4	5	5	3			
Rosaceae	*Rubus ellipticus* Sm.	2.1	1.7	2	1.3					
Thymelaeaceae	*Daphne bholua* Buch.- Ham. ex D. Don.	10.5	11.8	10.1	6.6	29.8	64.3	80	70	50

The overview of the vegetation gradient at "Korila"

The plant species composition as well as the vegetation analysis of the Korila forest had revealed that the vegetation belongs to the broad-leaf lower montane forest type in general as the major component of the tree species of the area belongs to *Castanopsis* spp. and *Quercus* spp. (Fagaceae). The slight change of the vegetation type along the altitude at Korila from ca. 2,000 – 2,500 m asl. could be also recognized, as the vegetation type could be divided into four types according to the cluster analysis of the dominant species components. In general, the type of the vegetation at Korila should be that *Quercus – Persea* woodland which occurred at an altitude of ca. 2,200 m onwards to the peak of the Korila mountain (ca. 2,600 m asl.), however, frequently anthropogenic disturbances in these areas have some impact to the species composition on such vegetation, especially to the lower layer (shrub/ shrubby tree species) of the vegetation as well as the ground flora (herbs). In spite of that, the *Quercus – Persea* woodland in Korila areas has performed as a good representative of a broad-leaf lower montane forest of the region of Himalaya according to its natural component; The alien species found in the areas was few and the continual natural recovery process (secondary) of the vegetation that could be seen from the numbers and the percentage of coverage of the natural "pioneer" species: *Symplocos glomerata* King ex C.B. Clarke in some place that formed a distinct community (the *Symplocos glomerata* community in plot 7 comparing to *Quercus – Persea* woodland in plots 5, 6, 8, 9).

The types of plant community recognized in the study areas i.e. *Daphniphyllum chartaceum* heath was not only different from other plant communities in terms of species composition which could be seen clearly in the cluster analysis (Fig. 4) but also its structure and physiognomies were different. It might due to the property of slightly different soil types and humidity that have influenced to the different species composition which determined the structure of the vegetation. More investigation in future concerning the physical environment in the areas is, therefore, needed. The *Castanopsis-Elaeocarpus-Quercus* woodland (Plot 4) contained elements of both *Daphniphyllum chartaceum* woodland (Plots 1-3) and *Quercus – Persea* woodland (Plots 5-9), therefore, this community type is more

diverse than others at Korila lower montane forest. As, it was situated between those two mentioned plant communities, it is suggested here that this might be an "ecotone" community between those *Daphniphyllum chartaceum* heath and *Quercus – Persea* woodland.

Conservation measures and recommendation

The lower montane forest of Korila is not only a significant areas of cattle grazing in the eastern Bhutan. The forest is richly stocked with numerous forest products such as mushrooms, wild vegetables and medicinal plants in which local communities' accesses on these forest resources for their source of income. Since, the forest is not under any protecting area system of Bhutan and people have a rights and privileges with regards to the use of forest resources. Almost, entire areas of forest are under stress of uncontrolled cattle grazing, harvesting of timber and fuel woods. The human interference has not only caused the degradation of natural vegetation along the mountain slopes, it facilitated the introduction of non-native species damaging the native species and ecosystem. The forest along the roadsides exhibits signs and symptoms of heavy browsing, trampling and degradation by anthropogenic activities. These anthropogenic activities, if continued in the near future the forests with diverse pattern of vegetation are likely to get disappear. It was observed from this study that the numerous patches of original vegetation have been already disappeared owing to the anthropogenic activities. The makeup of such forest patches at frequent intervals along the mountain slopes has supported the invasion by the non-native plant species. Therefore, the detailed scientific researches both on the flora and vegetation of the whole areas and the anthropogenic activities on the forest would be needed as to understand and support the forest conservation policy maker as to protect this valuable representative of the lower montane broad-leaf forest of Bhutan Himalaya as a whole.

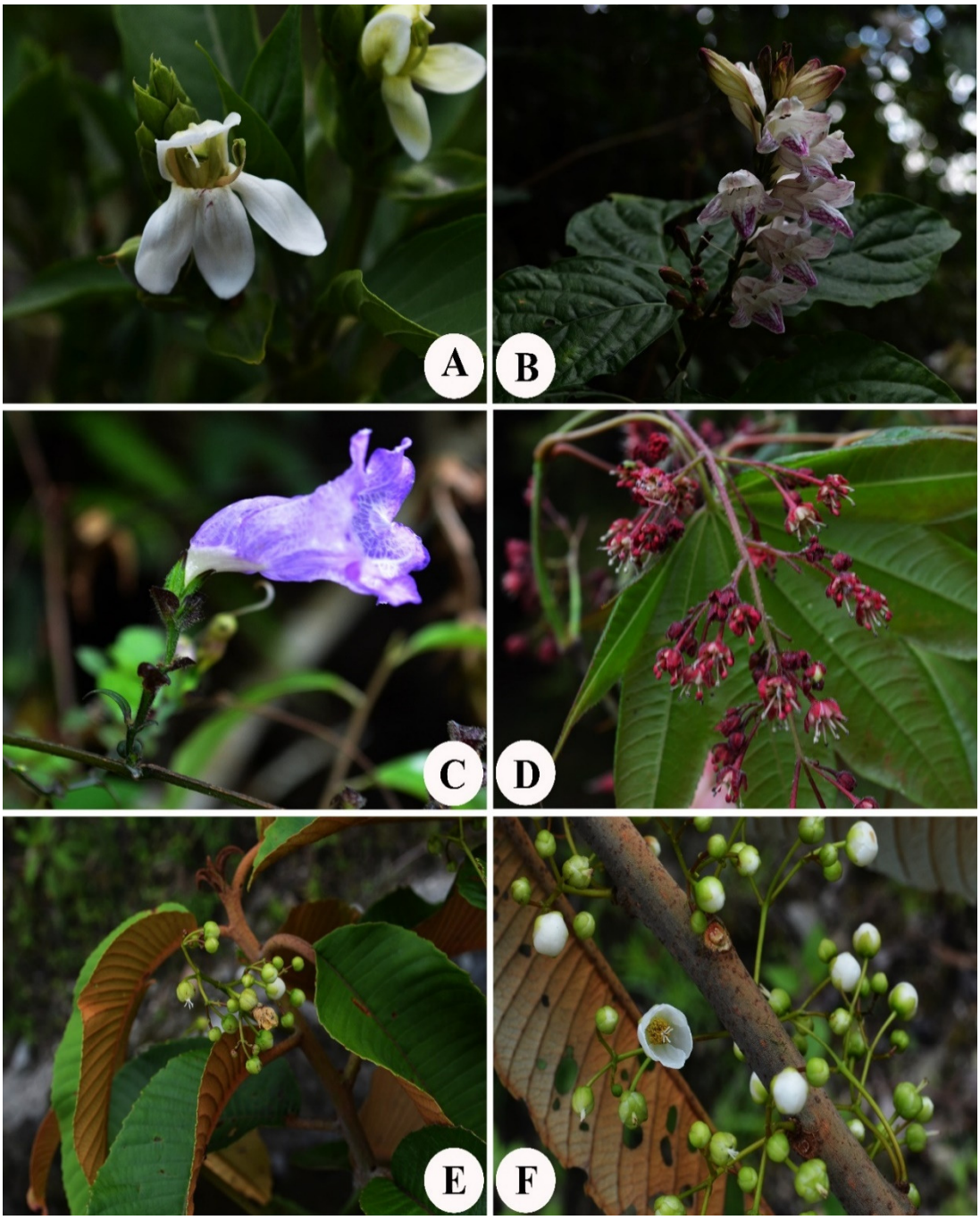

Plate 1: A. *Justicia adhatoda* L.; B. *Mackaya indica* (Nees) Ensermu; C. *Strobilanthes capitata* (Nees) T. Anderson; D. *Acer campbellii* Hook. f. & Thomson; E-F. *Saurauia roxburghii* Wall.

Plate 2: A-B. *Viburnum erubescens* Wall.; C. *Viburnum cylindricum* Buch.-Ham. ex D. Don; D-E. *Hydrocotyle himalaica* P. K. Mukh.

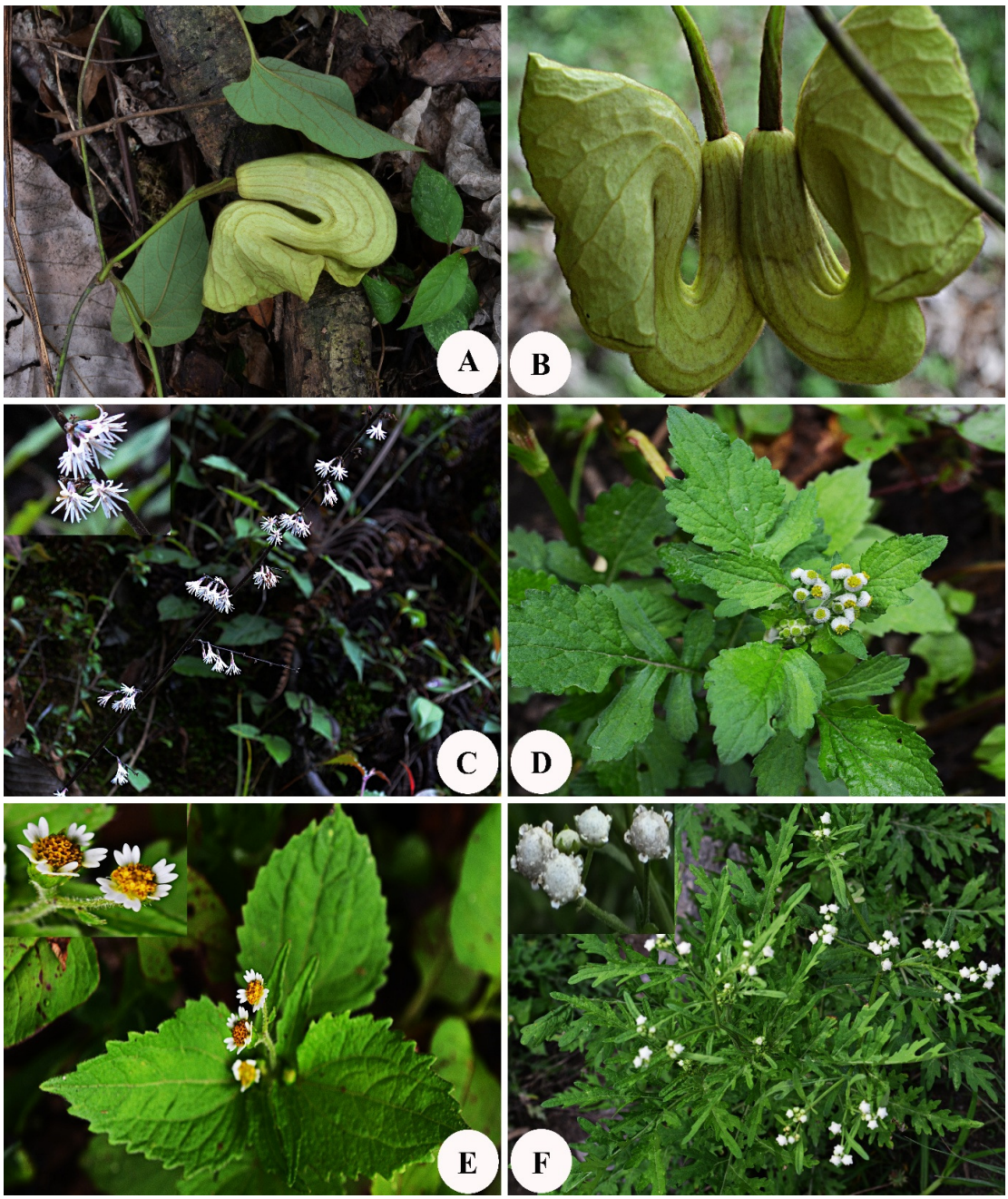

Plate 3: A-B. *Aristolochia griffithii* Hook. f. & Thomson ex Duch.; C. *Ainsliaea latifolia* (D. Don) Sch. Bip.; D. *Dichrocephala integrifolia* (L.f.) Kuntze; E. *Galinsoga parviflora* Cav.; F. *Parthenium hysterophorus* L.

Plate 4: A. *Pseudognaphalium affine* (D. Don) Anderb.; B-C. *Sonchus oleraceus* L.; D-E. *Impatiens spirifer* Hook. f. & Thomson; F. *Impatiens stenantha* Hook. f.

Plate 5: A-B. *Berberis griffithiana* C.K. Schneid.; C-D. *Cynoglossum furcatum* Wall.; E. *Nasturtium officinale* W.T. Aiton

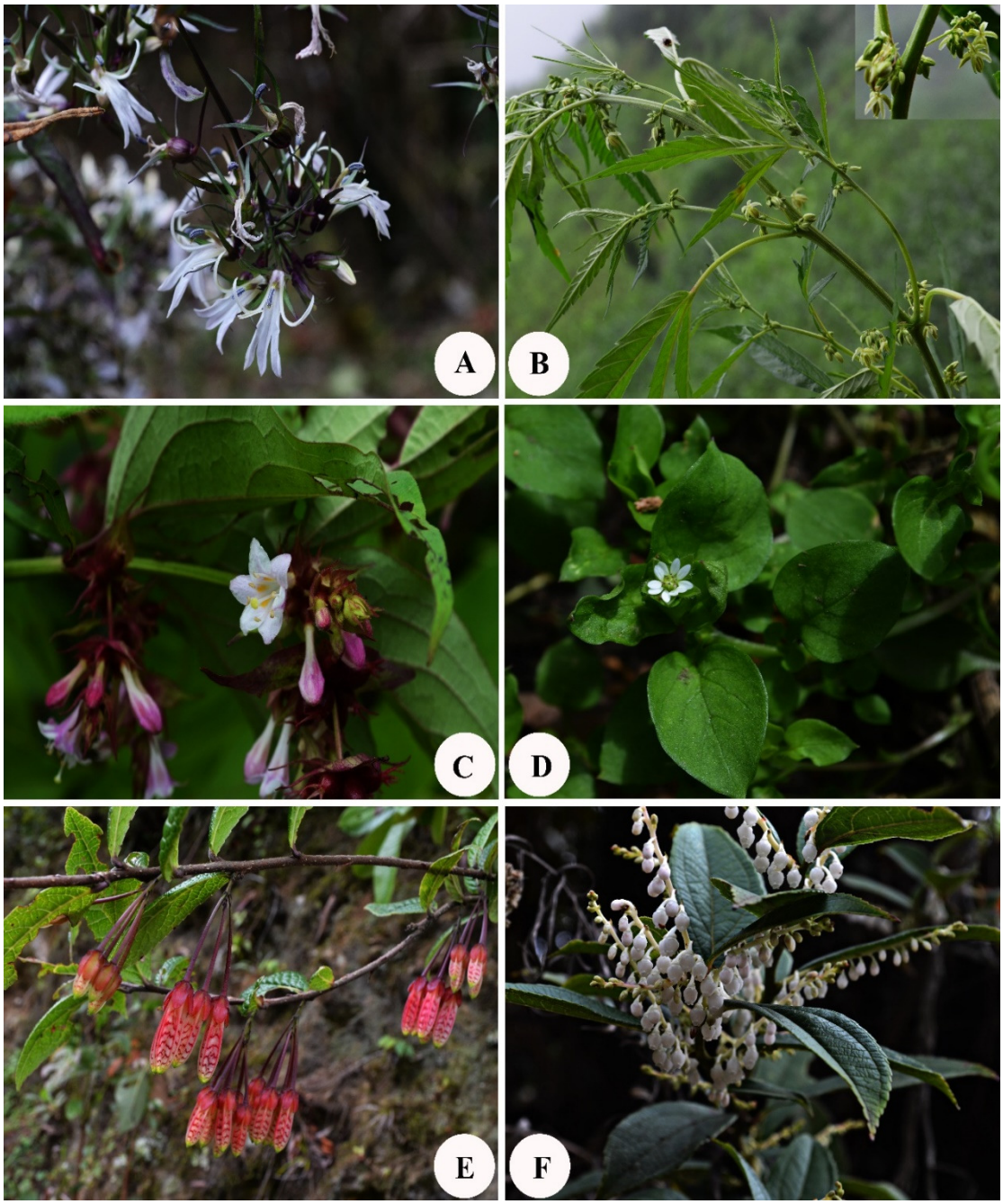

Plate 6: A. *Lobelia pyramidalis* Wall.; B. *Cannabis sativa* L.; C. *Leycesteria formosa* Wall.; D. *Stellaria media* (L.) Vill.; E. *Agapetes incurvata* (Griff.) Sleumer; F. *Gaultheria fragrantissima* Wallich

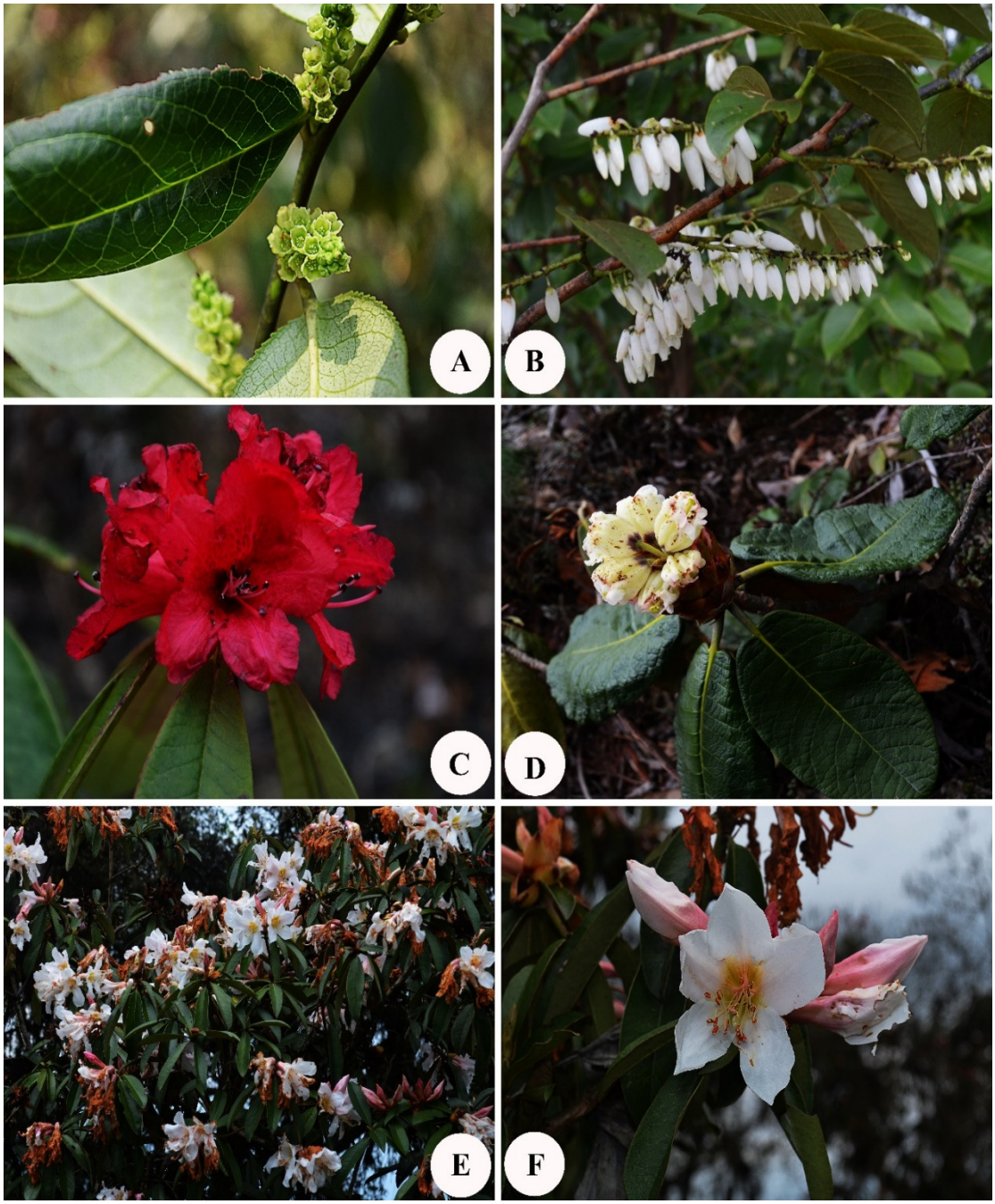

Plate 7: A. *Gaultheria griffithiana* Wight; B. *Lyonia ovalifolia* (Wall.) Drude; C. *Rhododendron arboreum* Sm.; D. *Rhododendron falconeri* Hook. f.; E-F. *Rhododendron maddenii* Hook. f.

Plate 8: A. *Vaccinium retusum* (Griff.) Hook. f. ex C.B. Clarke; B. *Vaccinium vacciniaceum* (Roxb.) Sleumer; C. *Albizia sherriffii* E. G. Baker; D. *Desmodium confertum* DC.; E. *Indigofera heterantha* Wall. ex Brandis; F. *Indigofera tinctoria* L

Plate 9: A. *Parochetus communis* Buch.-Ham. ex D. Don; B. *Trifolium repens* L.; C-D. *Castanopsis indica* (J. Roxb. ex Lindl.) A. DC.; E-F. *Quercus oxyodon* Miq.

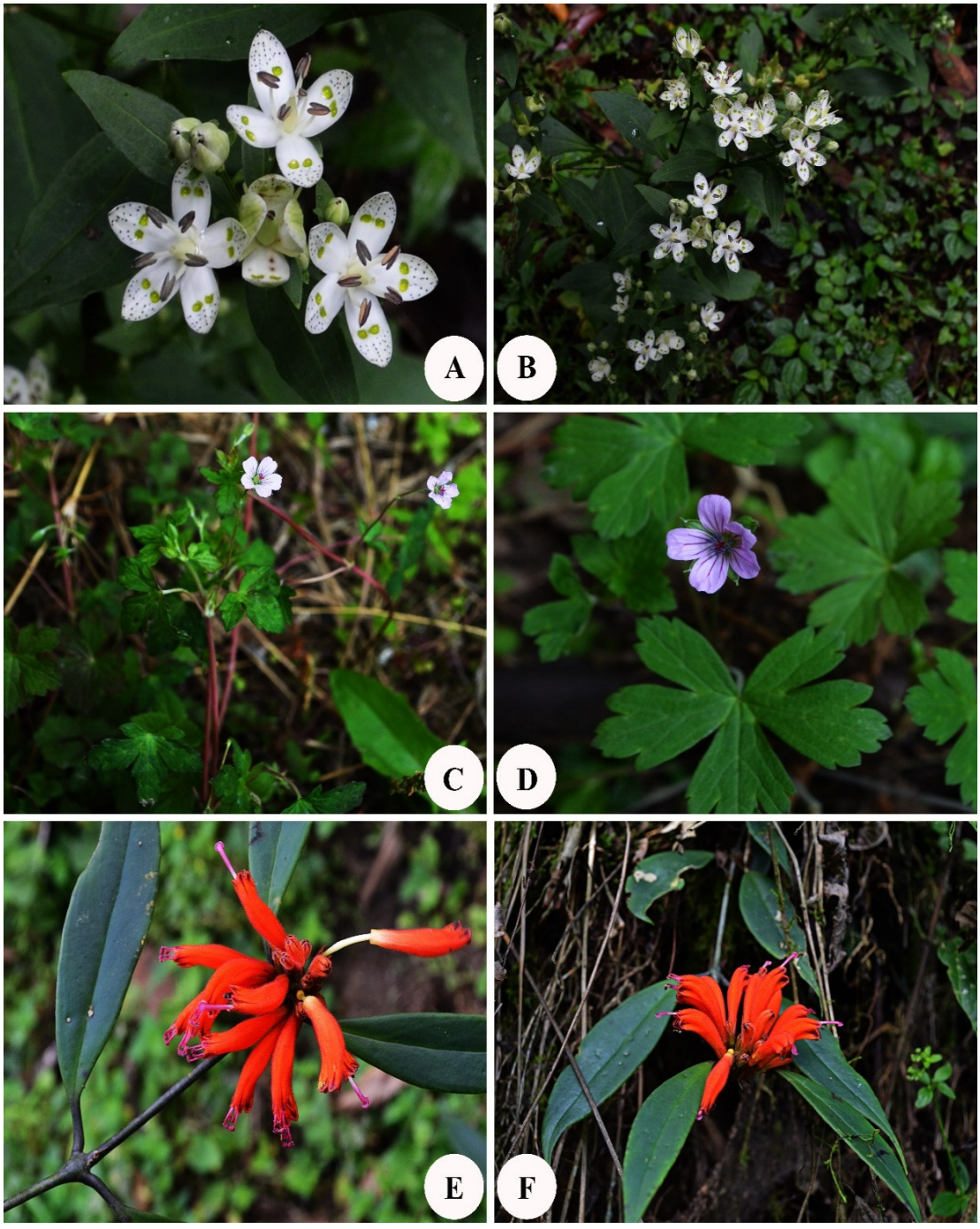

Plate 10: A-B. *Swertia bimaculata* (Siebold & Zucc.) Hook. f. & Thomson ex C.B. Clarke; C-D. *Geranium nepalense* Sweet; E-F. *Aeschynanthus parasiticus* (Roxb.) Wall.

Plate 11: A-B. *Dichroa febrifuga* Lour.; C-D. *Hydrangea heteromalla* D. Don; E-F. *Philadelphus tomentosus* Wall. ex G. Don

Plate 12: A. *Hypericum choisyanum* Wall. ex N. Robson; B. *Callicarpa arborea* Roxb.; C. *Leucas aspera* (Willd.) Link; D. *Prunella vulgaris* L.; E-F. *Mazus surculosus* D. Don

Plate 13: A. *Melastoma normale* D. Don; B. *Ardisia macrocarpa* Wall.; C-D. *Oxalis corniculata* L.; E-F. *Oxalis griffithii* Edgew. & Hook. f.

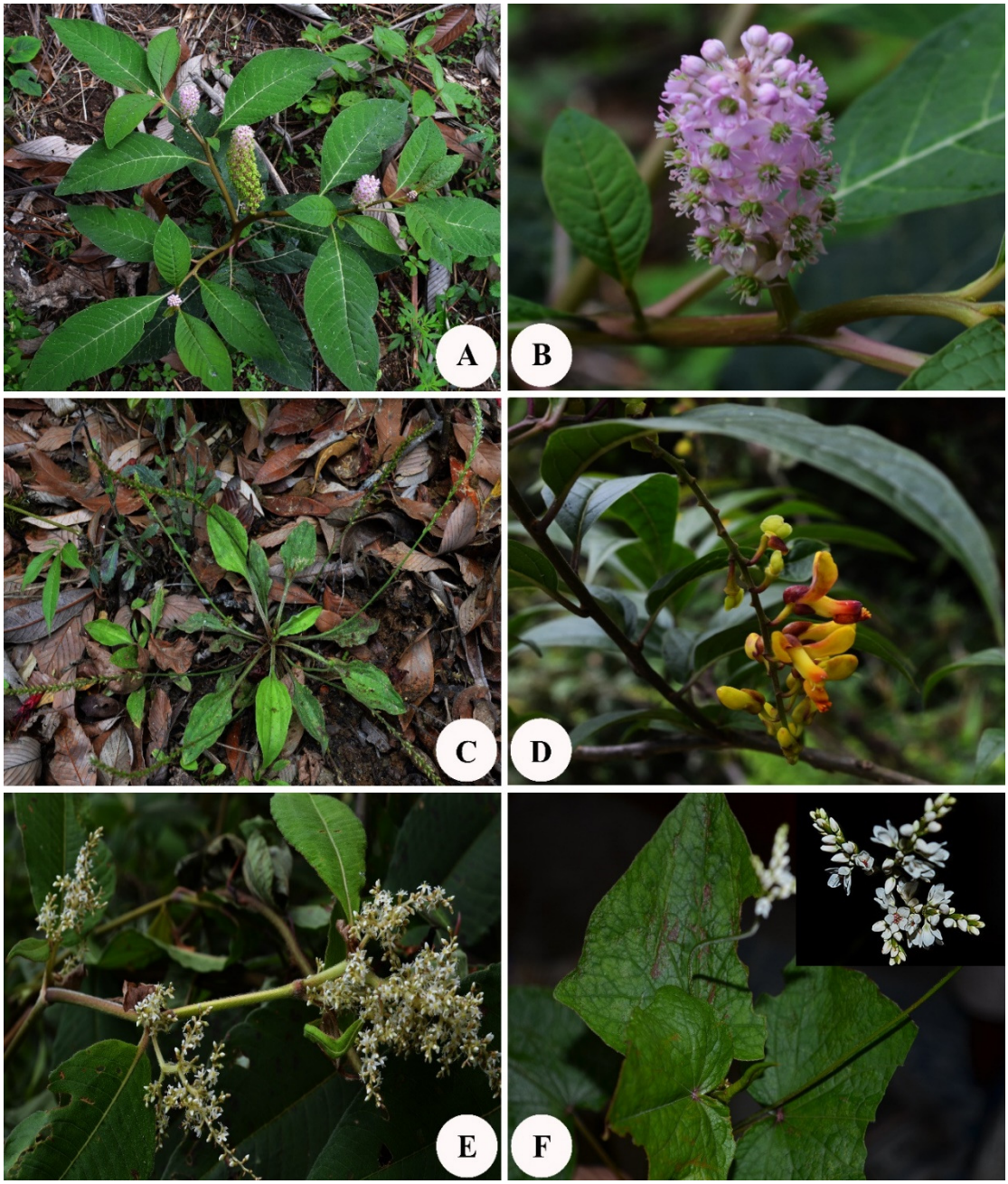

Plate 14: A-B. *Phytolacca acinosa* Roxb.; C. *Plantago erosa* Wall.; D. *Polygala arillata* Buch.-Ham. ex D. Don.; E. *Aconogonum molle* (D. Don) H. Hara; F. *Fagopyrum dibotrys* (D. Don) H. Hara

Plate 15: A-B. *Persicaria capitata* (Buch.-Ham. ex D. Don) H. Gross; C. *Rumex nepalensis* Spreng.; D. *Lysimachia japonica* Thunb.; E. *Duchesnea indica* (Andrews) Teschem.; F. *Neillia rubiflora* D. Don

Plate 16: A-B. *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita; C. *Potentilla sundaica* (Blume) W.Theob.; D. *Prunus nepaulensis* (Ser.) Steud.; E-F. *Rubus ellipticus* Smith in Rees

Plate 17: A. *Prunus* sp.; B. *Spiraea micrantha* Hook. f.; C-D. *Rubus rosifolius* Sm.; E-F. *Mussaenda roxburghii* Hook. f.

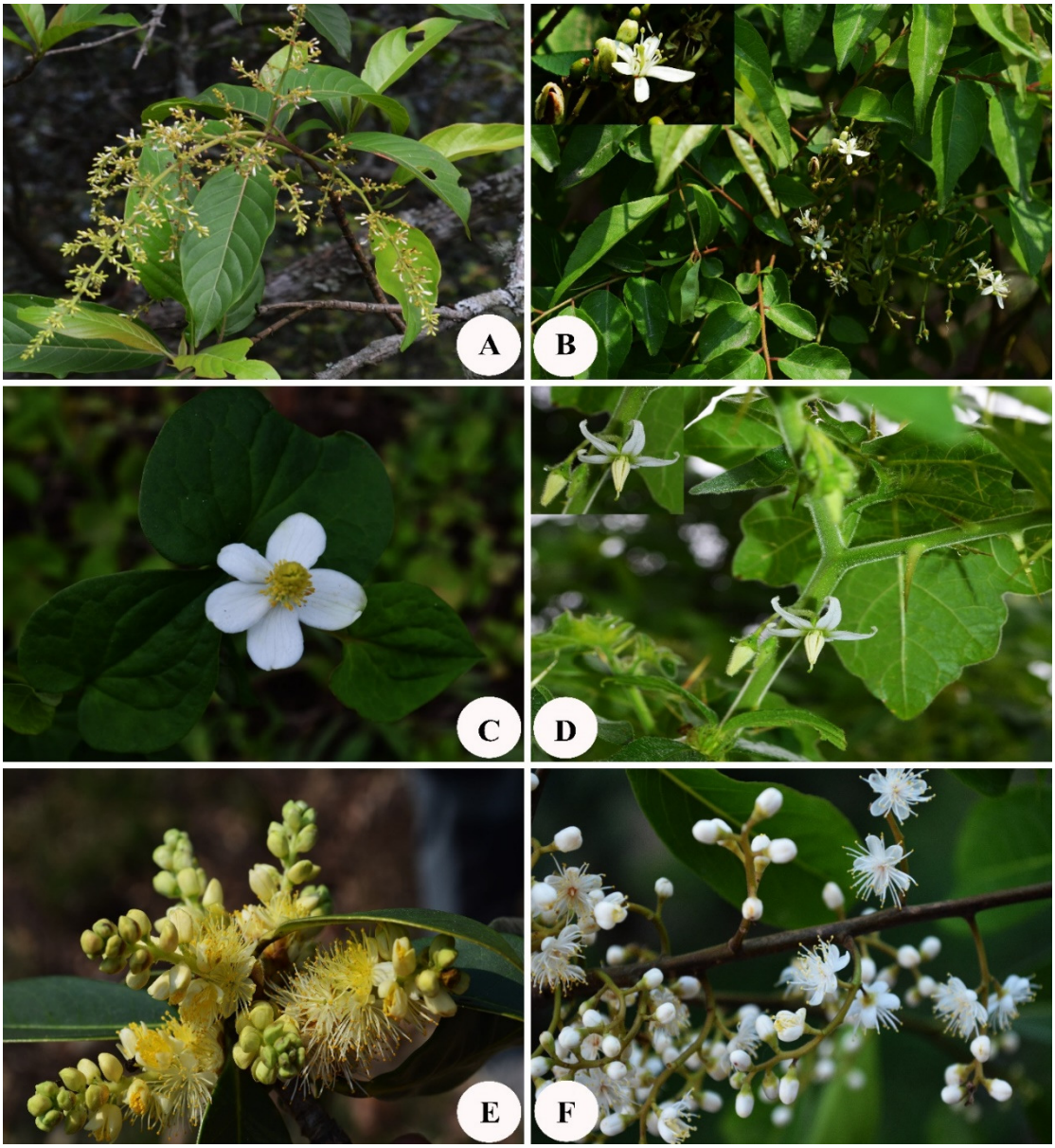

Plate 18: A. *Wendlandia grandis* (J. D. Hooker) Cowan; B. *Murraya* koenigii (L.) Spreng.; C. *Houttuynia cordata* Thunb.; D. *Solanum viarum* Dunal; E. *Symplocos dryophila* C.B. Clarke; F. *S. glomerata* King ex C.B. Clarke.

Plate 19: A-B. *Symplocos sumuntia* Buch.-Ham. ex D. Don; C. *Schima wallichii* (DC.) Korth.; D. *Daphne bholua* Buch.-Ham. ex D. Don; E. *Elatostema lineolatum* Wight; F. *Elatostema sessile* J.R. Forst. & G. Forst.

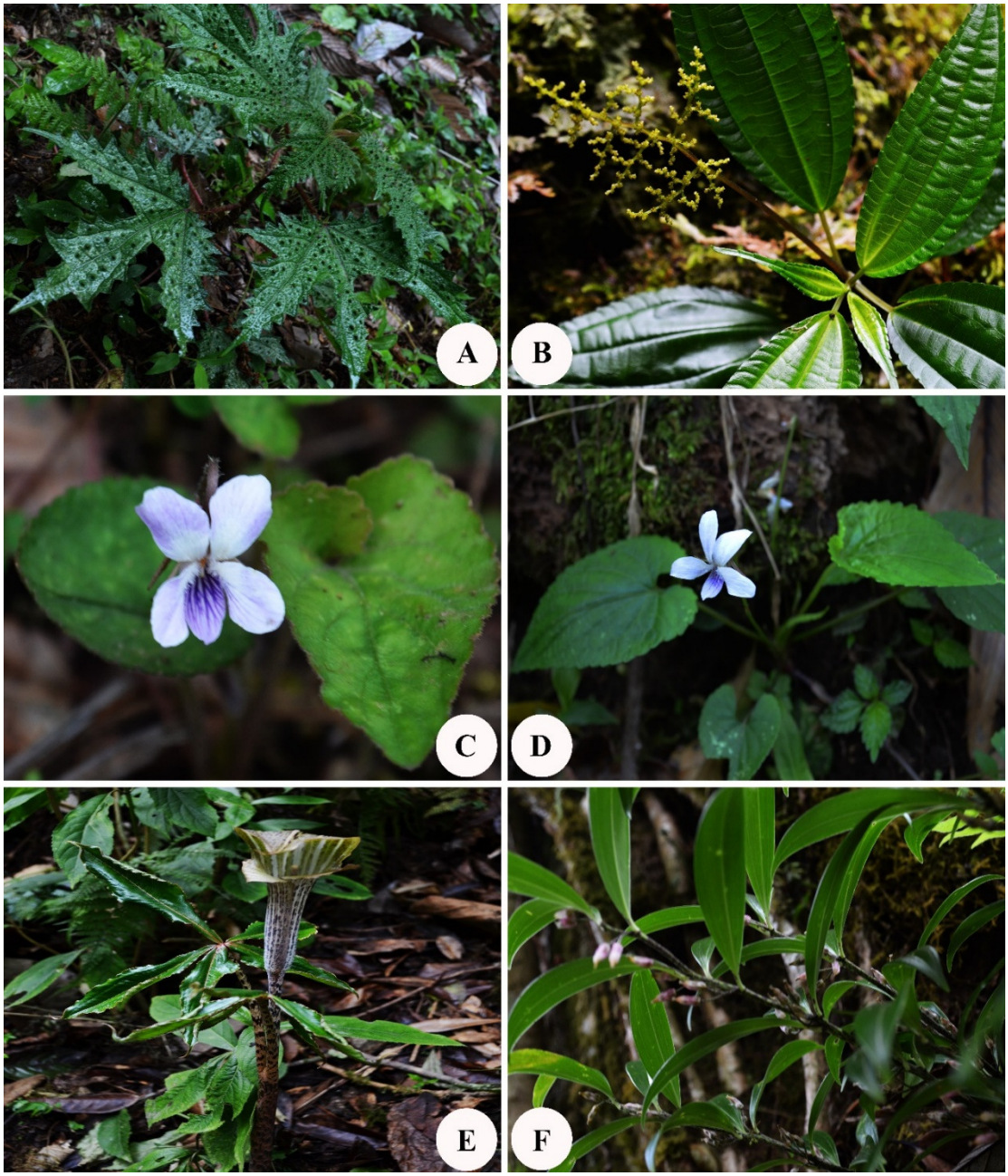

Plate 20: A. *Girardinia diversifolia* (Link) Friis; B. *Pilea scripta* (Buch.-Ham. ex D. Don) Wedd.; C-D. *Viola yunnanfuensis* W. Becker; E. *Arisaema nepenthoides* (Wall.) Mart. ex Schott & Endl.; F. *Polygonatum punctatum* Royle ex Kunth

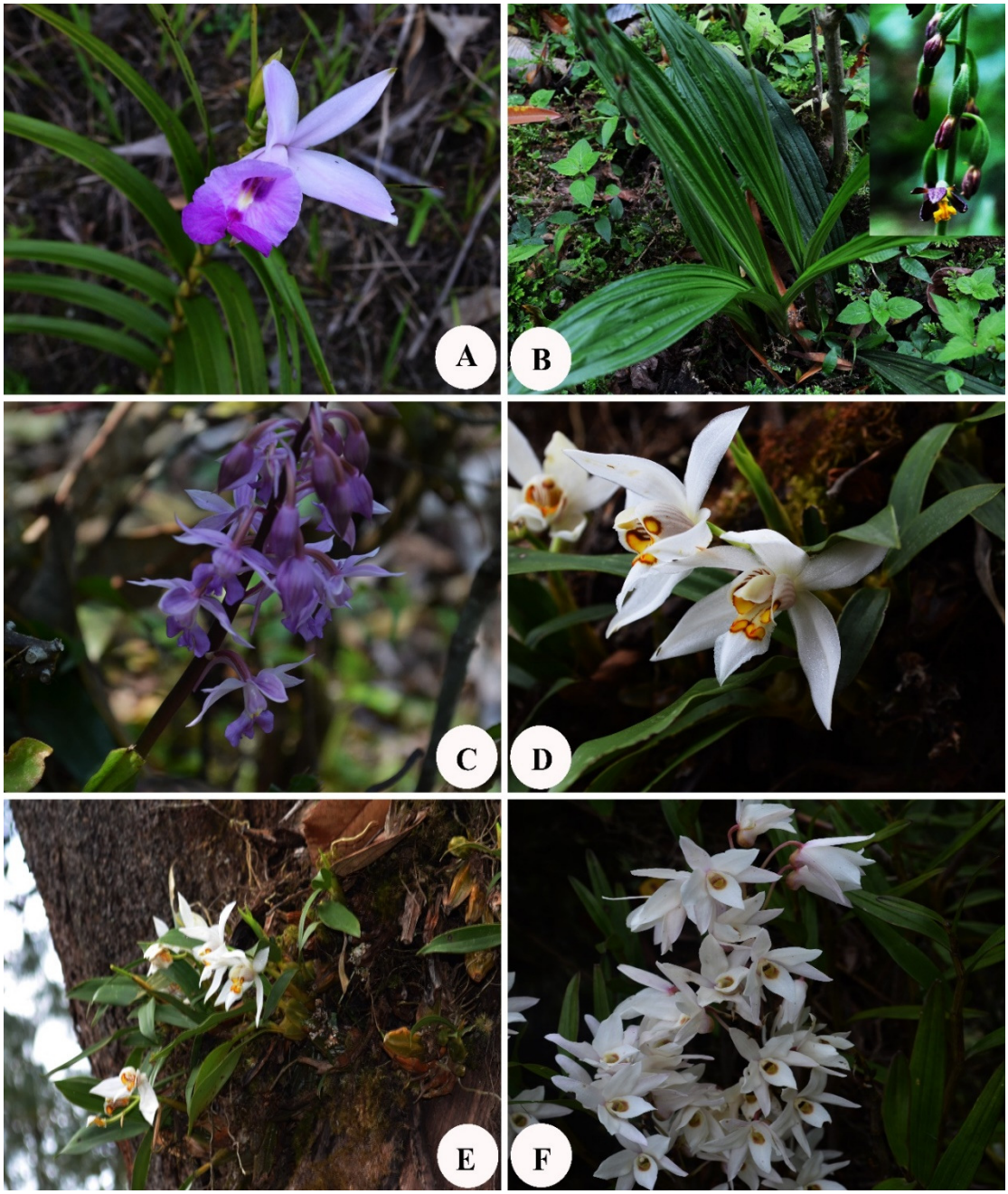

Plate 21: A. *Arundina graminifolia* (D. Don) Hochr.; B. *Calanthe mannii* Hook.f.; C. *Calanthe plantaginea* Lindl.; D-E. *Coelogyne corymbosa* Lindl.; F. *Dendrobium candidum* Wall. ex Lindl.

Plate 22: A-B. *Cautleya gracilis* (Sm.) Dandy; C-D. *Nephrolepis cordifolia* (L.) C. Presl; E. *Leucostegia* sp.; F. *Drynaria propinqua* (Wall. ex Mett.) J. Sm.

Plate 23: A-B: *Neocheiropteris normalis* (D. Don) Tagawa; C-D. *Lycopodium clavatum* L; E-F. *Athyrium thelypterioides* (Michx.) Desv.

Plate 24: *Daphniphyllum chartaceum* heath forest

Plate 25: *Castanopsis – Elaeocarpus – Quercus* woodland

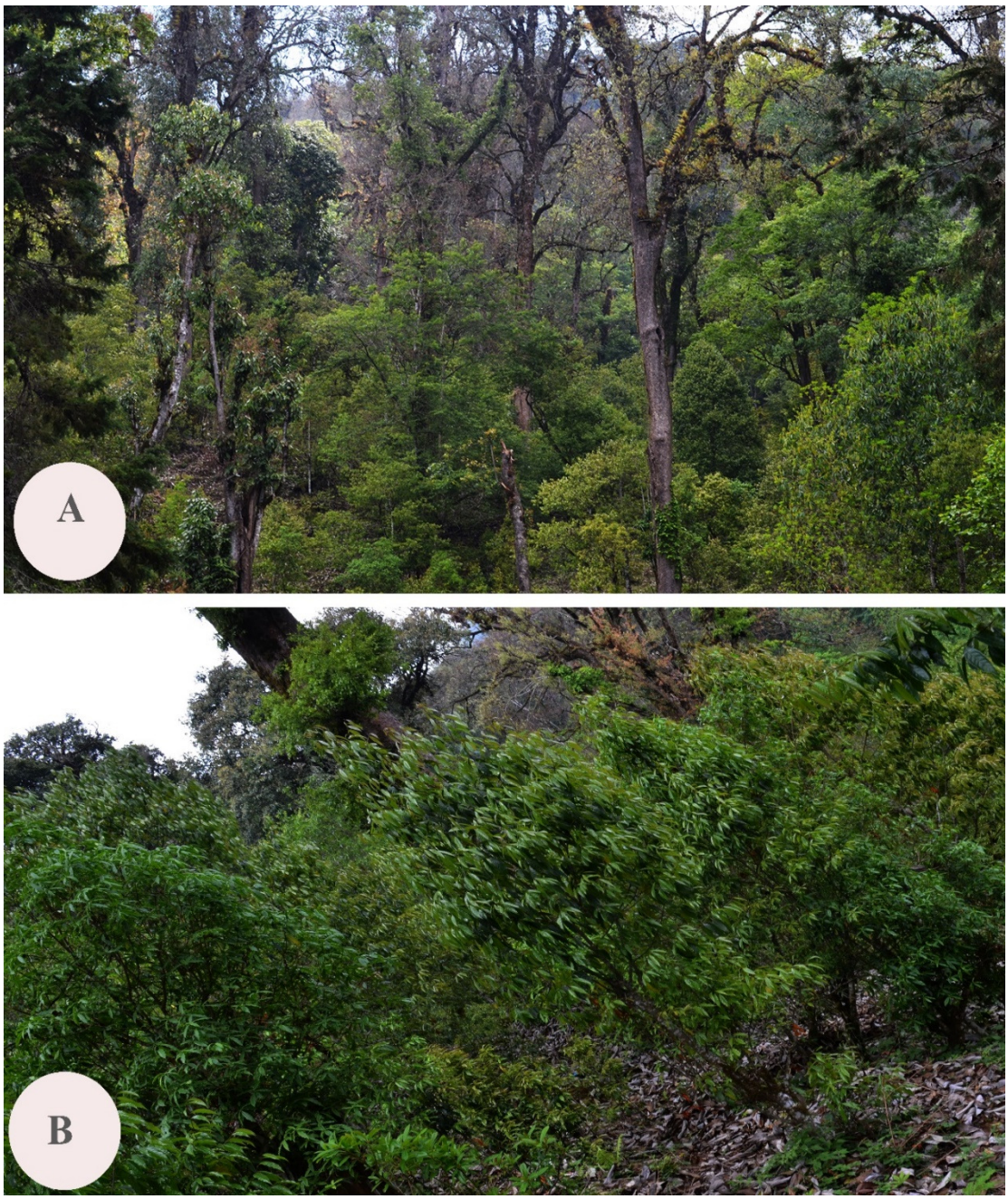

Plate 26: A: *Quercus – Persea* woodland, B: *Symplocos* community

Plate 27: Anthropogenic activities

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Species Index

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