Butterfly-Forest Type Associations in Uttarakhand



ARUN PRATAP SINGH





(Indian Council of Forestry Research & Education)

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Forest Research Institute (Indian Council of Research & Education) Dehradun





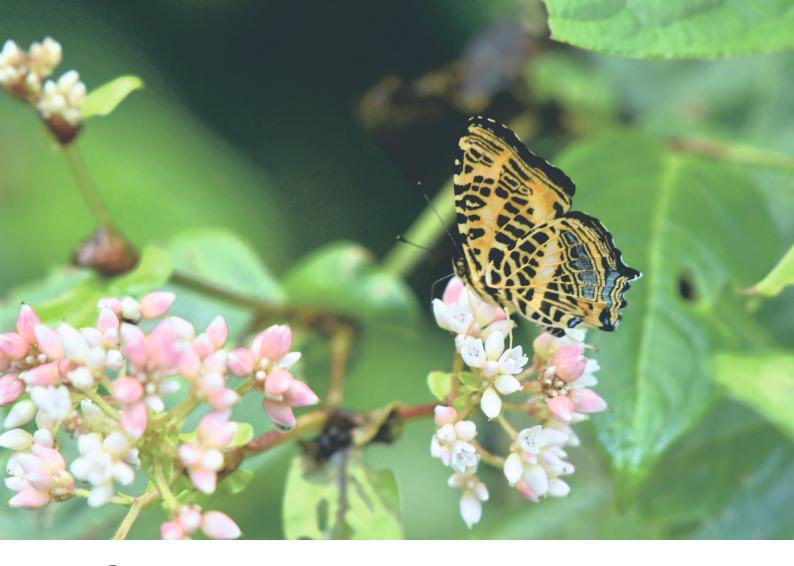


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Butterfly-Forest Type Associations in Uttarakhand

C 2021, Forest Research Institute (ICFRE), Dehradun, India

Written by ARUN PRATAP SINGH

Printed by M.S. Printers & Creators Dehradun



अरूण सिंह रावत, भा.व.से. Arun Singh Rawat, IFS





कुलाधिपति , व.अ.सं. विश्वविद्यालय Chancellor, FRI University

महानिदेशक भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद् डाकघर न्यू फॉरेस्ट, देहरादून - 248006 (आई.एस.ओ. 9001: 2008 प्रमाणित संस्था)

Director General Indian Council of Forestry Research and Education P.O. New Forest, Dehra Dun - 248 006 (An ISO 9001:2008 Certified Organisation)

Foreword

The book entitled "Database on Butterfly-Forest Type Associations in Uttarakhand" produced by Forest Research Institute with information on 365 species of butterflies recorded across different forest sub-types found in Uttarakhand, each depicted with beautiful photographs, is unique and first of its kind in the country. The book also contains vital information on butterfly species associated with 20 different major forest sub-types found in the state along with their classification, seasonality, relative abundance, altitudinal distribution, larval hosts plants and conservation status of each taxon. The book has come out at a time when the conservation, ecological and socio-economic value of butterflies are being realized all over the globe and the general interest in butterflies is increasing across people from all walks of life. The database will be used as a reference book with baseline information for future research and many other applications in various scientific and socio-economic fields such as conservation planning, climate change, butterfly inclusive ecotourism, butterfly identification, etc. The reference book is hoped to spark interest amongst butterfly enthusiasts and conservation planners. I would like to congratulate the author and the project team for their relentless efforts in gathering data and bringing this out wonderfully in the form of a database. It is anticipated that the database will persuade the stakeholders including the forest department, researchers, wildlife conservationists, nature lovers, students, communities and NGO's to join hands in conservation of these beautiful creatures and their forests habitats in which they flourish along with promoting butterfly inclusive ecotourism in the state.

(Arun Singh Rawat)

पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की एक स्वायत परिषद् An Autonomous Body of Ministry of Environment, Forest & Climate Change, Government of India

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PREFACE

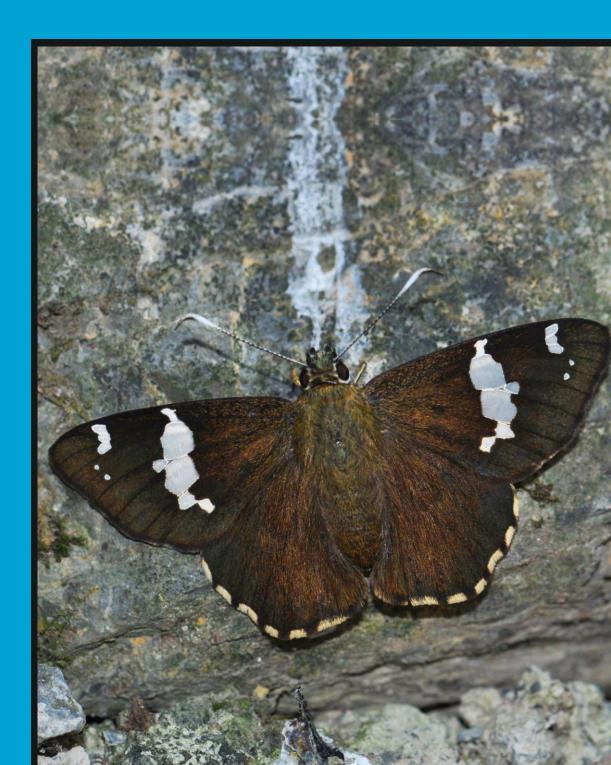


Preface

Champion and Seth (1968) classified Indian forests into different forest types and sub-types, based on their similarity of dominant vegetation and structural arrangement of species in each forest subtype and dissimilarity with other forest sub-types. However, it was not known if the species composition and community structure of lower groups of animals i.e. butterflies within them, is also similar within each forest-sub-type or different in each forest sub-type. If this is the case then, each forest sub-type harboring rare species can be taken as unique habitat or units of conservation at the lower level on a regional scale. The present study assessed the species composition and community structure of butterflies, that are biological indicators, across 20 different and prominent forest sub-types out of 42 existing across state of Uttarakhand, lying in the Western Himalaya, for the first time. With the associations of butterflies with each forest sub-type revealed important forest sub-types in the state in terms of rare species of conservation priority and high in butterfly species richness. Thus, sites with concentrations of rare species and unique forests areas outside the PA network, can be recommended as new areas for conservation that can be used for filling the gaps and linkages in the current PA network in the state. This book "Database on Butterfly-Forest Type Associations in Uttarakhand" provides baseline information on 365 butterfly species found across the Western Himalayan state of Uttarakhand. Information is provided for each species on their classification, seasonality, geographical & altitudinal distribution, forest type association, larval host plants, Wildlife Protection Act status, along with images of both the sexes. A handy conservation and eco-tourism field guide for naturalists, researchers, forest managers, ecotourism guides, NGO's, and students provides GIS based species distribution maps and images for identification of butterflies.

> (Arun Pratap Singh) Entomology Branch Forest Protection Division Forest Research Institute

ACKNOWLEDGEMENTS



Acknowledgements

The author is thankful to the A.S.Rawat, Director General, Indian Council of Forestry Research and Education, (ICFRE), Dehradun for providing necessary funding for carrying out the above study for the present database on "Butterfly-Forest Type Associations in Uttarakhand". Thanks are due to the Director, Forest Research Institute and Head, Forest Entomology, Forest Protection Division, for providing the necessary facilities to carry out the above study. Most importantly I would like to thank Tribhuwan Singh (JPF) and Rohit Kumar (FA) for assisting the PI in the field and laboratory in collection of butterfly data and specimens, data compilation and generating GIS maps. Manoj Kumar, Officer-in-Charge, GIS Cell, IT Division, FRI is thanked for providing GIS facility for generating butterfly speciesforest type distribution maps. Help of Praveen Verma and H.B.Naithani, plant taxonomists, Botany Division, FRI is also duly acknowledged in identification of plant specimens associated different forest sub-types. Lastly, I would also like to thank the Chief Wildlife Warden, Uttarakhand Forest Department; Divisional Forest Officer, Chakrata Forest Division; Tehri Garhwal; Pauri, Uttarkashi; Kedarnath Soil Conservation Division; Rudraprayag; Almora; Pithoragarh; Bageshwar; Ramnagar; Haldwani; Kalagarh Forest Division; Haridwar & Dehradun; Director, Rajaji National Park and their field staff for providing logistical support during field surveys in the state, from time to time.

(Arun Pratap Singh)

SINENCO



Contents

01.	Introduction	1
02	Database	11
	Classification of Butterflies	15
	1. Papilionidae (Swallowtails) (1-31)	17-50
	2. Pieridae (White & Yellows) (32-62)	51-84
	3. Lycaenidae (Blues) (63-160)	85-184
	4. Riodinidae	
	(Punches & Judie's) (161-167)	185-194
	5. Nymphalidae	
	(Brush-footed Butterflies) (168-304)	195-334
	6. Hesperiidae (Skippers) (305-365)	335-398
03	References	399
04	Index	403

INTRODUCTION



INTRODUCTION

Uttarakhand State

The state of Uttarakhand covers an area of 53,483 km2, which is 1.63% of the geographical area of the country, and lies between 28°43' N to 31°28' N latitude & 77°34' E to 81°03' E longitude. This predominantly mountainous state shares its borders with Himachal Pradesh state in west & Uttar Pradesh state in south, in India. It also shares international borders with Nepal in the east and China (Tibet) in the north. The state is mainly representative of the Western Himalayas, the climate and vegetation vary greatly with altitude, from glaciers at the highest elevations, from temperate to subtropical at the lower elevations. The average annual rainfall is 1,500 mm and the annual temperature varies from below 0°C to 43°C. Major rivers Ganga, Yamuna, Ramganga & Sharda drain the state along with their tributaries. The Himalayan range in Uttarakhand is divided into the distinct non-montane and montane physiographic zones. The lower zone comprises the 'Bhabhar' region in nonmontane lowland woodlands having Gangetic moist deciduous forests and the Tarai region (below 500m) running parallel to it, which comprises mainly the marshes and grasslands. Montane region is divided into Sub-Himalaya which consists of the Shiwalik ranges, the lower Himalayan ranges and the Doon (flat long valleys) lying north of the Shiwaliks (~500-1000m). Above this region are the Lesser Himalayas (~1,000-3,000m) followed Mid Himalaya (~3000-4000m)and then Greater Himalaya (~4000-6,000 m) and the Trans-Himalaya (above 5000m) also known as the Tethys Himalaya and the Indo-Tibet plateau, the region is in the rain shadow area that transforms into the Cold Desert (Khanduri et al.,2013).

Biodiversity of Uttarakhand

Forests cover an area of 24,303.04 km2 in the state which constitutes 45.44 % of the state's geographical area (FSI,2019). The state is represented by biogeographic zone 2B Western Himalaya and 7B Shiwaliks of India (Rodgers & Pawar, 1988). The state is rich in biodiversity having about 102 species of mammals, 692 birds (https://ebird.org/region/IN-UL), 13 amphibians & 53 reptiles (Vasudevan & Sondhi 2010) and 124 fishes (https://forest.uk.gov.in/wildlifemanagement). Some of the globally endangered fauna like the Asiatic elephant Elephas maximus, snow leopard Panthera uncia, tiger Panthera tigris, leopard Panthera pardus, musk deer Moschus chrysogaster, swamp deer Rucervus duvaucelii, cheer pheasant Catreus wallichii, king cobra Ophiophagus hannah are found in the state. Uttarakhand shelters around 4,000 species of plants, belonging to

1198 genera, under 192 families, of which ~34 species have been listed as threatened (Nayar & Sastry1987, 1988, 1990; https://india.biodiversity.org/).

Protected Area Network of Uttarakhand

The protected area network covers 12 percent of total geographical area of the state which includes 6 national parks, 7 wildlife sanctuaries, 4 conservation reserves & 1 biosphere reserve.

S. No.	Name	Area (Km.2)
1	Corbett National Park	520.82
2	Gangotri National Park	2390
3	Govind National Park	558.88
4	Nanda Devi National Park	624.6
5	Rajaji National Park	819.54
6	Valley of Flowers National Park	87.5
7	Askot Wildlife Sanctuary	600
8	Asan Conservation Reserve	4.44
9	Binsar Wildlife Sanctuary	45.59
10	Govind Wildlife Sanctuary	481.05
11	Jhilmil Conservation Reserve	37.84
12	Kedarnath Wildlife Sanctuary	975.2
13	Benog/Mussoorie Wildlife Sanctuary	10.82
14	Nandhaur Wildlife Sanctuary	269.96
15	Pawalgarh Conservation Reserve	58.25
16	Sonanadi Wildlife Sanctuary	301.18

List of Protected Areas

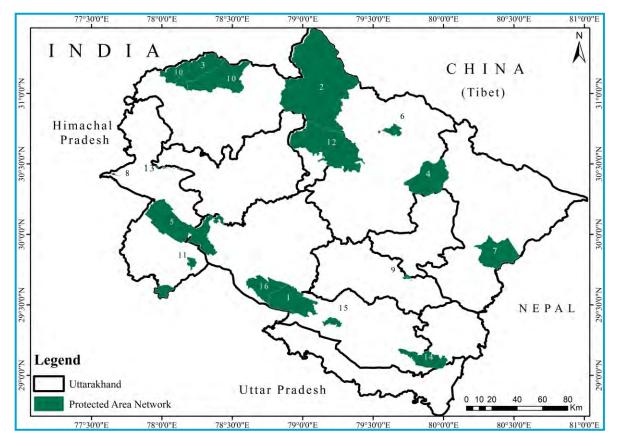


Fig. 1. Locations of 16 Protected Areas of Uttarakhand state, India

Previous studies

Studies on natural history of butterflies and checklists of different areas in Uttarakhand have been published from time to time ever since 1889. The first comprehensive record butterflies of Mussoorie and neighbouring regions in Garhwal was published by Mackinnon & de Nicéville (1899). They produced a list of 323 species collected during an eleven year period Later, Ollenbach (1930) listed 144 species in and around Mussoorie town. Shull (1958, 1962) also reported on the butterflies of Mussoorie. Much later, Baindur (1993) documented 27 species from Nanda Devi National Park. Bhardwaj et al., (2012) & Bhardwaj & Uniyal (2013) reported 140 species from Govind Wildlife Sanctuary in the Tons river catchment and Gangotri landscape in Uttrakhashi district of Garhwal. The author published a list of butterflies from Garhwal which reported 349 species with the checklist of Garhwal comprising of 407 species including historic records of 84 species (Singh & Sondhi,2016). From the Kumaon region the first comprehensive list of butterflies was published by Doherty (1886) which was followed by a comprehensive list of 271 species given by Hannyngton (1910). Recently various authors have published site specific checklists from the Kumoan region focusing mainly on Nainital district (Smetacek, 2002,2004 &2012; Tyagi et al., 2011; Arya et al., 2014 & 2016, Verma and Arya, 2018). The checklist on butterflies of Uttarakhand state today stands around 500 species (Sondhi&Kunte, 2017) based on literature published between 1899-2017, and includes ca. 50 historic records of species that are nowhere to be seen now and several new range extensions have occurred into the state from neighboring Central Himalaya and Peninsular India. However, non of these earlier studies give an account of the association of butterfly species with different forest sub-types as classified by Champion and Seth (1968), found across the state of Uttarakhand.

Present Study

The data used in this book was collected from under the ICFRE funded projects (No: FRI-627/FED-44) entitled "Butterflies associated with major forest types/subtypes in Uttarakhand" carried out from 2017-2021 and "Butterfly diversity in moist temperate Ban oak forests of Garhwal" (No.FRI-348/FED-23) carried out earlier by the author from 2006-2009. Besides, a 10 day survey was conducted in Kedarnath Wildlife Sanctuary during June2012. A total of over 79 major field surveys were carried out on 307 transects across 11 districts of Uttarakhand state, using 'Pollard Walk' sampling, where one transect was sampled for 1 km for 1 hr in a stretch. The surveys covered all the 6 butterfly seasons of the year (spring, summer, pre-monsoon, monsoon, post-monsoon, autumn & winter). These surveys covered 23 forest sub-types across the state (tables-1&2; fig.2) and recorded 369 taxa [365 species: 31 Papilionidae; 31Pieridae; 98 Lycaenidae; 7 Riodinidae; 137 Nymphalidae & 61 Hesperiidae].

Sl no.	Name of District	Surveyed sites	Altitudinal range	Months of survey
1.	Dehradun (30 surveys)	Chakrata Forest Division (Deoban, Mundali, Kauntlani, Kanasar, Kalsi; Ghodaghati), Mussoorie Forest Division (Benog Wildlife Sanctuary, Woodstock school forest, Hathipaon, Bataghat) & Dehradun Forest Division (Shiwaliks- Timli-Karvapani- Asarori; Rikhauli. Thano range;Devli & New Forest Campus FRI; Jhajra;Barkot;Gollataappar; Lachhiwala) ; Rajaji National Park (Satya Narayan; Kansrao; Mohand; Phanduwala).	500-2850m	March to November
2.	Haridwar (4 surveys)	JhilmilJheel; Laldhang; Shyampur; Laksar.	200-600m	March; May; June; Nov.
3.	Tehri Garhwal (6 surveys)	Tehri Forest Division (Vinayakkhal; Buddha kedar, Ghansali, Devalsari, Dhanolti, Kanatal, Rauto ki belli, Koti Kimoi, Suwakholi)	1550-2280m	January- February, September, November
4.	Pauri Garhwal (2 surveys)	Lansdowne Forest Division (Lansdowne; Sonanadi WLS (Mundiapani; Nauri; Rathuadhab), Garhwal Forest Division (Khirsu, Adwani, Bharsar, ,Chorikhal).	773-2000m	July, October, November-December.
5.	Uttarkashi (5 surveys)	Govind Wildlife Sanctuary Forest Division (Dangan, Naitwar, Sankri, Taluka, Osla, Istragaad);Gangotri NP (Bhauranghati-Nilang).	1944-2543m	August

Table1. Details of forest sites surveyed for sampling butterflies in Uttarakhand (2006-2009, 2010 & 2017-2021).

6.	Rudraprayag & Chamoli (17 surveys)	Kedarnath Forest Division (Makkumath, Chopta, Deoriatal, Tungnath, Chirbatiya, Dugalbitta, Mohankhal, Trijuginarayan);Kedarnath Forest Division (Mandal, Kachulakharak, Anusuyia Devi).	2120- 3500m	April- November
7.	Chamoli (5 surveys)	Badrinath Forest Division (Gopeshwar; Joshimath,Mana, Niti pass), Nanda Devi National Park Forest Division (Auli-Gorson), Valley of Flowers National Park- HemkundSahib;	1550-4000m	April- November
8.	Pithoragarh (2 surveys)	Pithoragarh Forest Division (Dharamghar, Thal, Didihat, Chaubati, Munsiyari, Birthi, Lamgharghati, Kamedi Devi)	1449-2620m	May, September
9.	Nainital (4 surveys)	Nainital Forest Division (Sattal, Kilbury, Mahesh Khan, Nainital, Pangot, Vinayak, Bhimtal, Naukuchiyataal)	1360-2330m	May, September
10.	Almora (2 surveys)	Almora Forest Division (Binsar WLS, Siuni, Kausani, Almora, Hichuagaad) Soil Conservation Ranikhet Forest Division (Ranikhet)	1598-2312m	May, September
11.	Bageshwar (2 surveys)	Bageshwar Forest Division (Kukkudgaad, Garud, Shama)	940-1330m	May, September

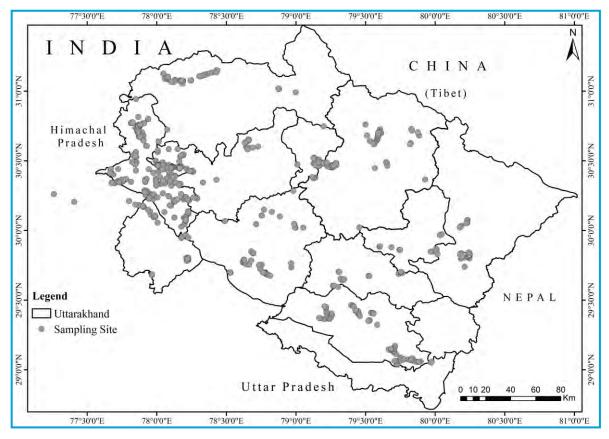


Fig.2. Map depicting the locations of sampling sites for study on butterflies undertaken during 2006-2009, June 2012 & 2017-2021.

Forest Sub-types of Uttarakhand

Champion and Seth (1968) classified Indian forest habitats into different types and subtypes, based on their similarity/dissimilarity of vegetation composition and structure. Out these 42 forest sub-types are known to occur in Uttarakhand state (FSI, 2019) out of which 23 prominent sub-types were sampled for butterflies (table.2).

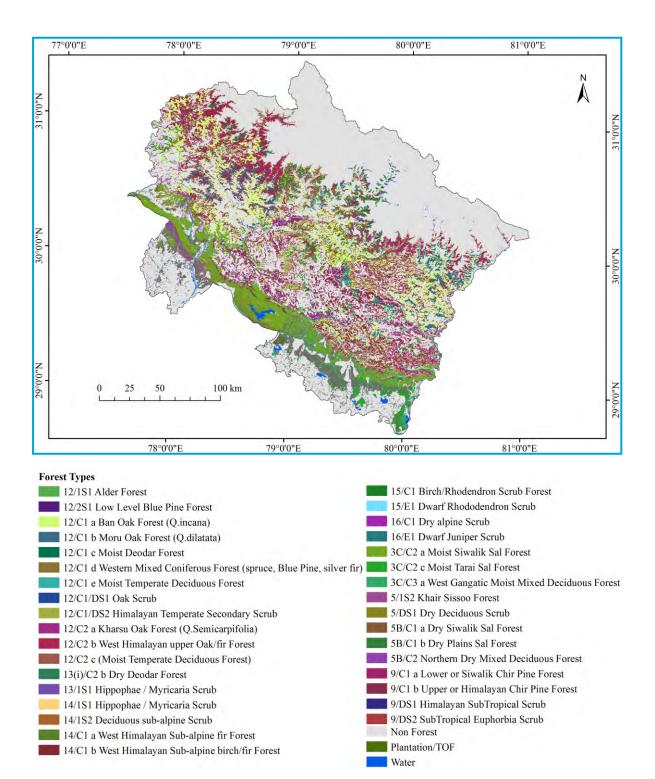


Fig3. Map depicting the spread/ distribution of major forest types occurring in the Uttarakhand state

Table2. The 23 Major Forest Sub-types covered during the surveys inUttarakhand, India

Sl. no.	Forest Sub-type	Area (km ²)	Percent of state cover
1	3C/C2a Moist Shiwalik Sal Forest	3158	12.97
2	3C/C2c Moist Terai Sal Forest	542	2.19
3	3C/C3a West Gangatic Mixed Moist Deciduous	868	3.5
4	5B/C1a Dry Shiwalik Sal Forest	236	1.5
5	5B/C2Northern Dry Mixed Deciduous Forest	678	2.82
6	5/1S2 Khair-Sissu Forest	236	0.98
7	9/C1a Lower or ShiwalikChir Pine Forest	436	1.75
8	9/C1b Upper or Himalayan Chir Pine Forest	6278	26.07
9	9/DS1 Himalayan Sub-tropical Scrub	165	0.67
10	12/C1a Ban Oak Forest	4798	20.23
11	12/C1b Moru Oak Forest	9317	3.95
12	12/C1c Moist Deodar Forest	485	1.96
13	12/C1d Western Mixed Coniferous Forest Spruce, Blue Pine Silver Fir	513	2.19
14	12/C1e Moist Temperate Deciduous Forest	246	1.07
15	12/C2a Kharsu Oak Forest (<i>Q.semicarpifolia</i>)	227	0.99
16	12/C2b West Himalayan Upper Oak/Fir Forest	1087	4.57
17	12/2S1 Low Level Blue Pine Forest	384	1.54
18	13/C2b Dry Deodar Forest	363	1.46
19	14/C1a West Himalayan Sub-Alpine Fir Forest	195	0.78
20	14/C1bWest Himalayan Sub-Alpine Birch/Fir Forest	583	2.47
21	14/1S2 Deciduous Sub-Alpine Scrub	200	0.86
22	15/C1 Birch/Rhododendron Scrub Forest	136	0.56
23	15/E1 Dwarf Rhododendron Scrub	32	0.13

DATABASE



DATABASE

A database was created on GIS platform for each taxa which not only depicts their geographical distribution in the state but also information on their classification, forest type association, seasonality, altitudinal distribution, wildlife protection act status, larval host plants along with images of both the sexes for identification. All these are depicted to help in conservation of butterfly biodiversity and ecology of the region i.e. Western Himalaya. The study for the first time assessed the species composition and community structure of butterflies across 20 prominent forest sub-types in Uttarakhand and revealed locations where taxa of conservation priority are located in the

Species pages

Classification: The database gives information of the classification of each taxa for their family, sub-family; tribe; genus, species, sub-species, author and year when described.

GIS Mapping and Forest-type Association: GPS locations/altitudinal distribution of all the 369 taxa recorded on 307 transects in each GIS map with 'grey dots'. False Color Composite GIS based maps for all the species were generated on a GIS platform using Arc GIS version 10.6., depicting the sites where they were recorded and thus distribution across associated forest sub-types in the state. Butterflies were recorded in 20 different forest sub-types across the state of Uttarakhand. GIS map generated for each taxa depicts the associated forest types of that that species with each forest sub-type represented in different colour in the map. The forest types associated with each butterfly taxa are mentioned in the legend in the map on the left side.

IWPA 1972 status: The legal status of species falling under various schedules of the Wildlife (Protection) Act,1972 in India have been given in the species page i.e. Schedule I, Part IV or Schedule II Part II or Schedule IV or Not Applicable (NA). 67 species in the database are protected under various schedules of the Wildlife (Protection) Act,1972 in India.

Relative Abundance status: The relative abundance of species ranged from 1-1596 individuals. These species were then ranked into four abundance classes based on their quartile division i.e. Q1= 1-7 Uncommon (1= rare); Q2=8-21= Fairly Common; Q3=22-69=Common; Q4=70-1596=Very Common; Median value = 21), as mentioned in the species page, for each taxa.

Altitudinal Distribution: This is based on the GPS Data for individuals sampled of each taxa. The range represents the lowest to the highest altitude (in meters) of record during sampling for the taxa, as points depicted on the GIS map.

Larval Host Plants: Data on larval host plants was gathered from various sources of literature (Wynter-blyth, 1957; Kehimkar, 2008; Robinson et. al.2010; Nitin et al,2018) and those recorded in this study and given in species pages along with the host plant family.

Images of species: Many of the species are dimorphic hence images of both the sexes are provided for identification which the author was able to capture in the field in the state of Uttarakhand.WSF stands for 'Wet Season Form' of that species, while DSF for 'Dry Season Form'. Symbol for male is \bigcirc and for female is \bigcirc . [All the images are by the author, except 3 images one each by Monsoon Jyoti Gogoi (species no.146); Tribhuwan Singh (no.299- female) and Sanjay Sondhi (no.363)].

Identification: Butterflies were identified from literature (Evans, 1932; Wynter-Blyth, 1957; Smith, 1989&2006; D'Abrera, 1982; 1985 & 1986; Kehimkar, 2008 & 2016) and comparison of museum specimens at National Forest Insect Collection at Forest Research Institute, Dehradun.

Seasonality: The season of occurrence of each taxa during different seasons of the year at a particular location is represented in 6 different colours in each map. The year has been broken into 6 seasons and represented in the legend of the map given in the left bottom, with a particular colour a mentioned below

- Winter (January-February): Dark Blue
- Spring (March-April): Red
- Pre-Monsoon (May-June): Yellow
- Monsoon (July-August): Light Green
- Post-Monsoon (September-October): Dark Pink
- Autumn (November December): Orange



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CLASSIFICATION OF BUTTERFLIES

Butterflies belong to the order 'Lepidoptera' also known as scaly winged insects, which include moths (Heterocera) and butterflies (Rhopalocera).

Sub-order: Rhopalocera (Butterflies: Clubbed antennae).

A.Super family: Papilionoidea

Family: 1. **Papilionidae (Swallowtails): 31 species..** Large butterflies with all legs fully developed. Hindwing is usually tailed with a concave inner margin and only one anal vein. Forewing vein in 3a is free towards the margin. Sub-families: Papilioninae (Swallowtails).

2. Pieridae (White and Yellows): 31 species. All legs functional, distinct bifid pretarsal claws, hindwing with a convex inner margin and 2 anal veins. Sub-families: Pierinae (Whites); Coliadinae (Yellows).

3. Lycaenidae (Blues): 98 species. All legs functional, although males may have claws missing from front legs, antennae bases adjacent to the eyes, and often indented. Mostly rather small, often metallic. Subfamilies: Poritinae (Gems): Lyphyrinae (Moth butterfly); Miletinae (Brownie, Darkie, Apefly); Curetinae (Sunbeams); Theclinae (Hairstreaks, Oakblues, Plushblues, Onyx, Silverlines, Royals, Tits, Sparks, Flashes); Lycaeninae (Coppers & Sapphires); Polyommatinae (Line Blues, Ceruleans, Pierrots, Hedge Blues, Jewels).

4. **Riodinidae (Judies and punches):** 7 species. The male's foreleg is non functional, and is much smaller then the rest .The foot (tarsus) is fused into a single segment and rarely has claws. Male lack scent scales. Brown butterflies with white spots and bands. The hindwings are lobed and may have a narrow tail. The punches can close their wings on their back while Judies can never close their wings as they are slightly curved.

5. Nymphalidae (Brush-footed butterflies): 137 species. Front legs useless for walking, brush-like in male, without claws, antennal club usually very clear. Sub-families: Amathusiinae (Faun, Jungle Queens & Kings, Glories, Duffers, Caliphs); Satyrinae (Palmflies, Browns, Foresters, Labyrinths, Goldenforks, Walls, Rings, Argus, Satyrs) Calinaginae (Freak); Charaxinae (Rajahs & Nawabs); Apaturinae (Emperors, Princes, Courtiers, Courtesans) Nymphalinae (Castors, Yeomans, Silverstripes, Fritillary's, Pansy's, Admirals, Tortoiseshells, Jesters, Eggflys, Oakleafs, Maps, Sailors, Sergeants, Commodores, Commanders, Barons, Dukes and Duchesses); Heliconiinae (Lacewings); Acraeinae(Costers); Danainae (milkweed

butterflies: Tigers and Crows); Libytheinae (Beaks).

B. Super-family: Hesperioidea

Family: 1. **Hesperiidae (Skippers): 61 species.** Antennae widely separated at base and gradually thickening to form the club, which is often hooked at the tip. Forewing with no stalked peripheral veins. Subfamilies: Coeliadinae (Awls, Awlets&Awlkings); Pyrginae (Flats); Hesperiinae (Hoppers, Aces, Bobs, Demons, Darts, Swifts).

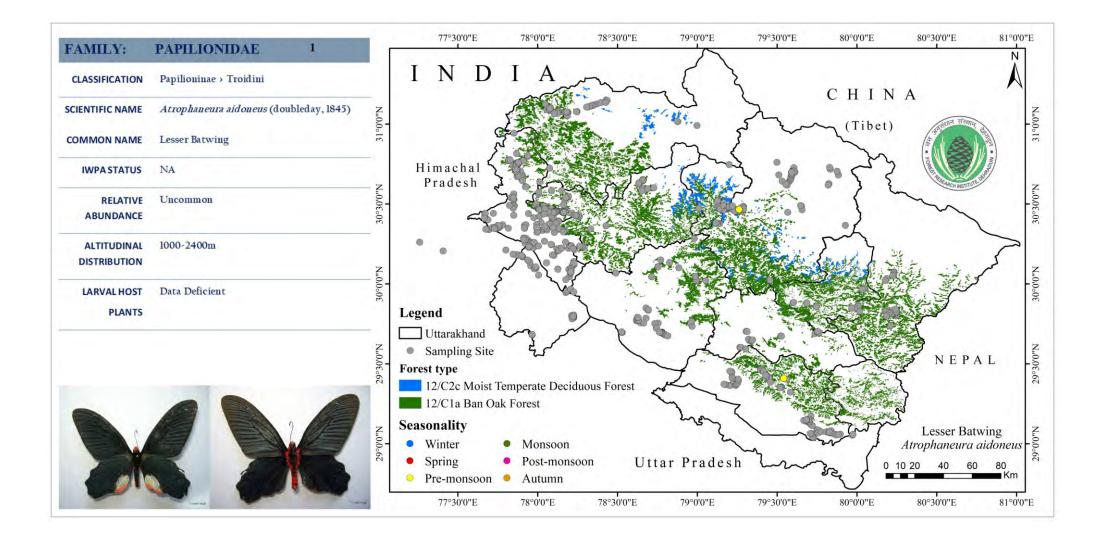
1.PAPILIONIDAE(Swallowtails)(1-31)

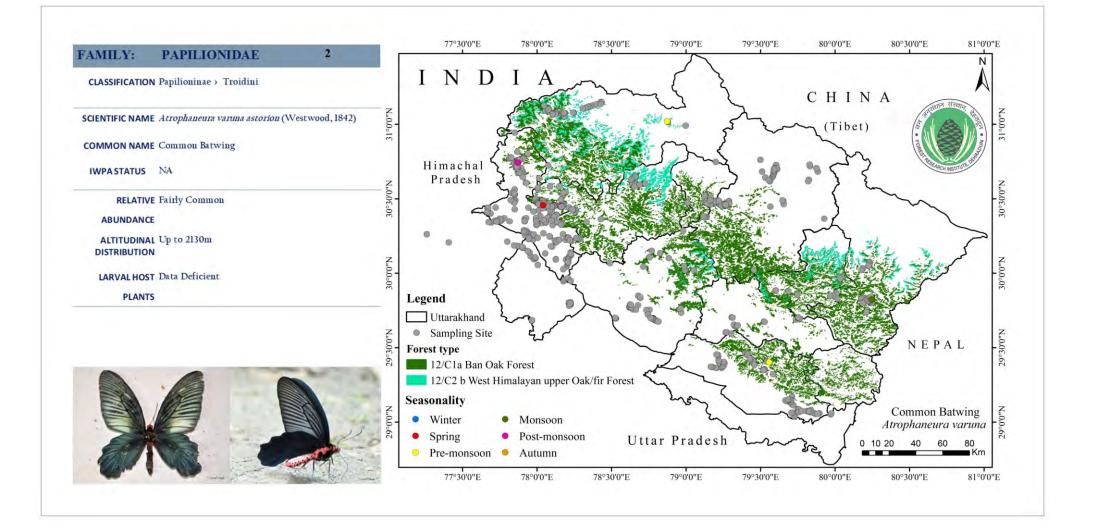


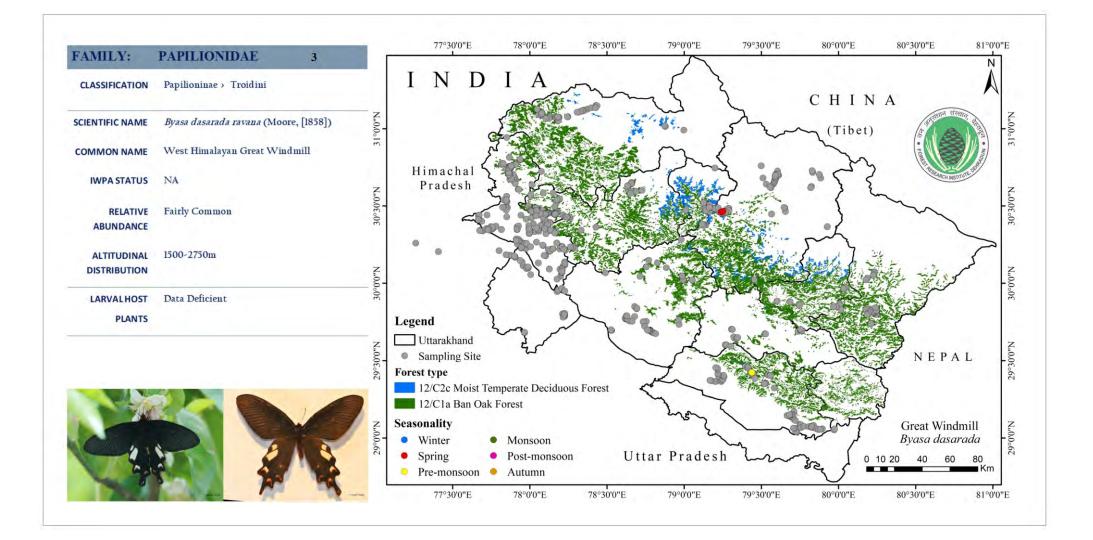
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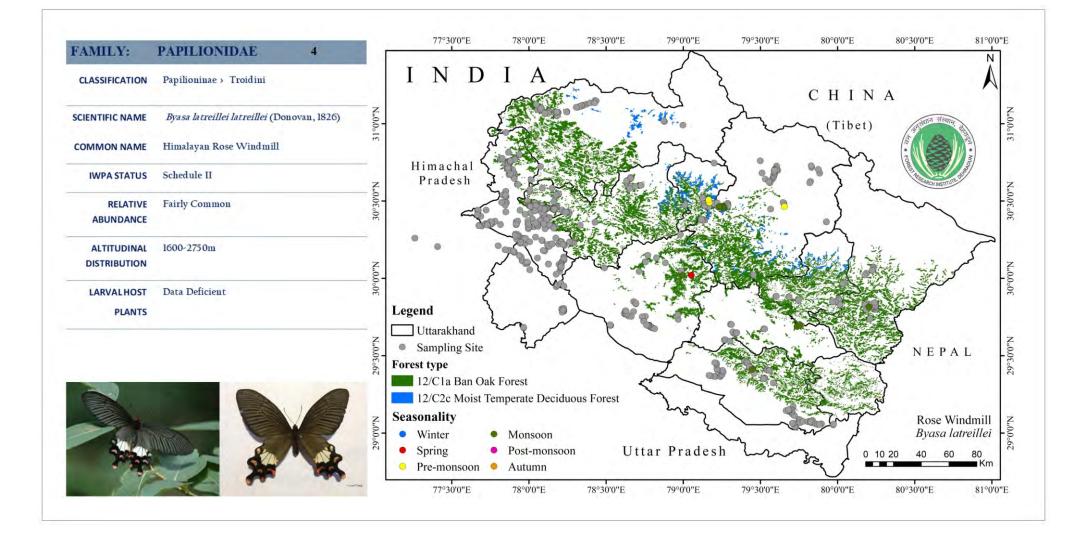
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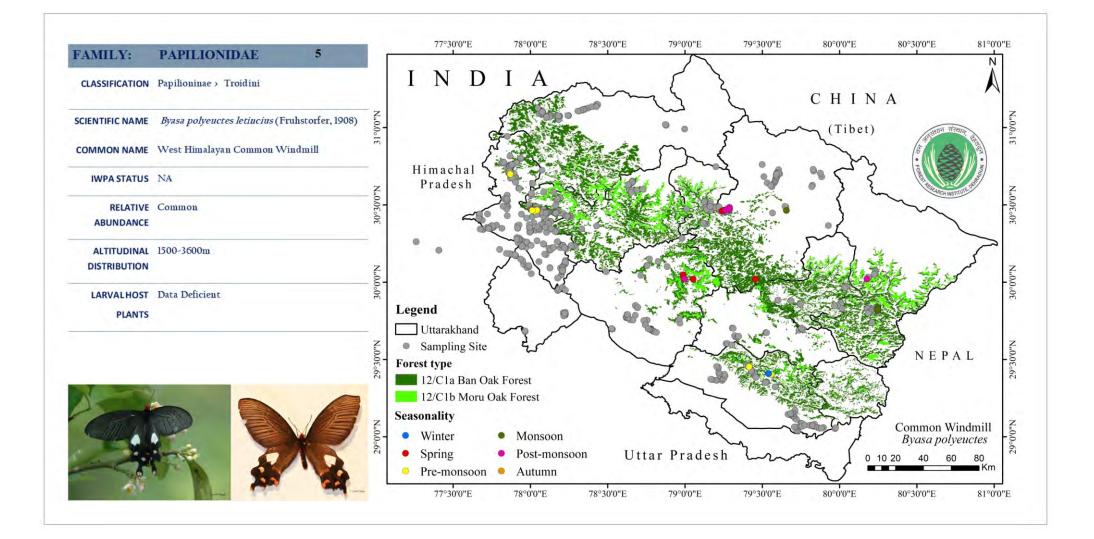
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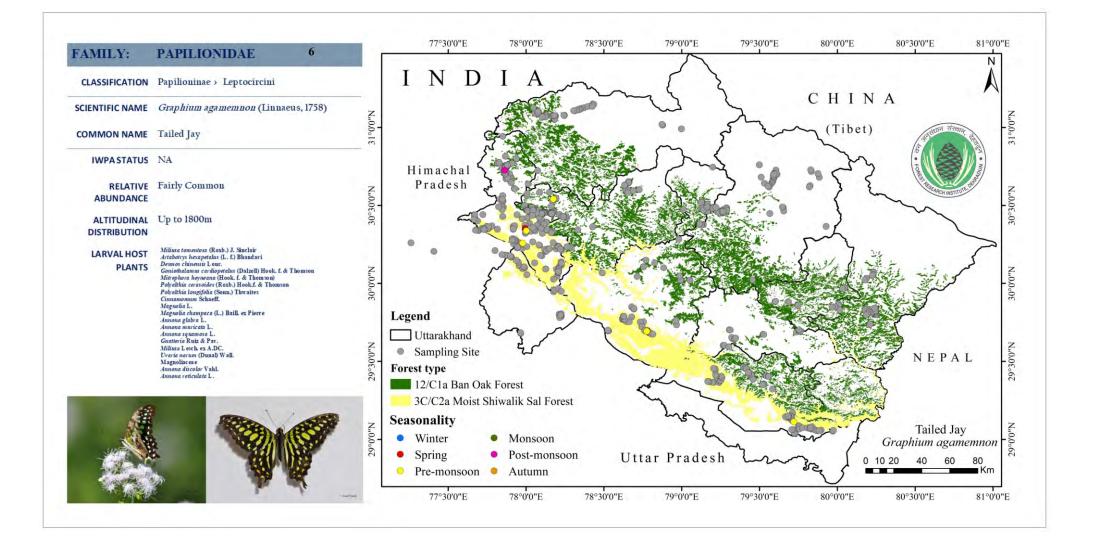


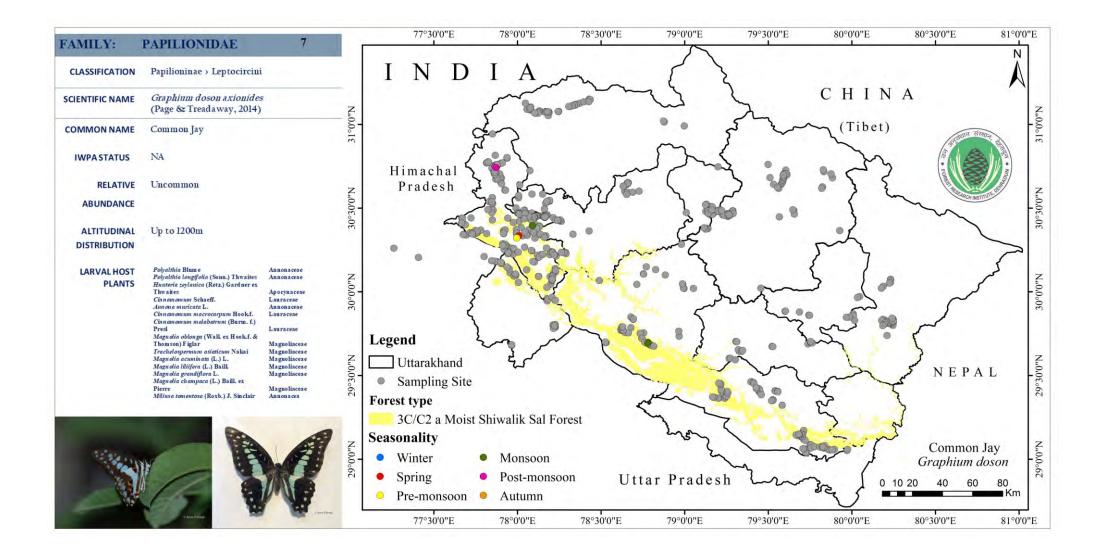


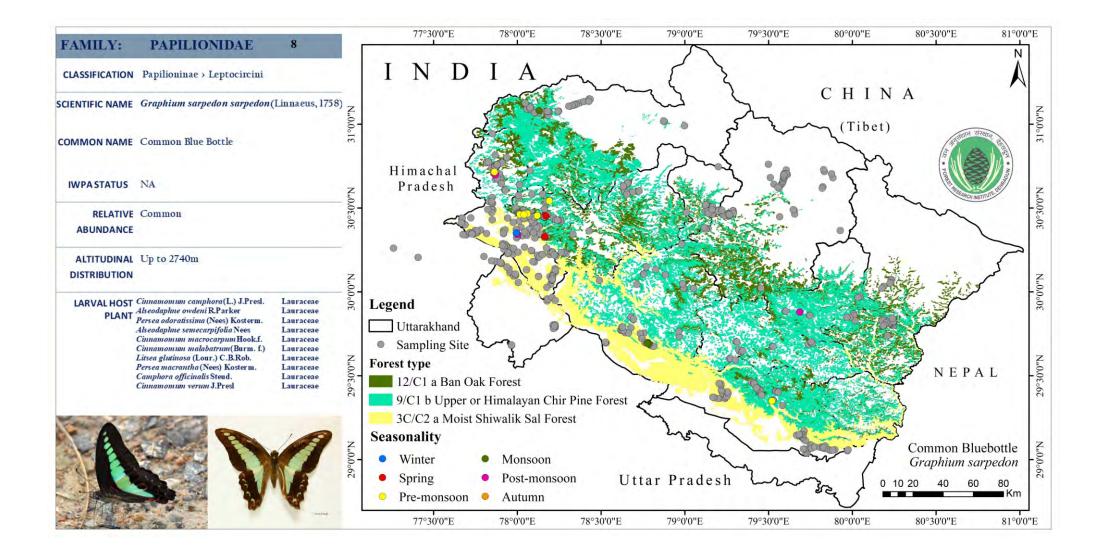


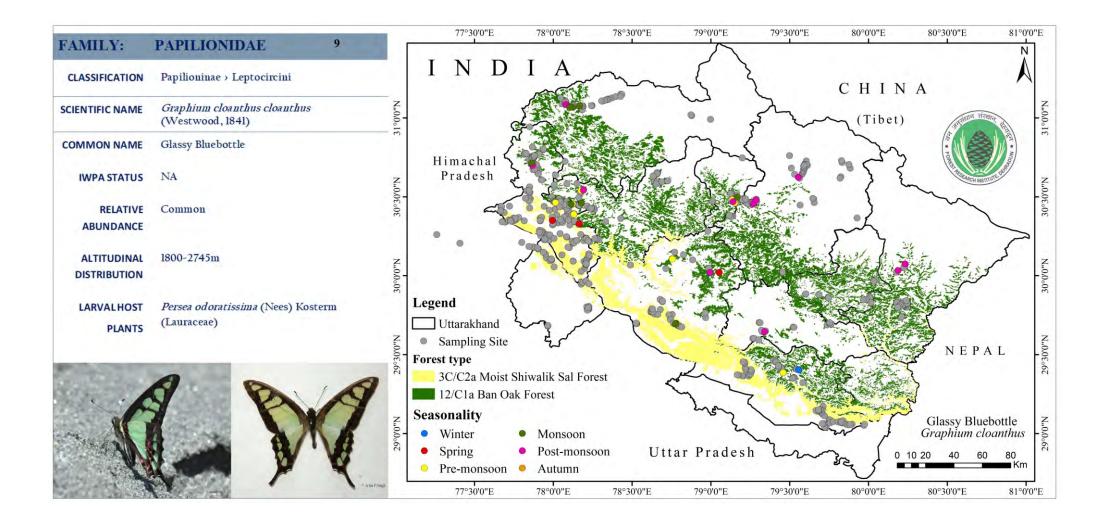


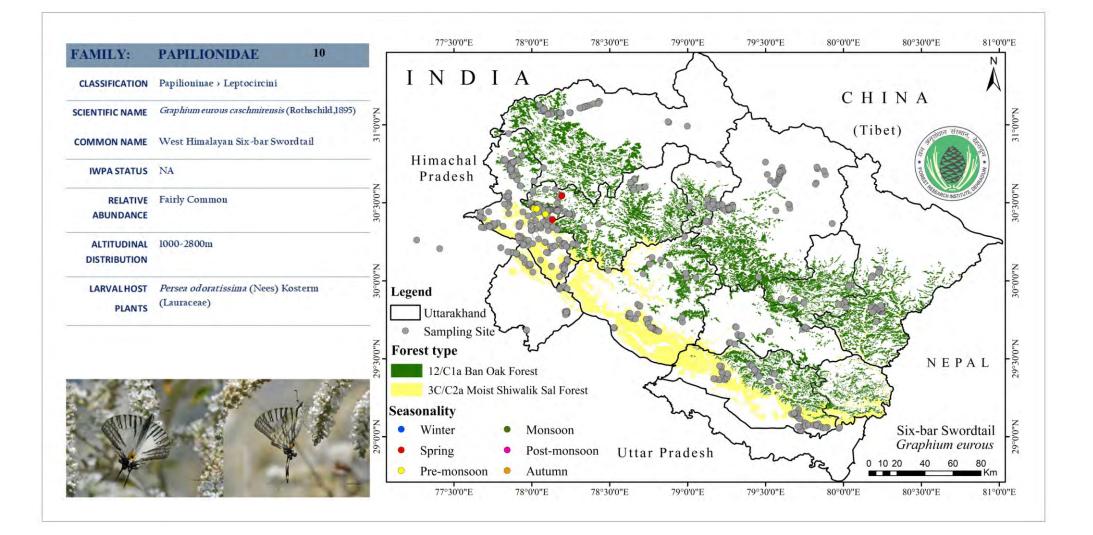


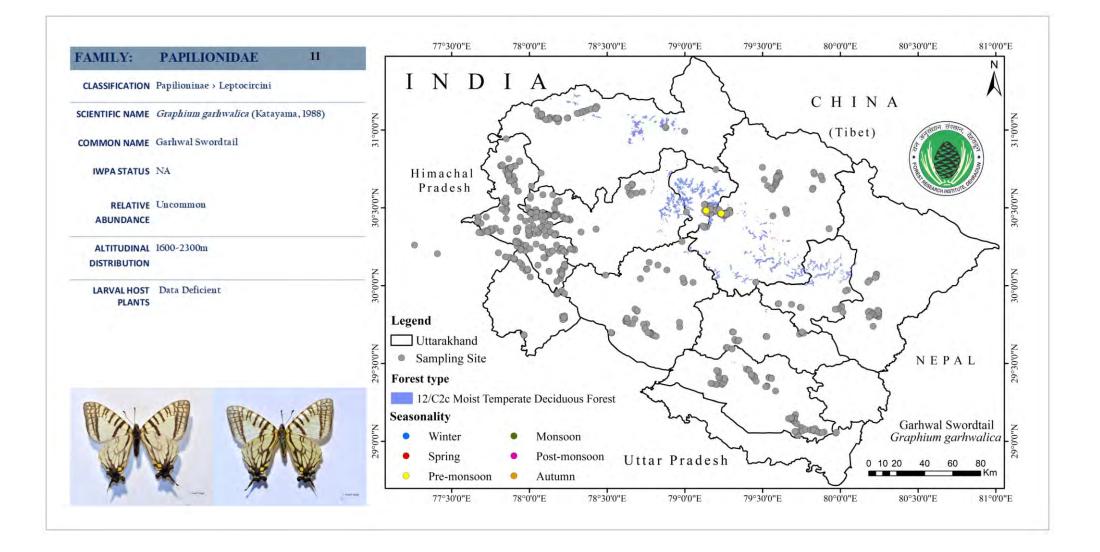


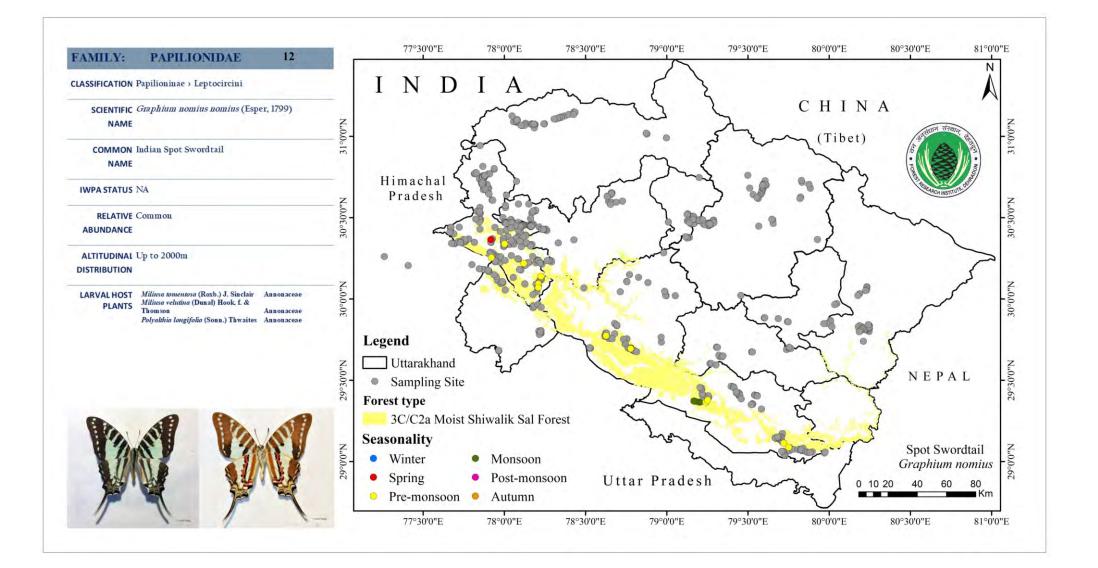


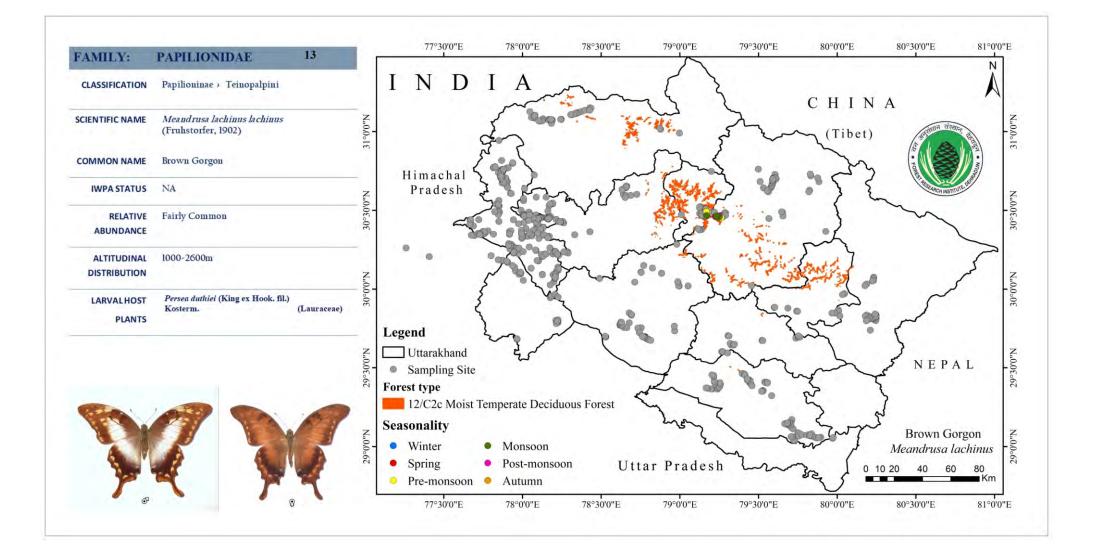


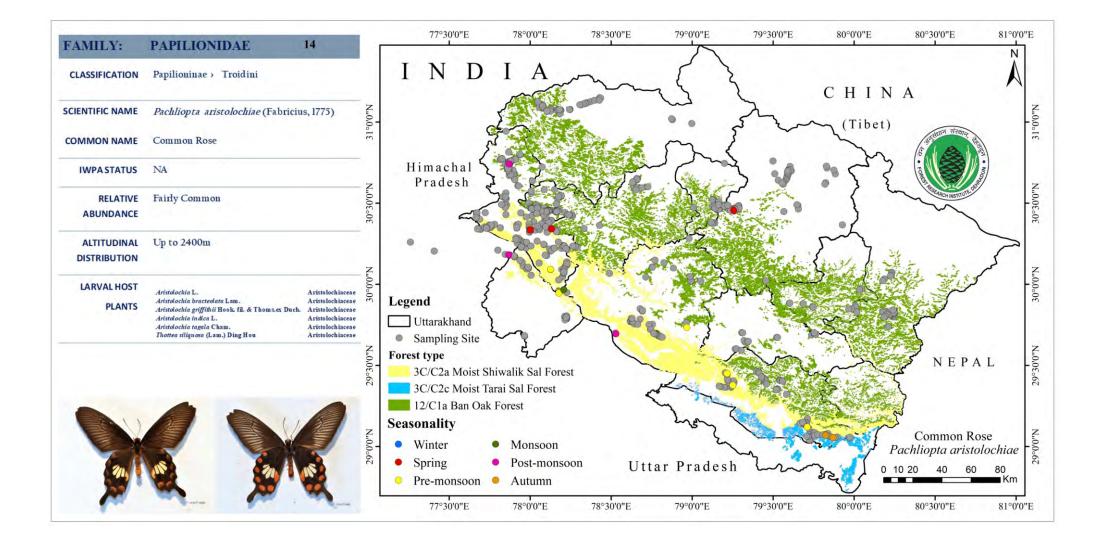


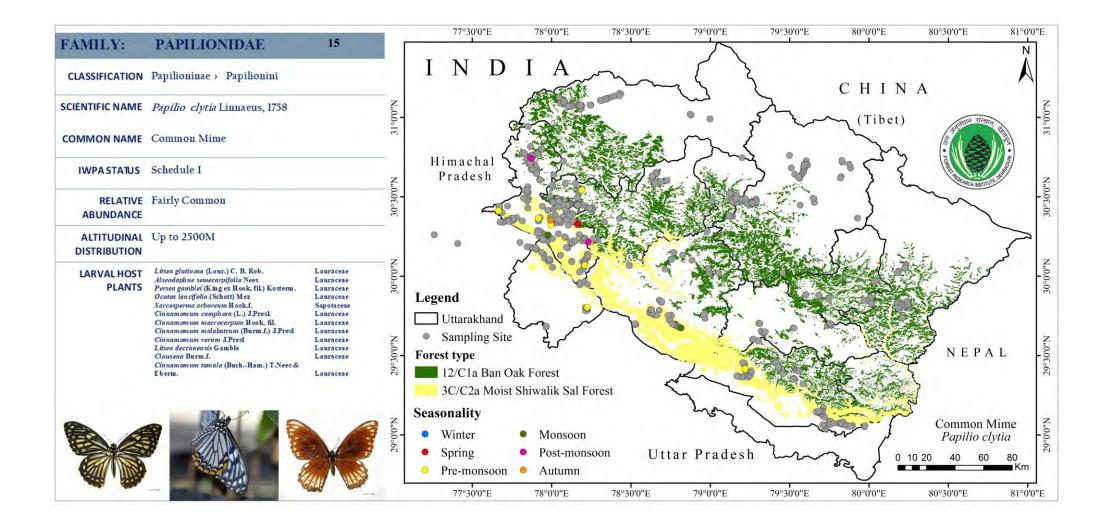


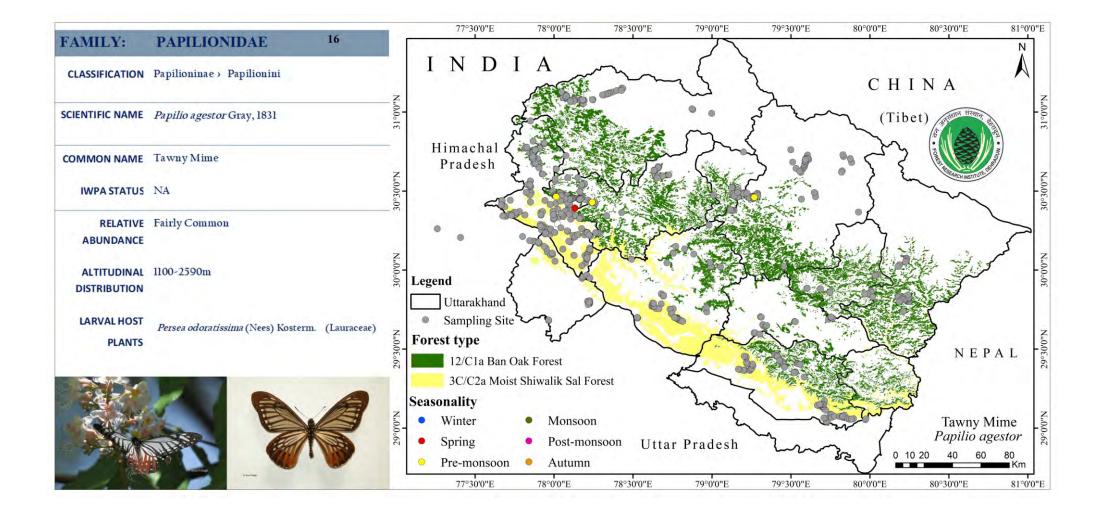


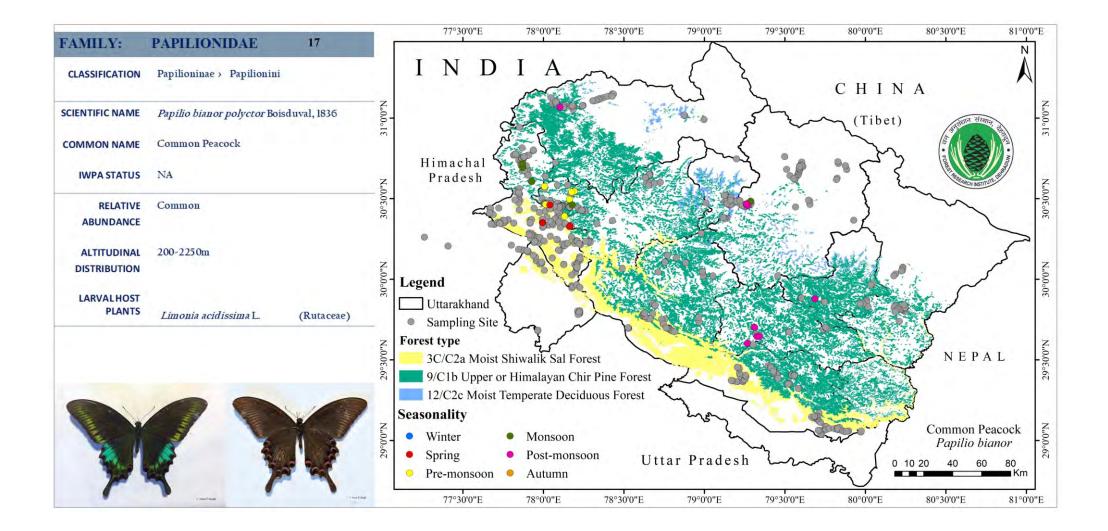


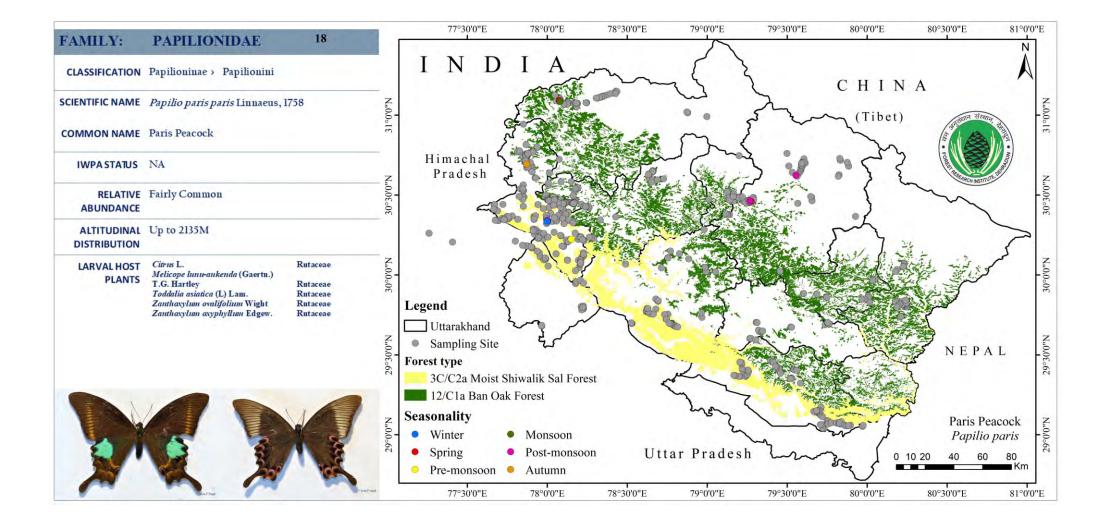


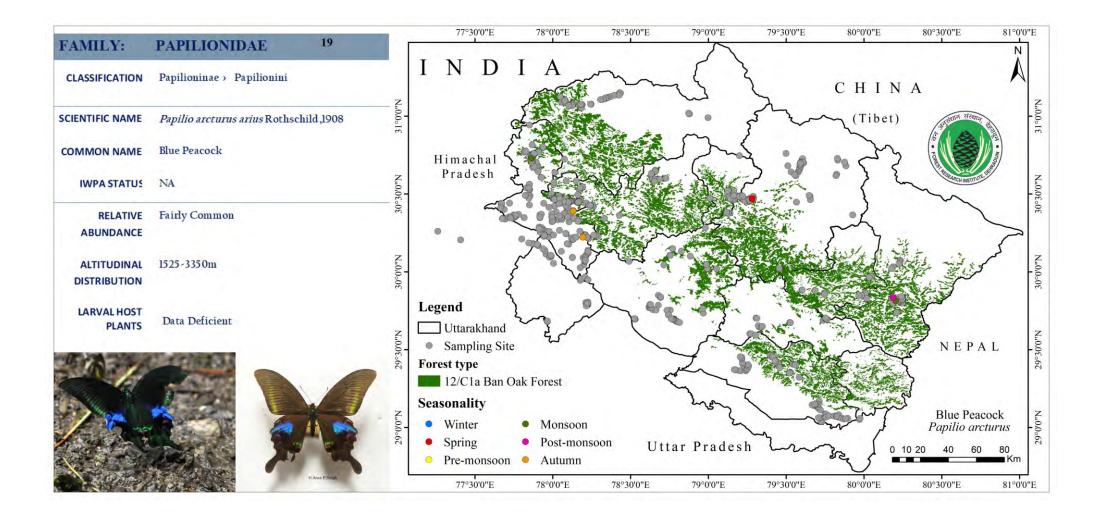


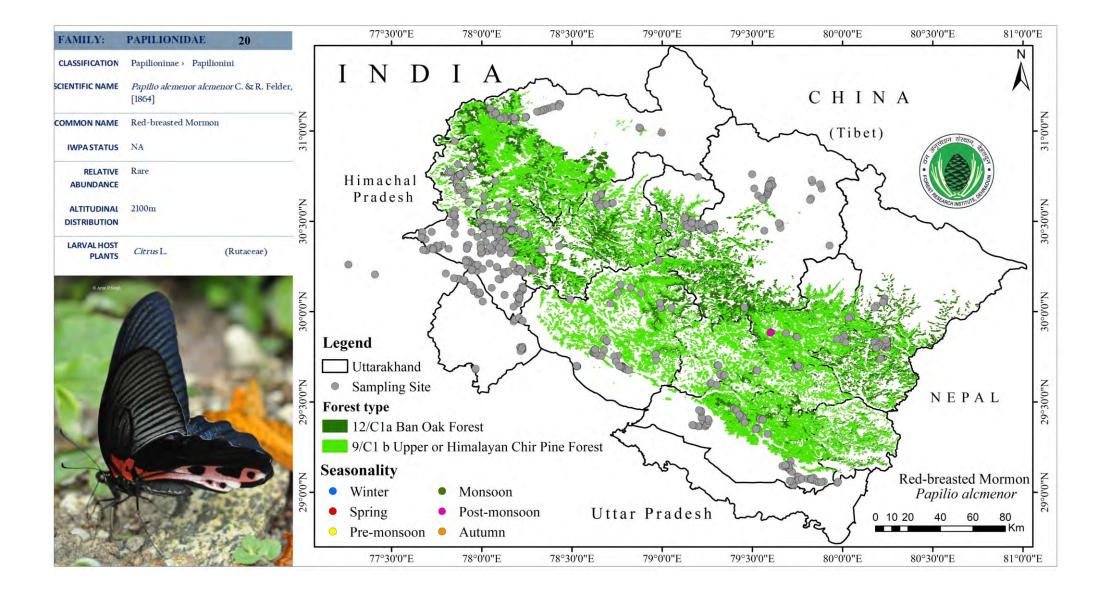


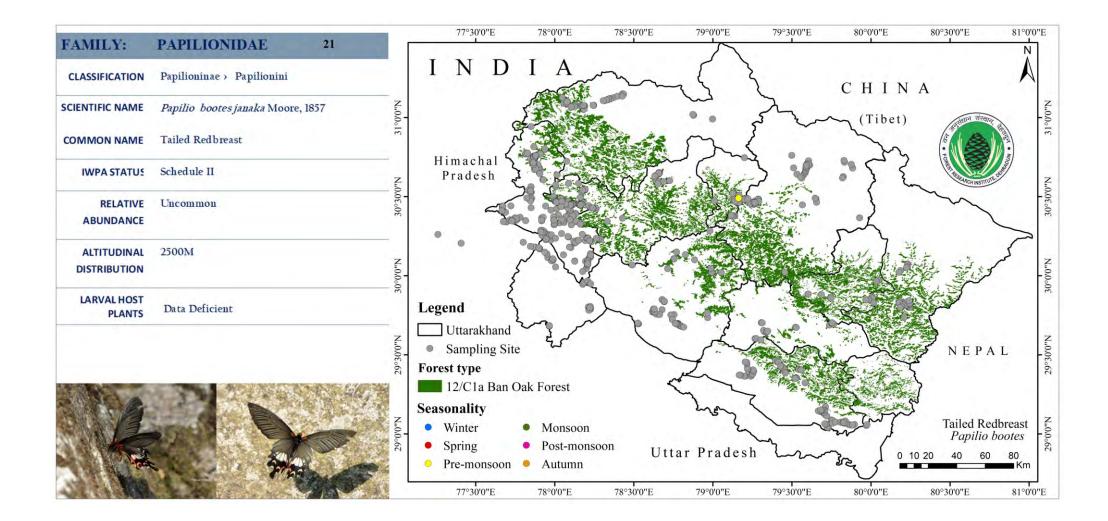


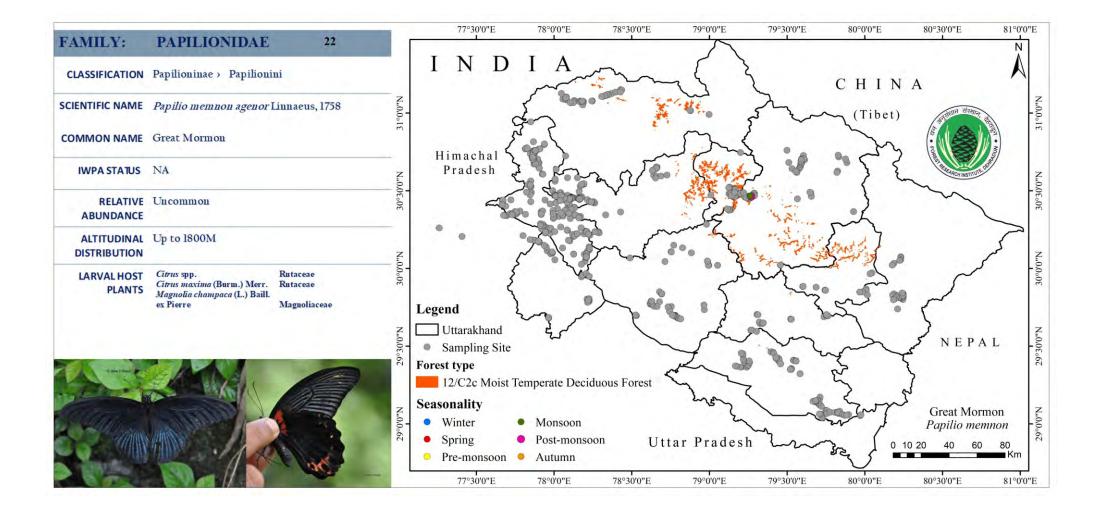


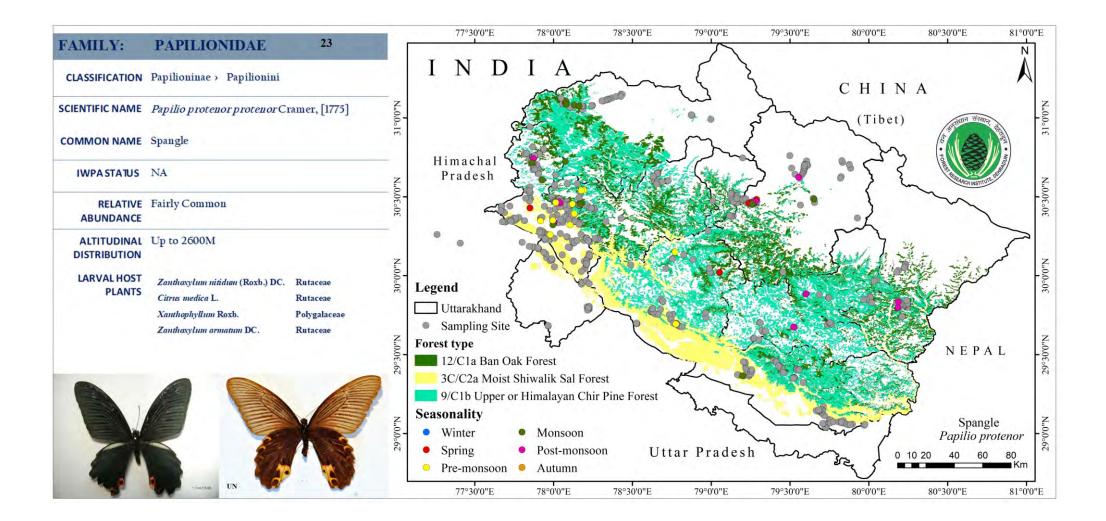


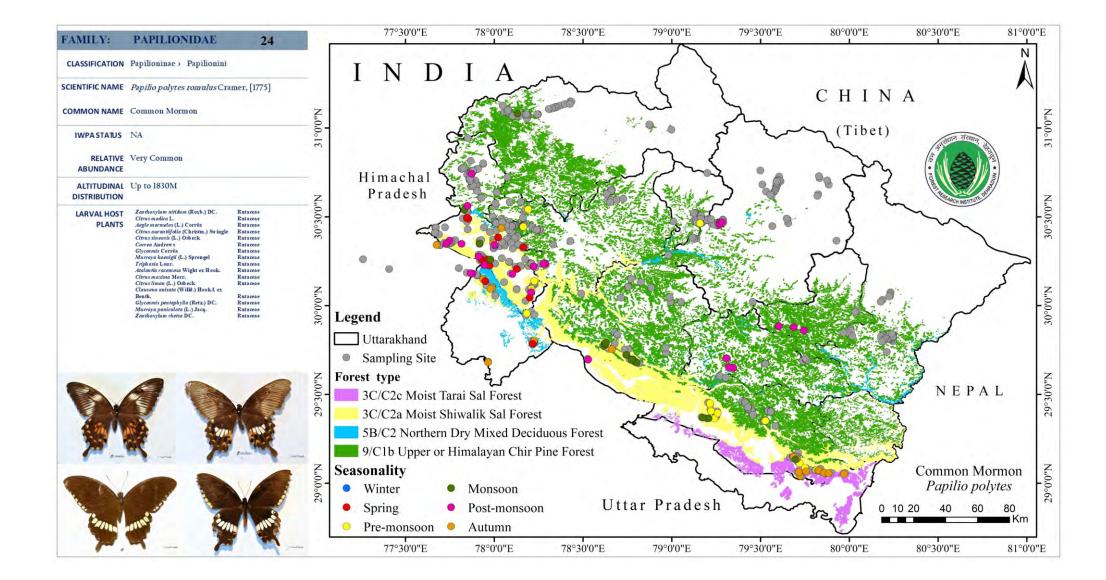


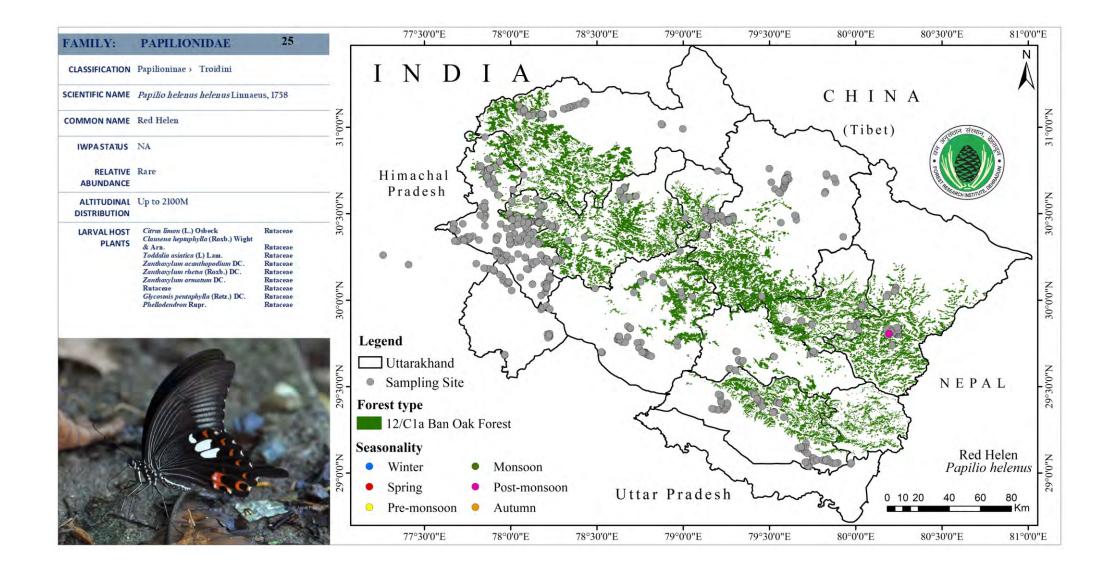


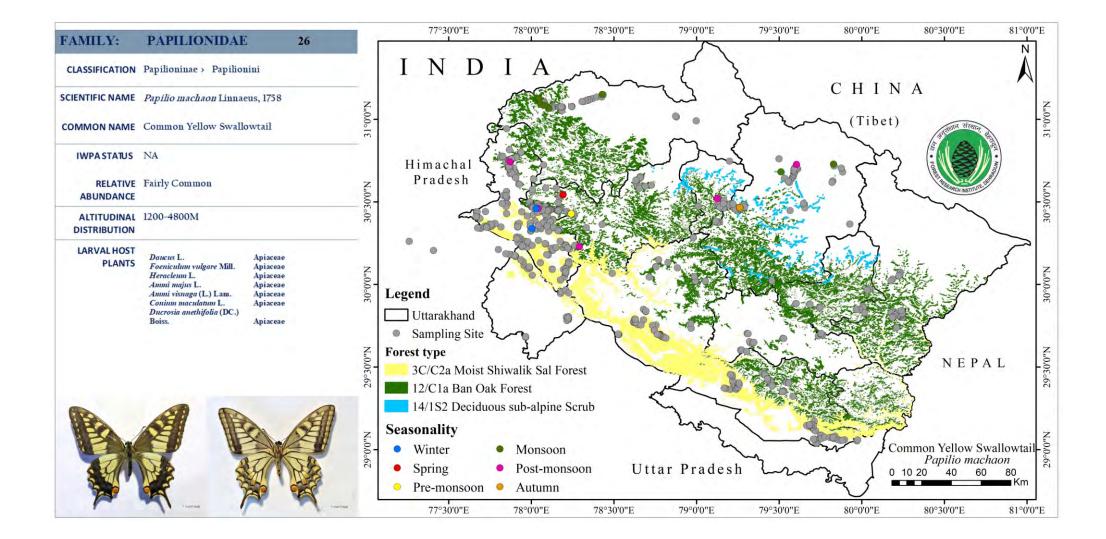


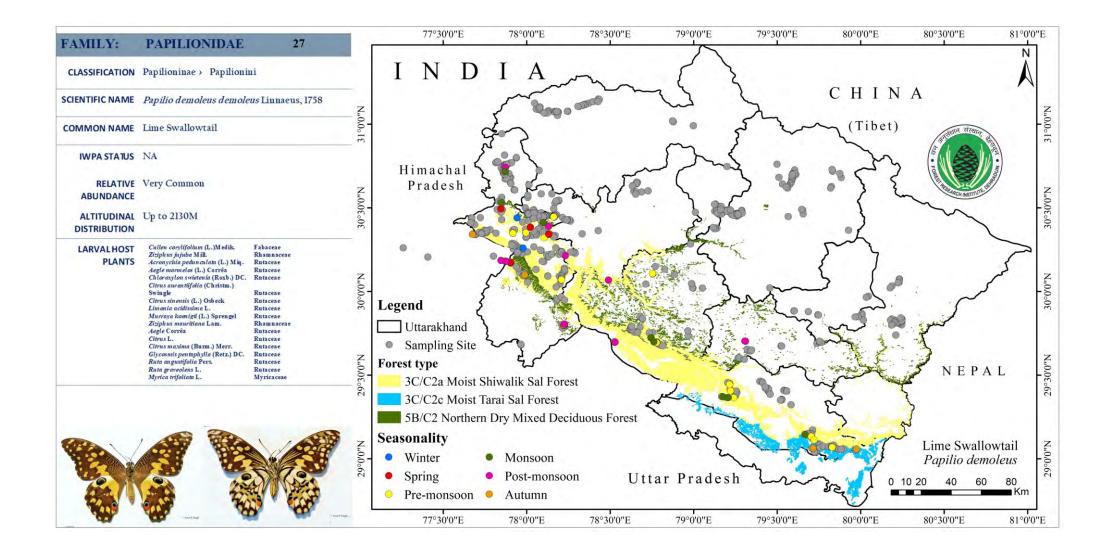


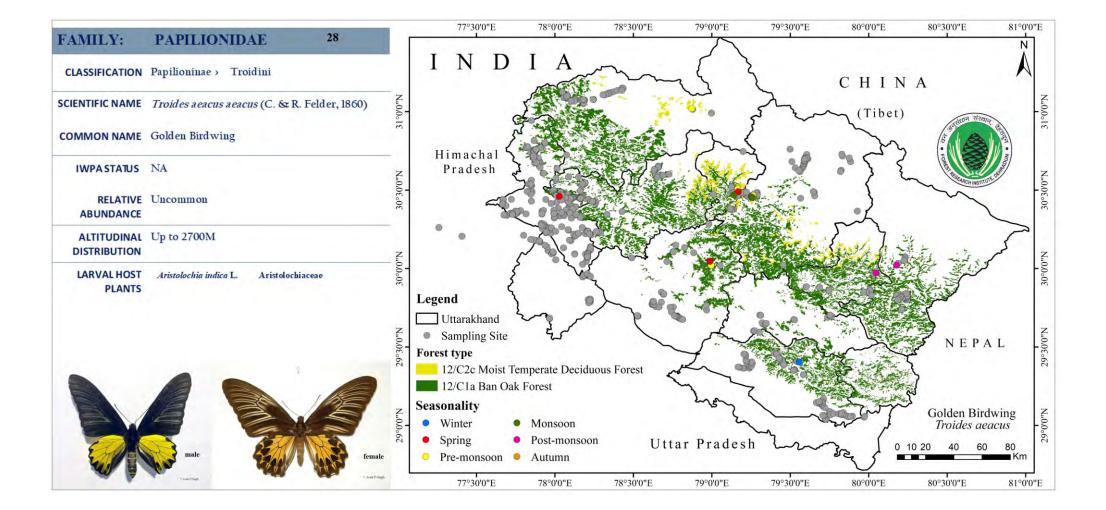


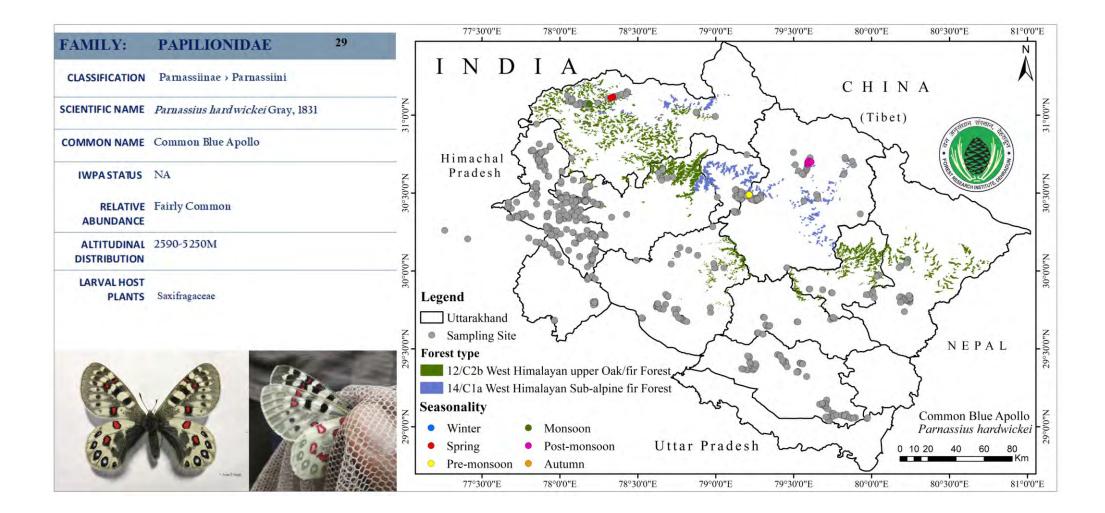


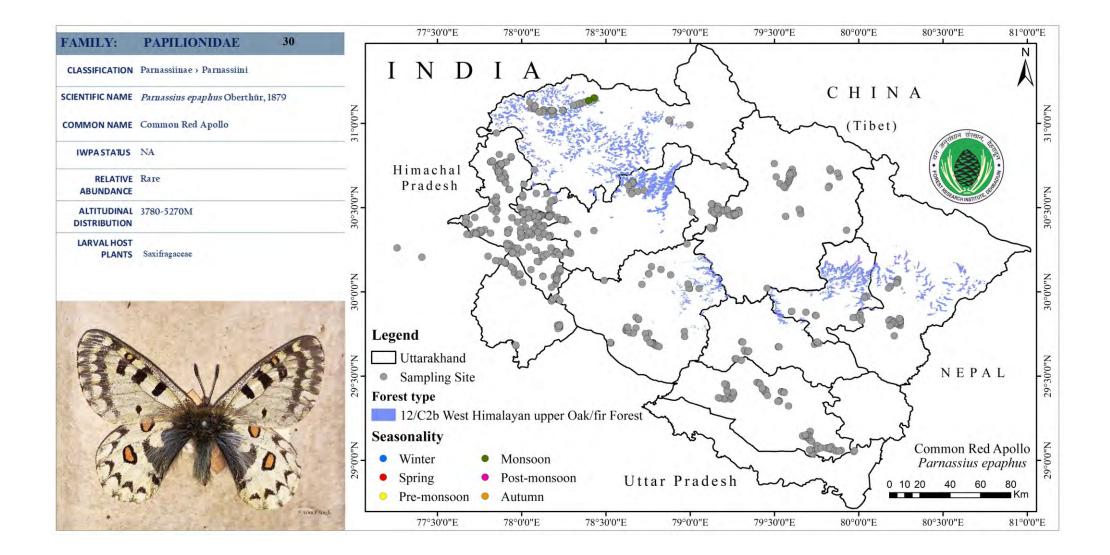


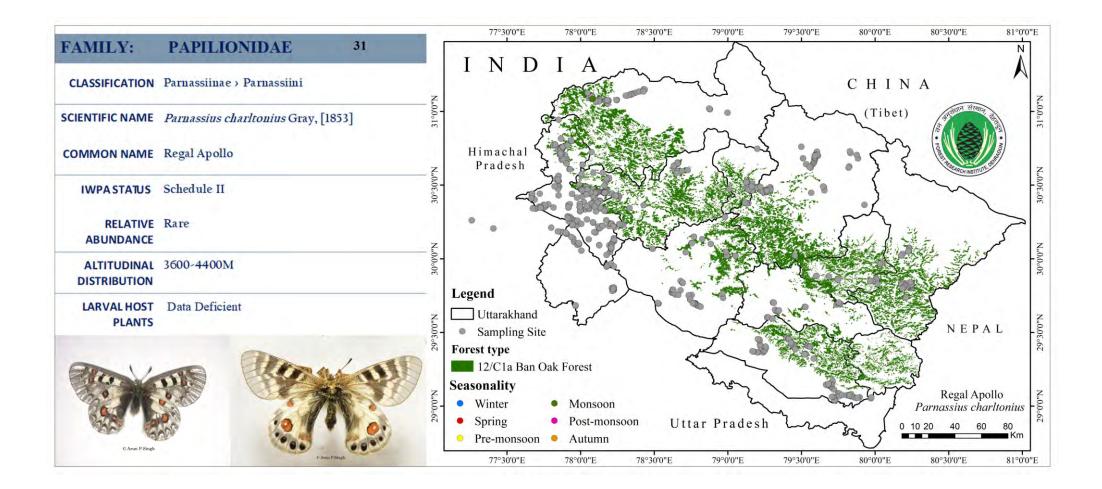










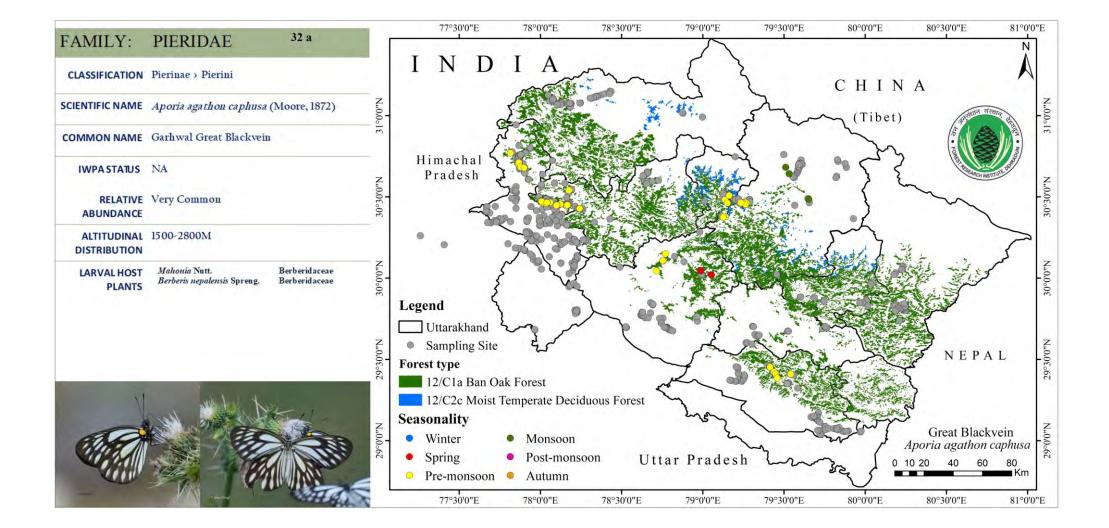


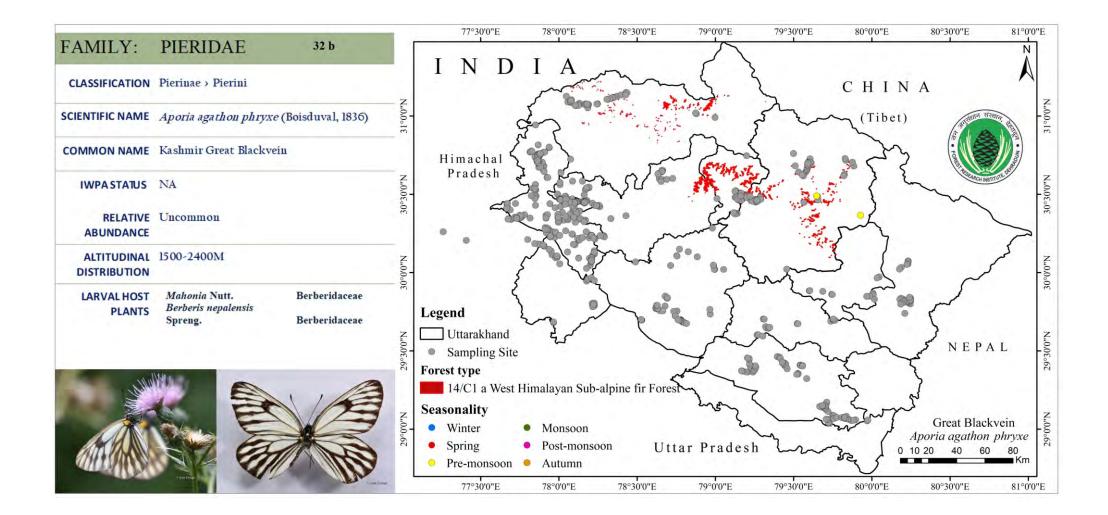


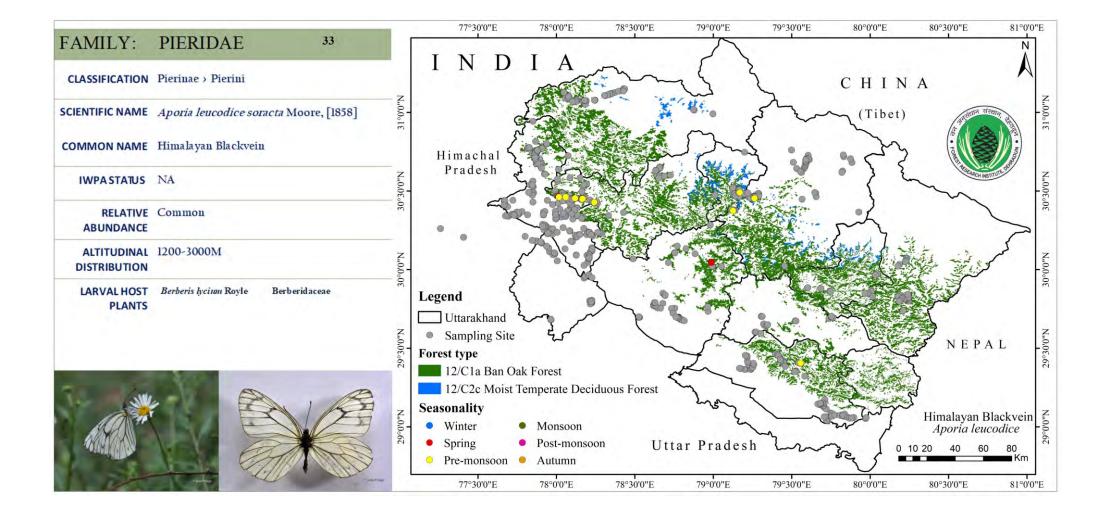
2.PIERIDAE (White & Yellows) (32-62)

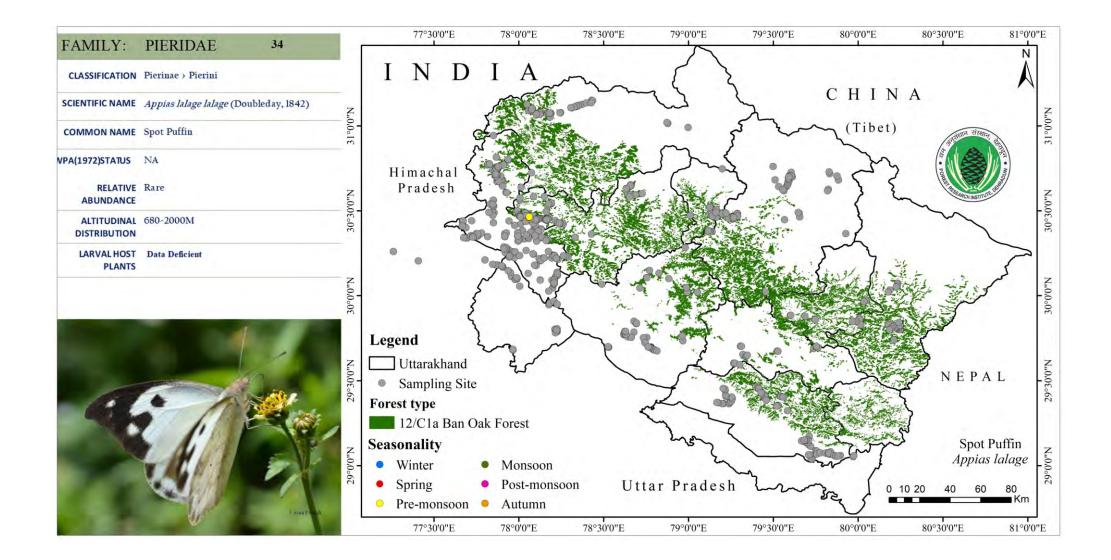


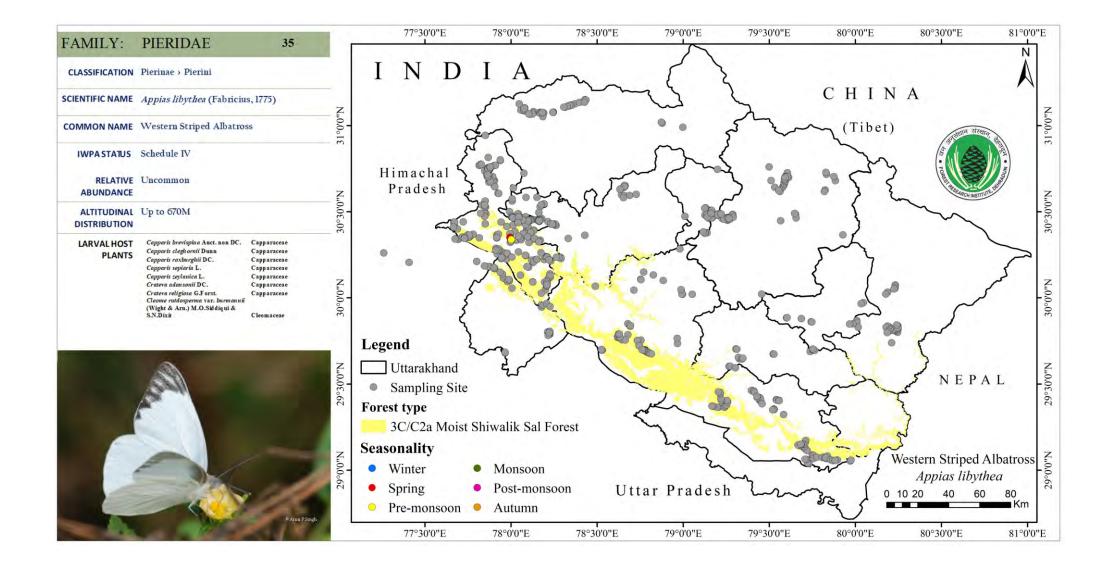
Moist Temperate Deciduous Forest

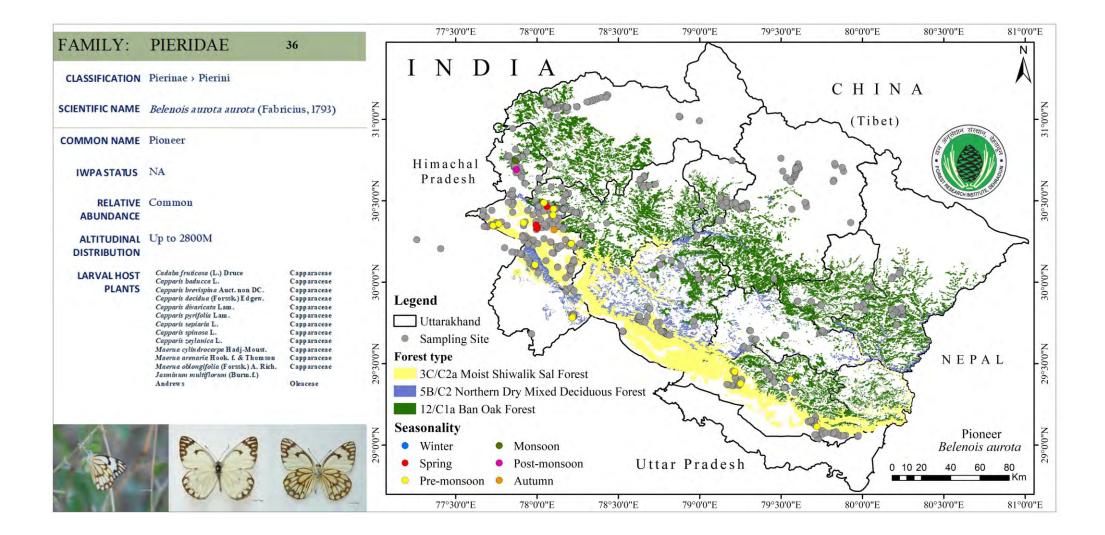


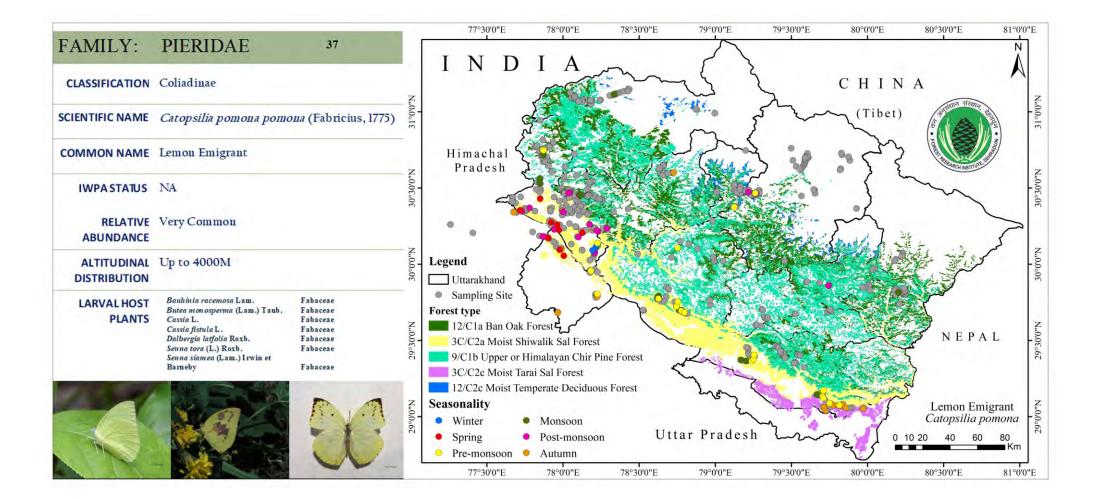


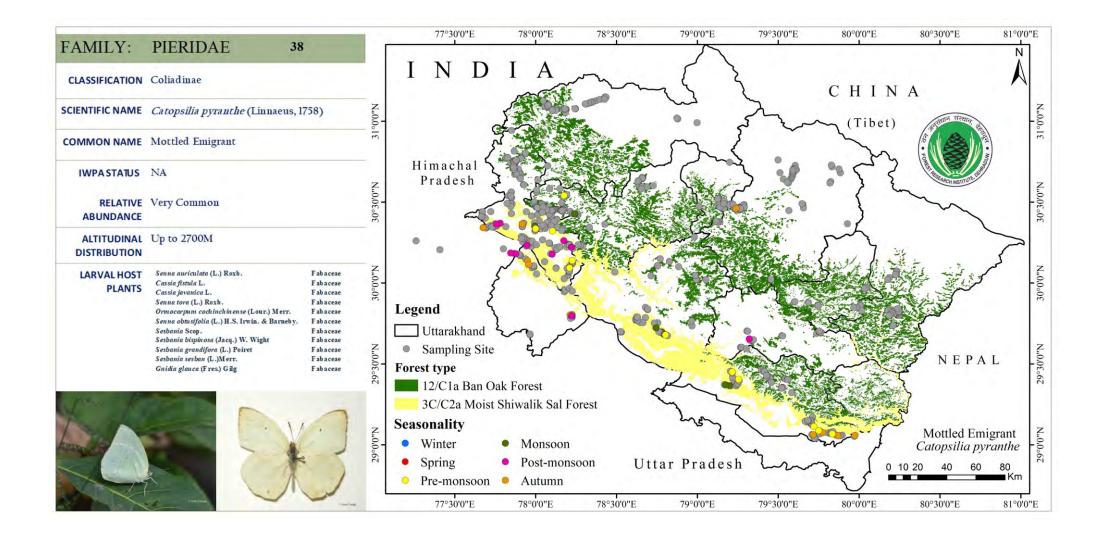


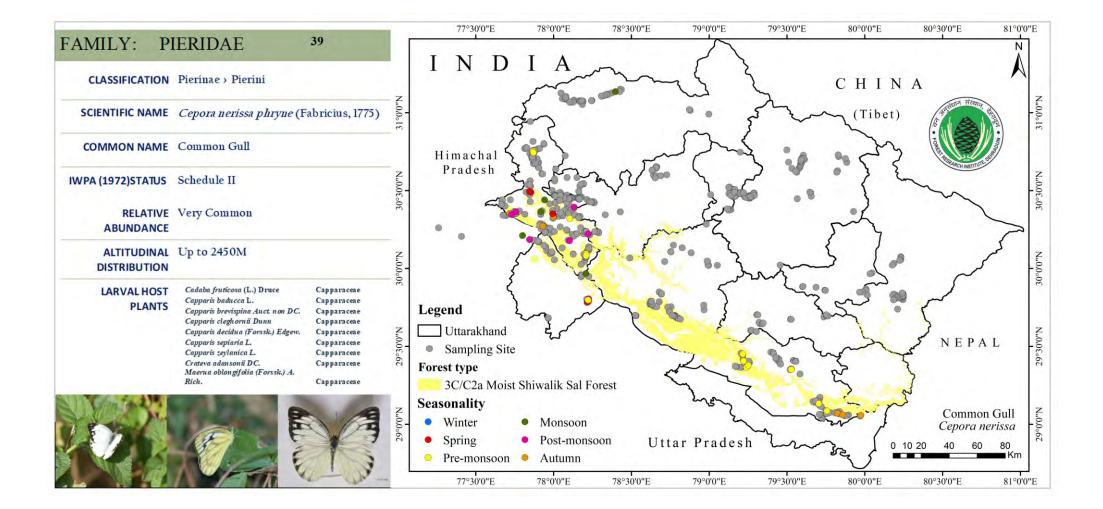


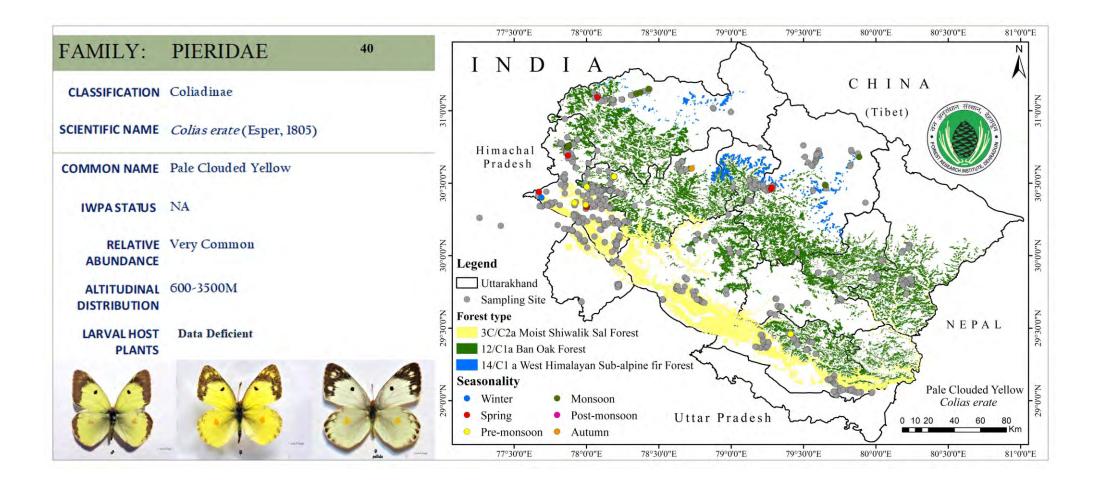


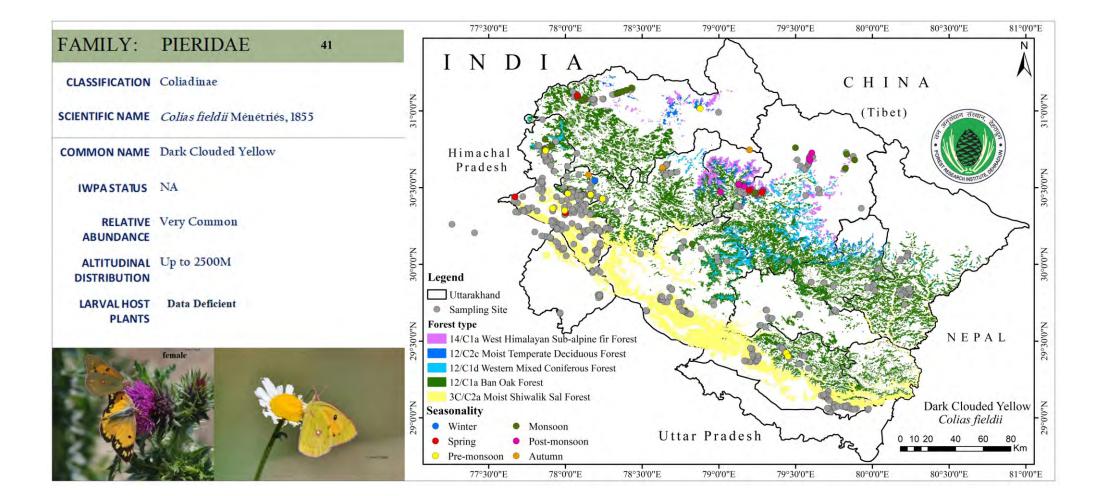


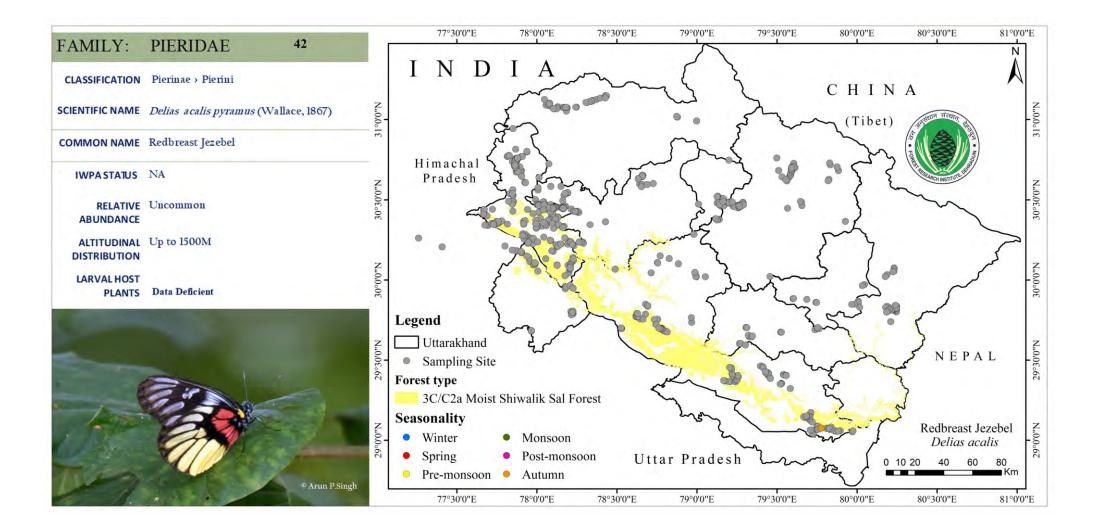


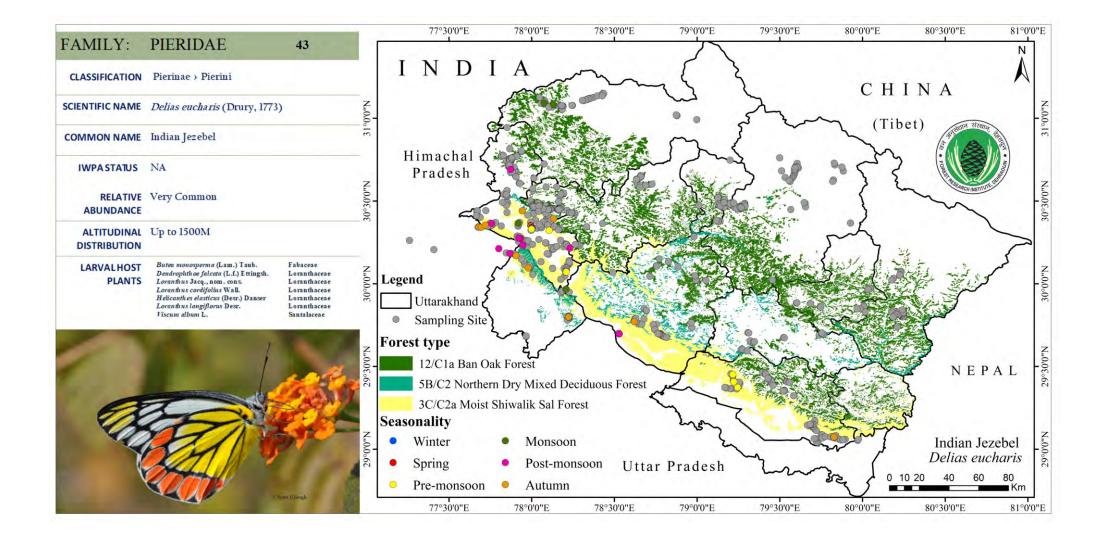


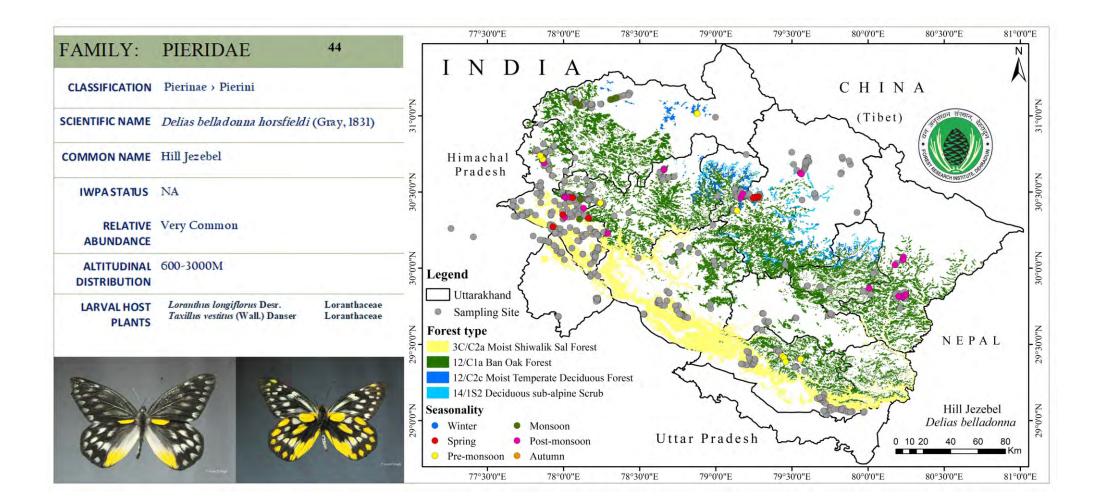


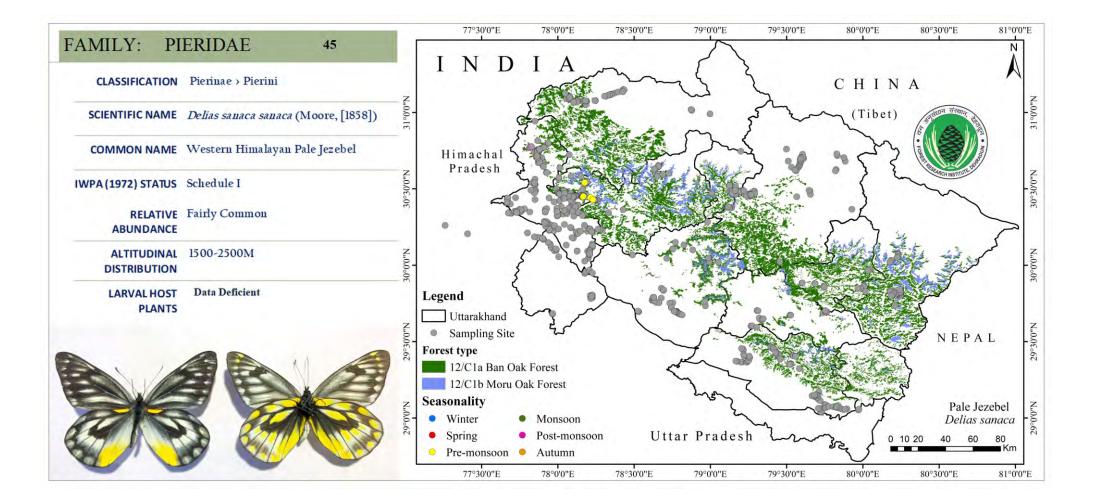


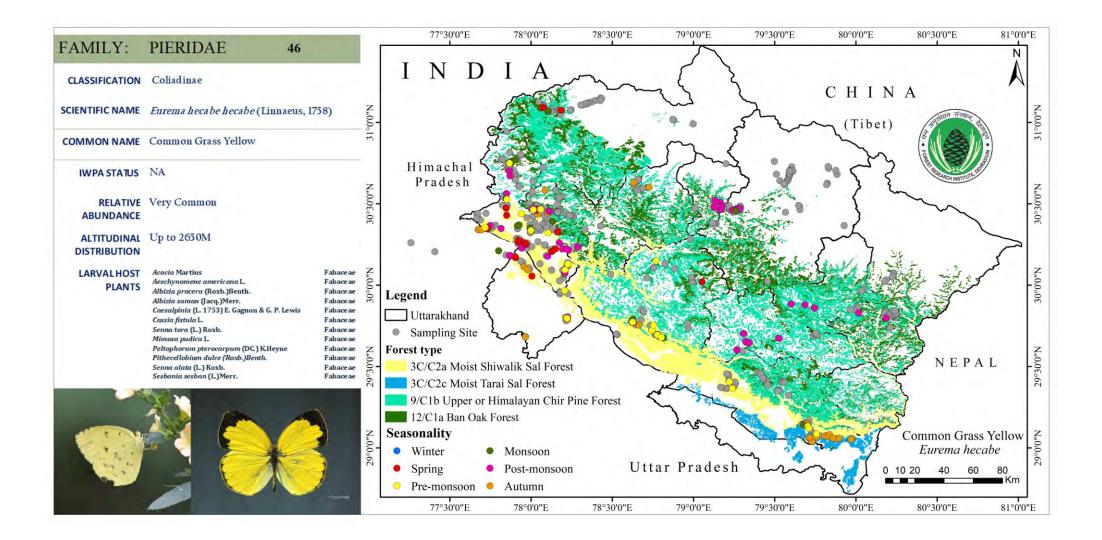


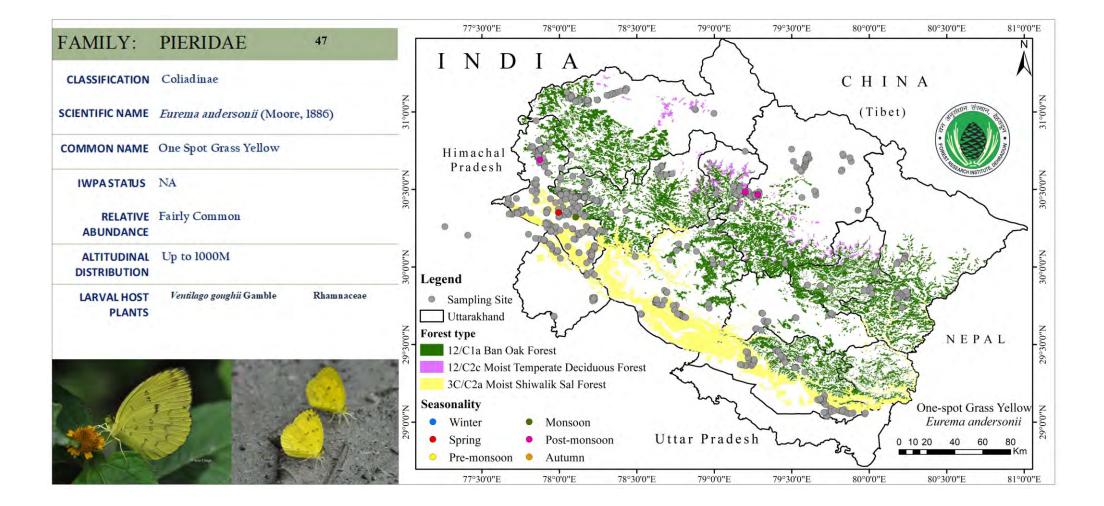


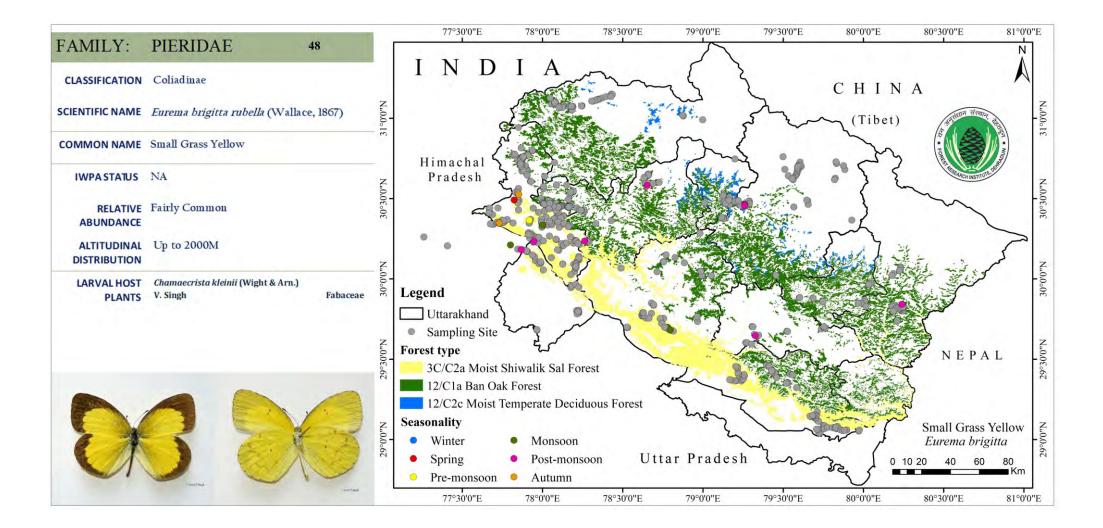


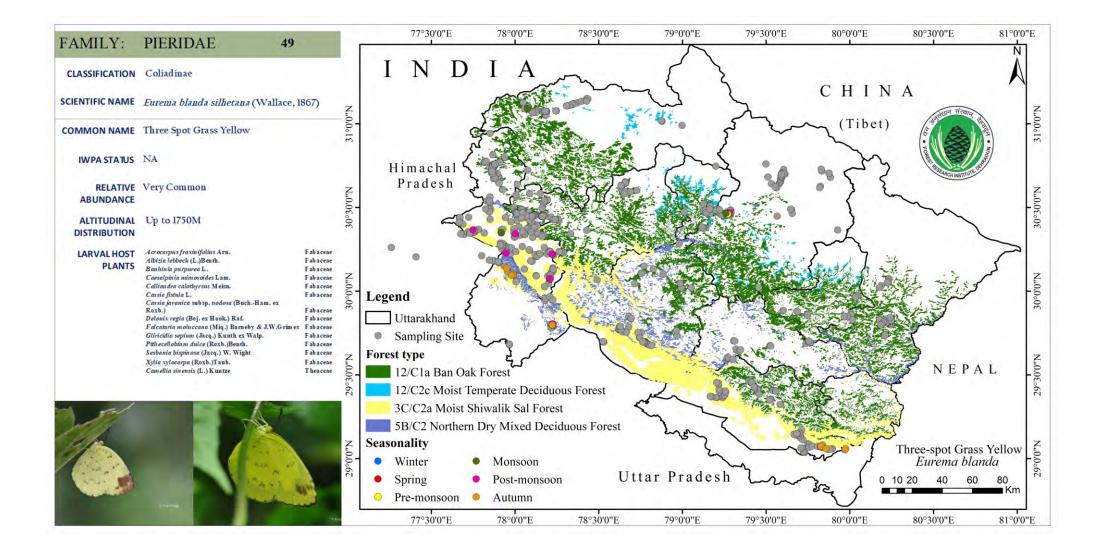


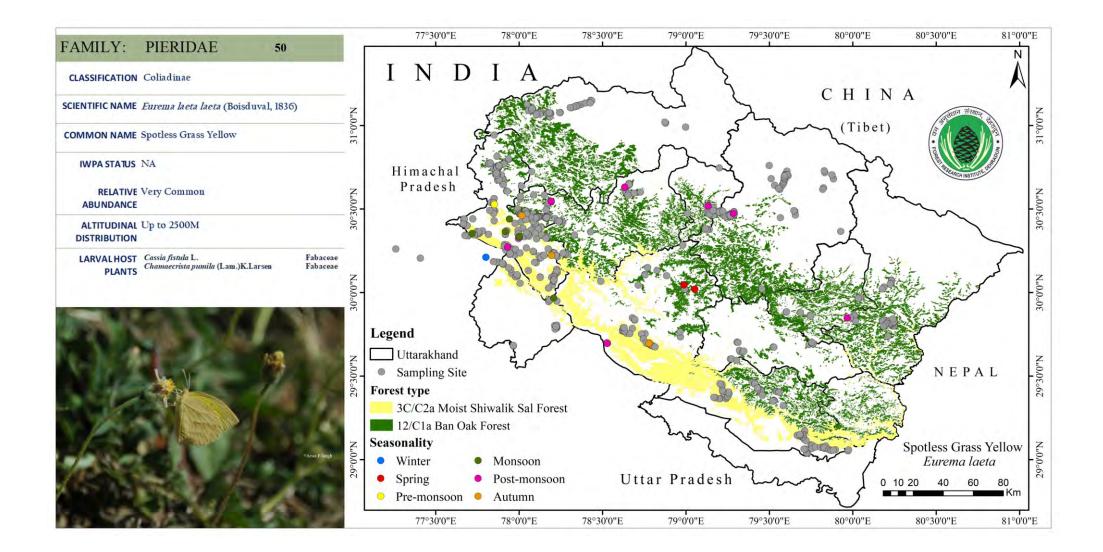


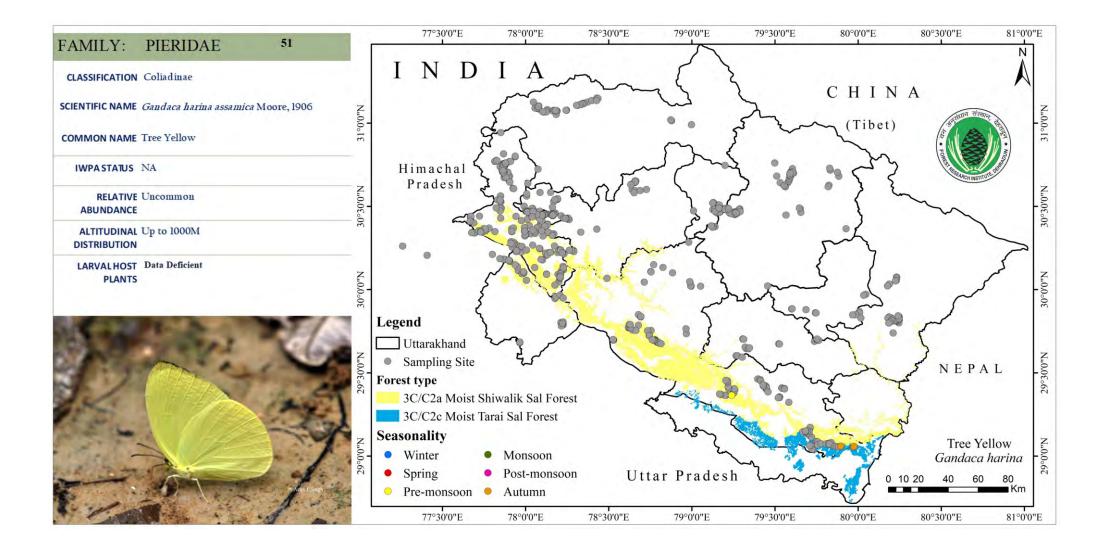


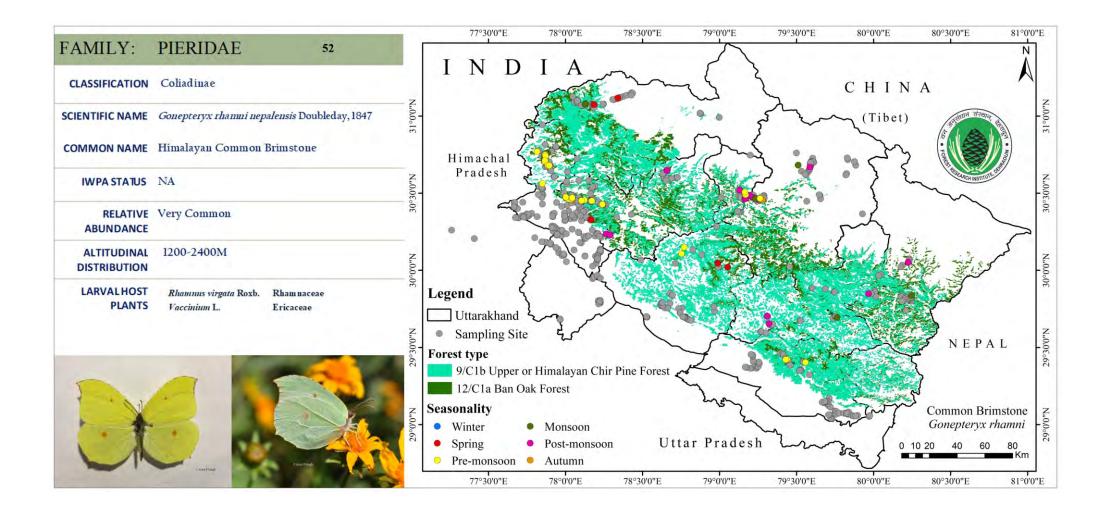


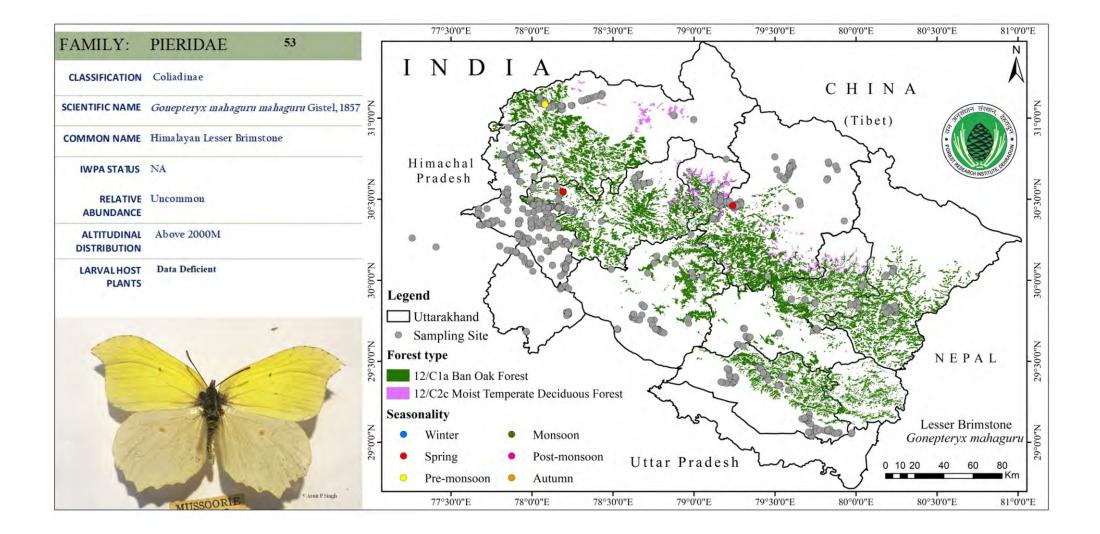


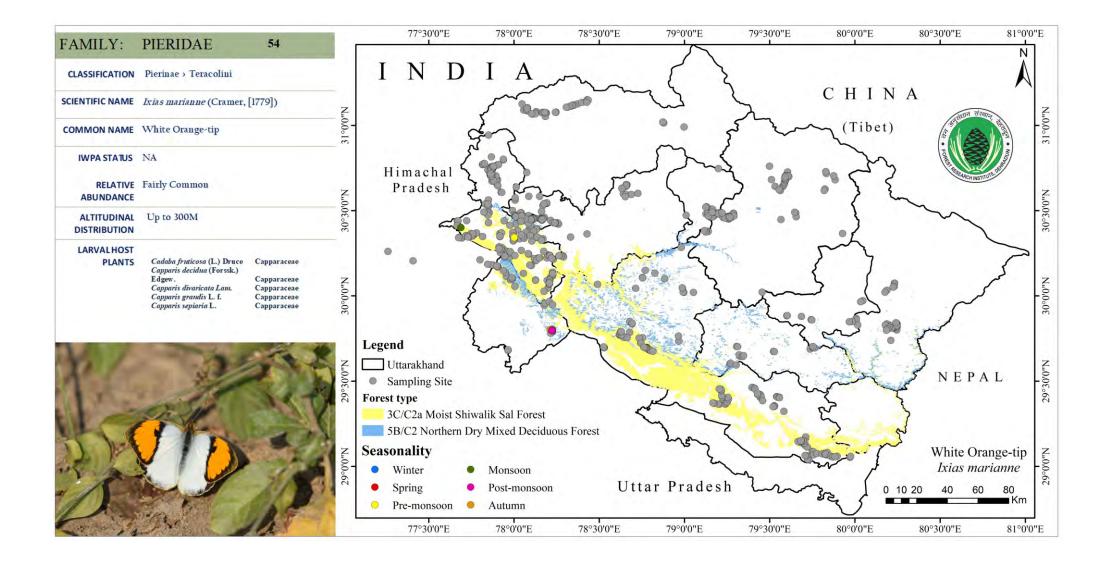


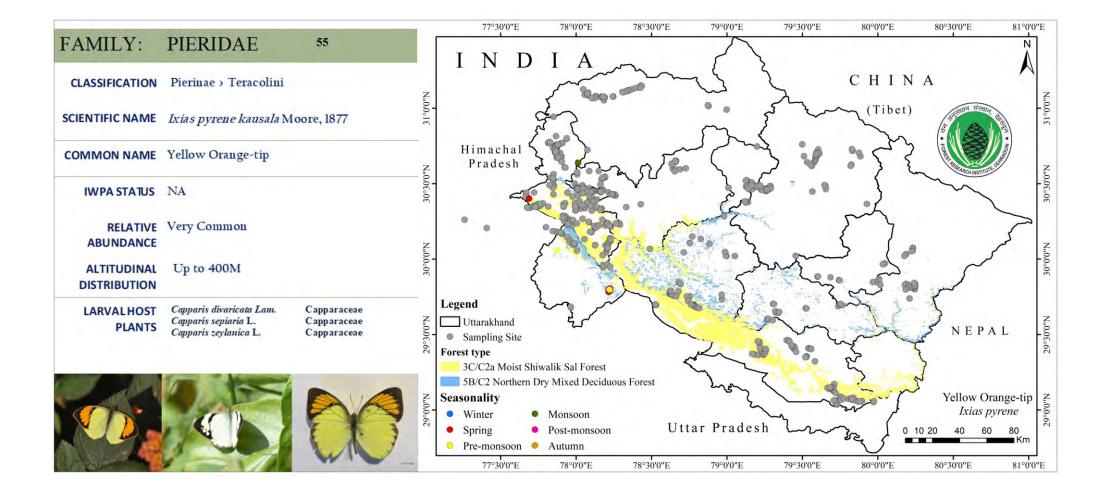


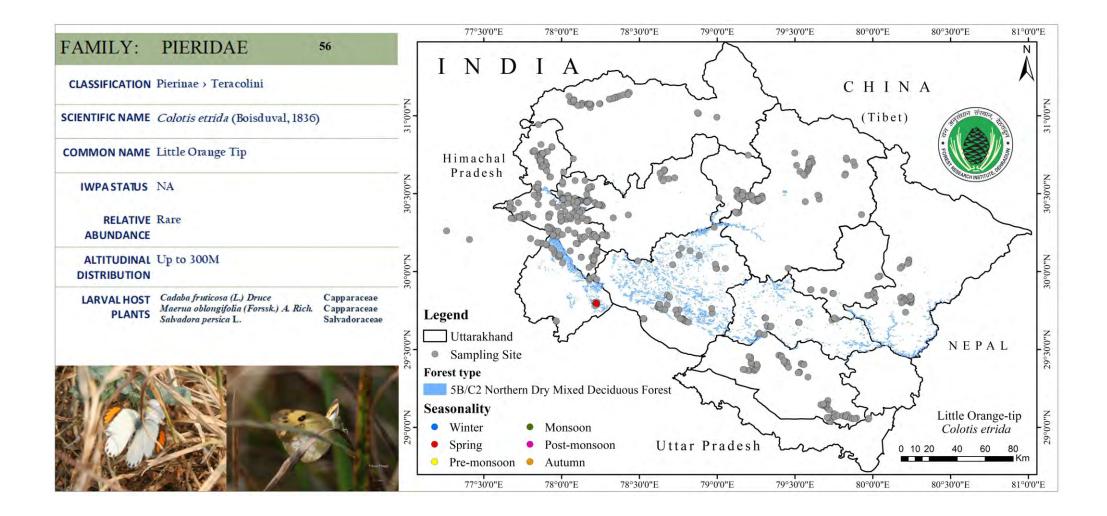


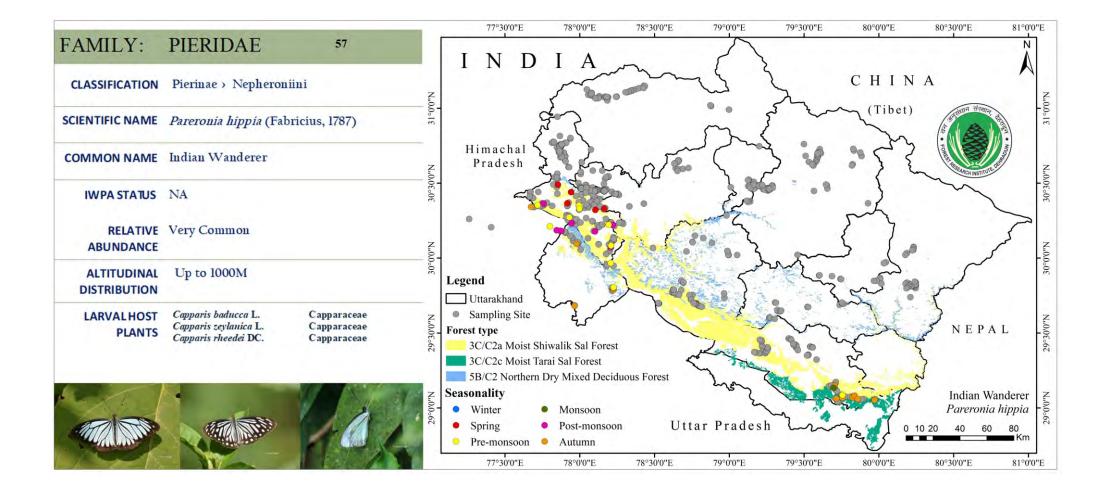


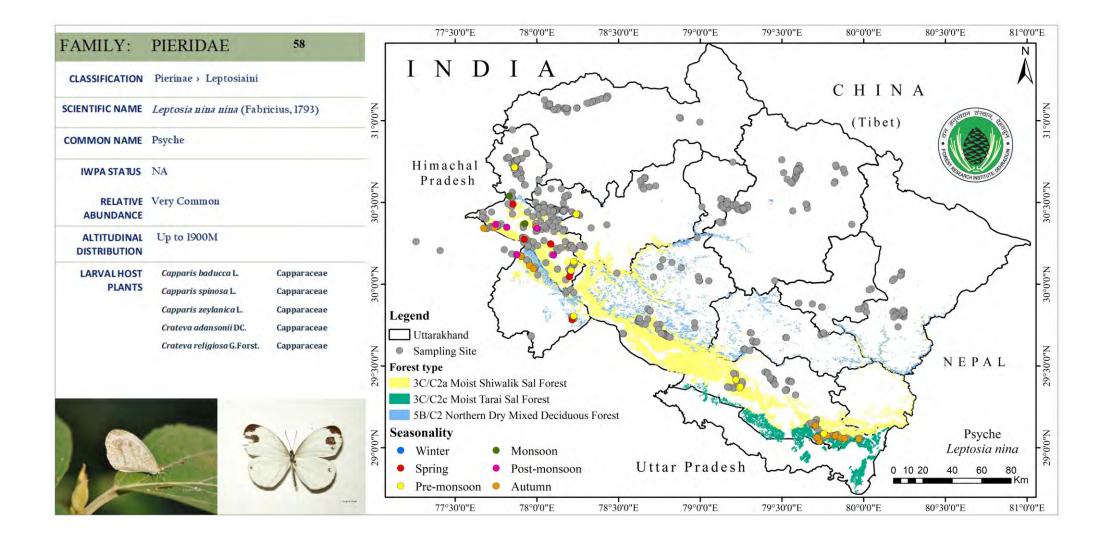


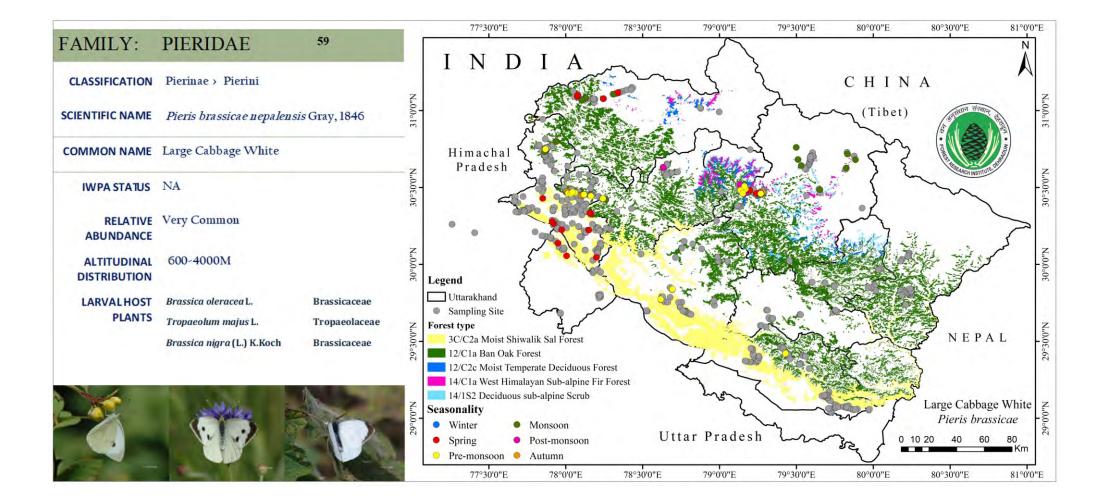


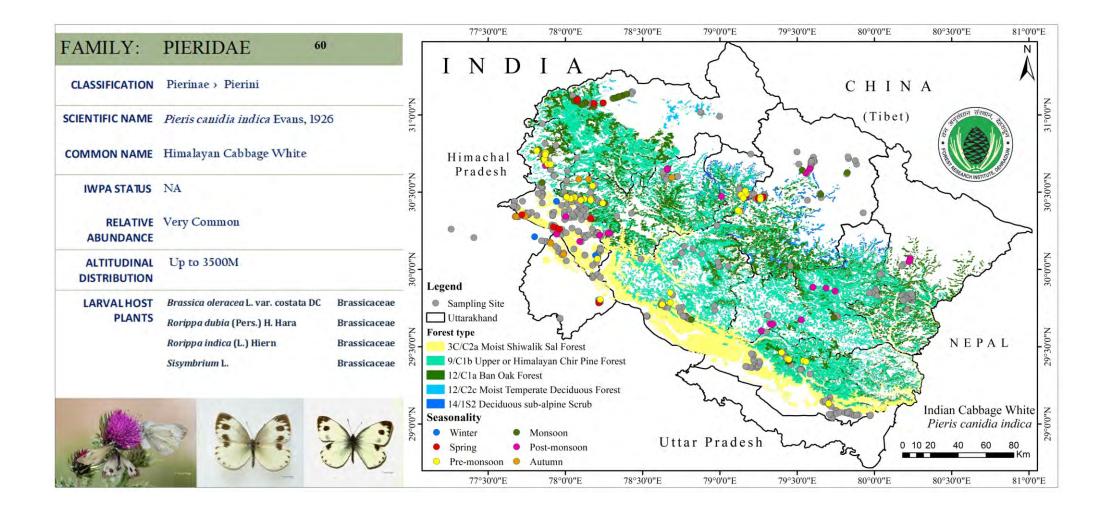


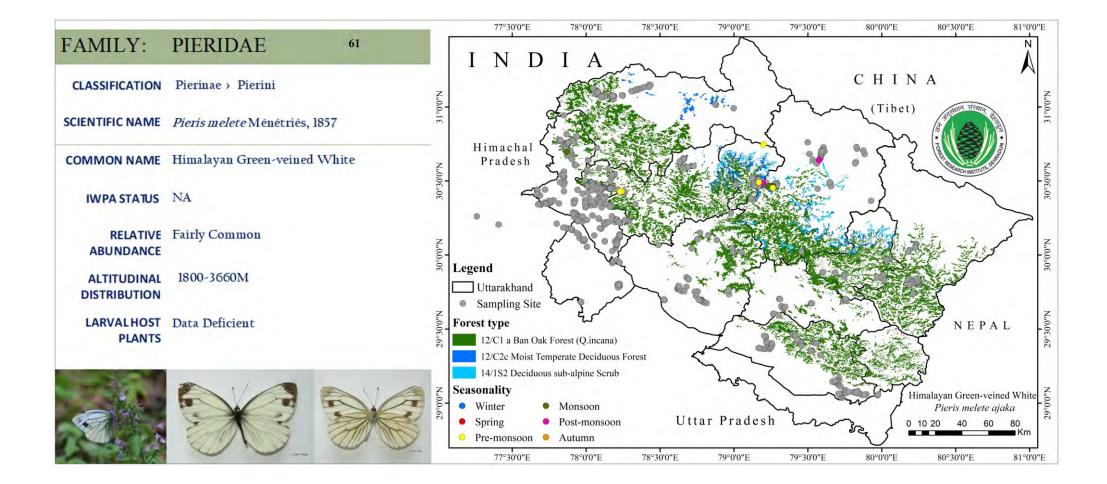


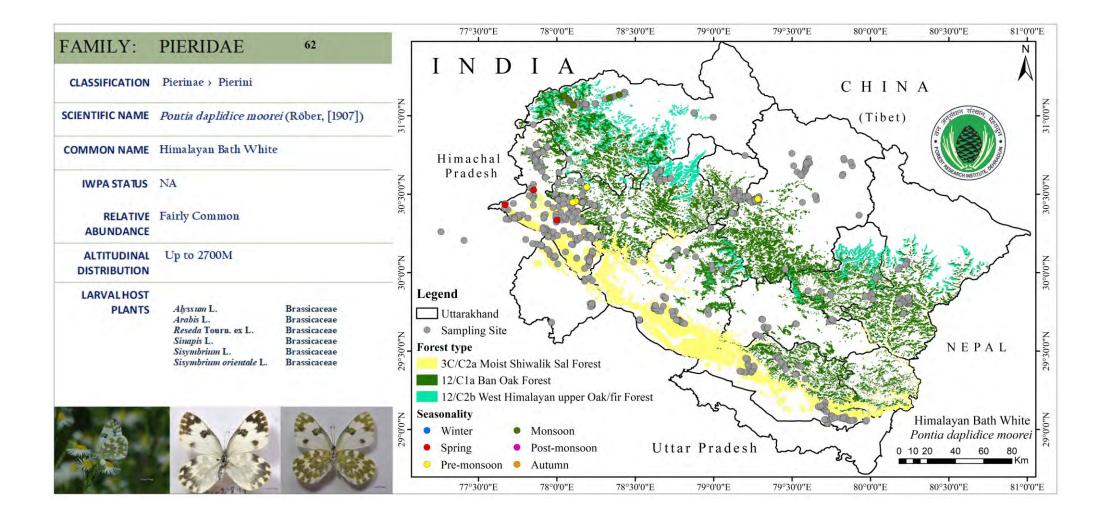








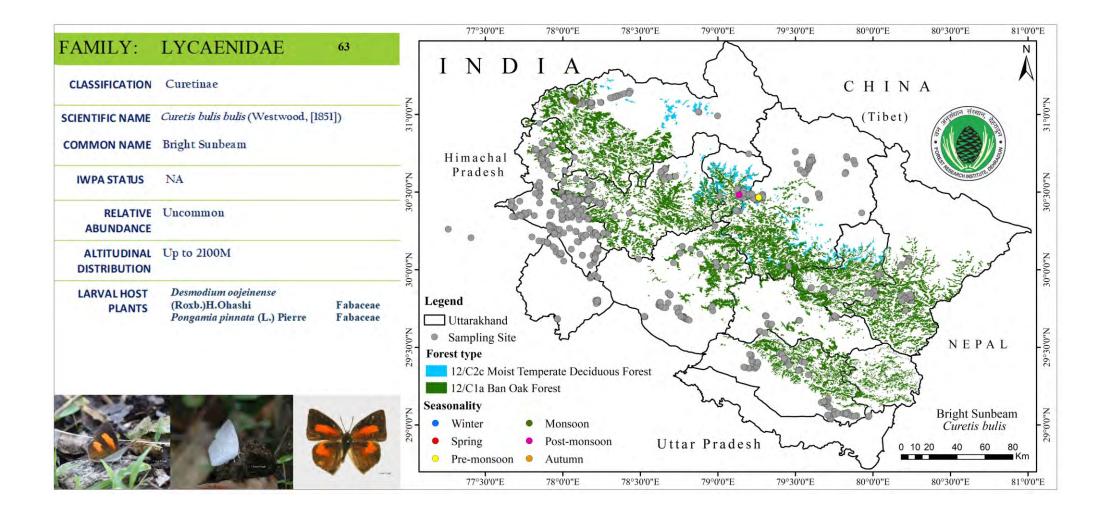


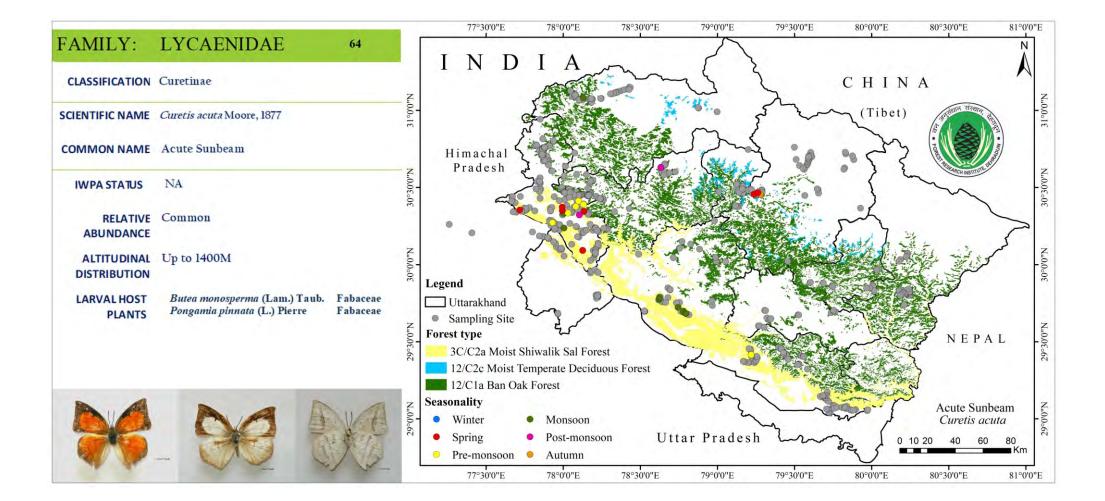


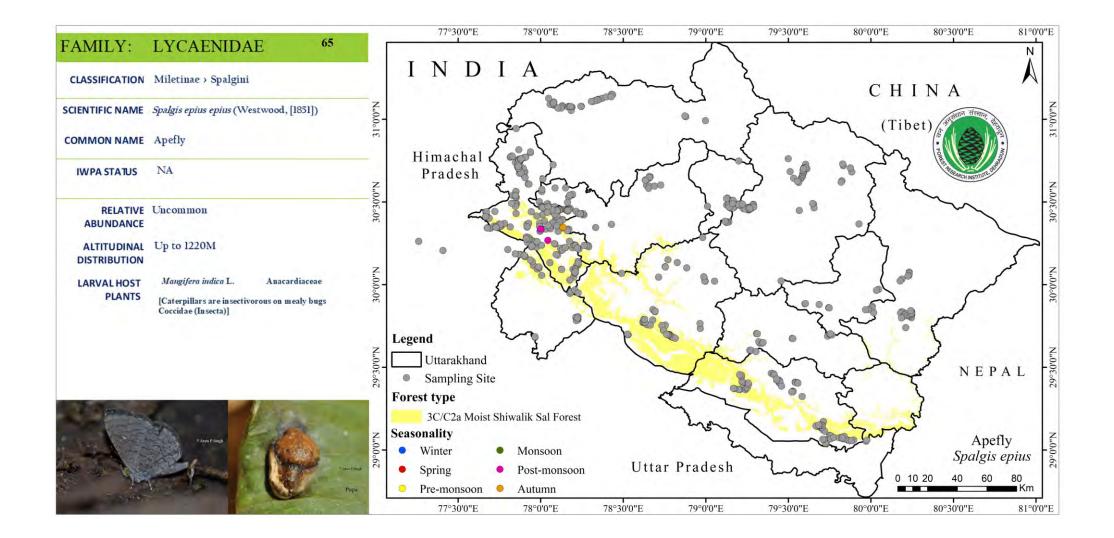
3.LYCAENIDAE (Blues) (63-160)

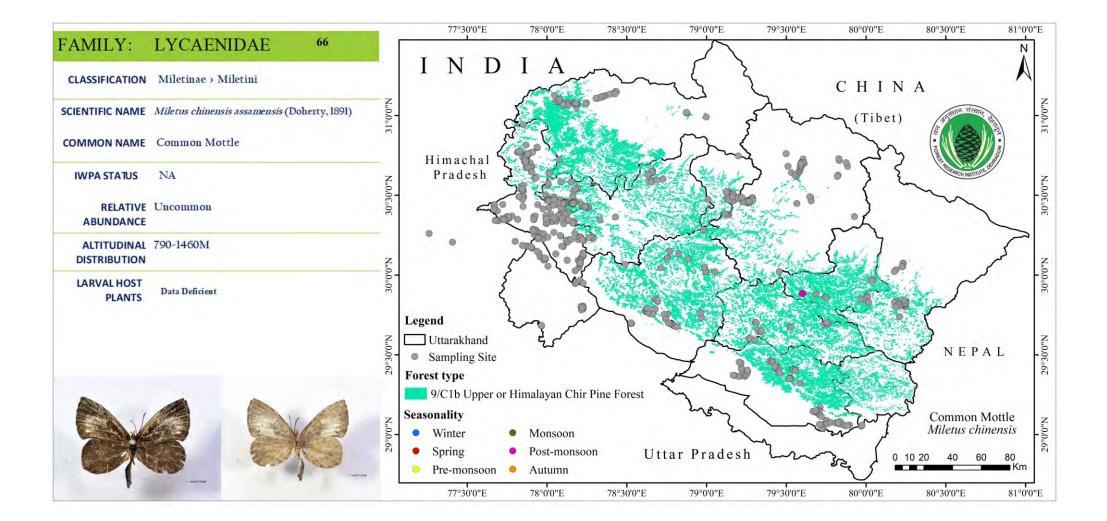


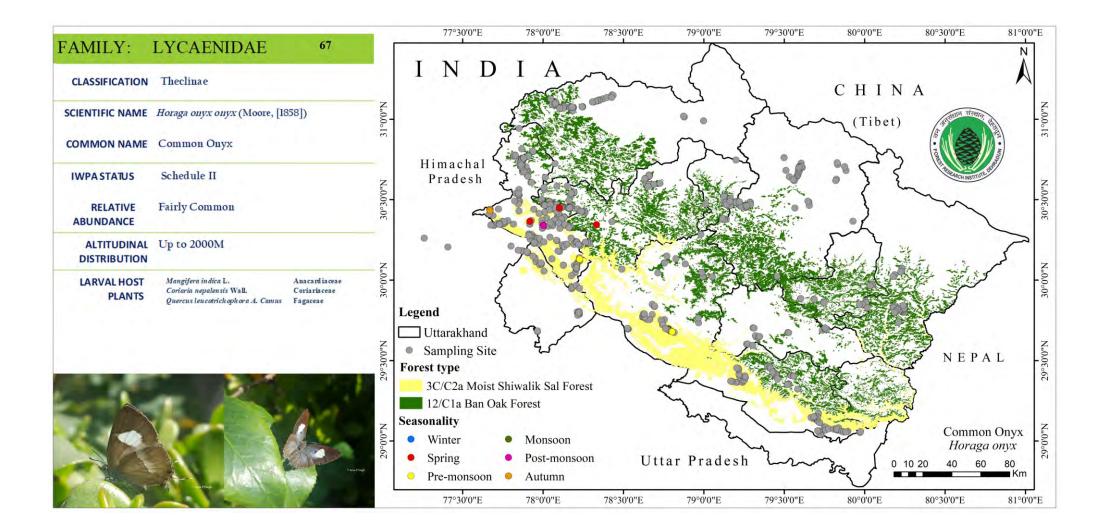
Upper or Himalayan Chir Pine Forest

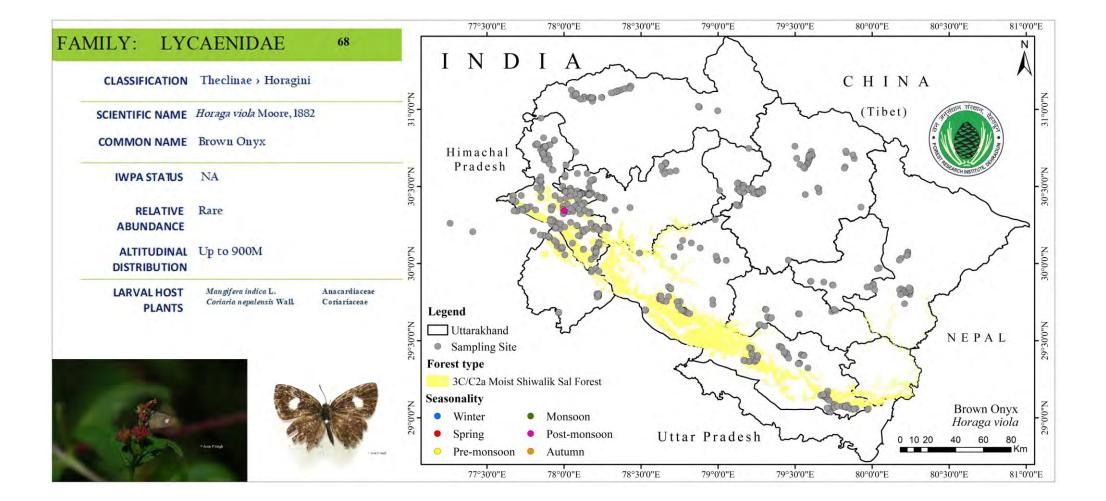


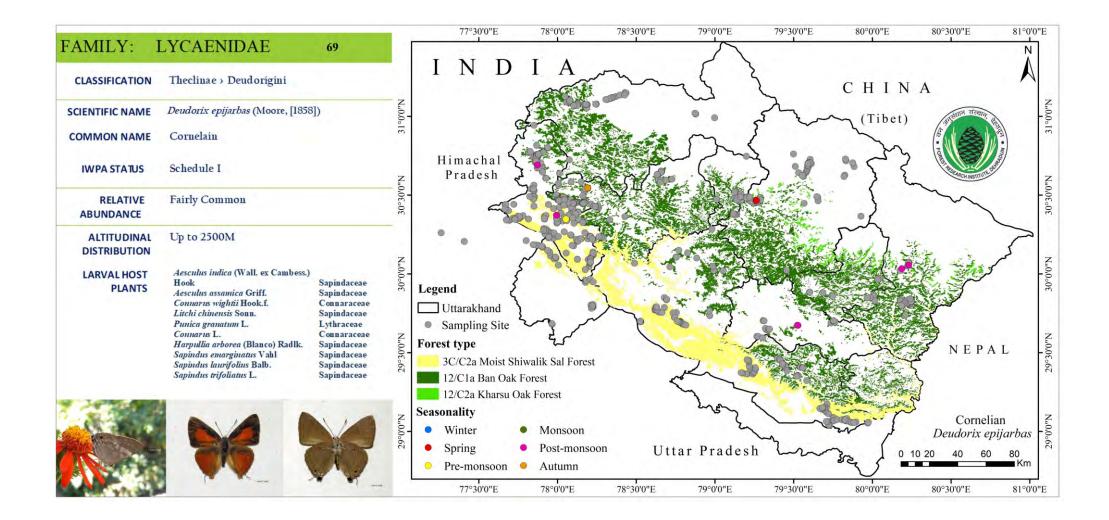


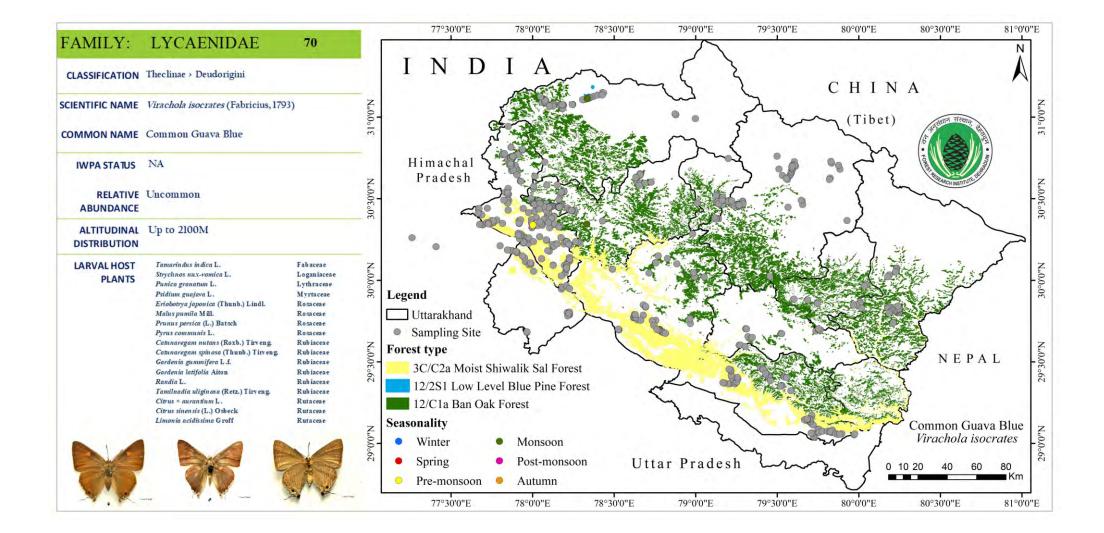


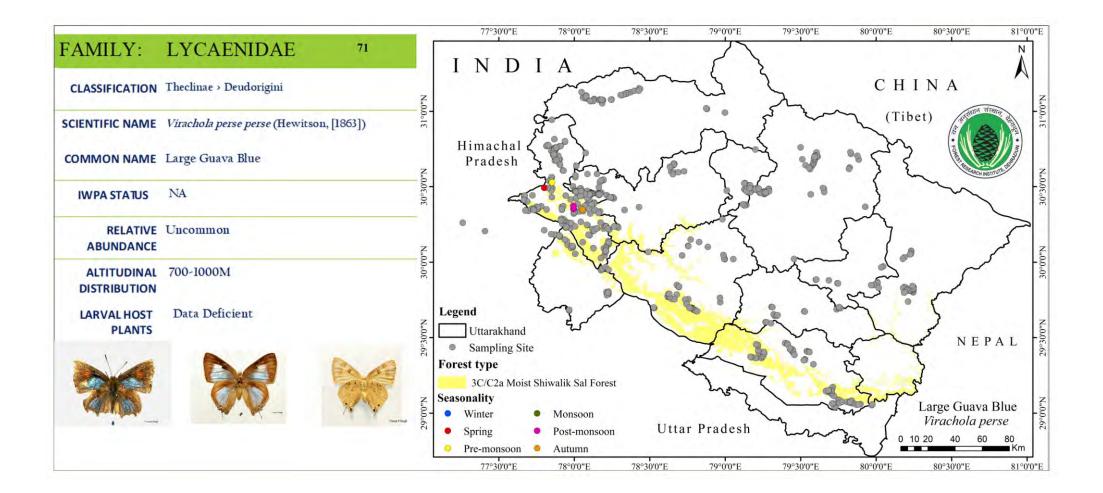


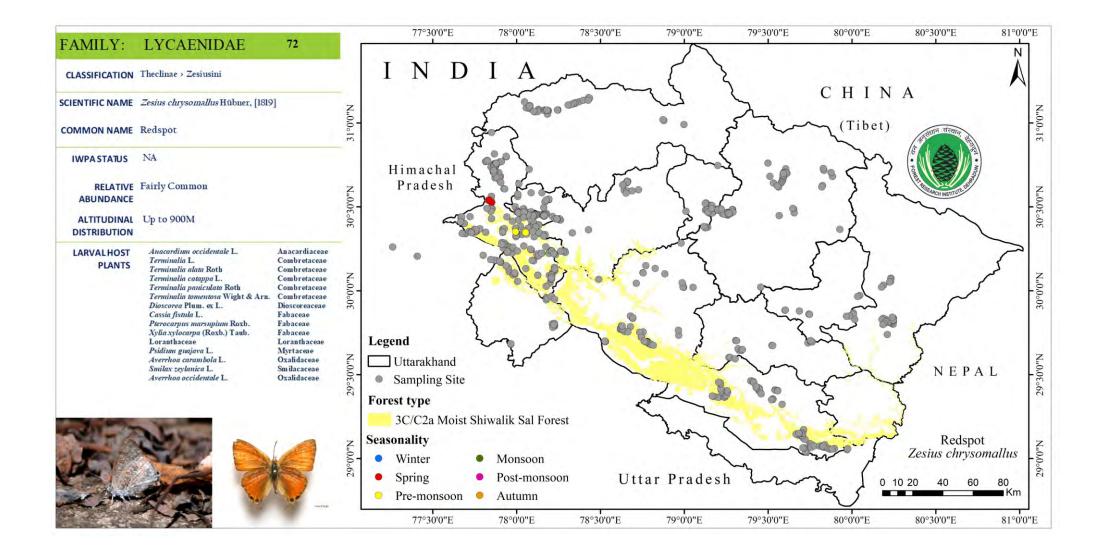


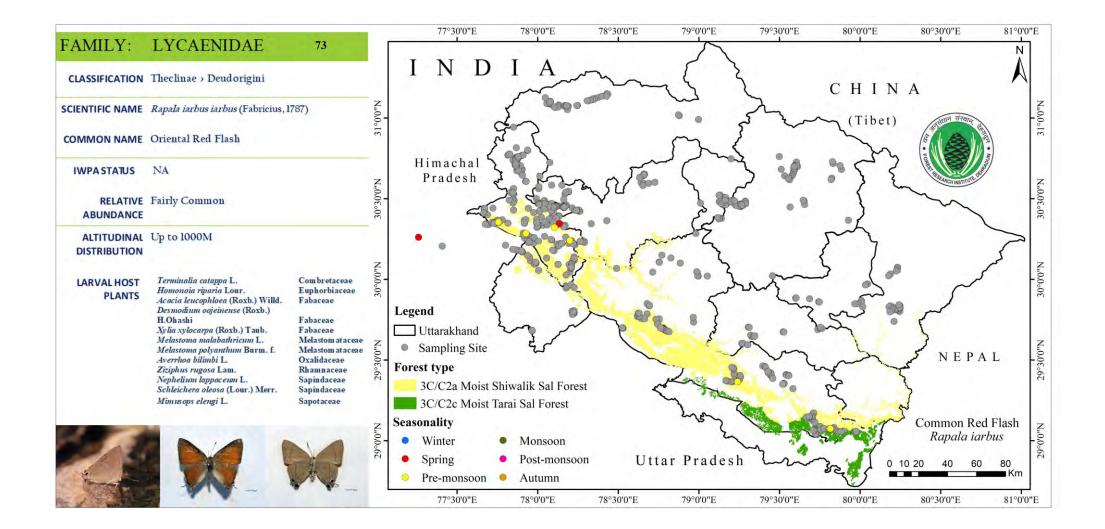


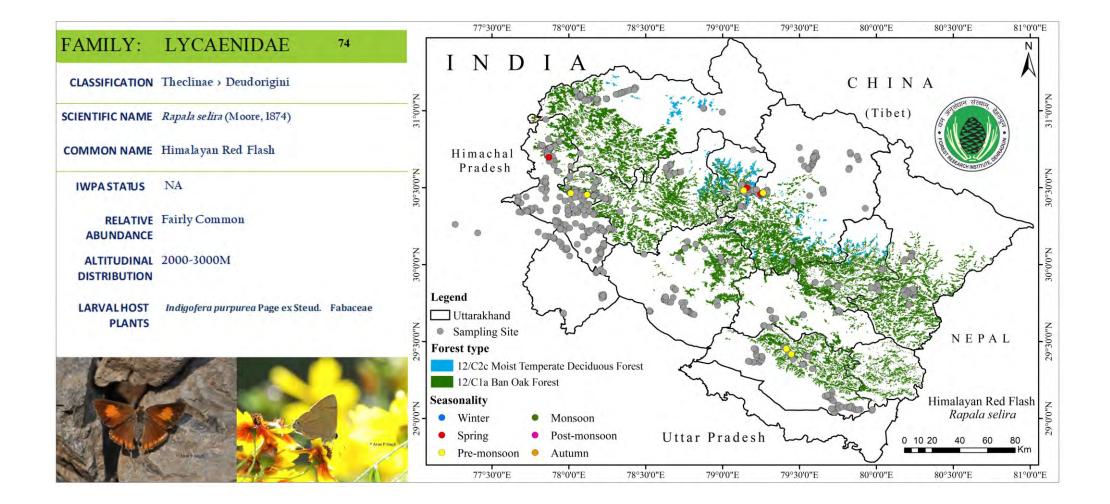


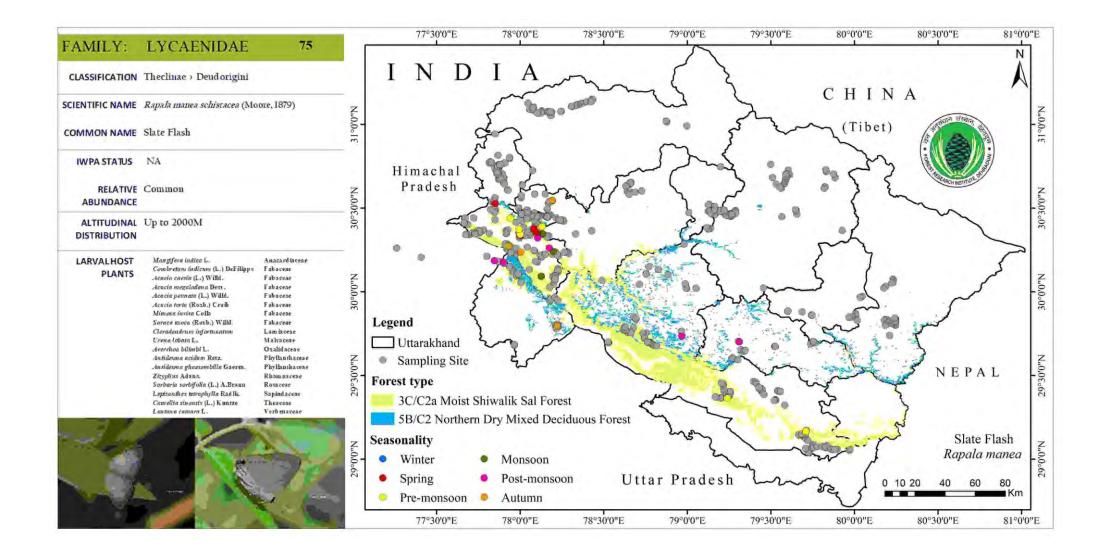


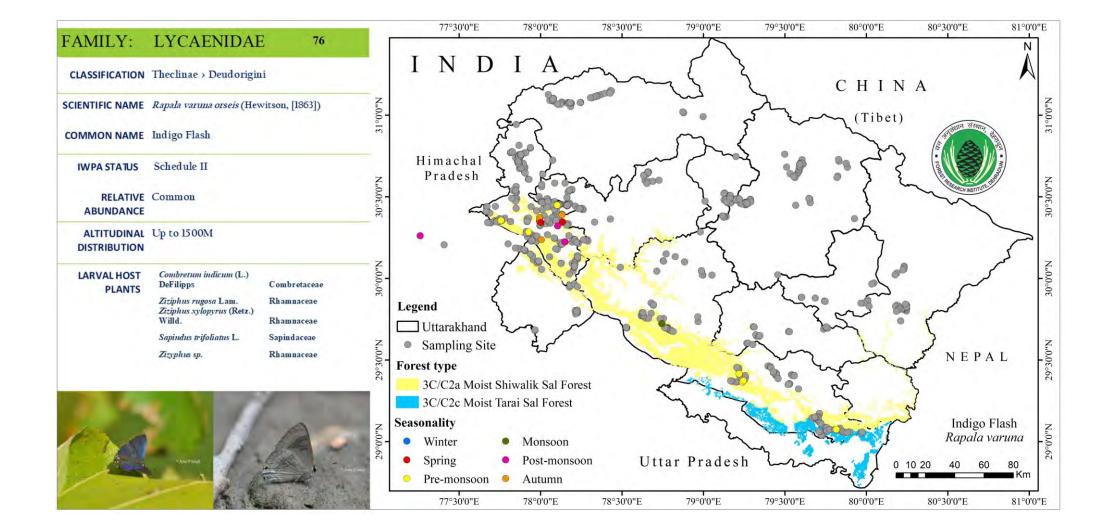


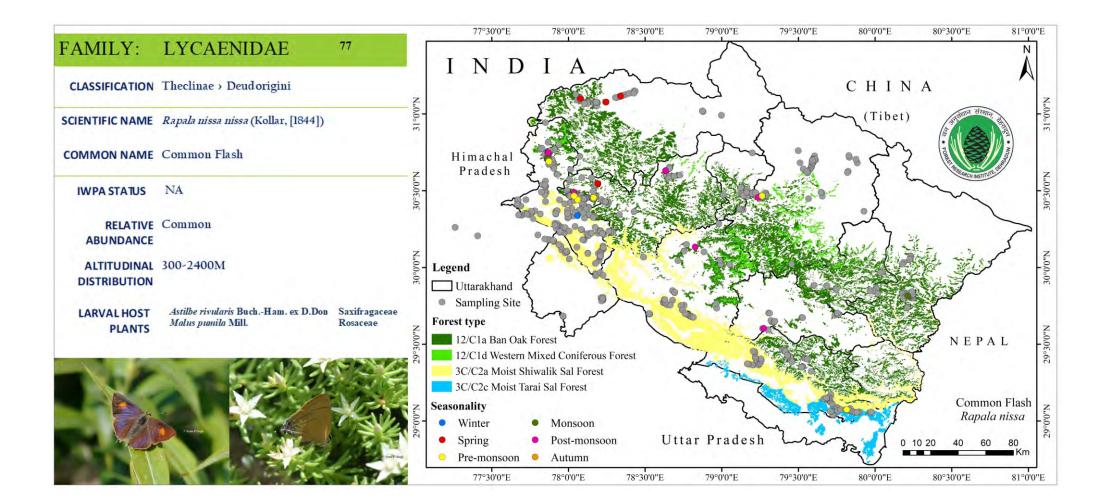


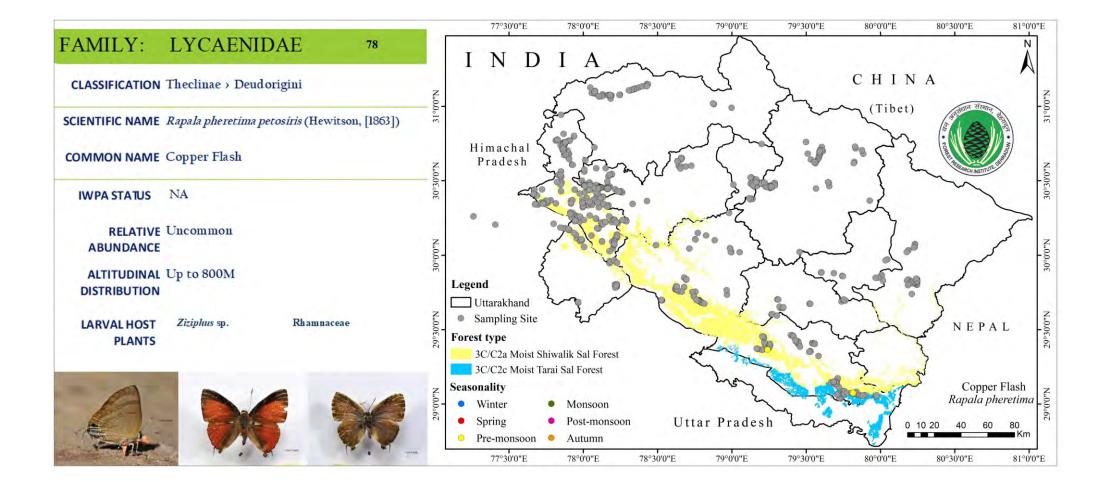


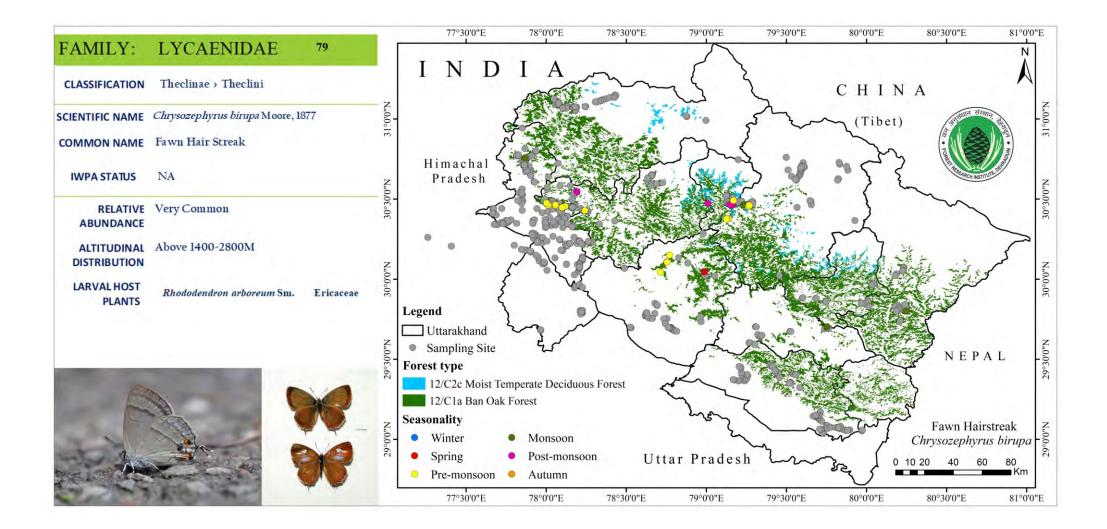


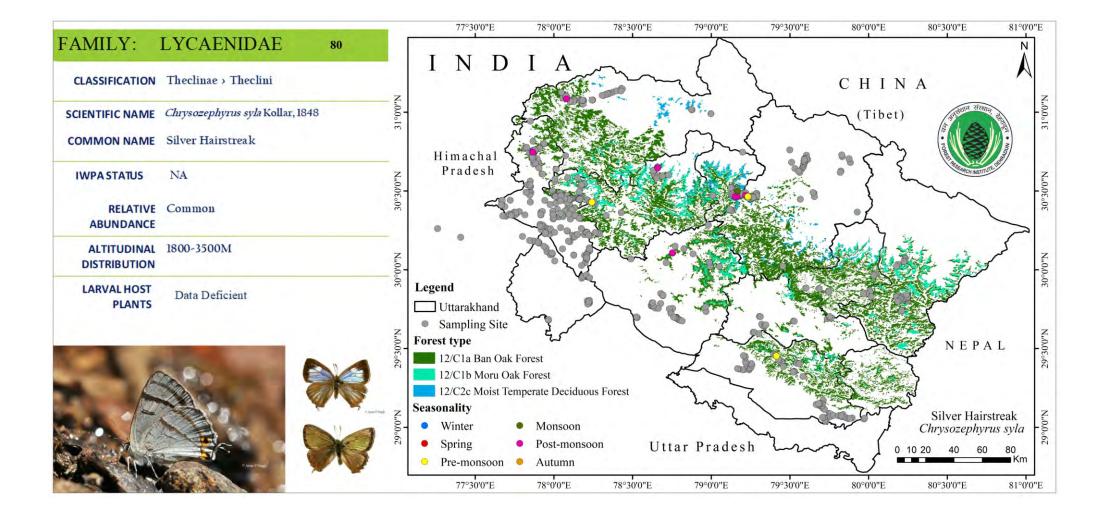


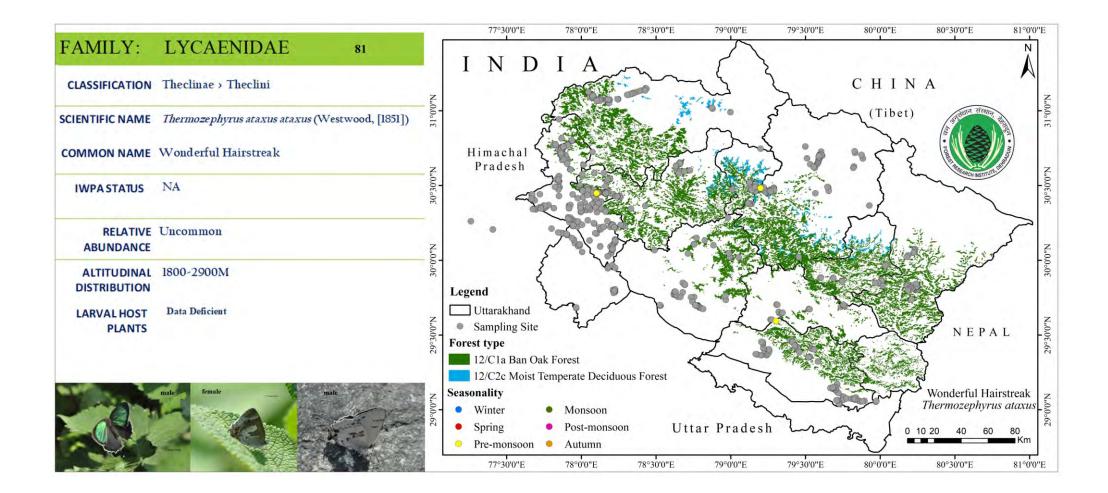


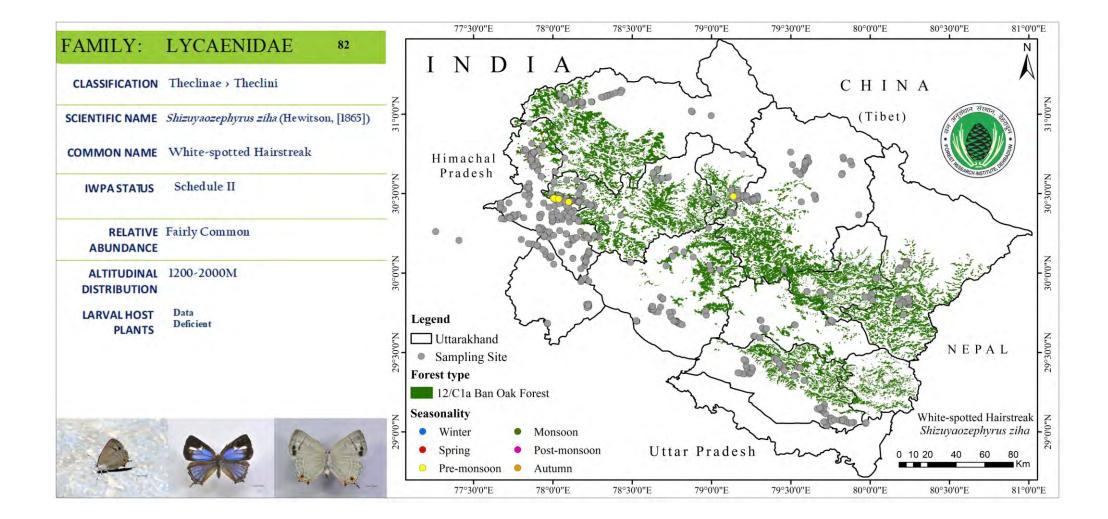


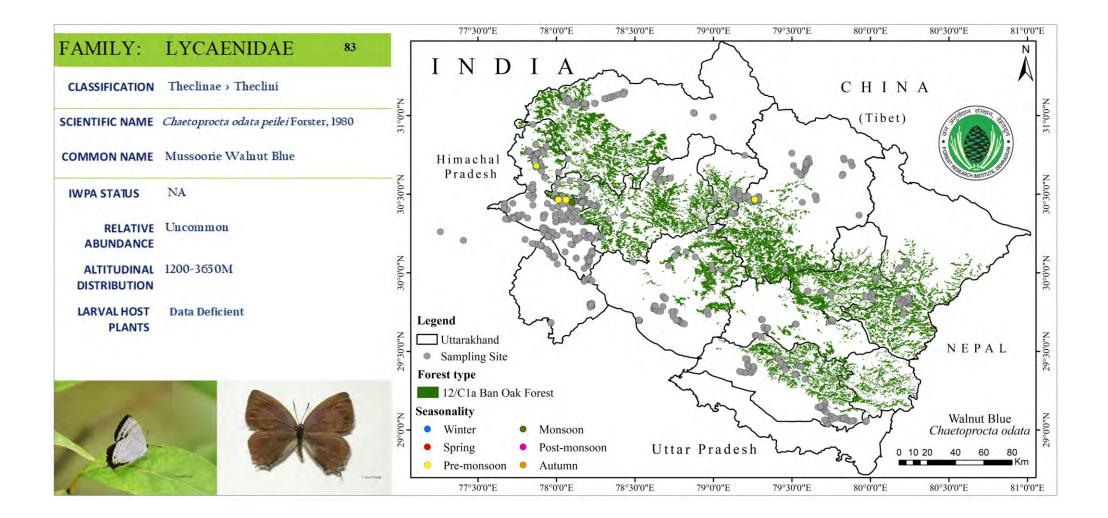


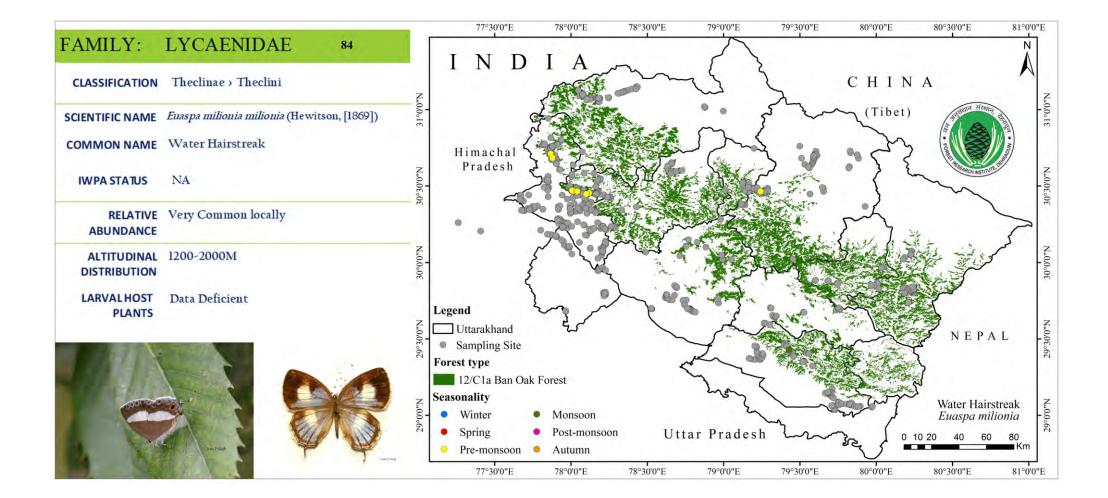


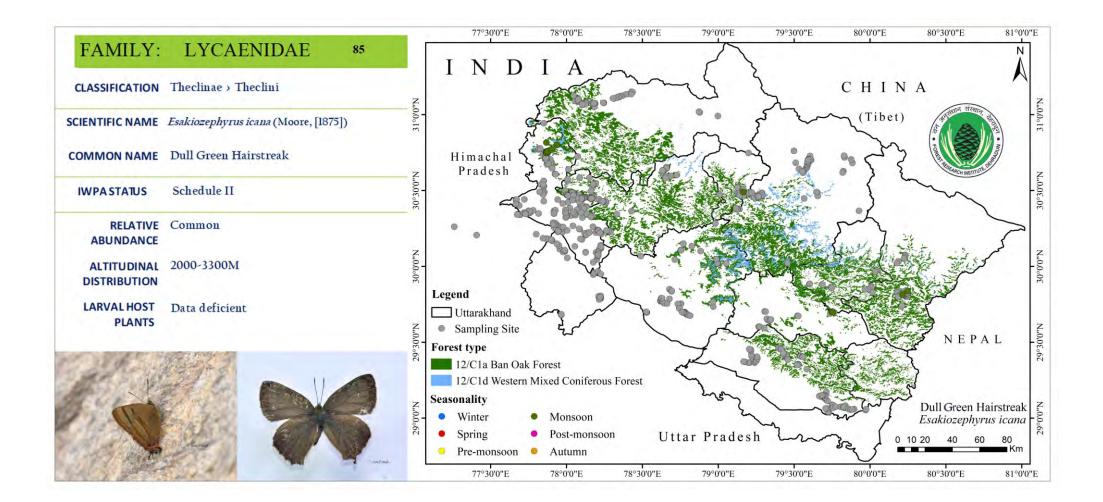


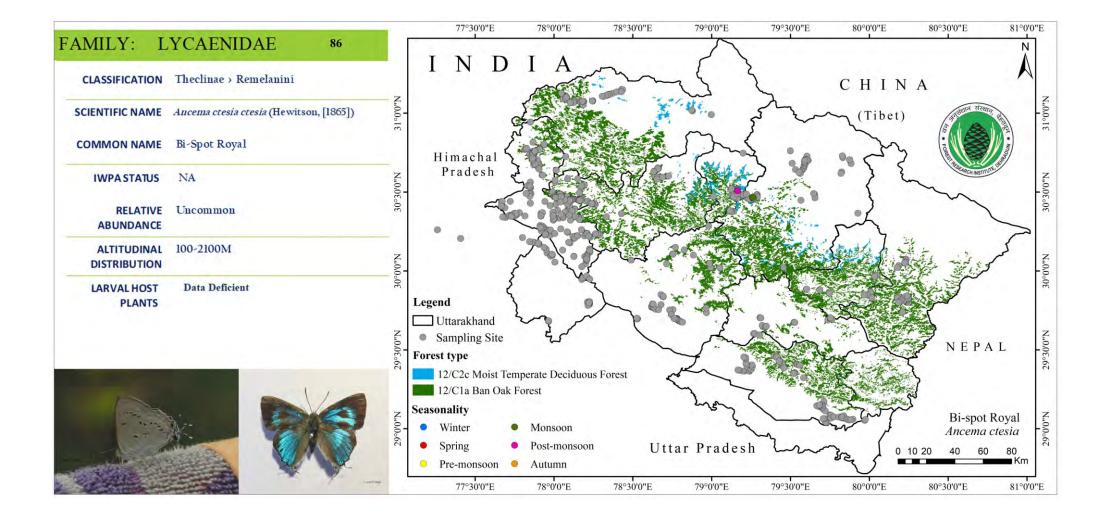


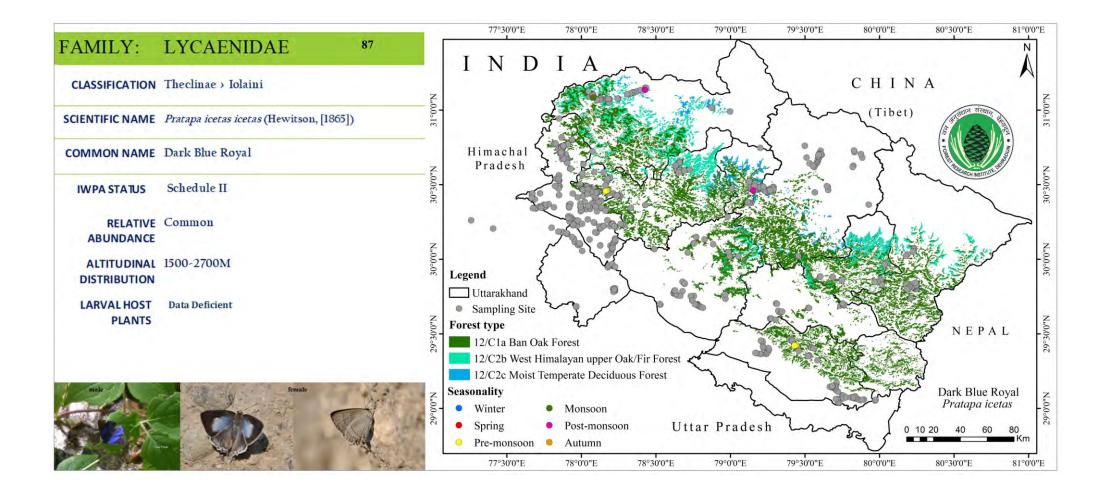


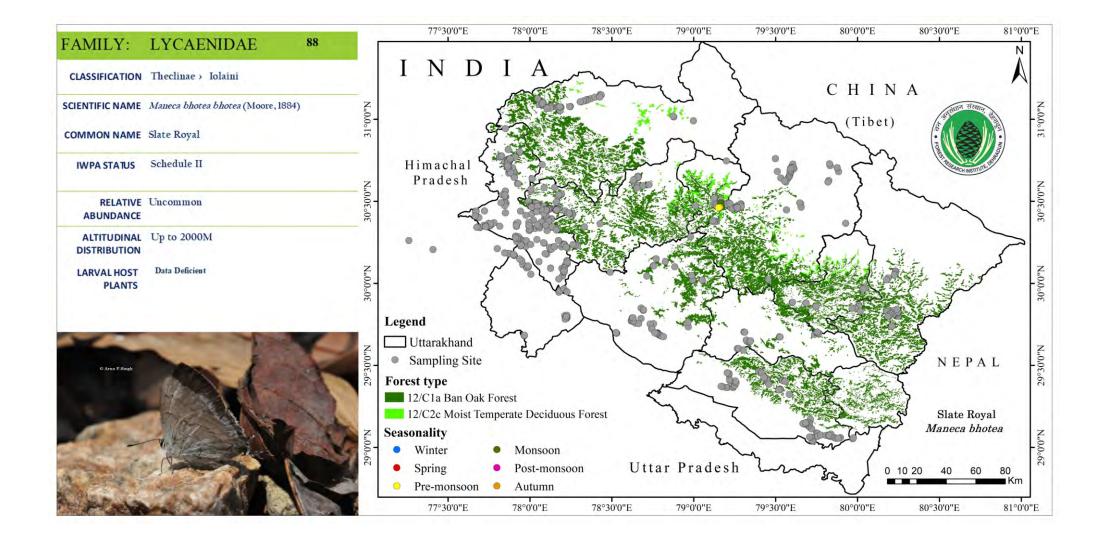


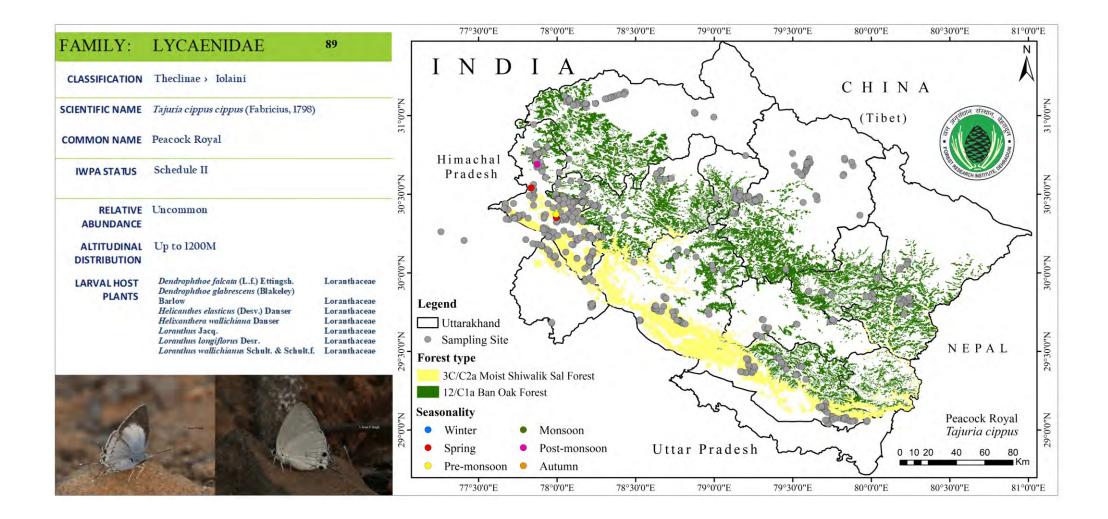


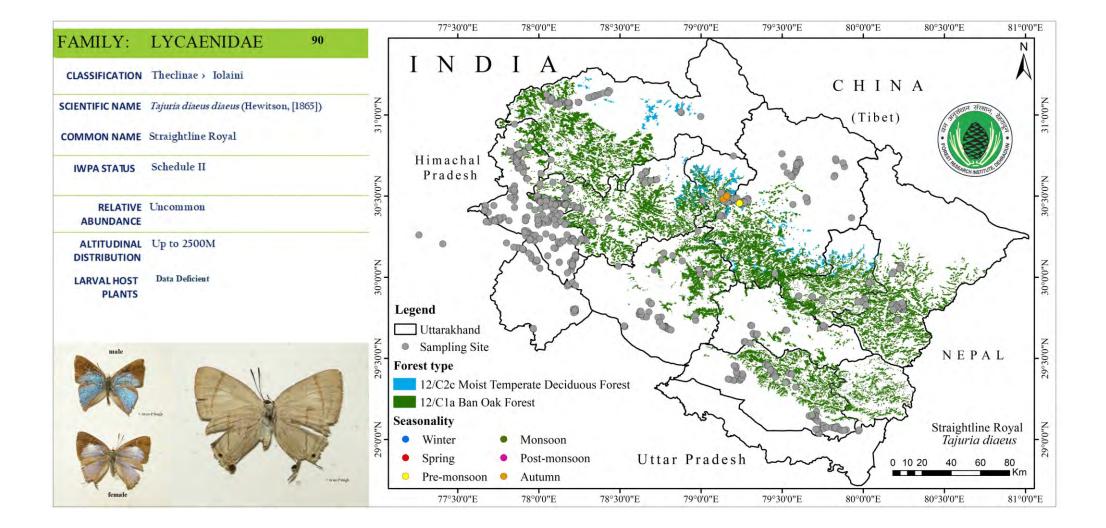


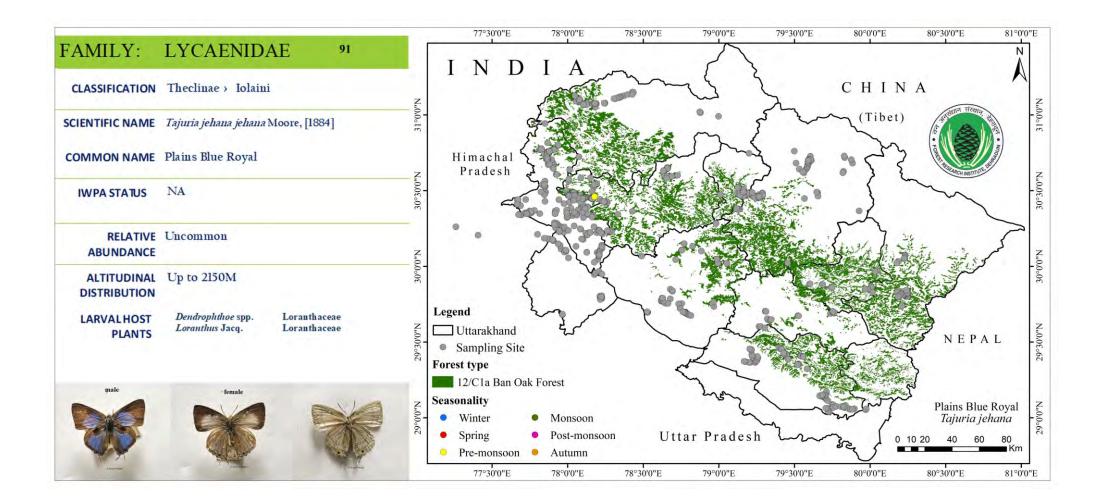


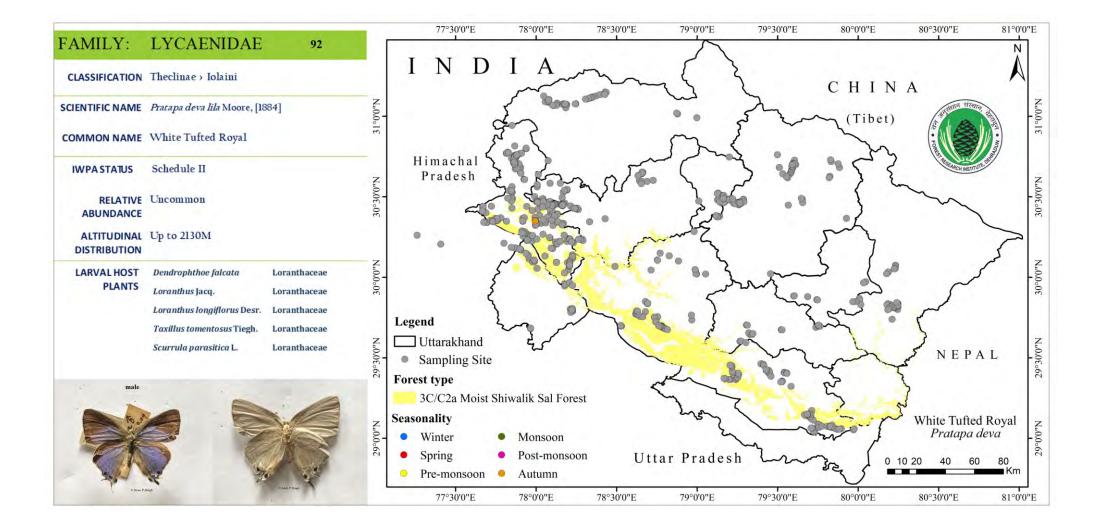


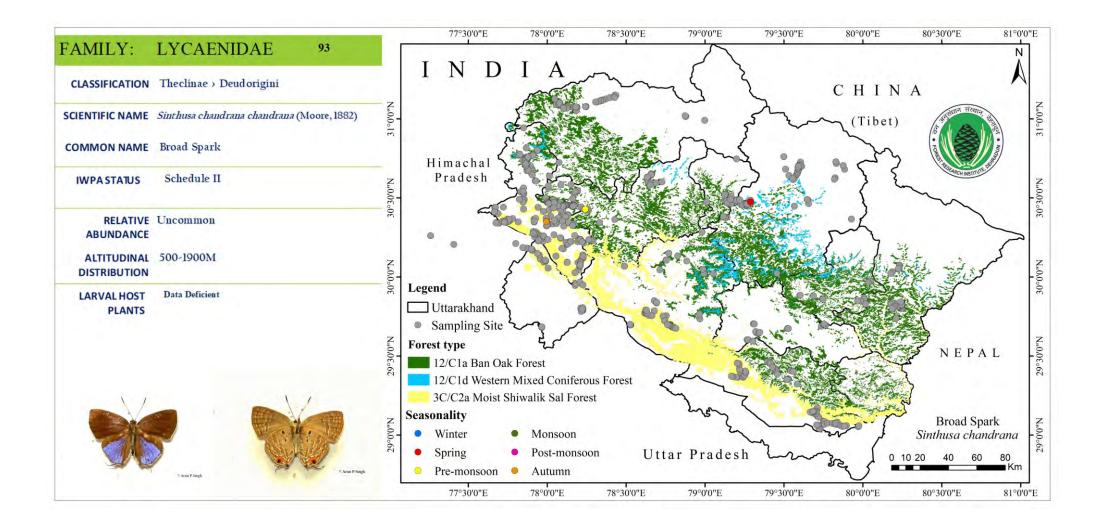


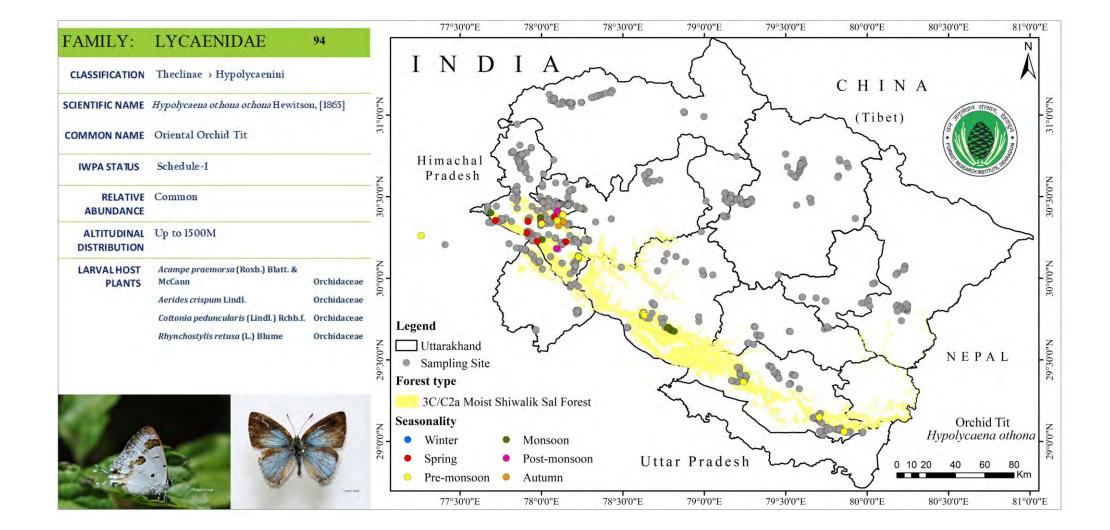


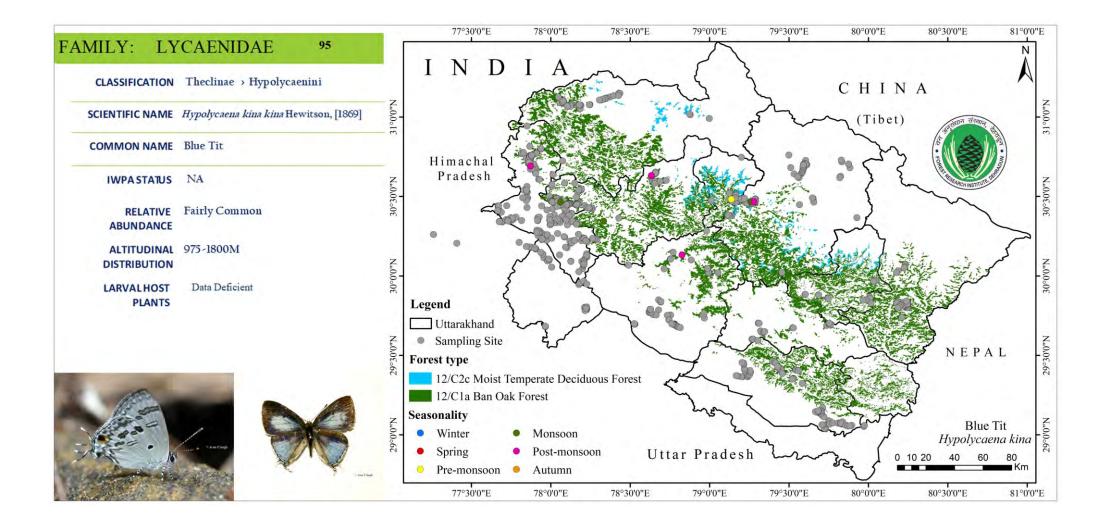


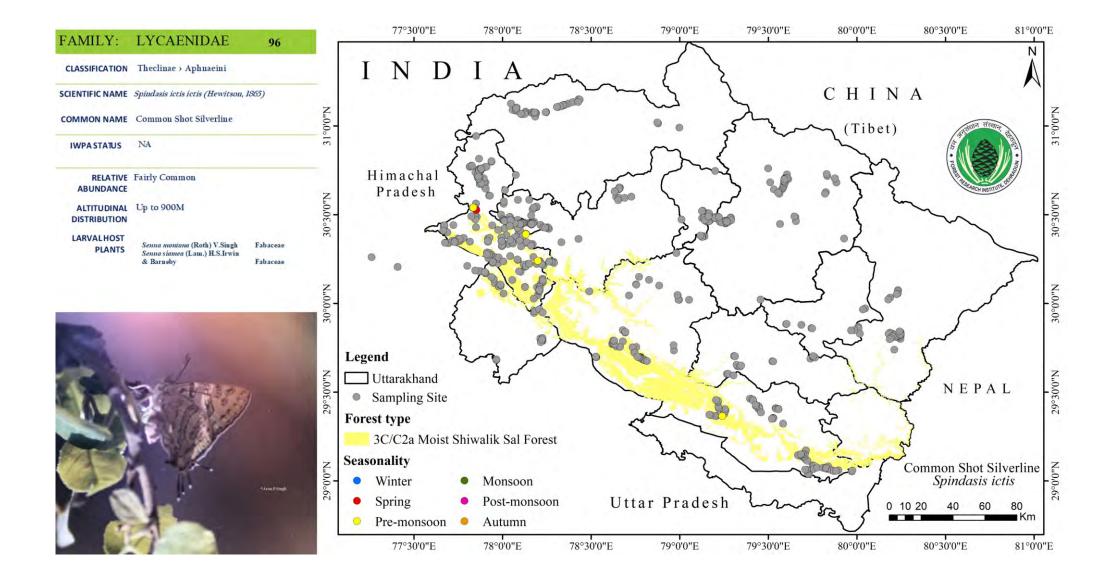


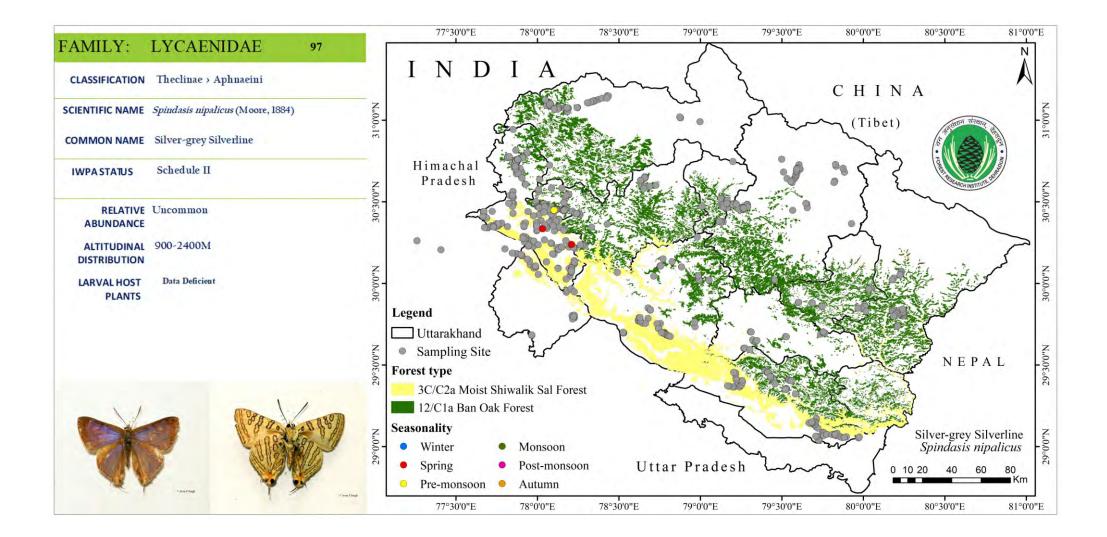


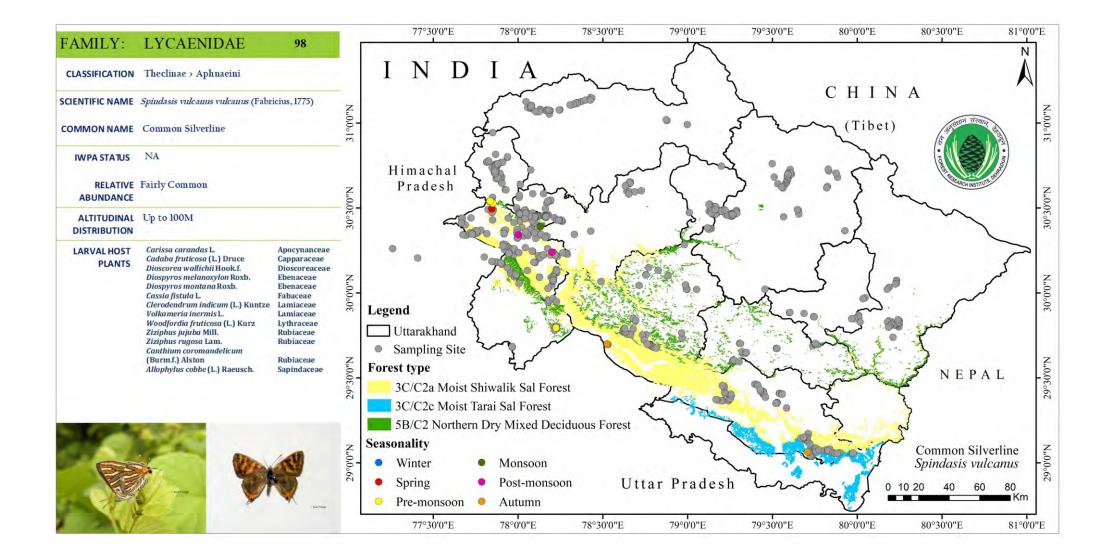


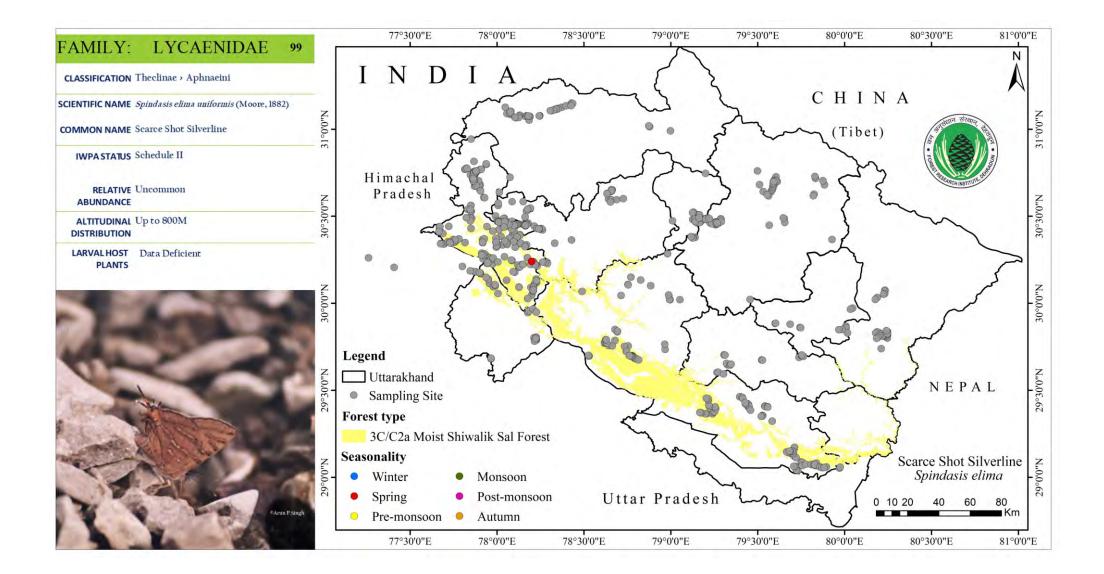


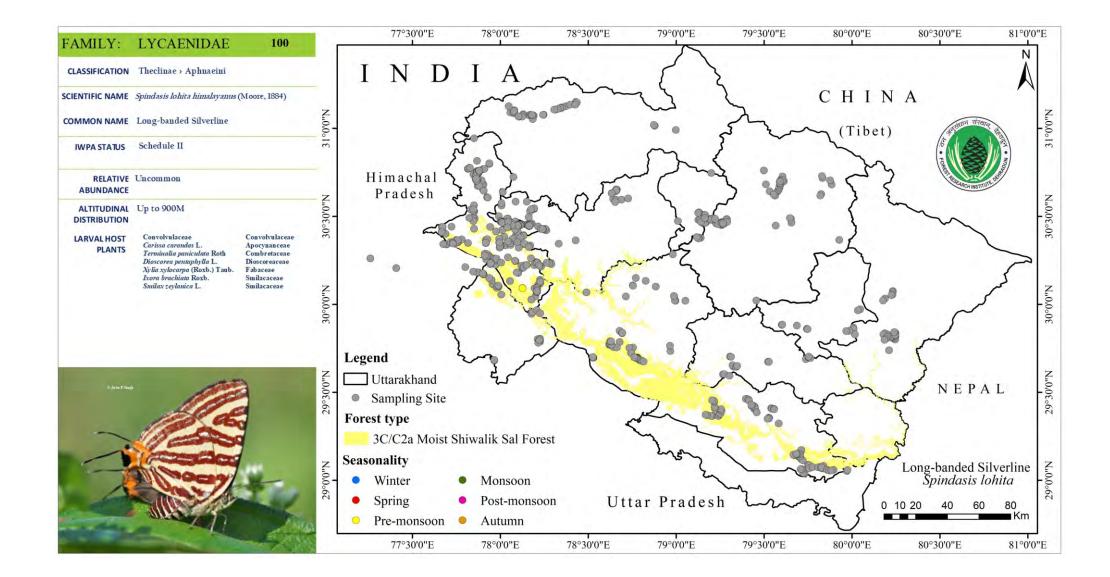


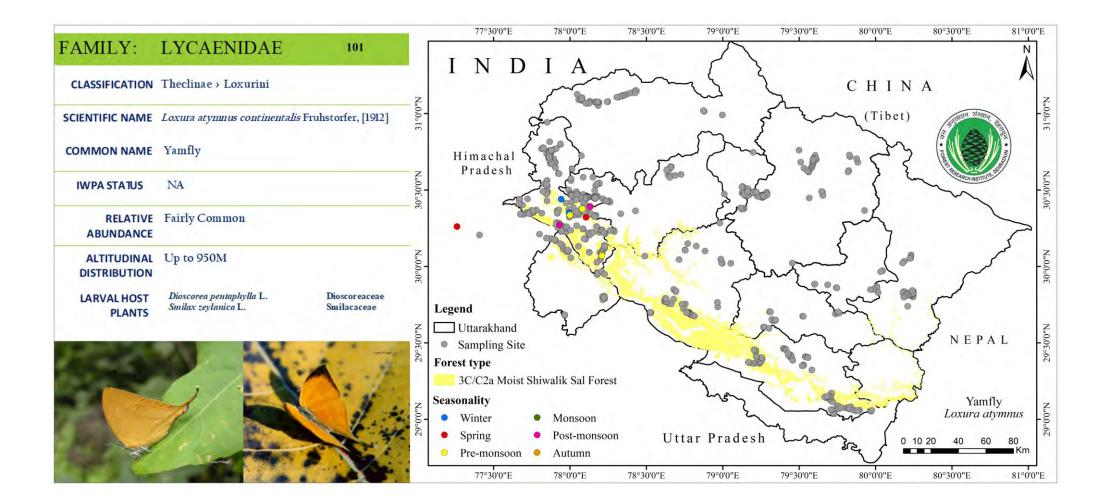


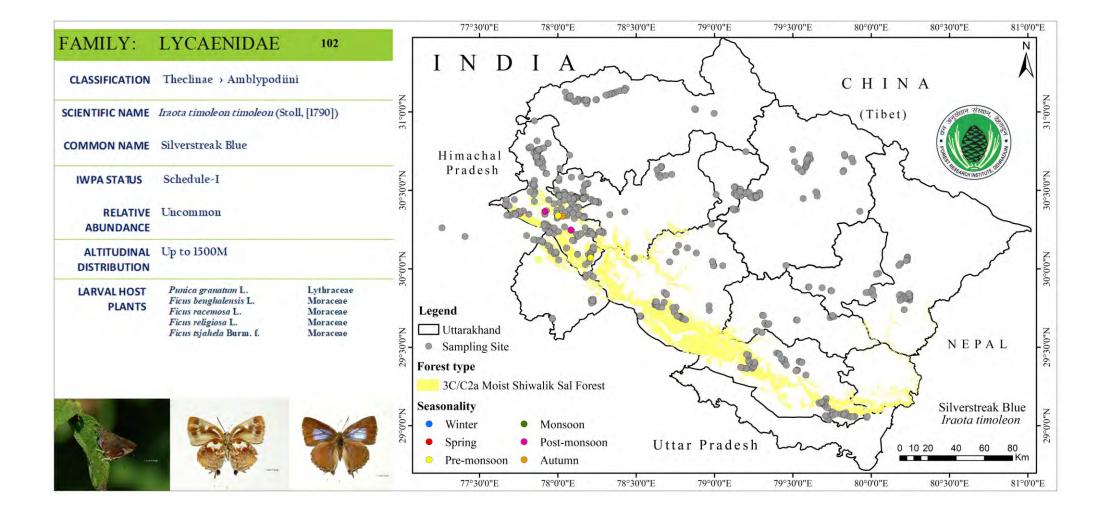


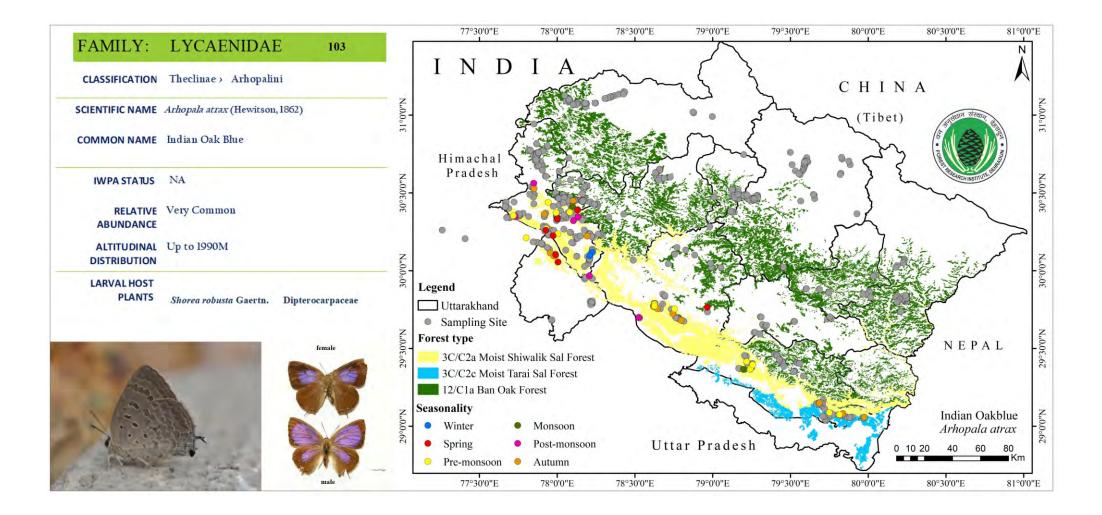


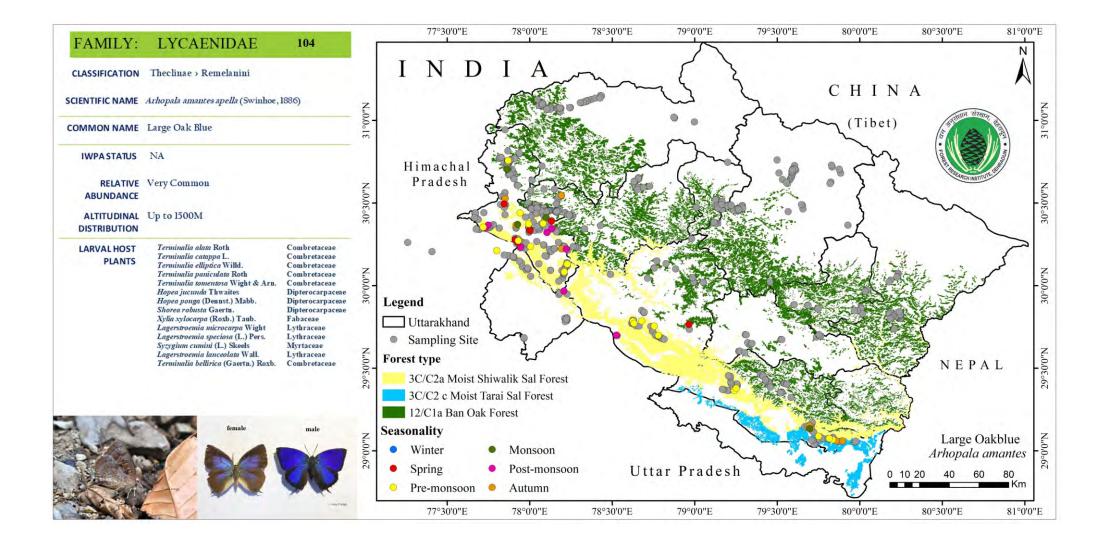


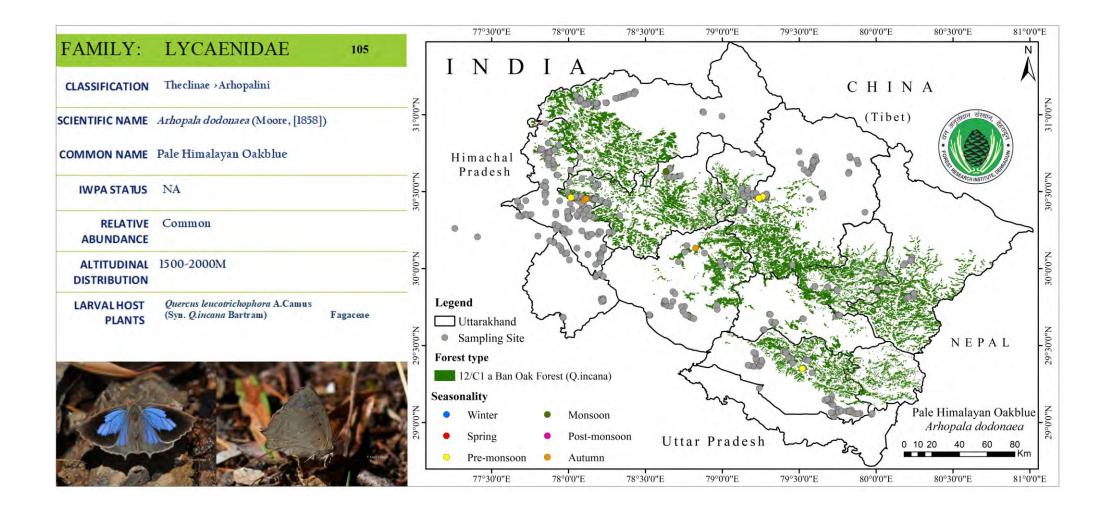


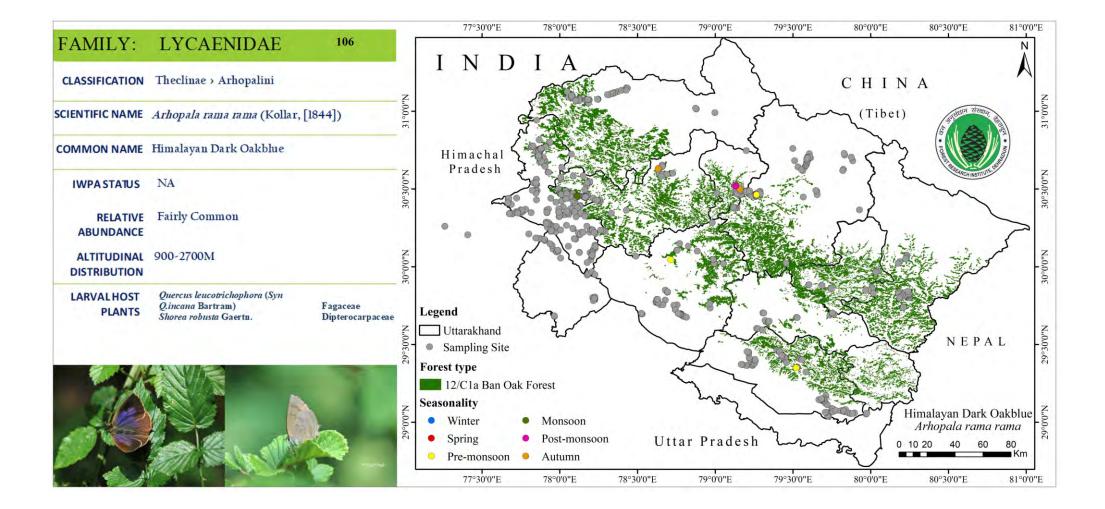


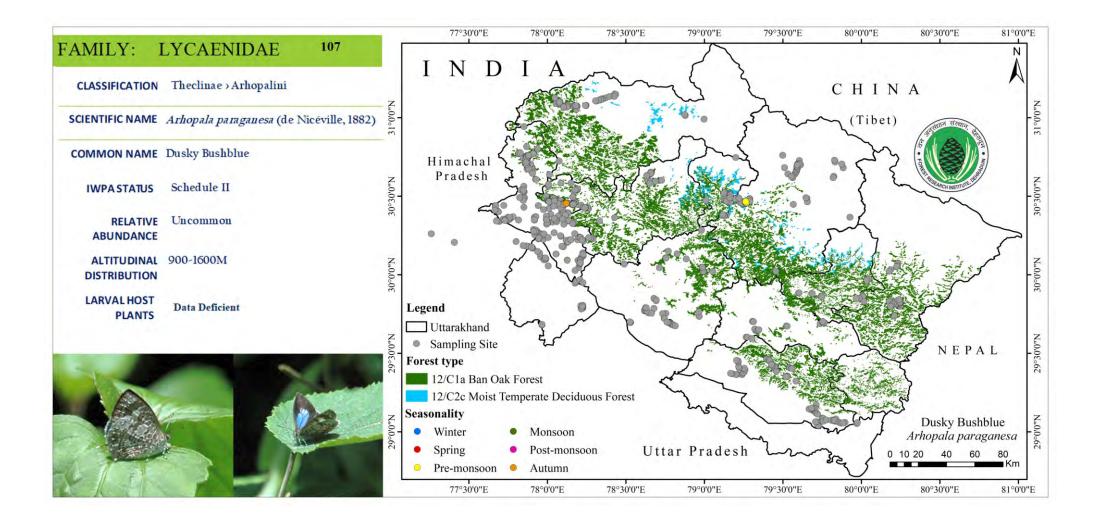


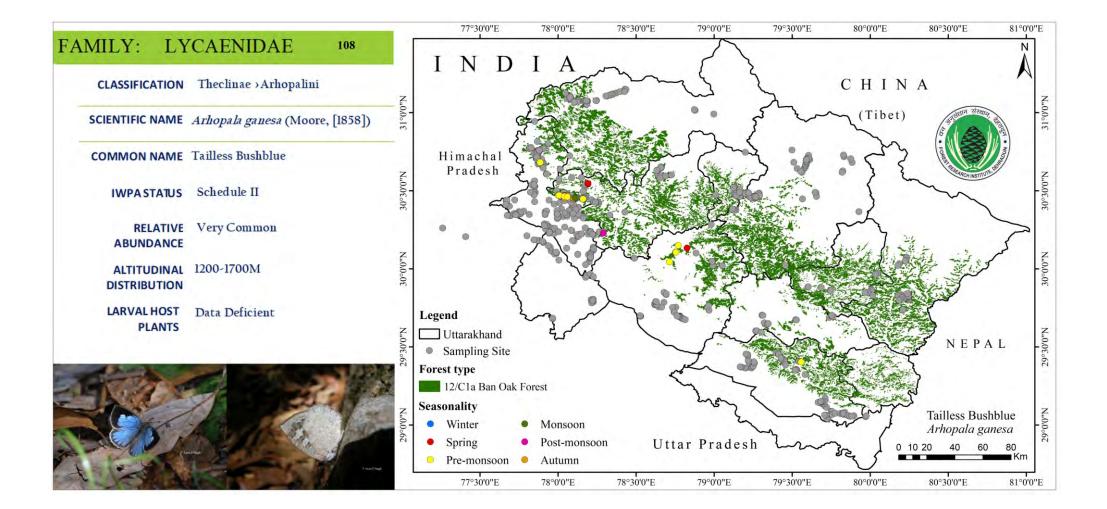


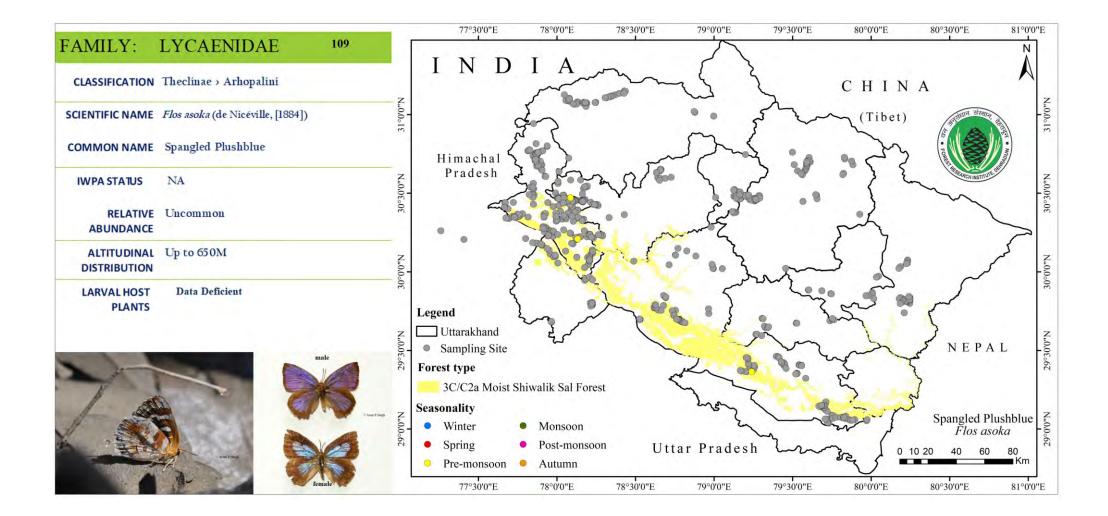


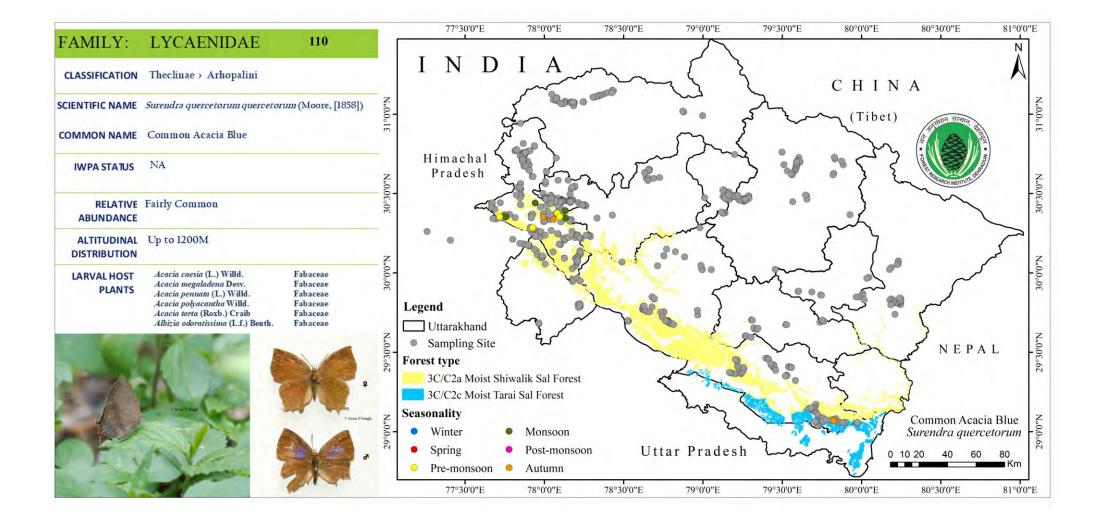


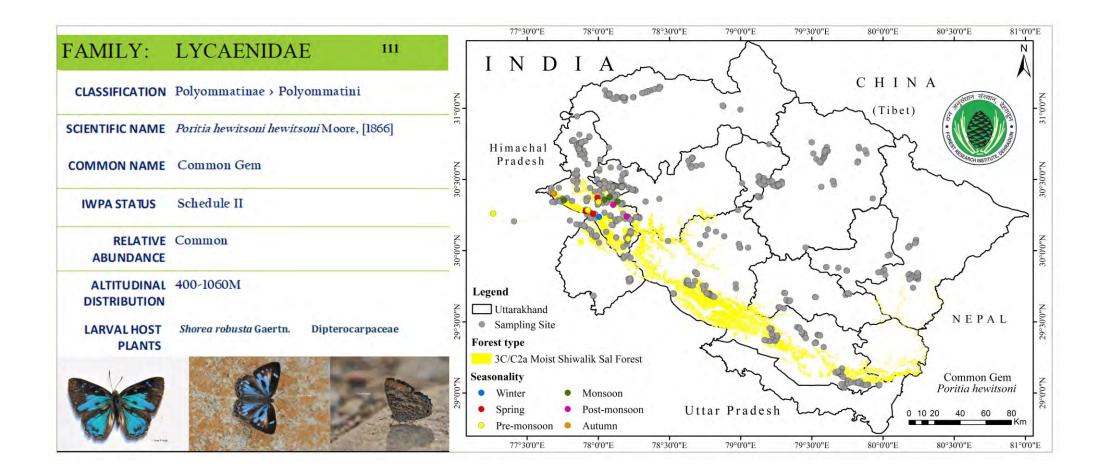


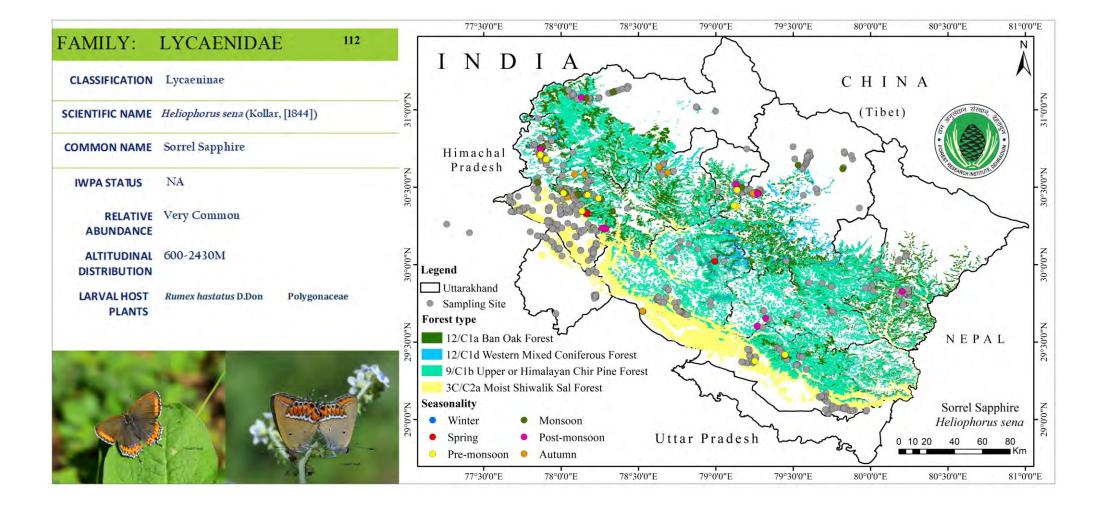


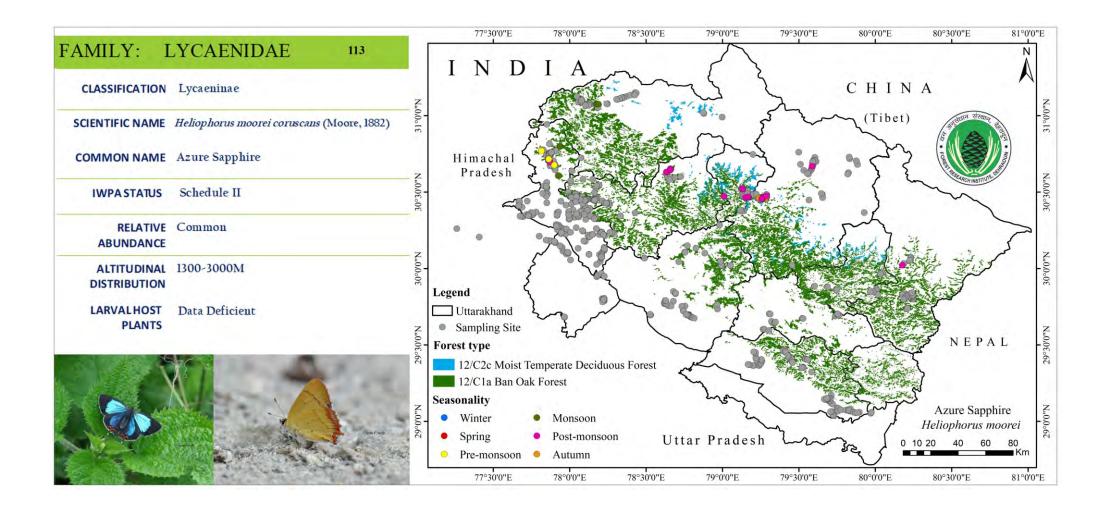


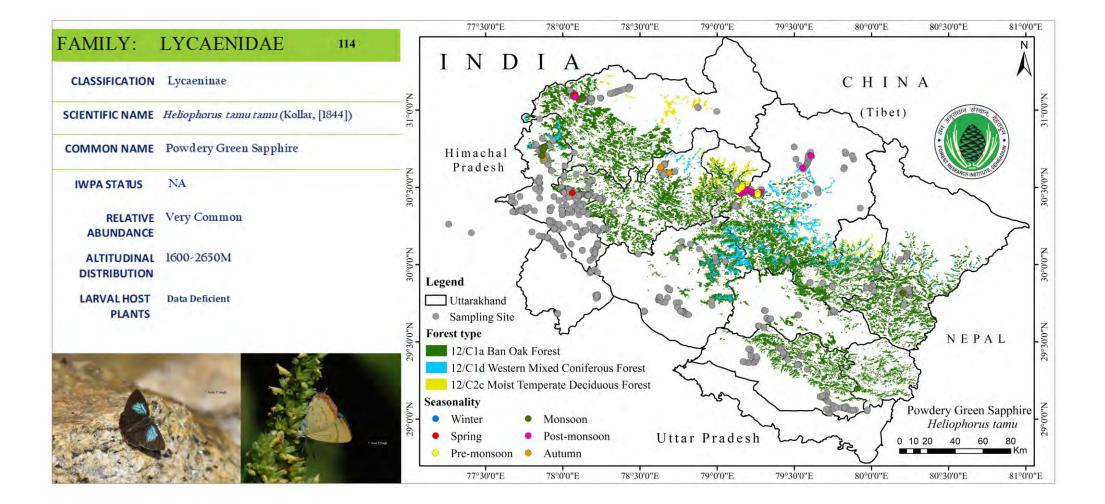


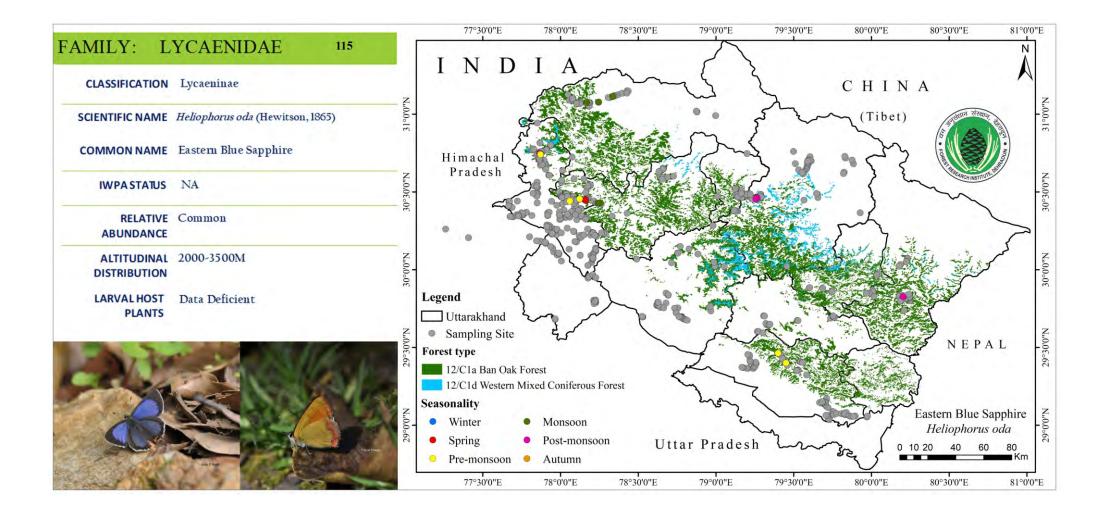


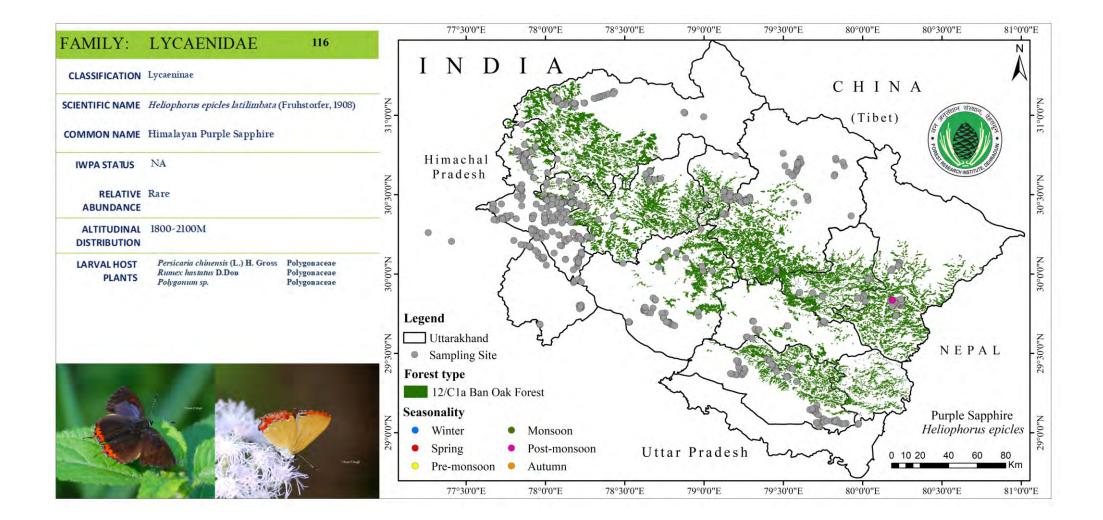


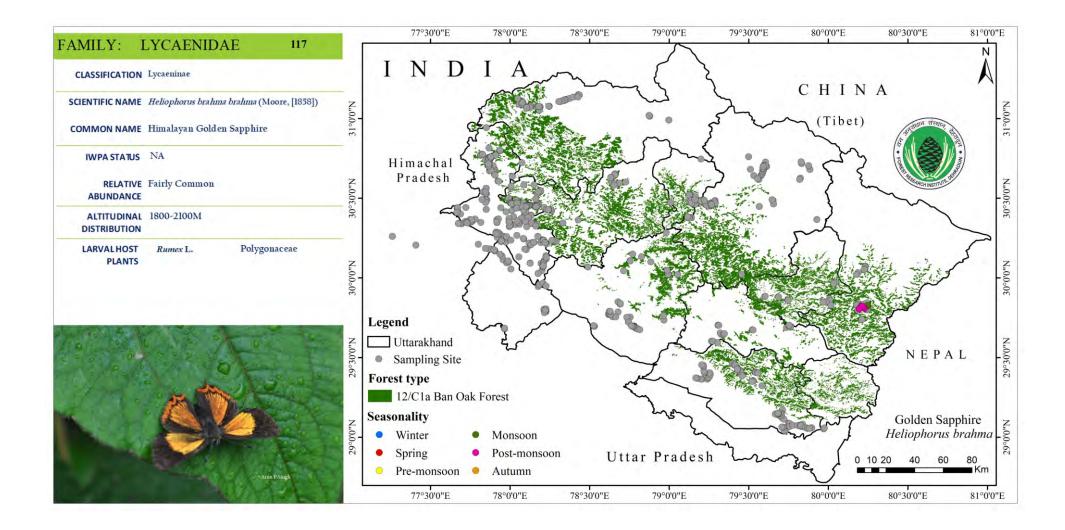


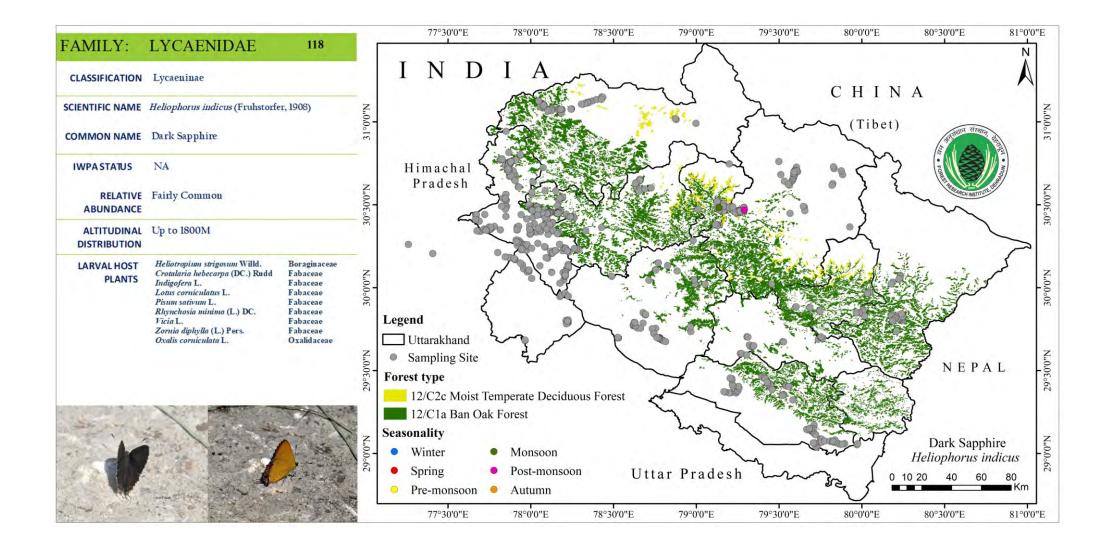


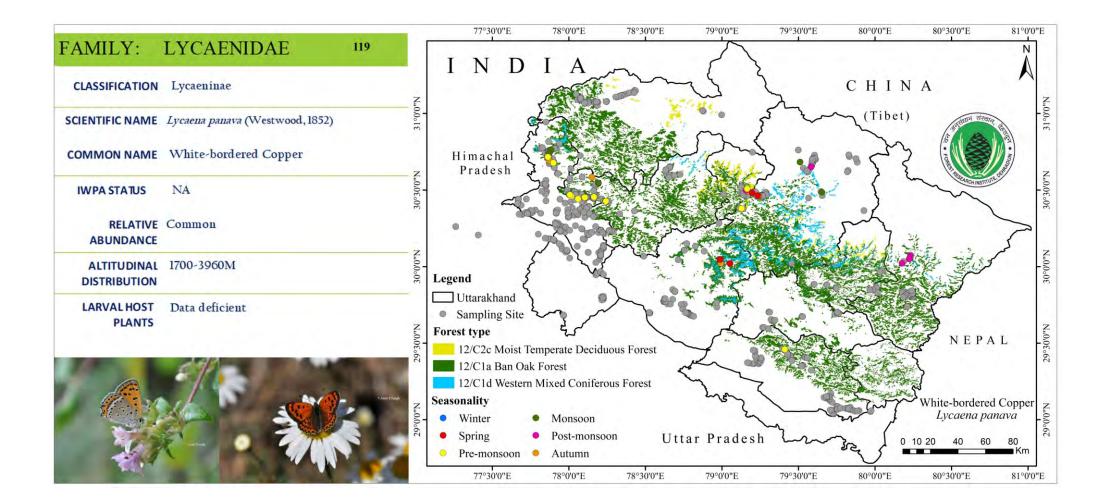


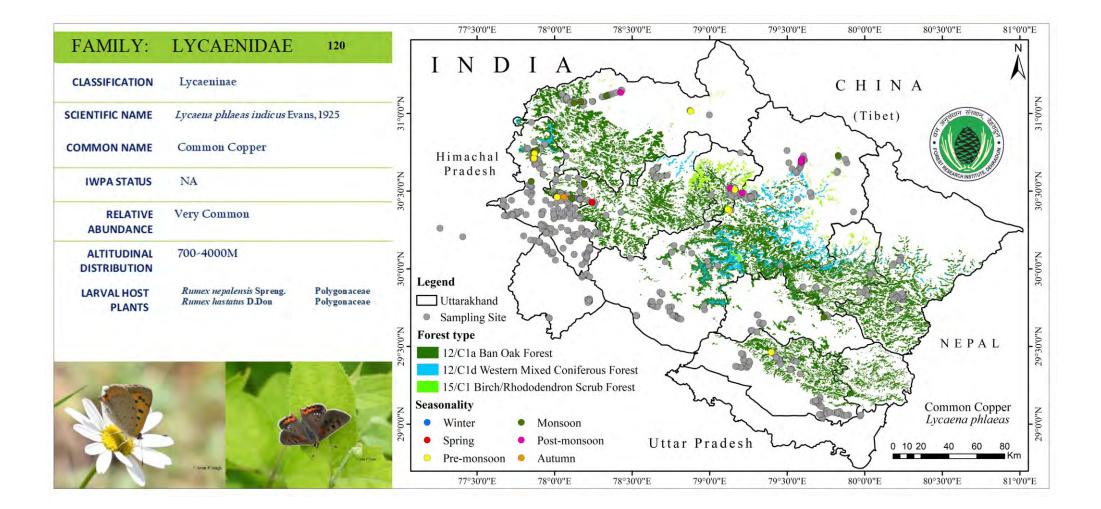


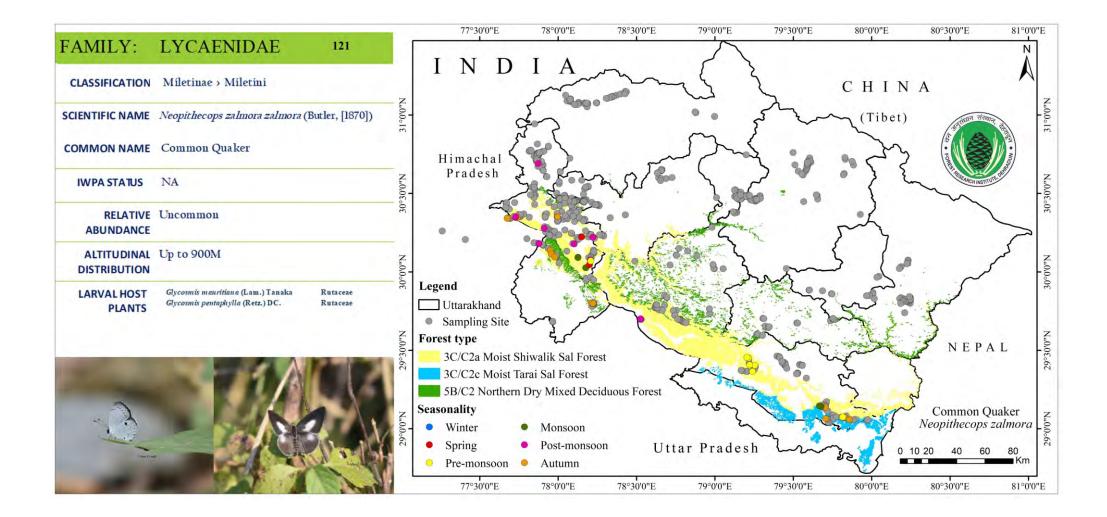


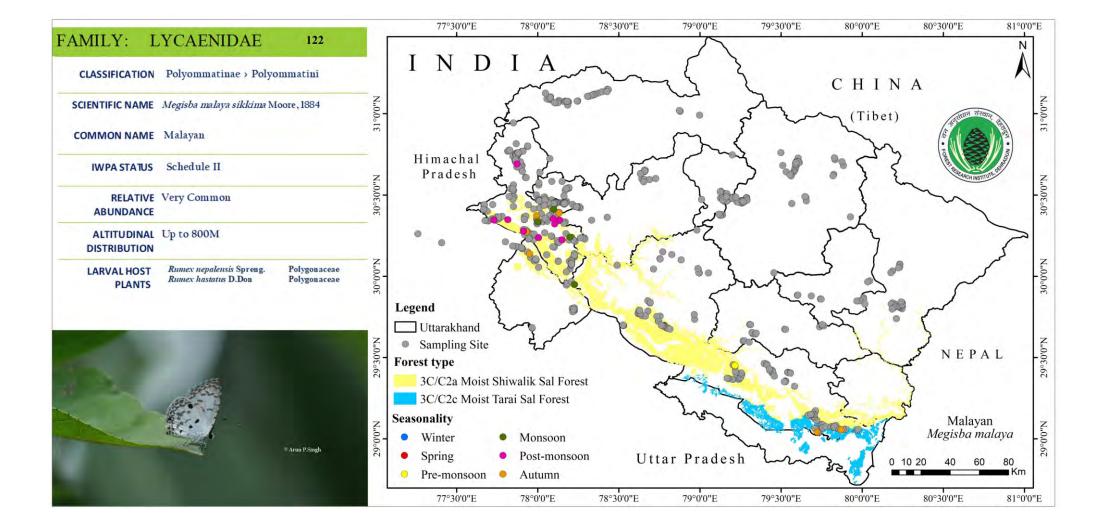


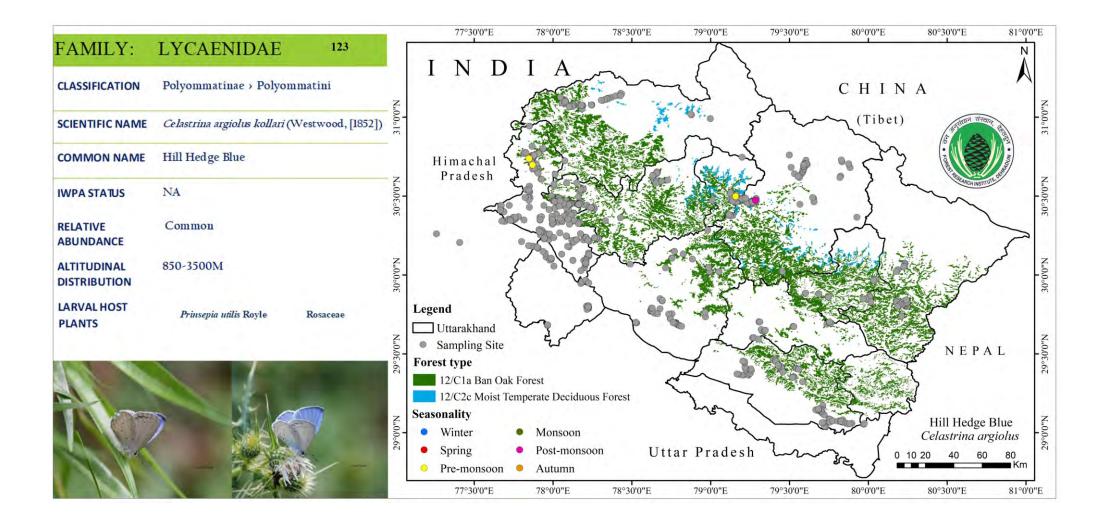


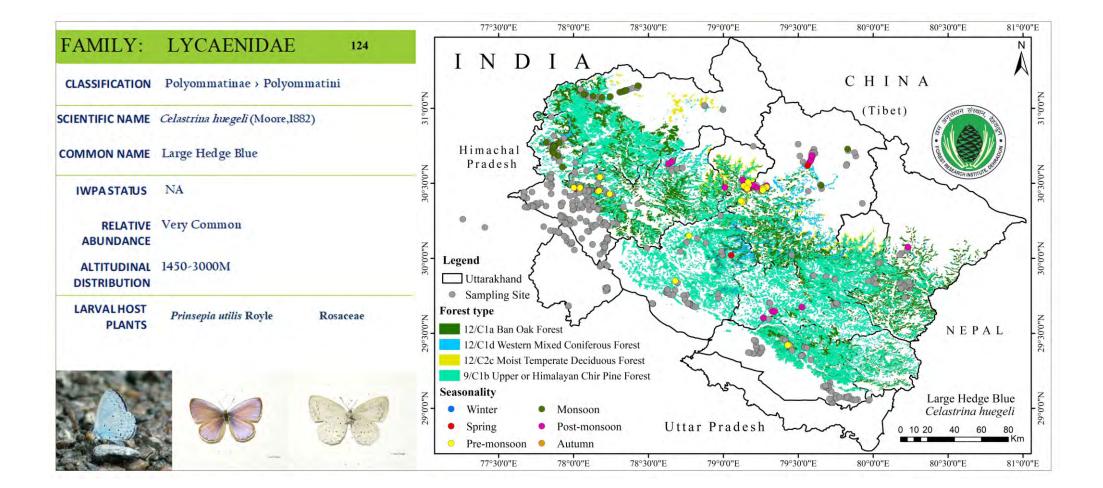


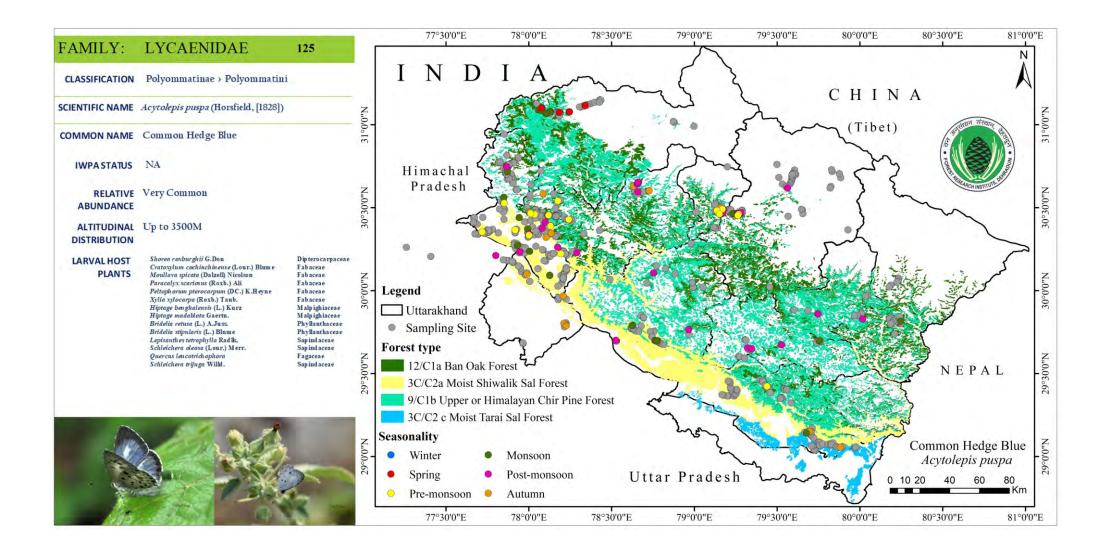


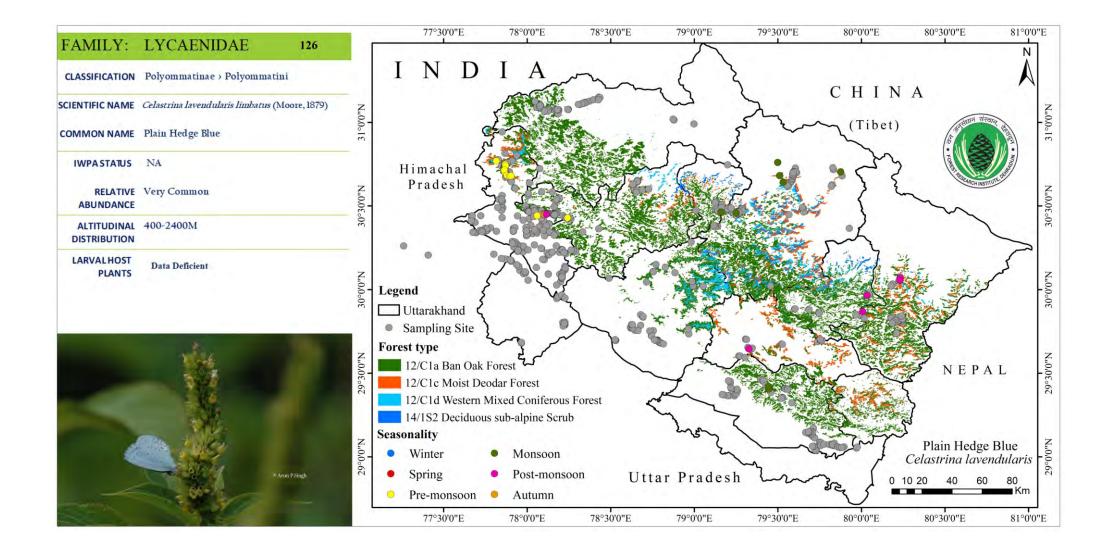


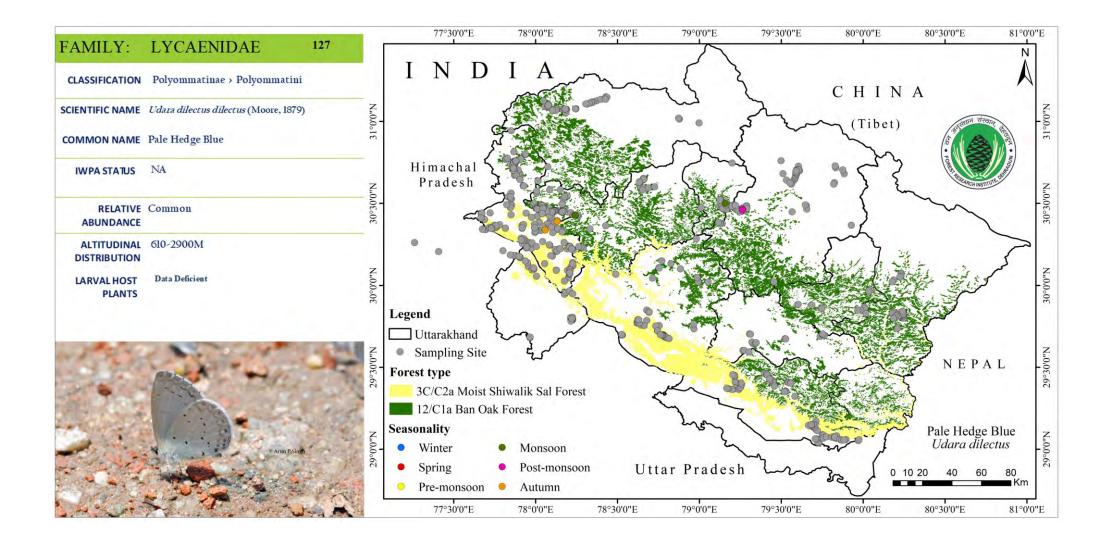


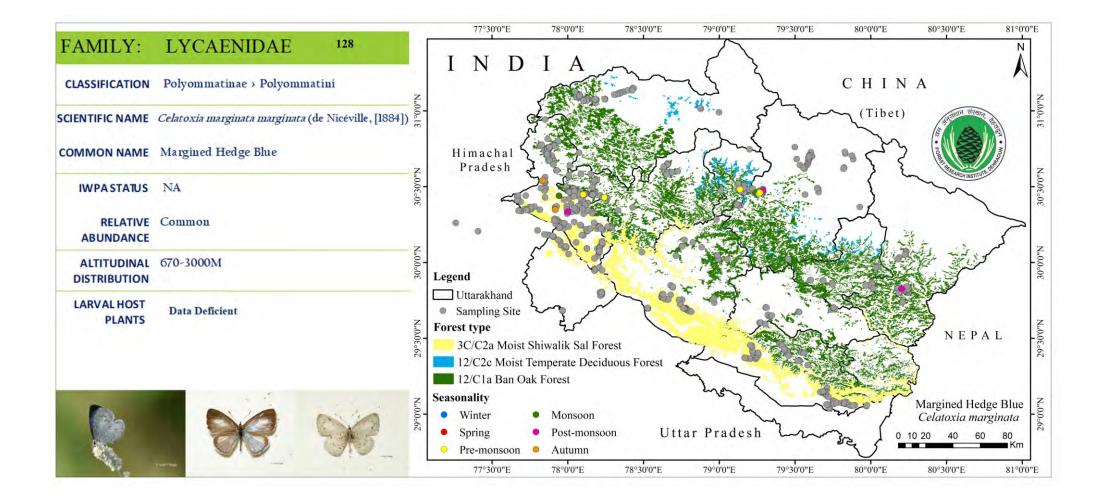


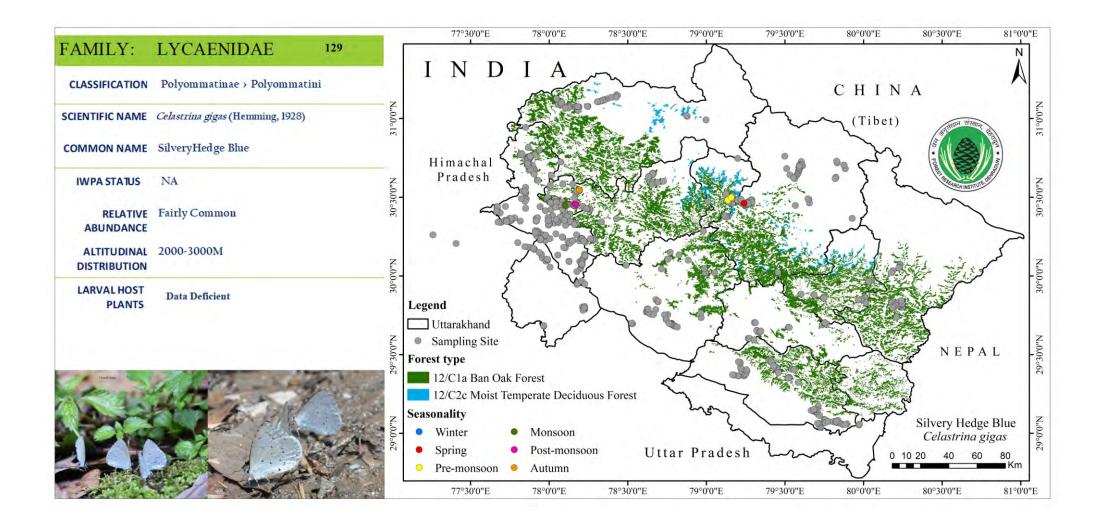


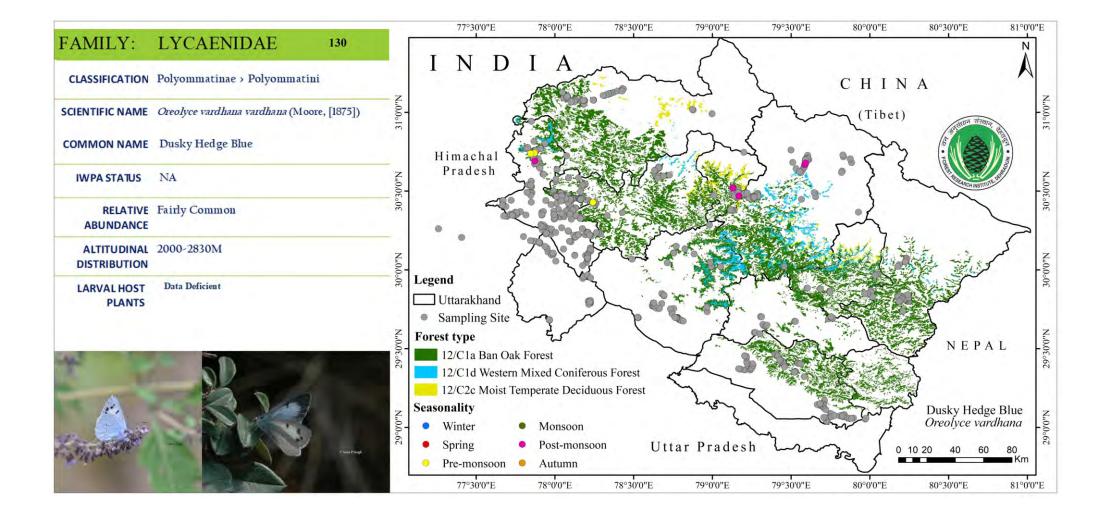


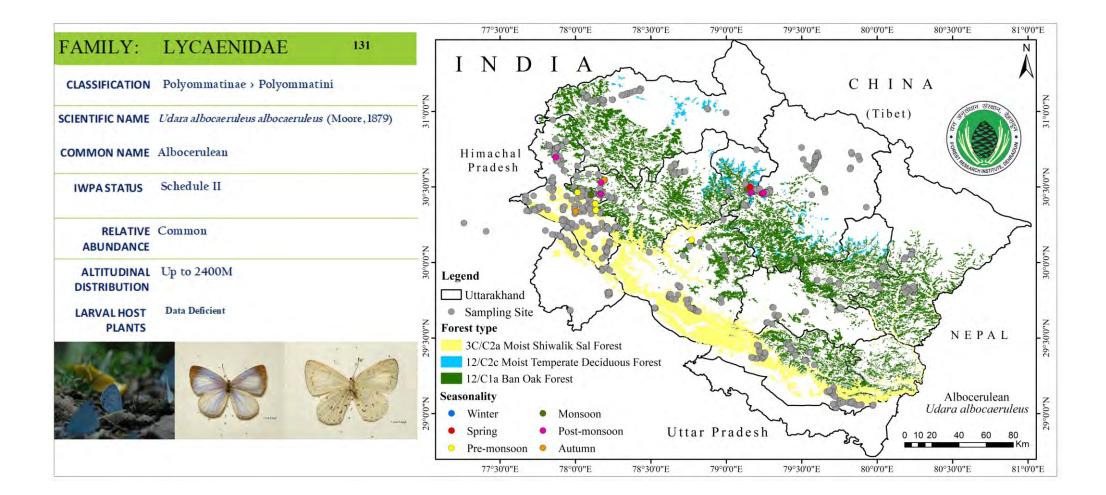


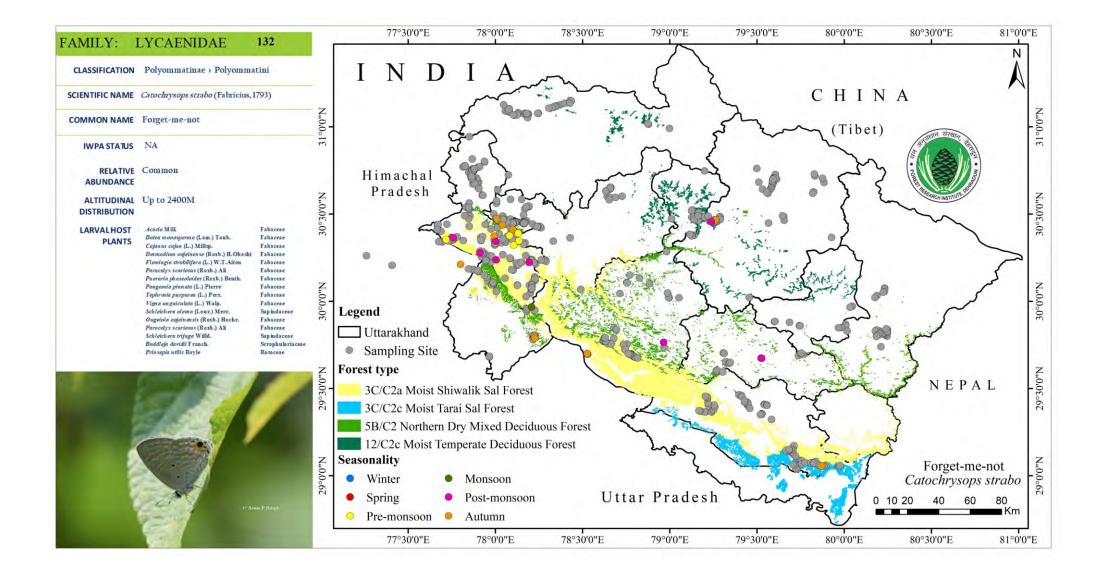


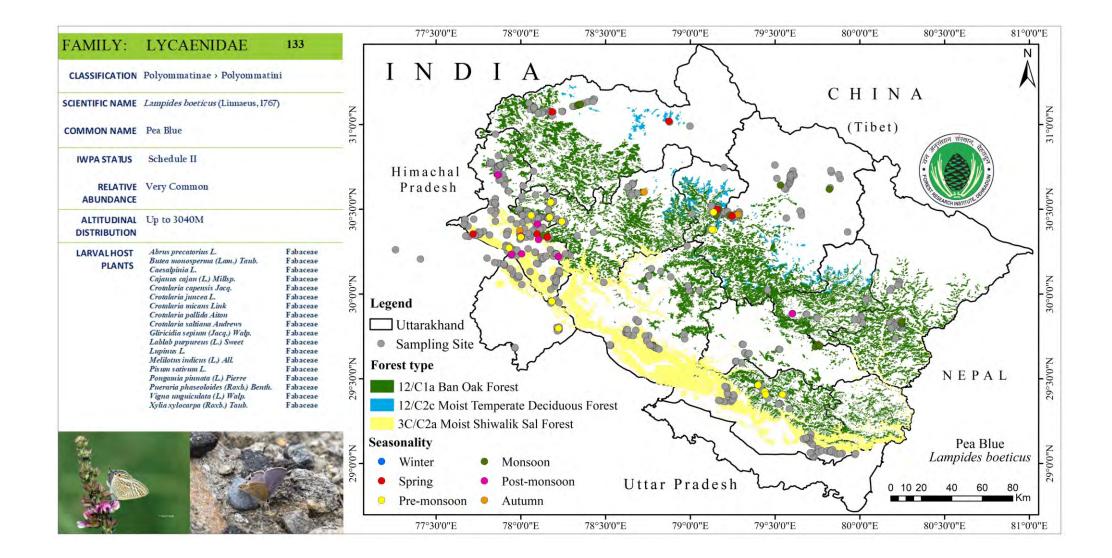


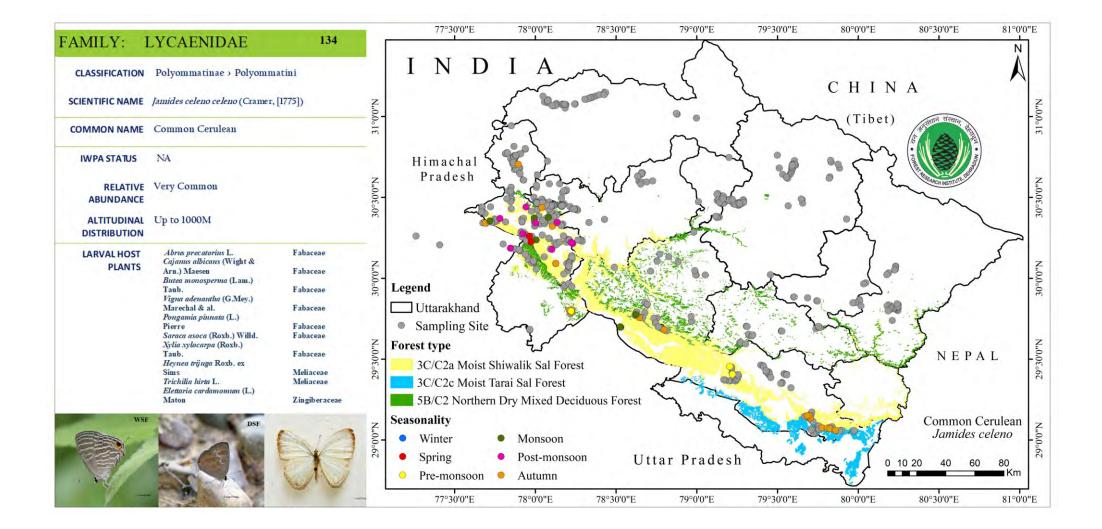


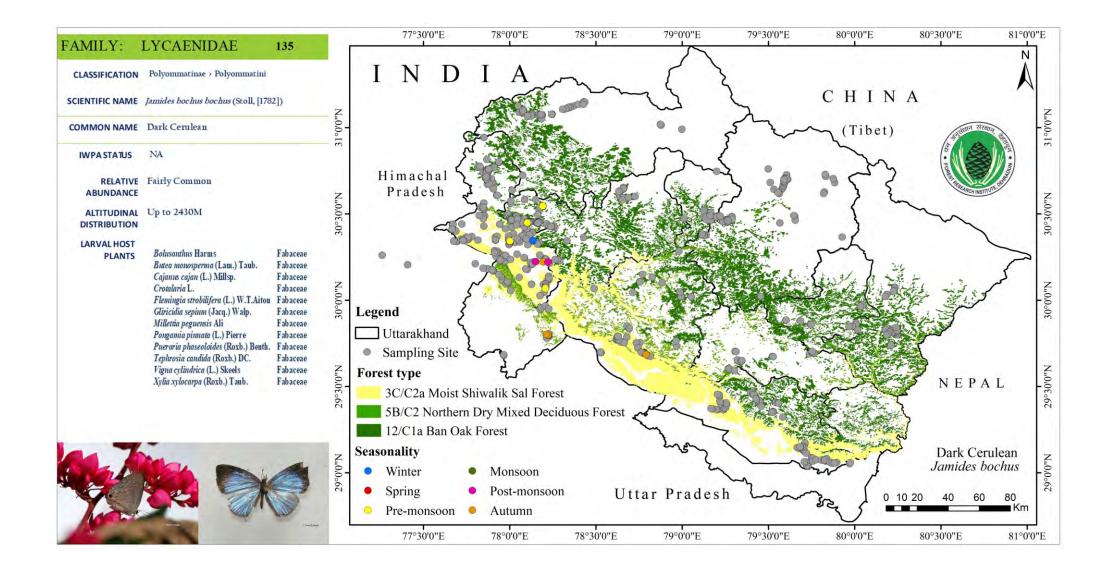


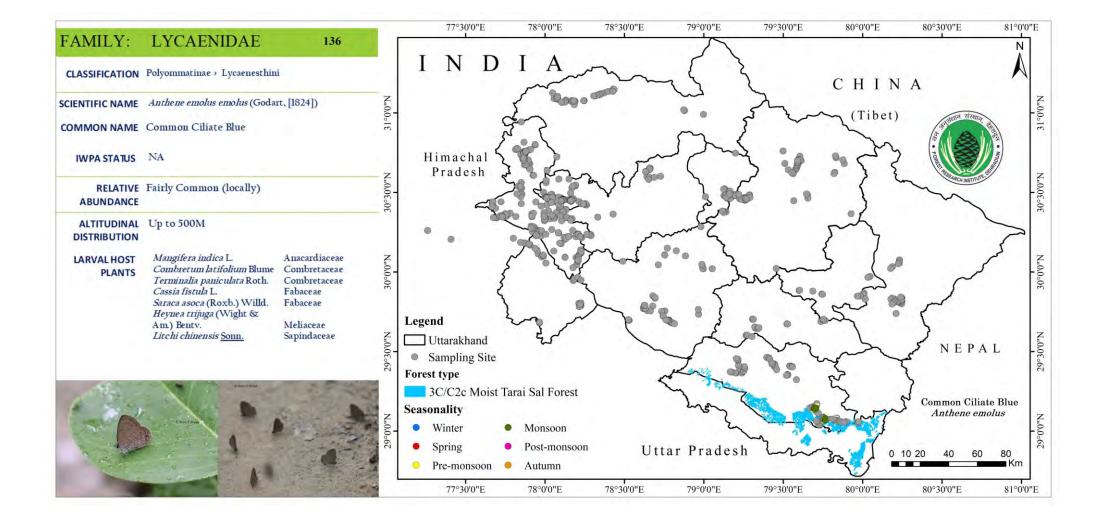


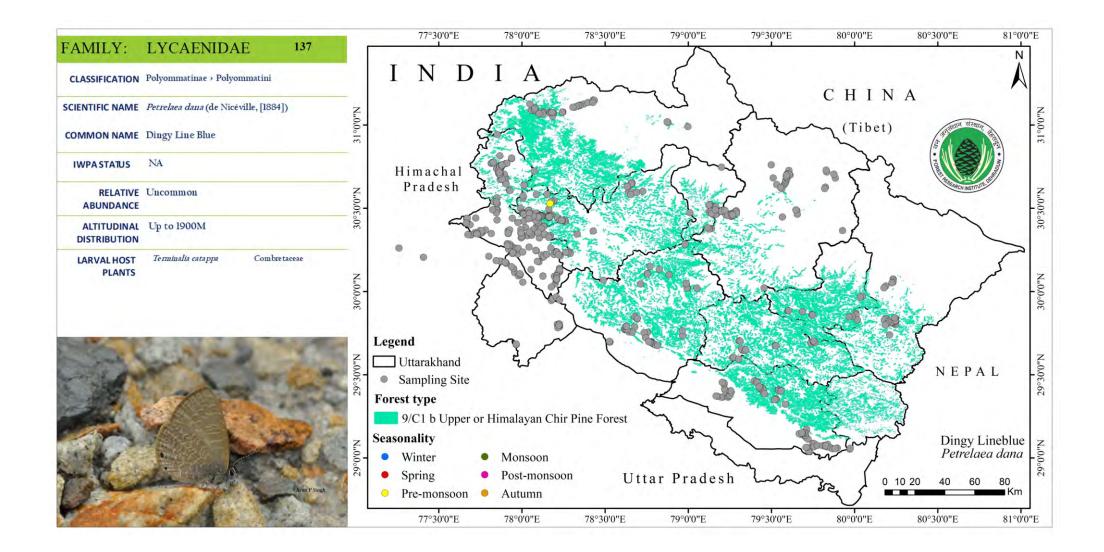


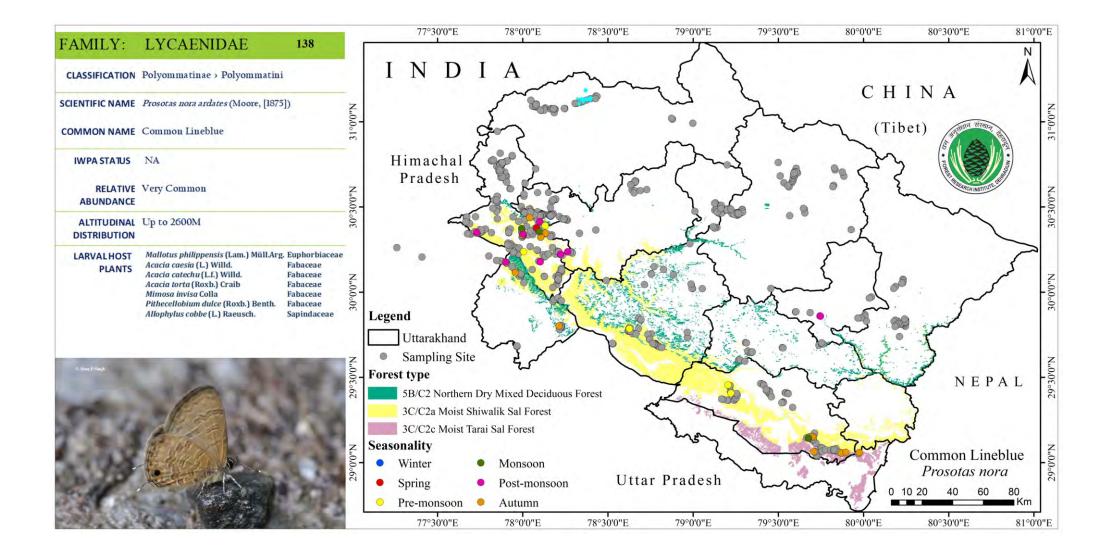


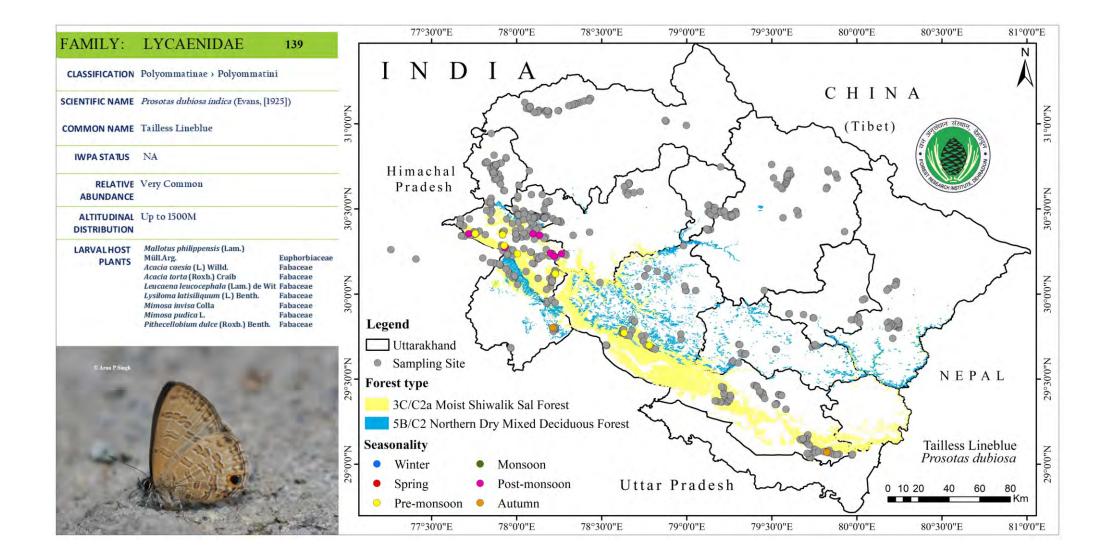


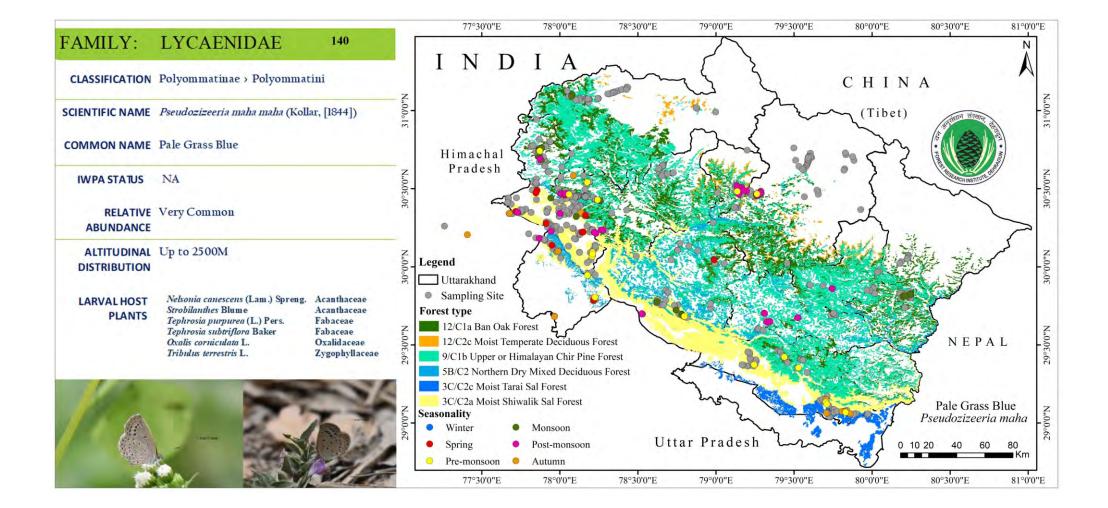


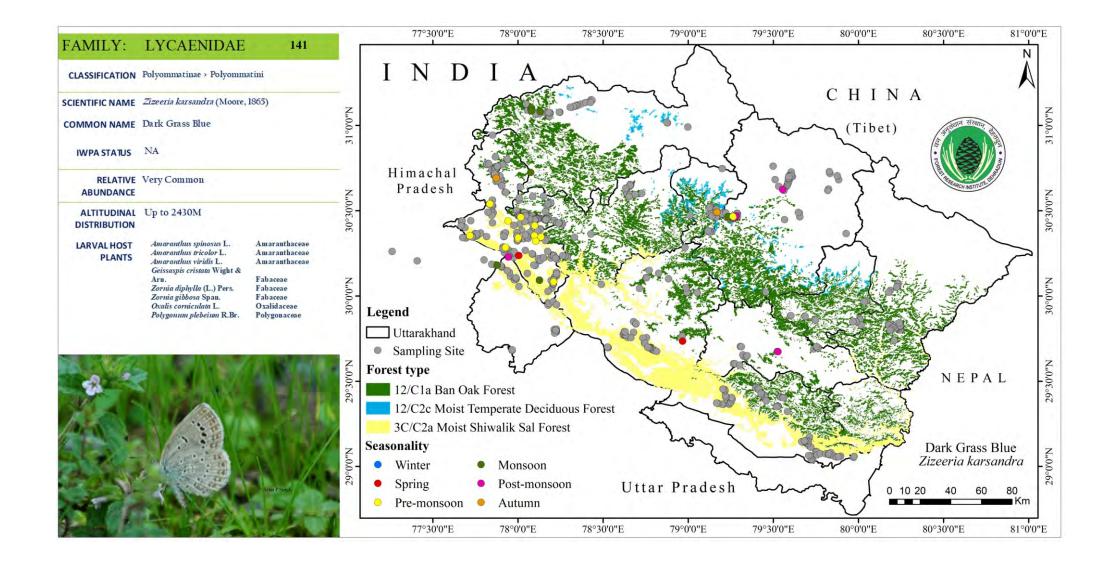


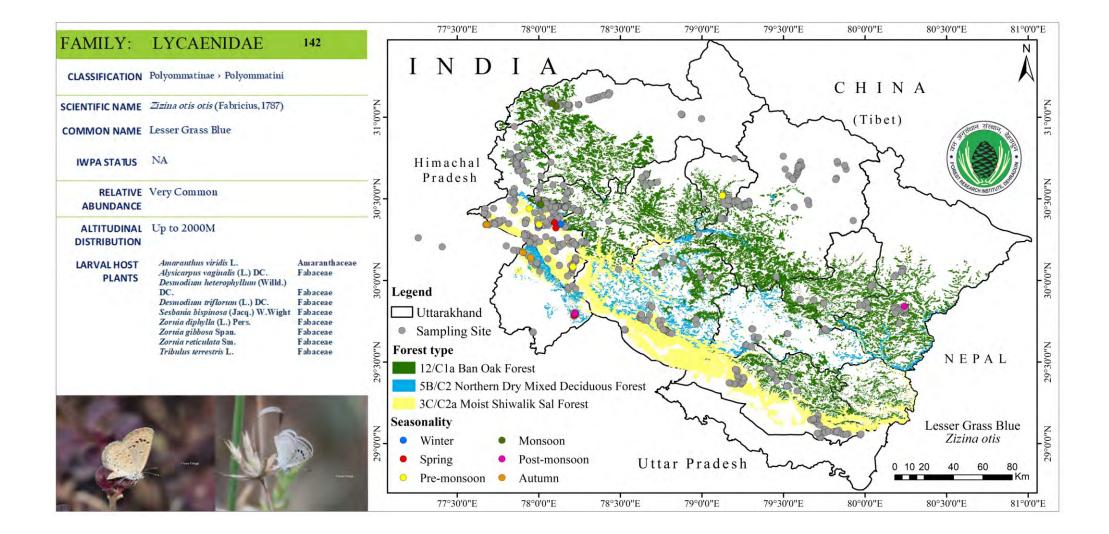


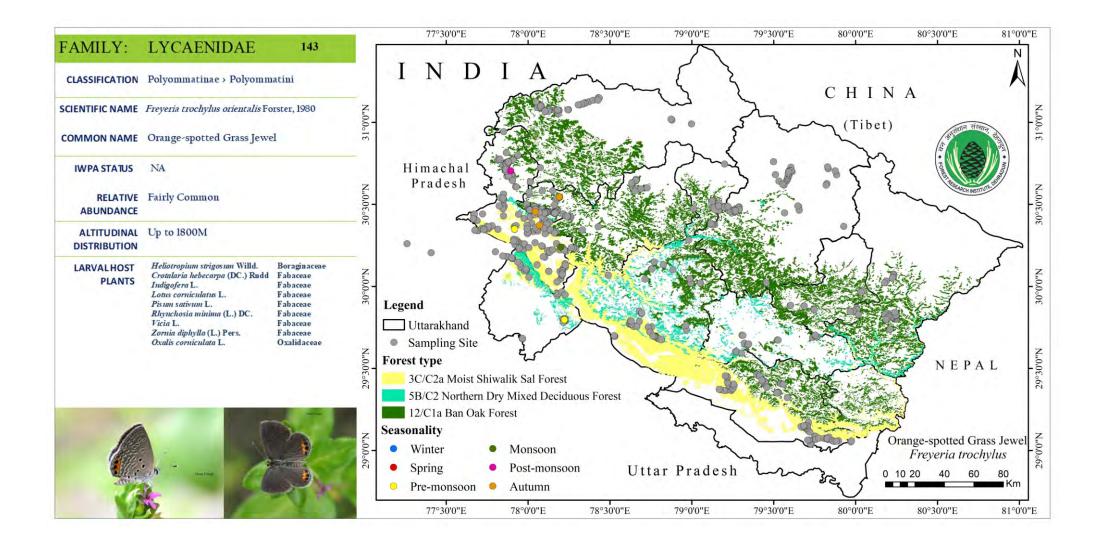


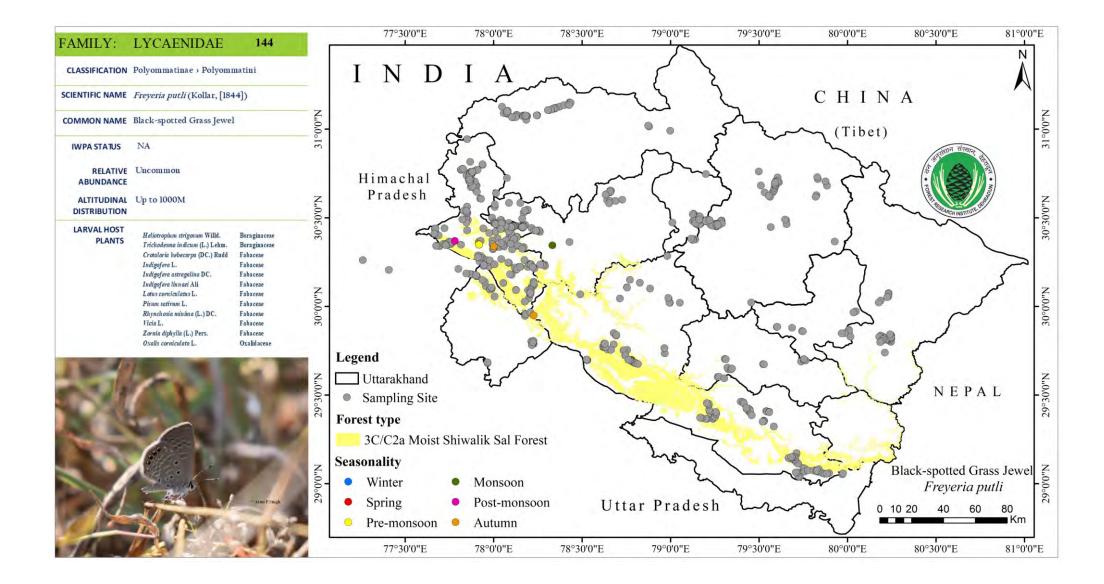


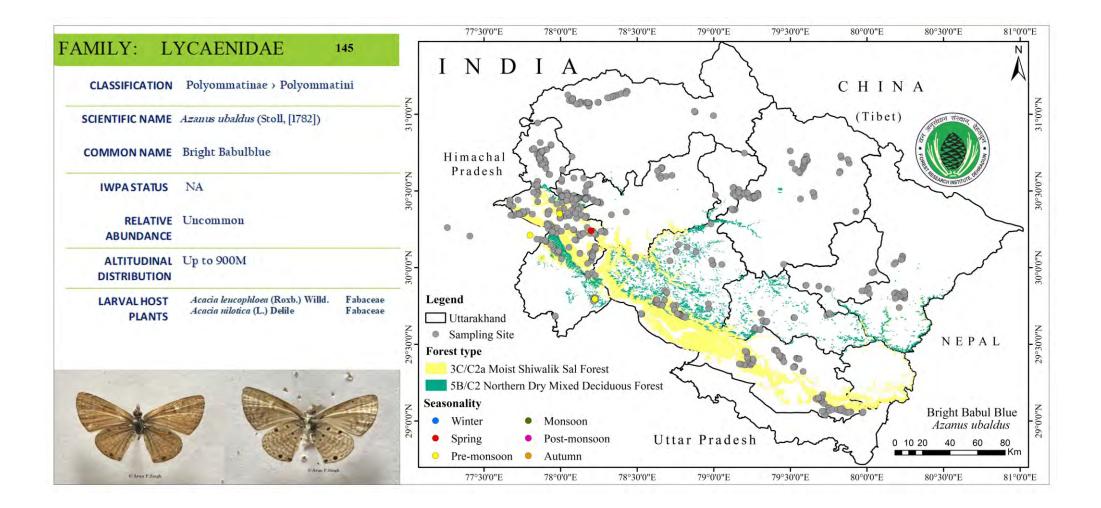


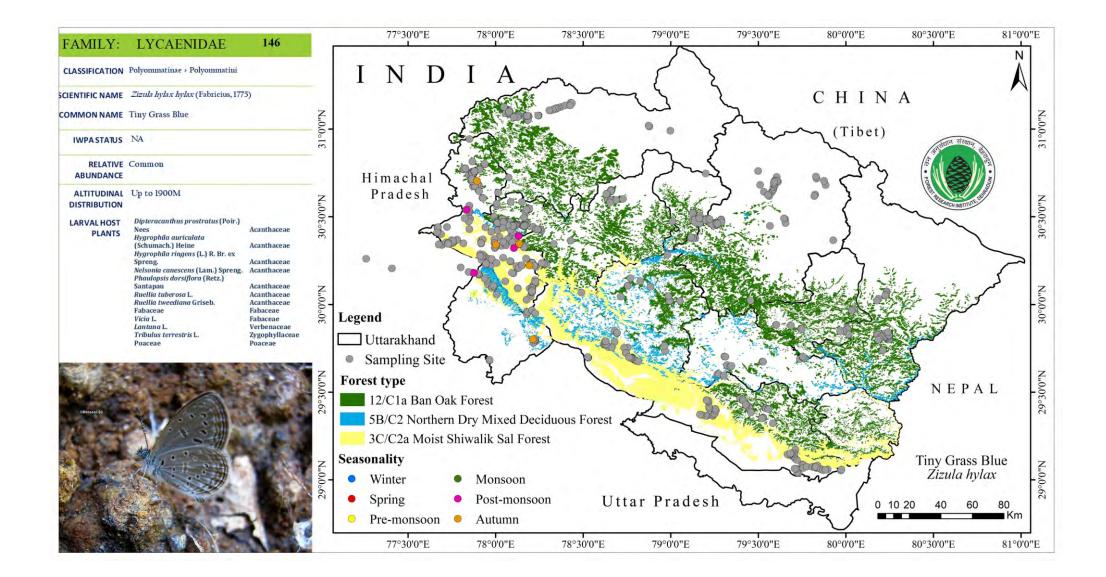


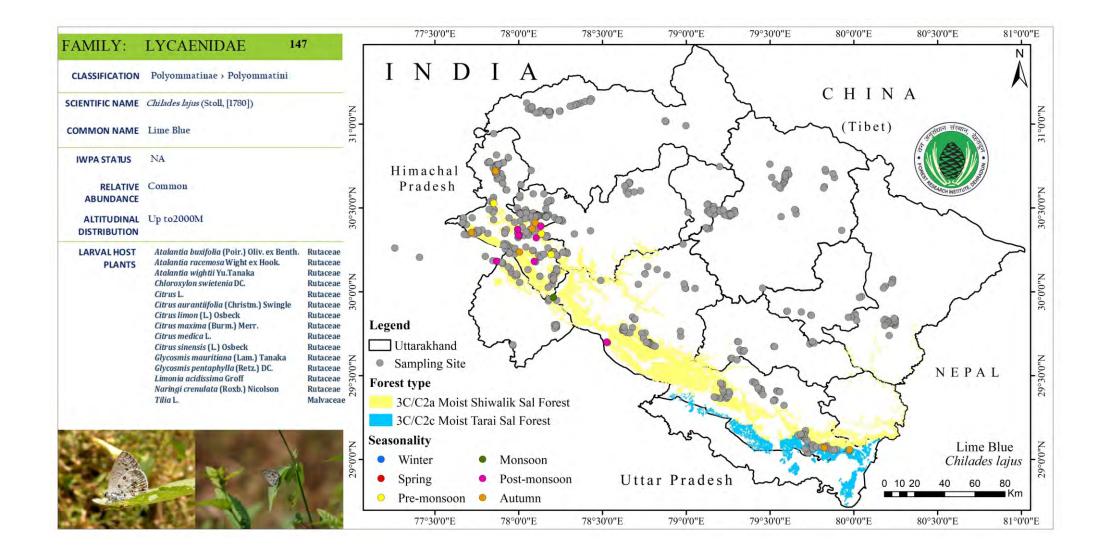


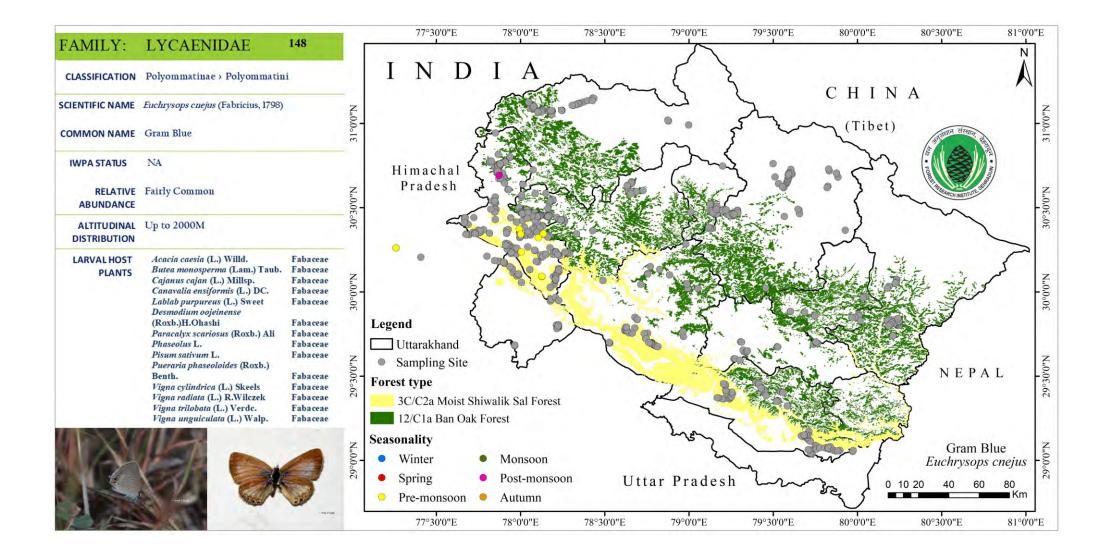


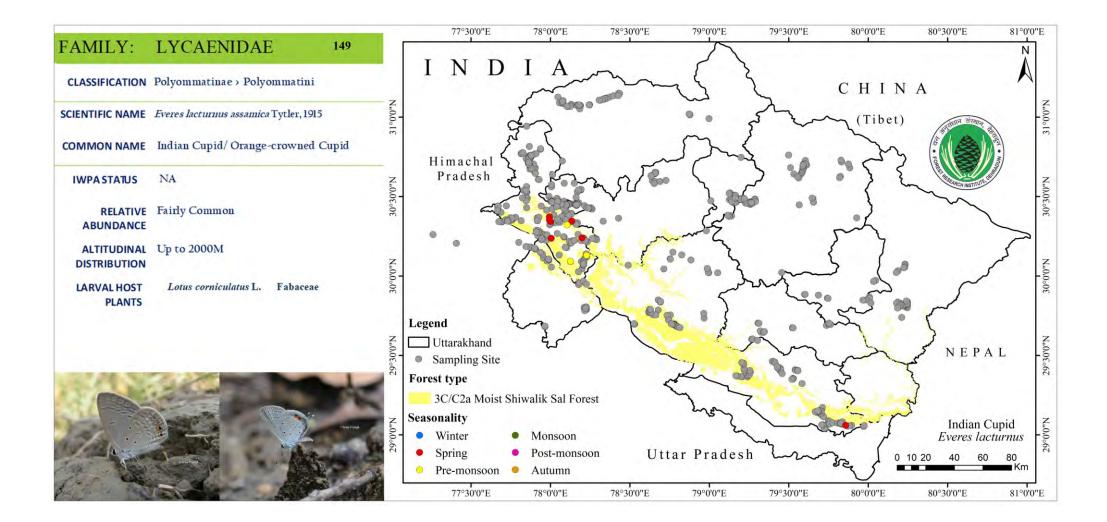


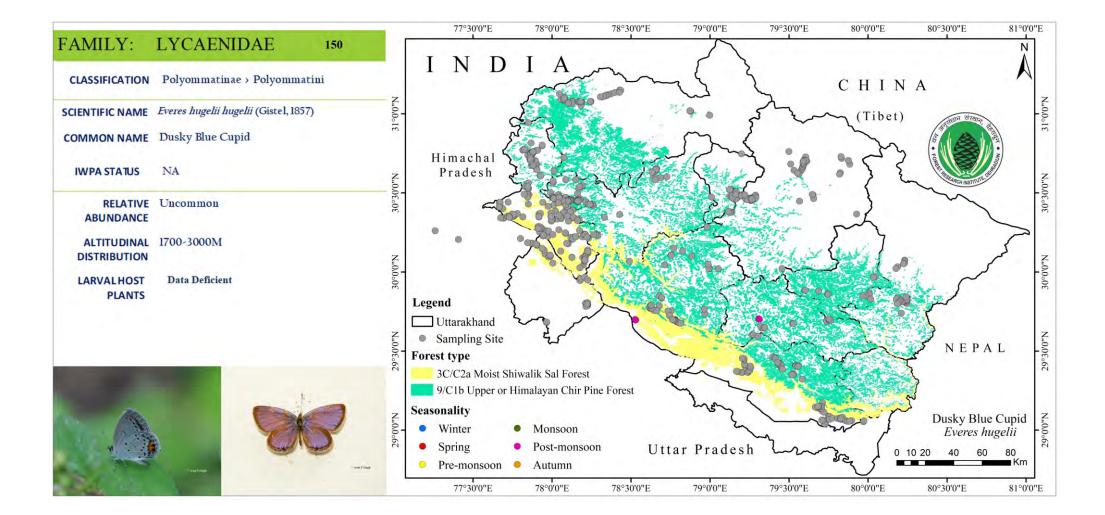


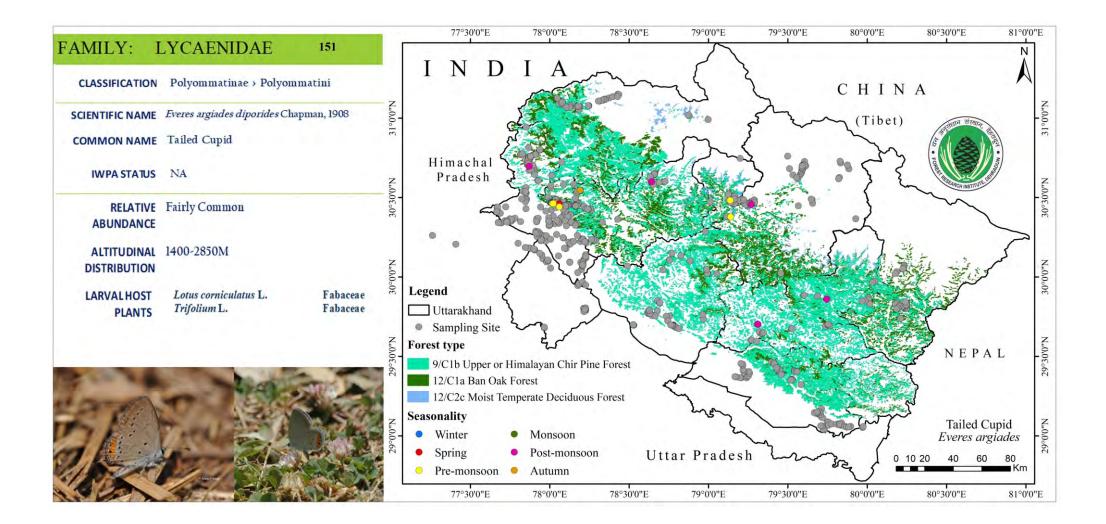


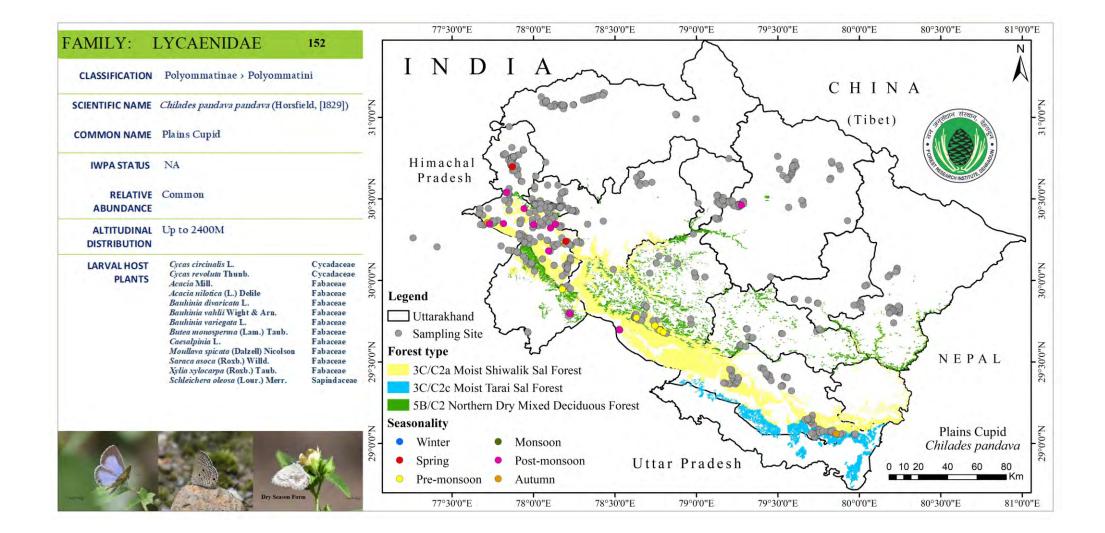


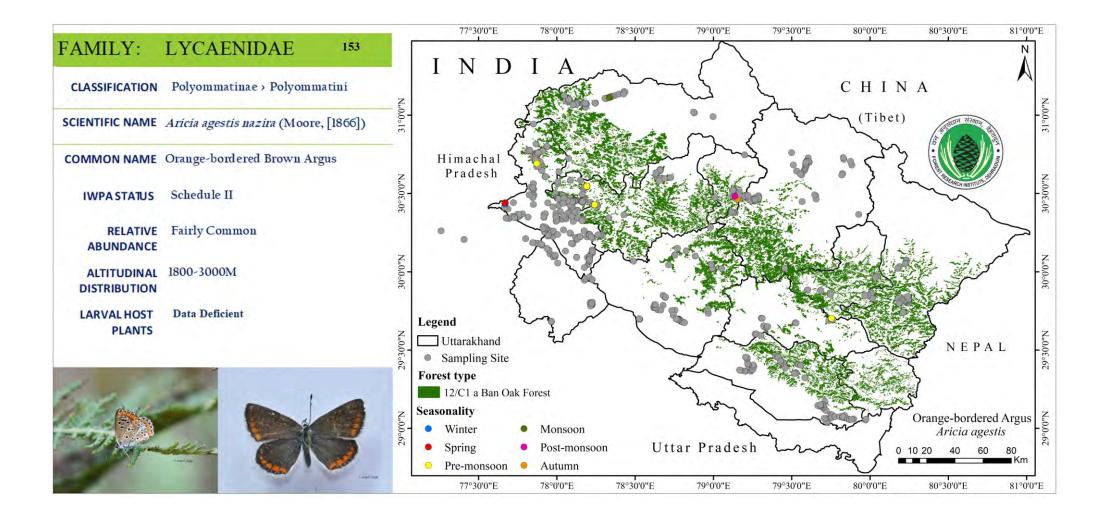


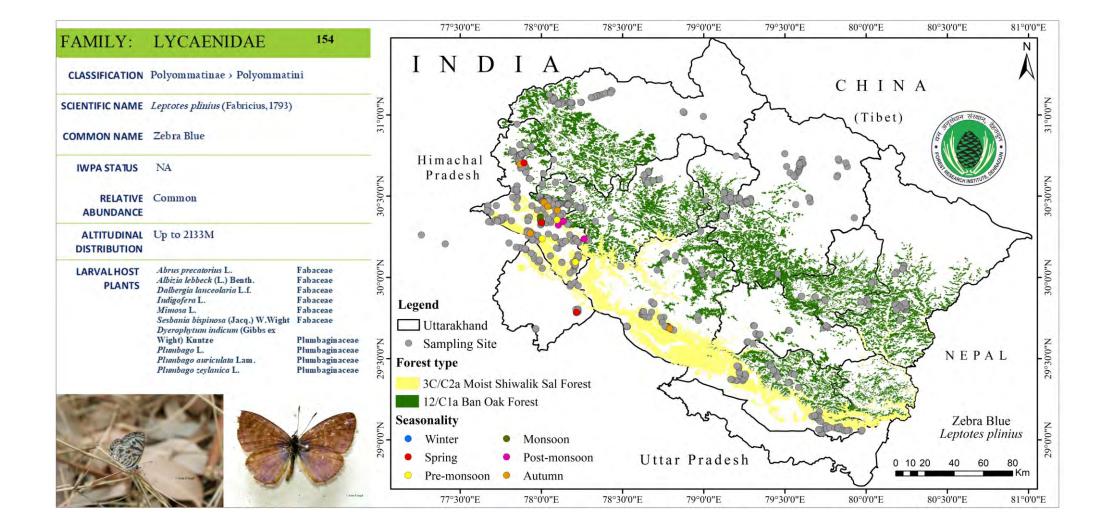


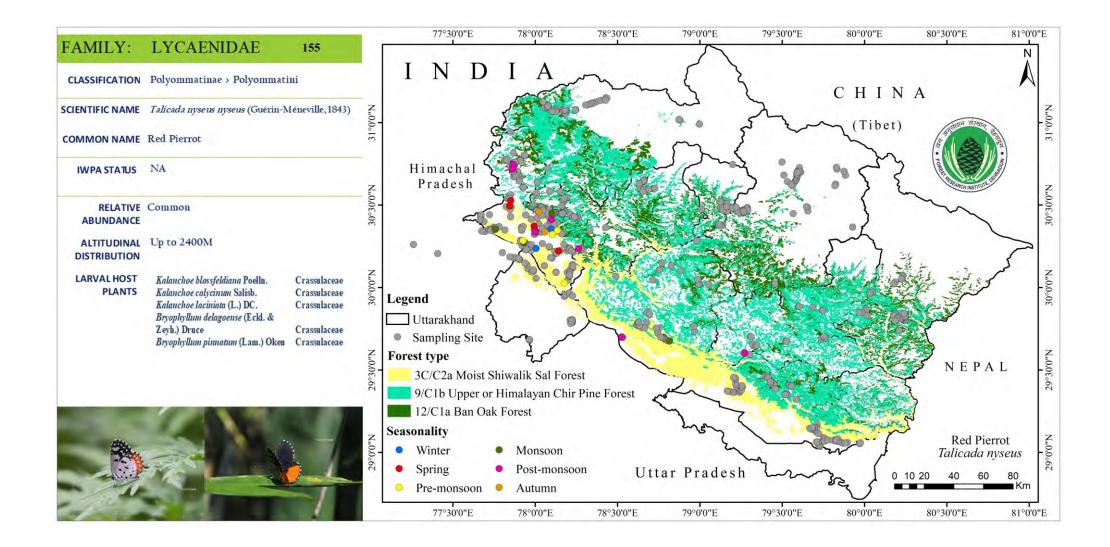


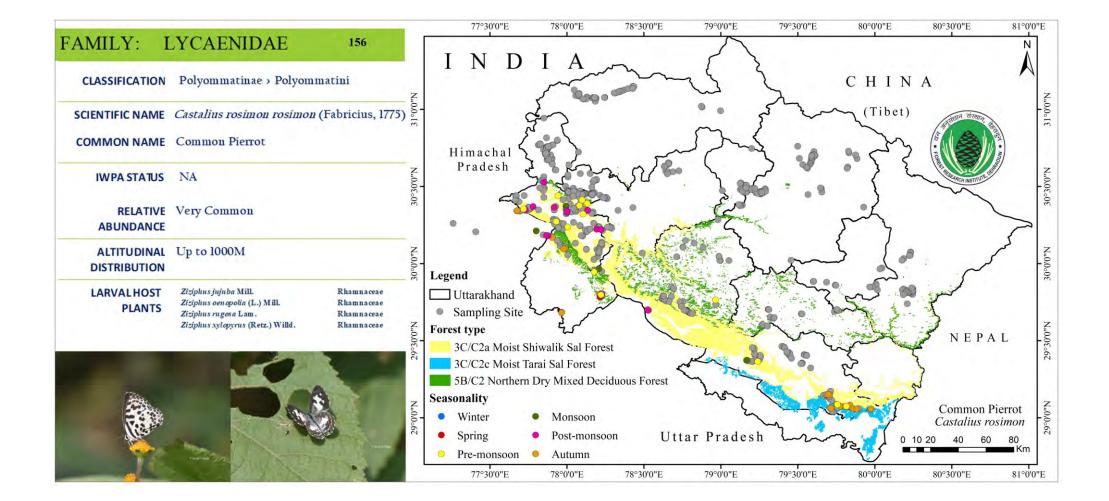


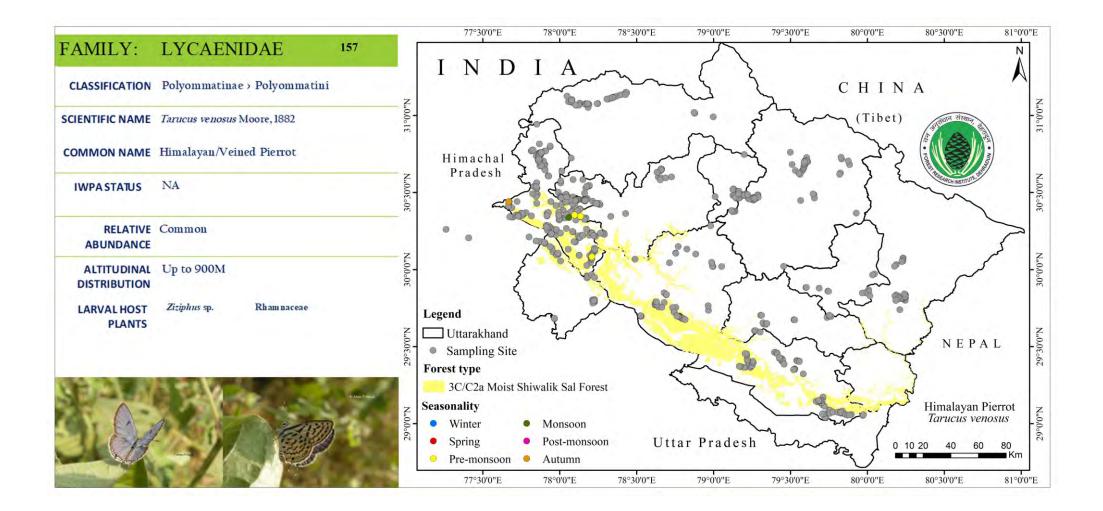


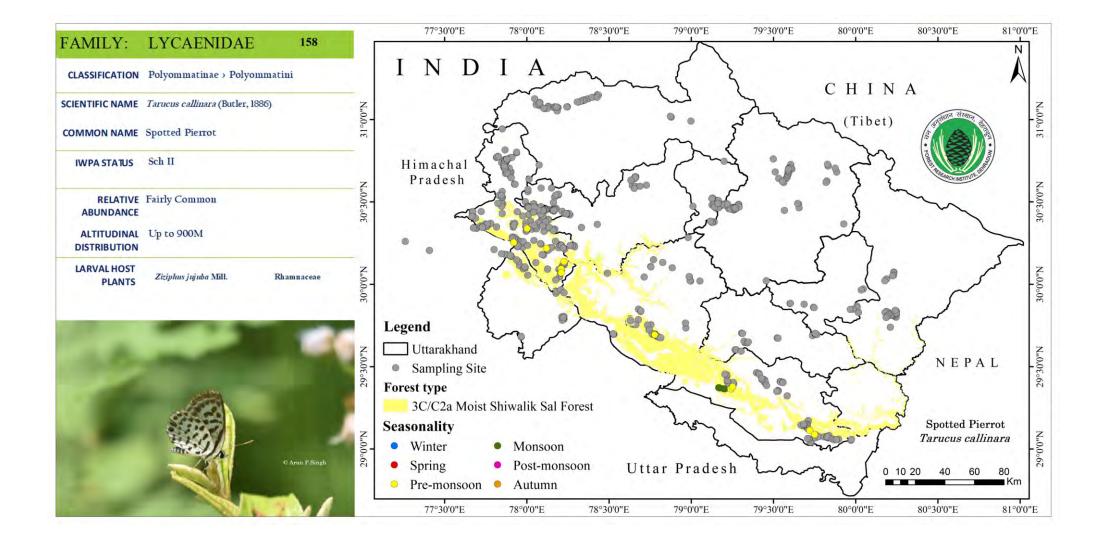


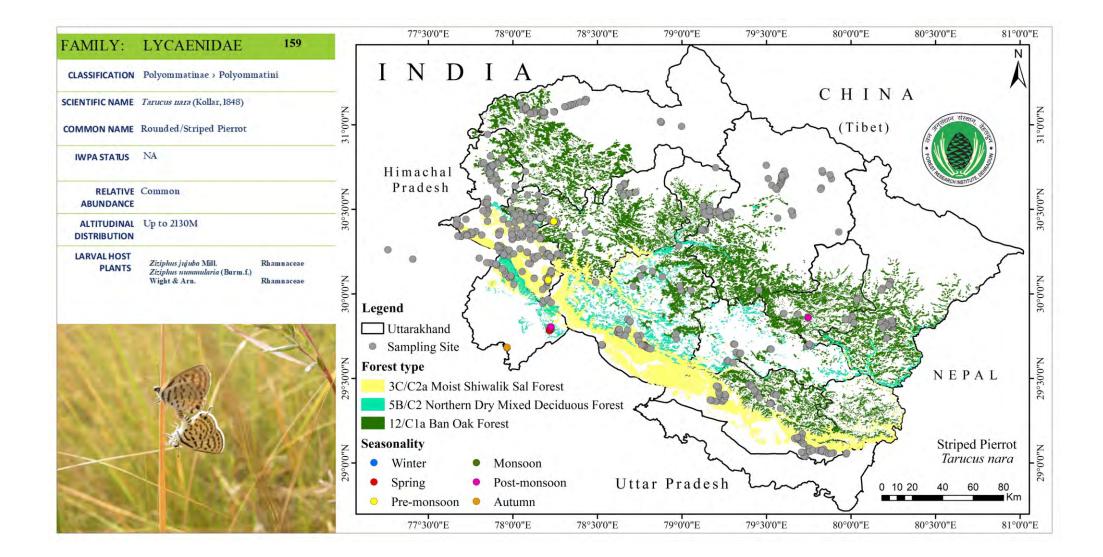


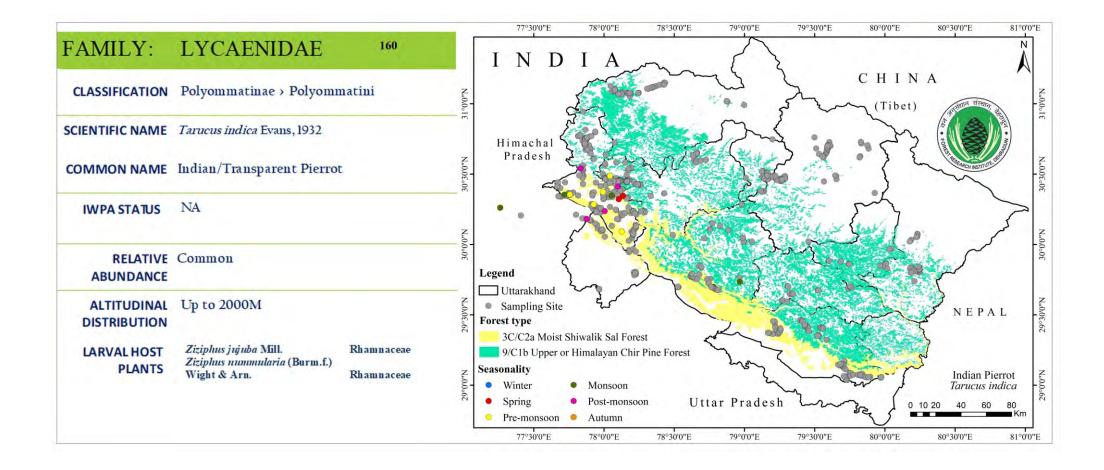






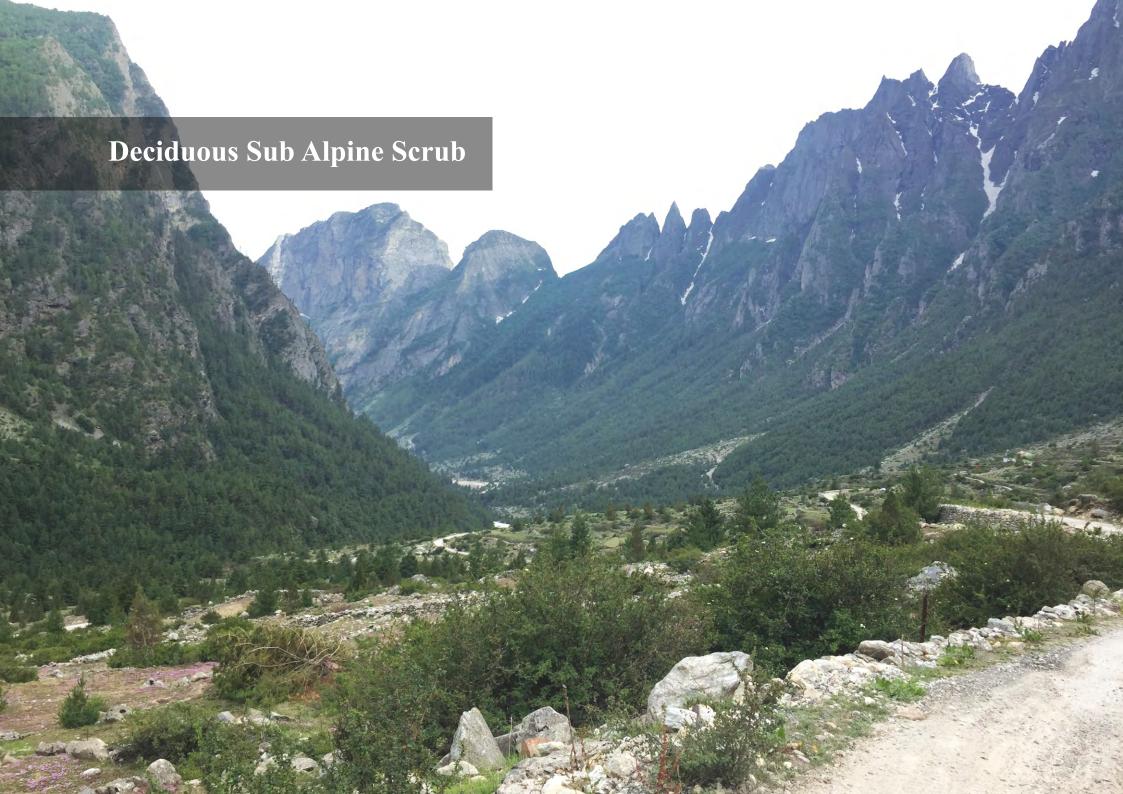


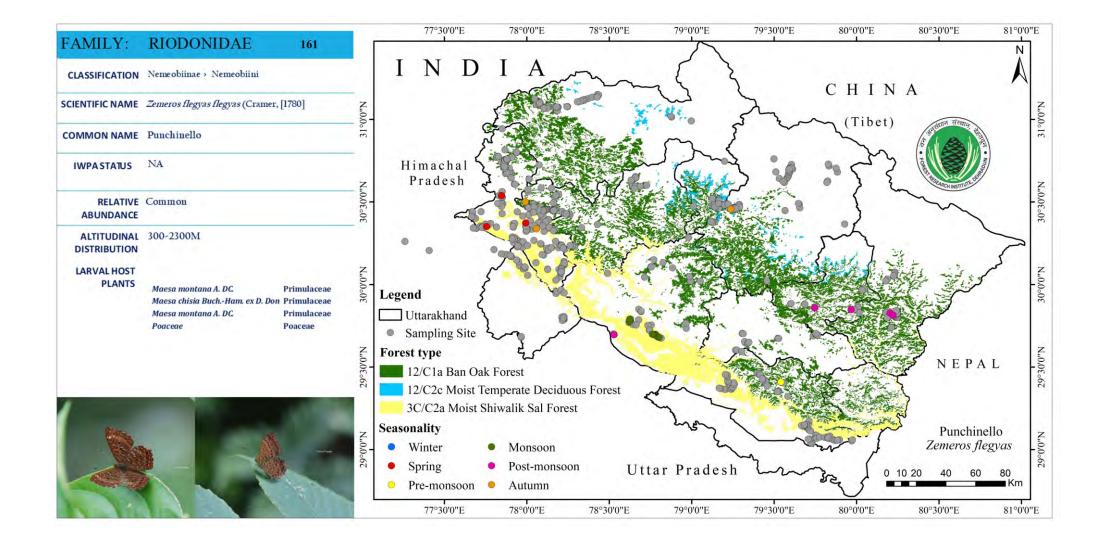


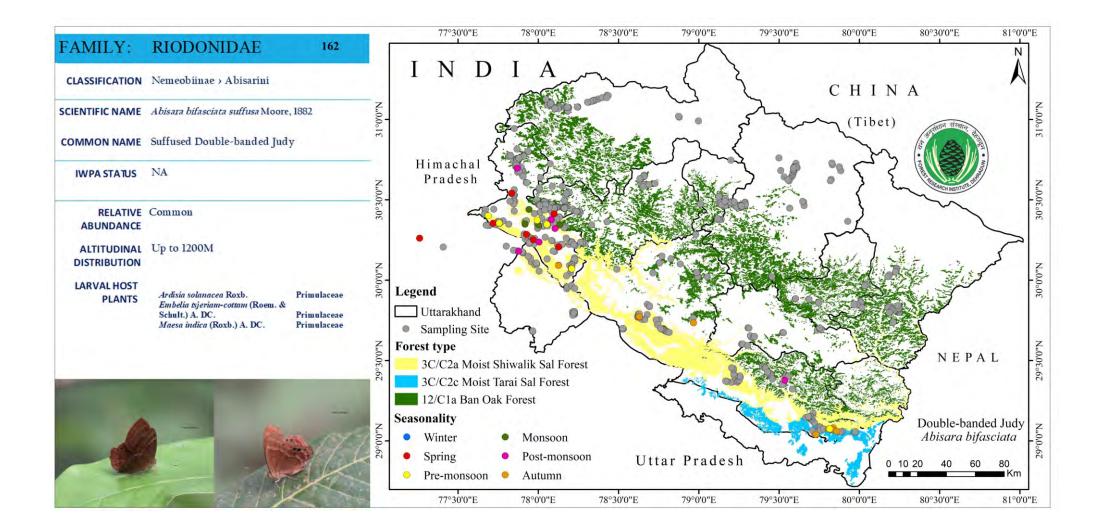


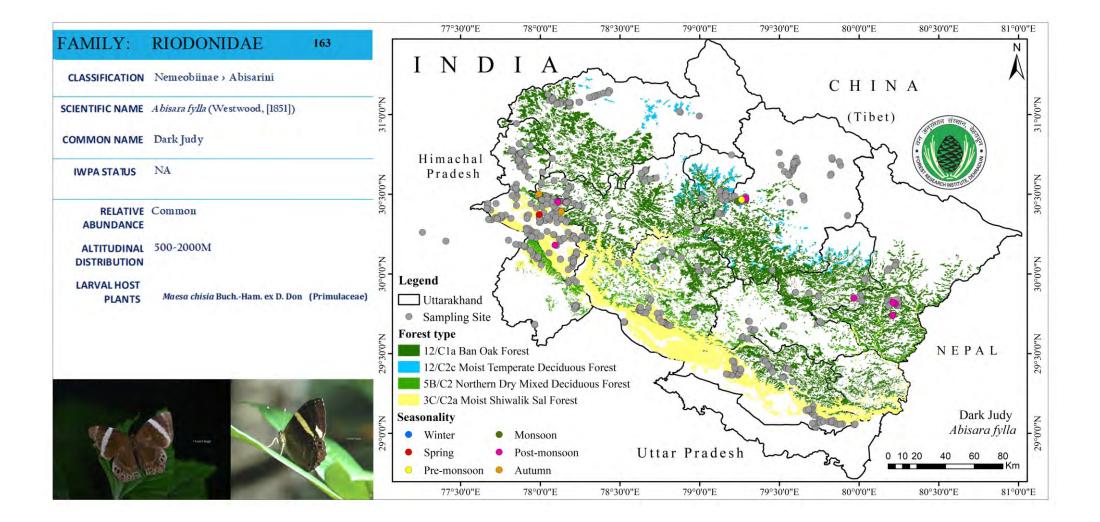
4.RIODINIDAE (Punches & Judie's) (161-167)

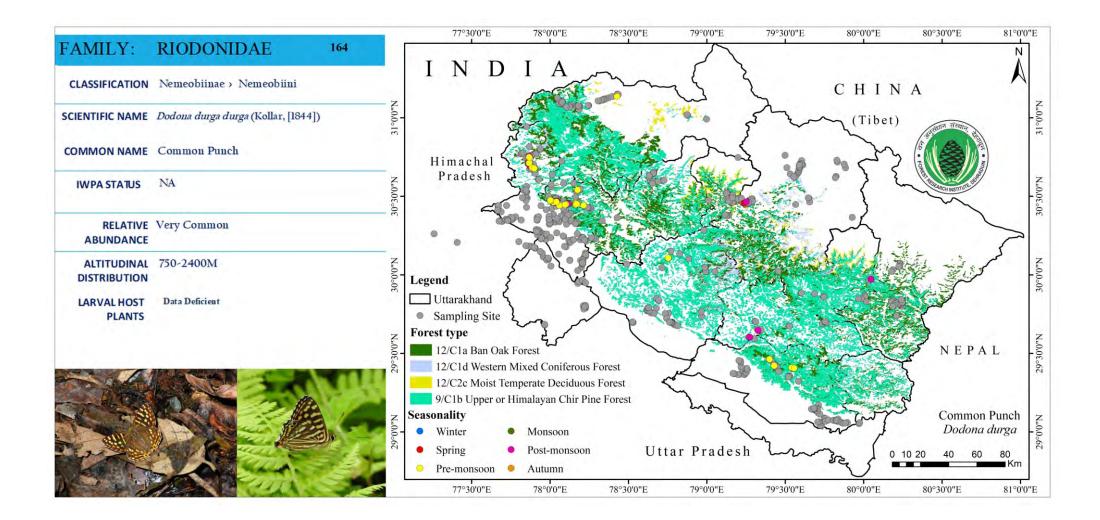


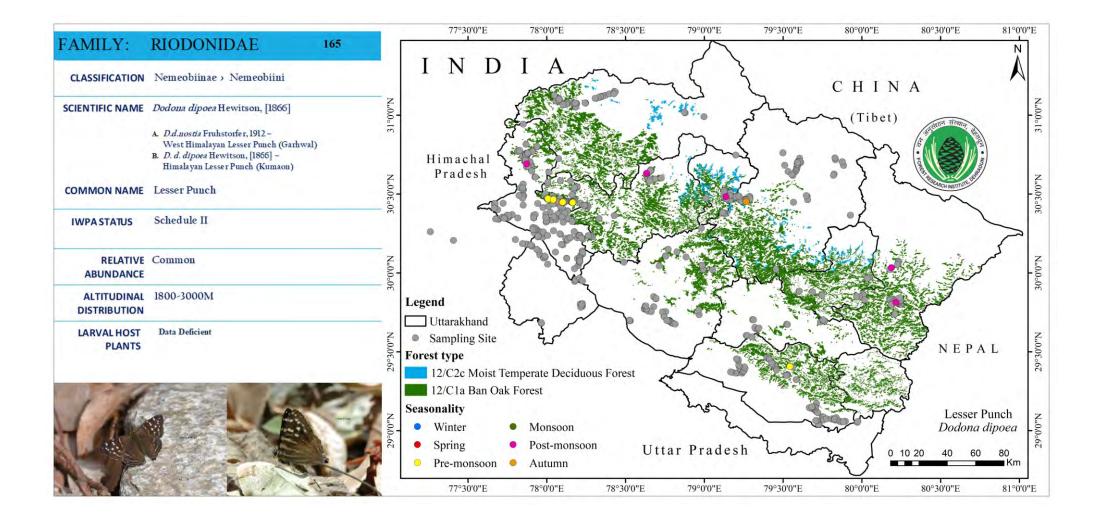


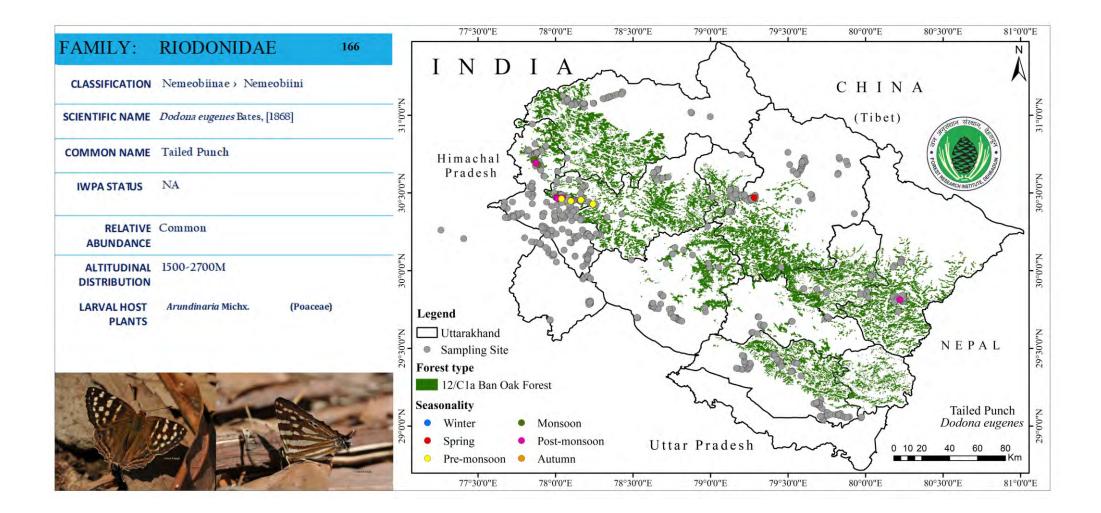


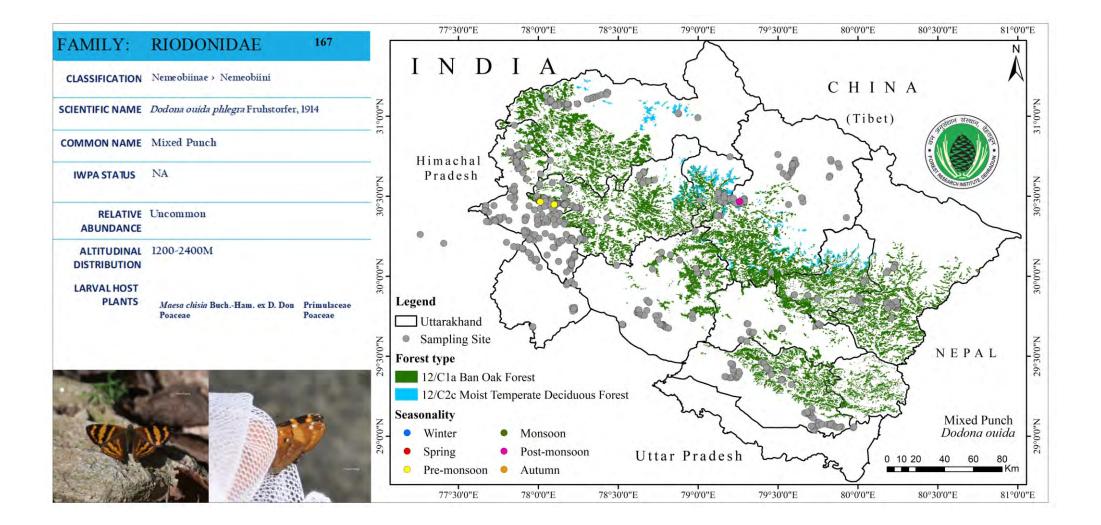










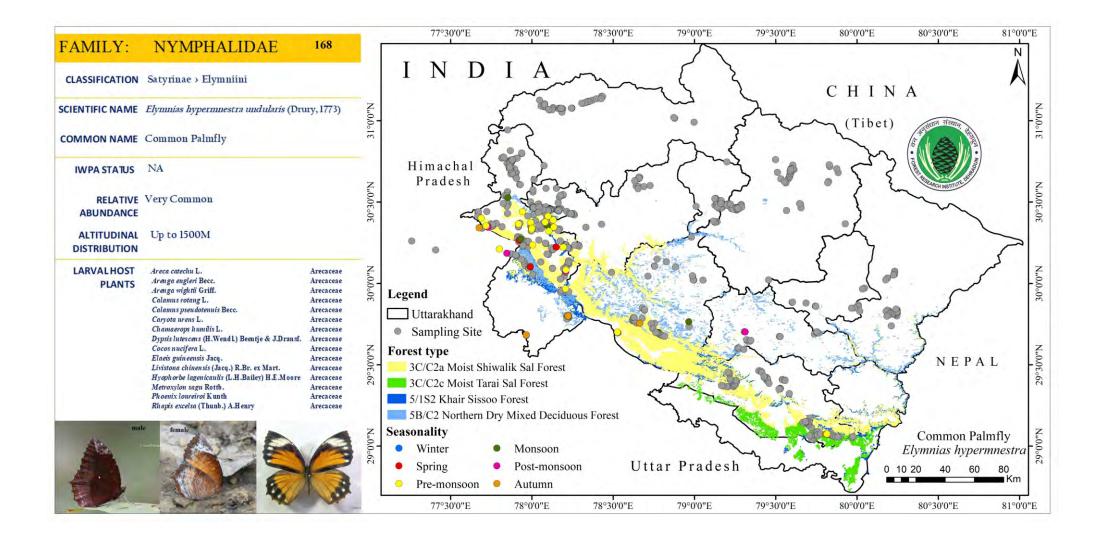


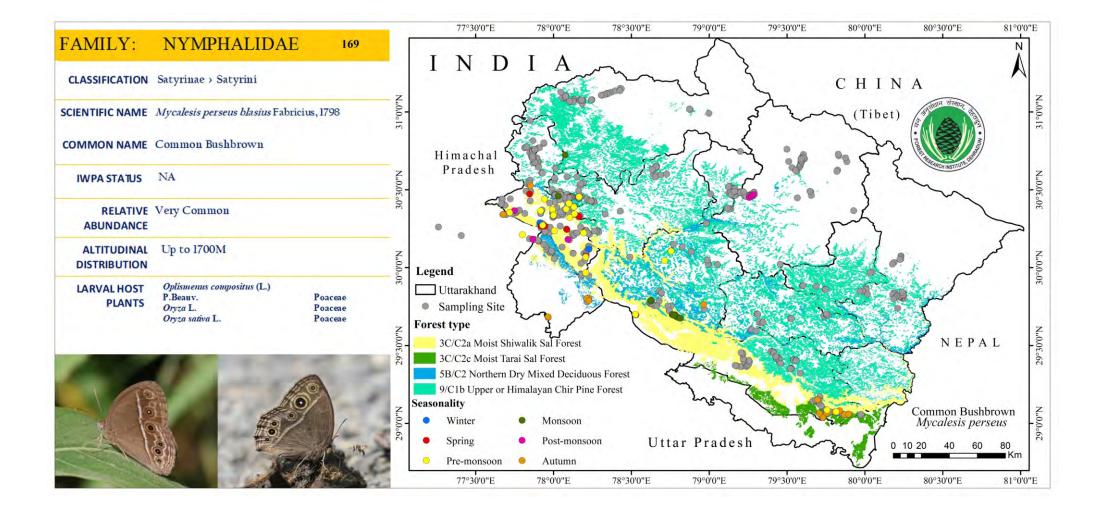


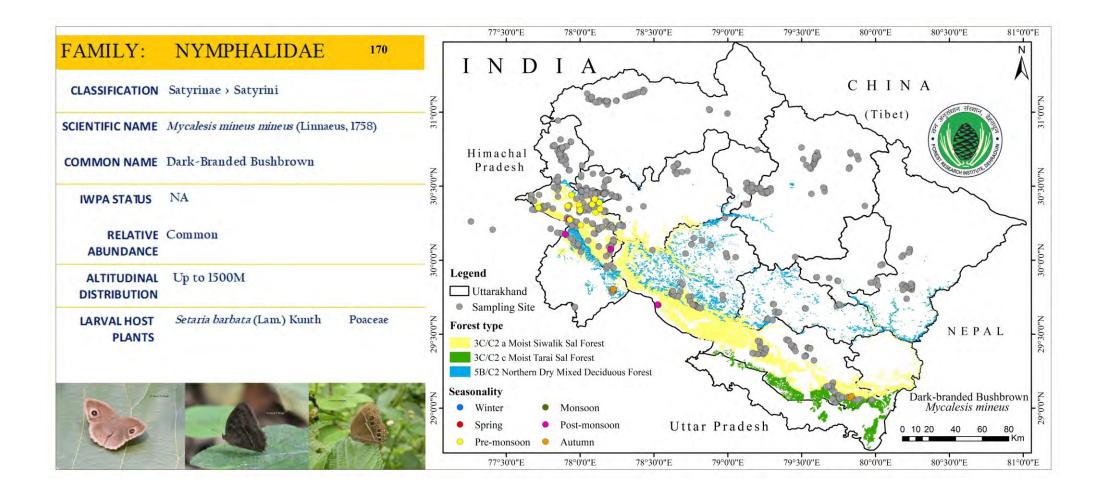
5.NYMPHALIDAE (Brush-footed Butterflies) (168-304)

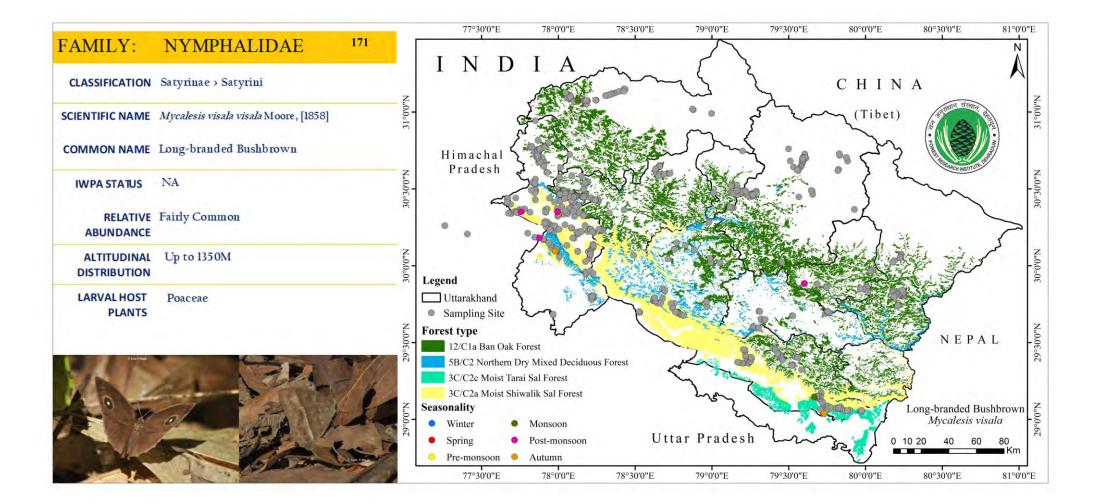


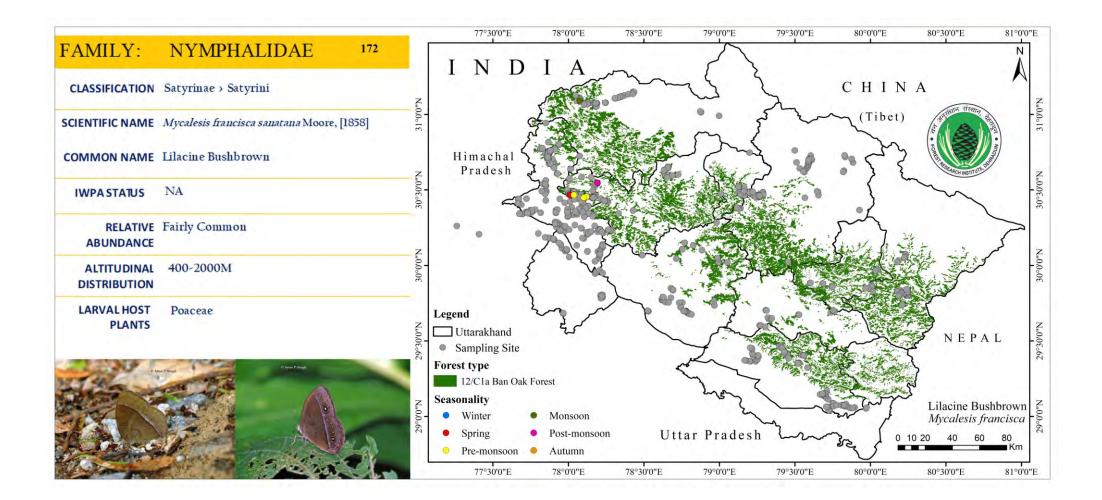
Ban Oak Forest (Q.incana)

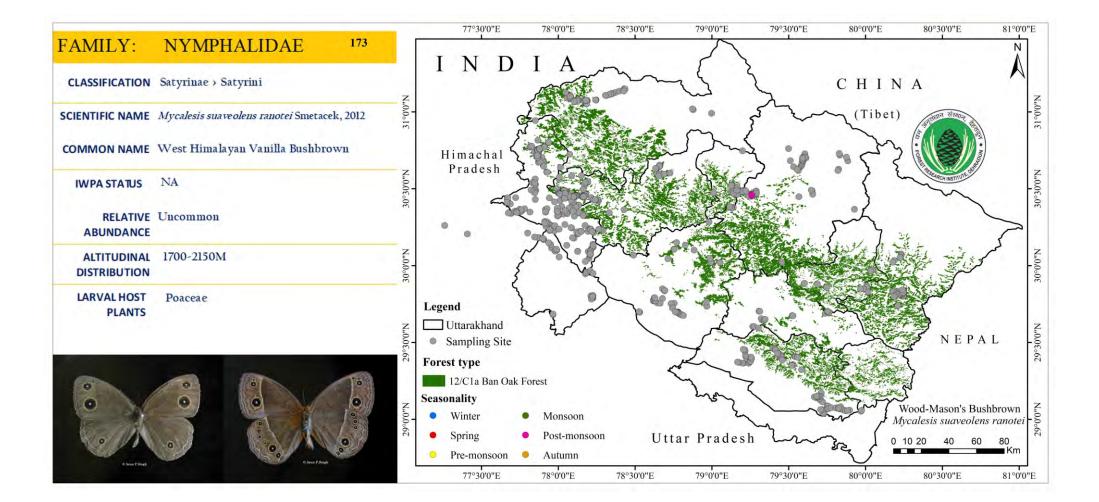


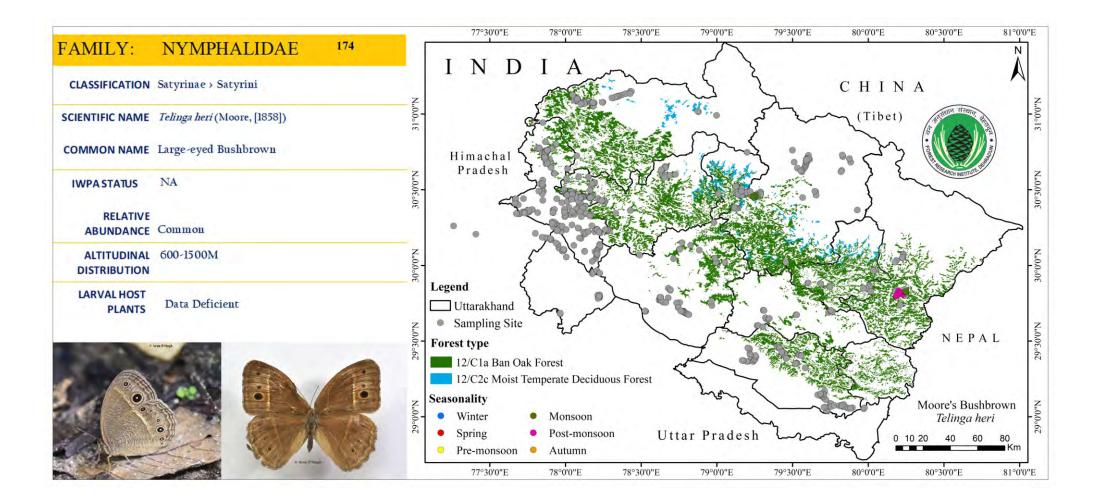


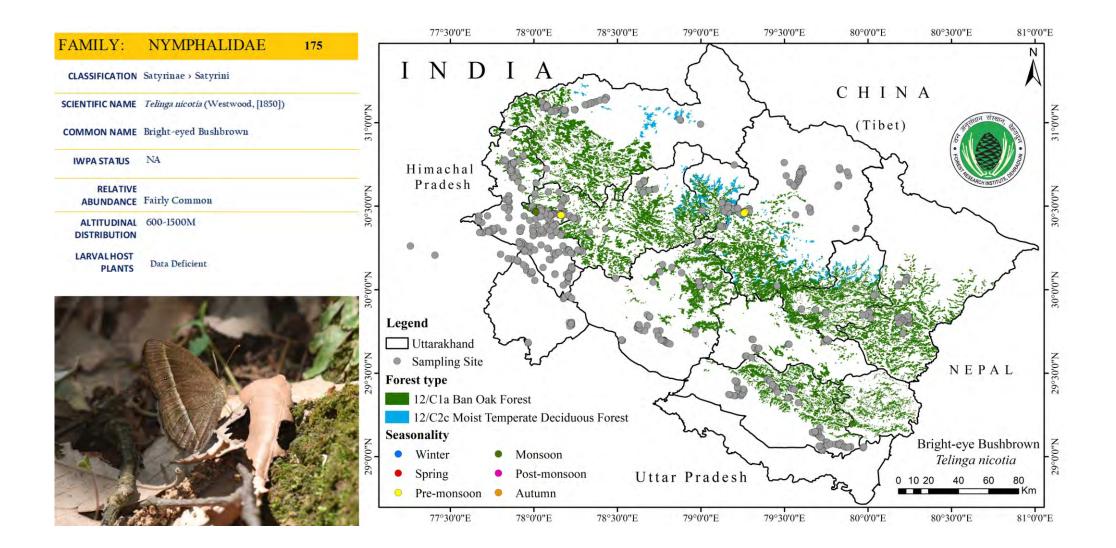


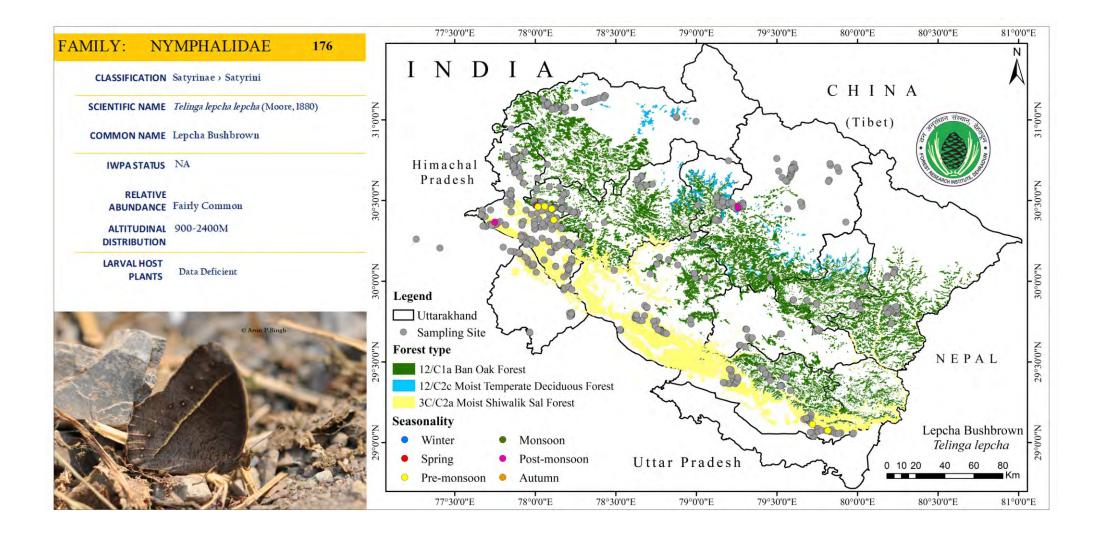


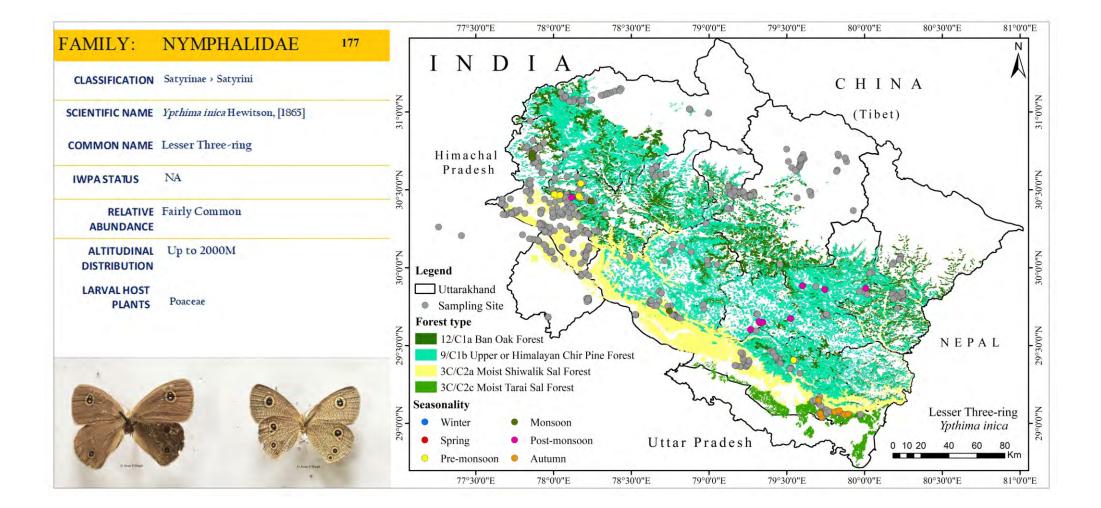


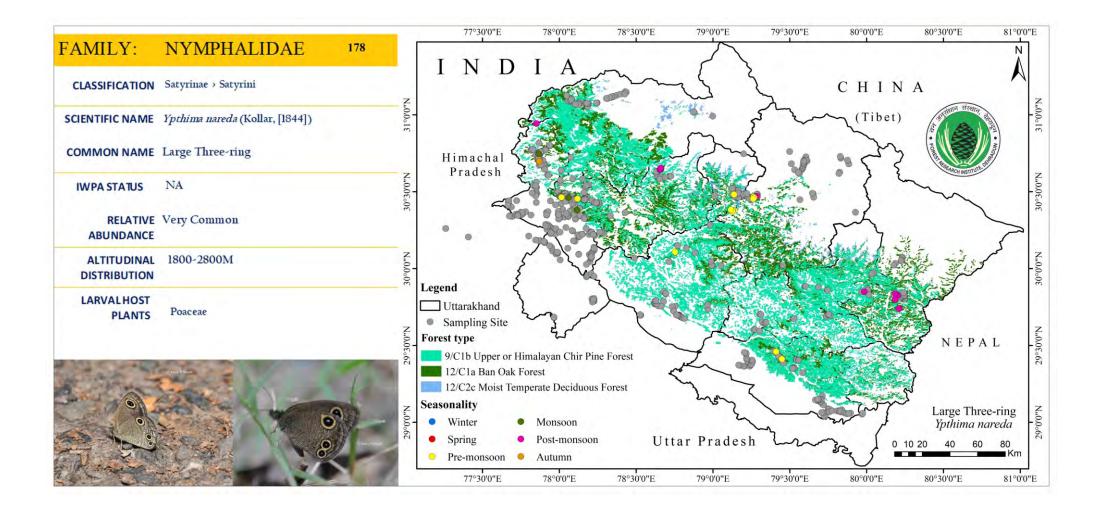


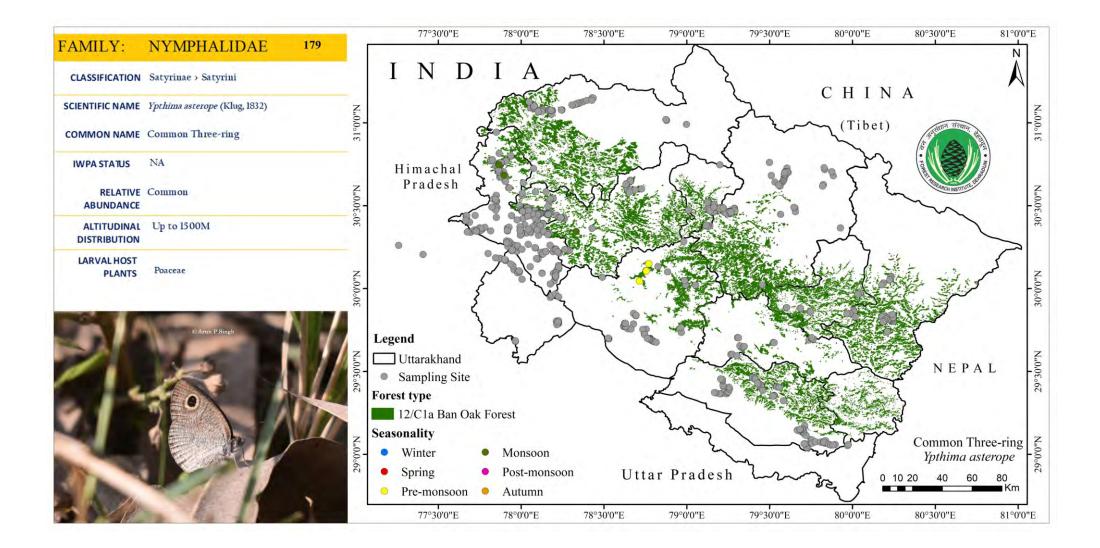


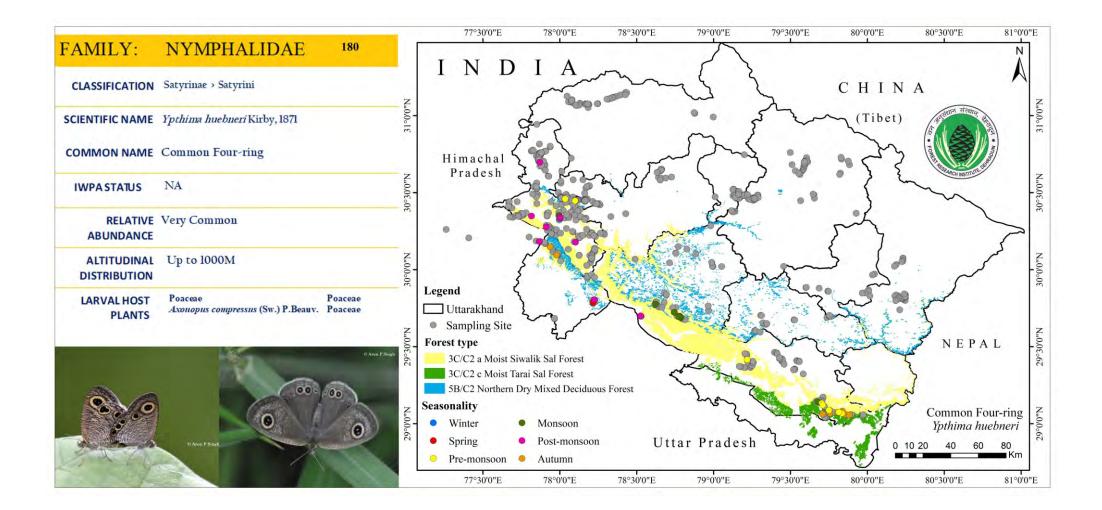


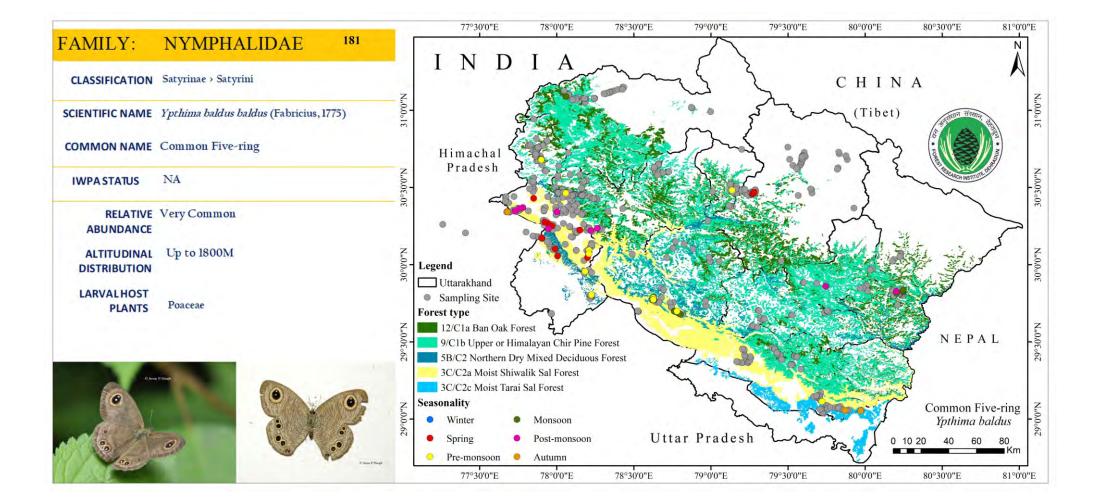


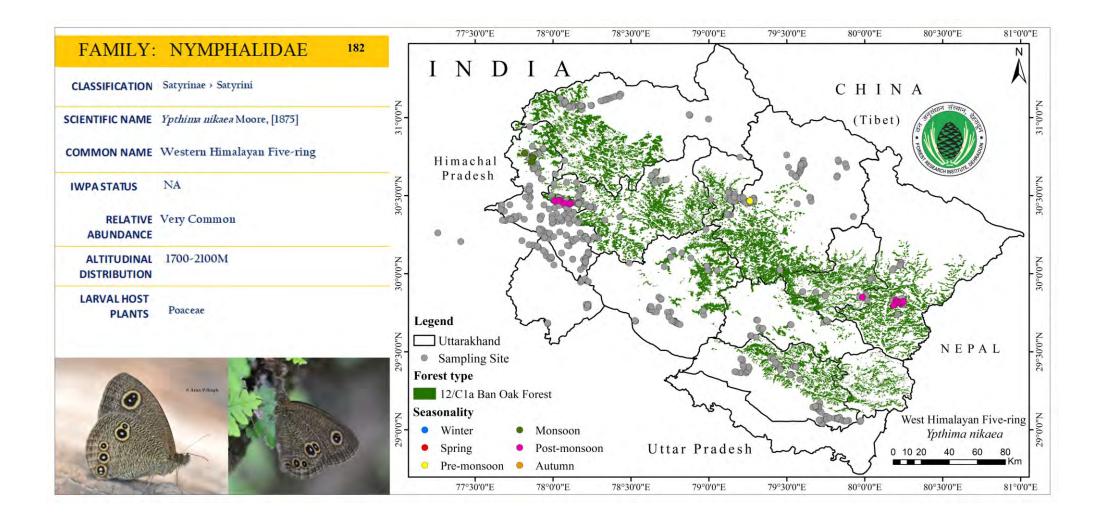


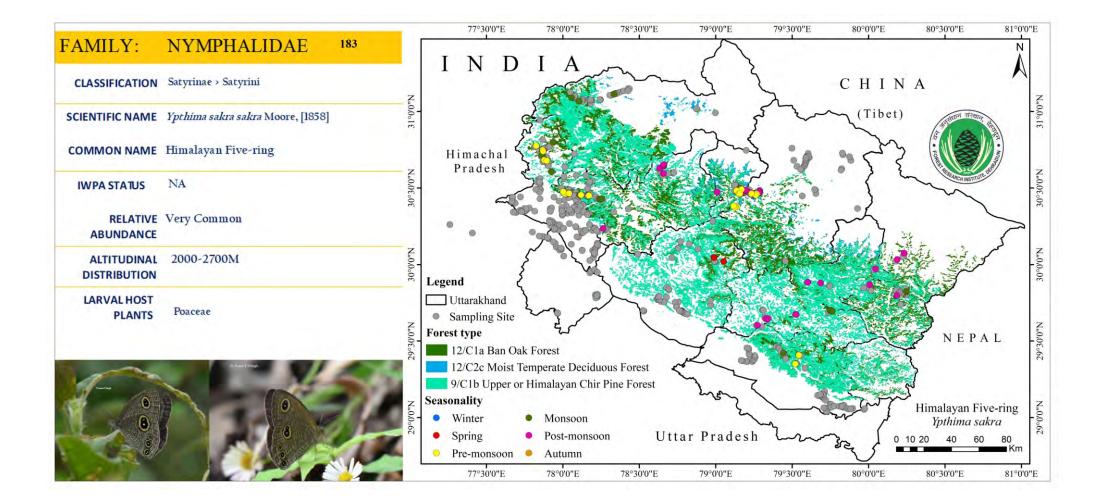


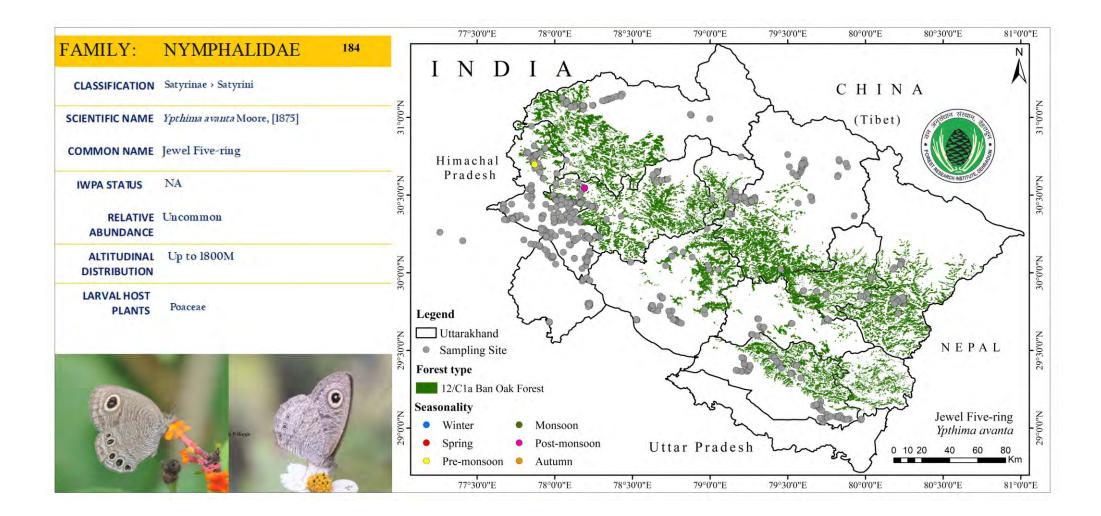


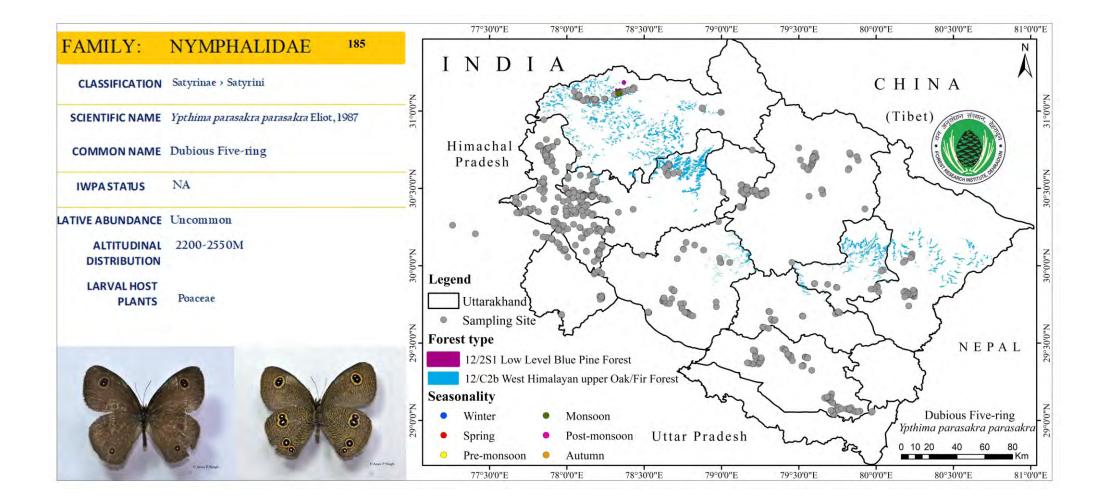


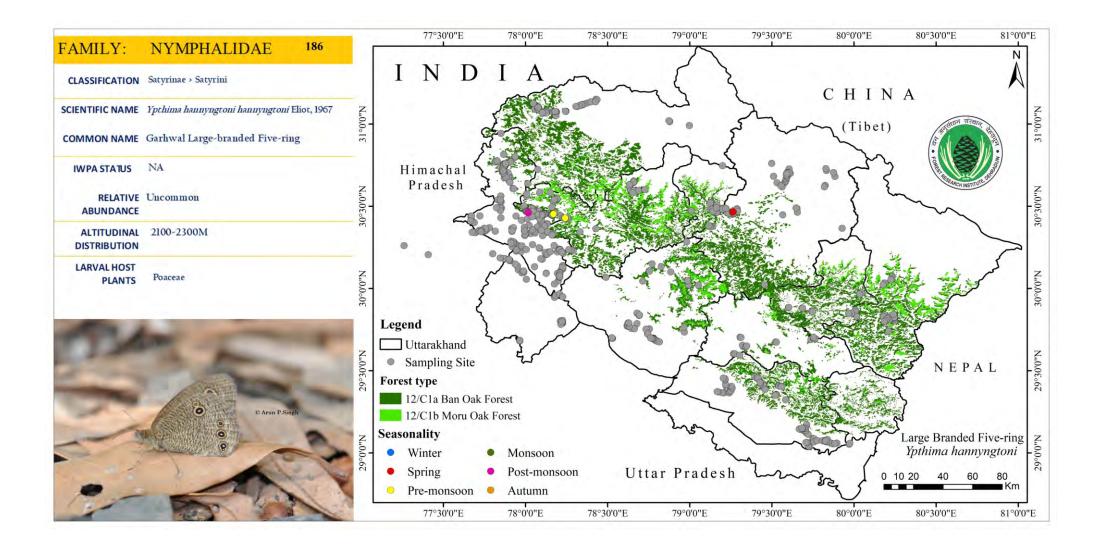


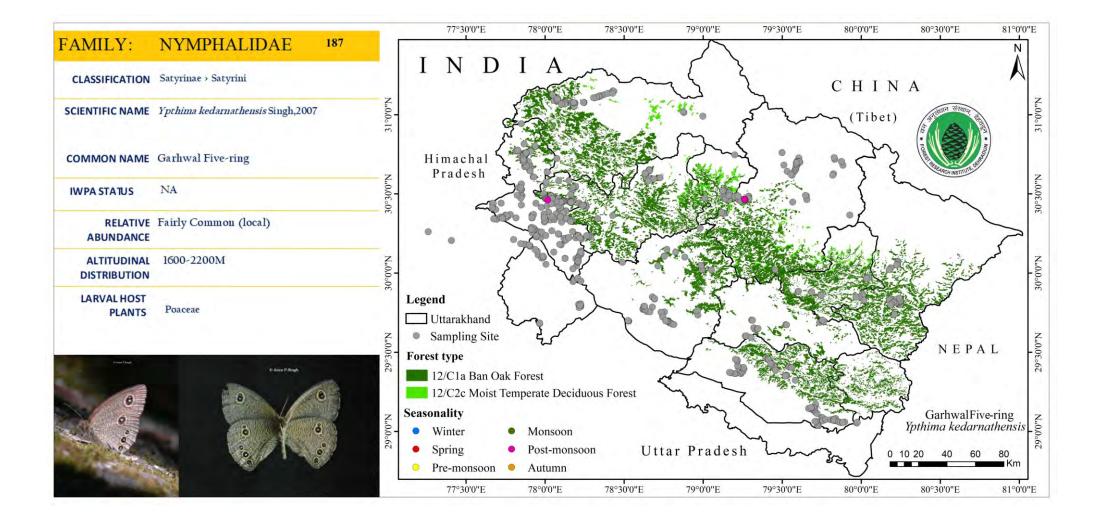


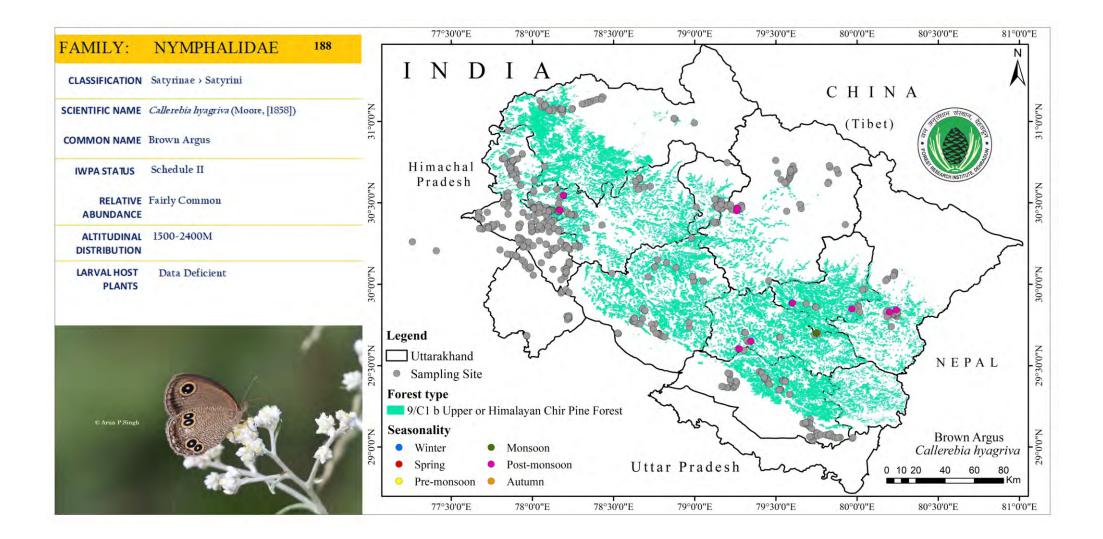


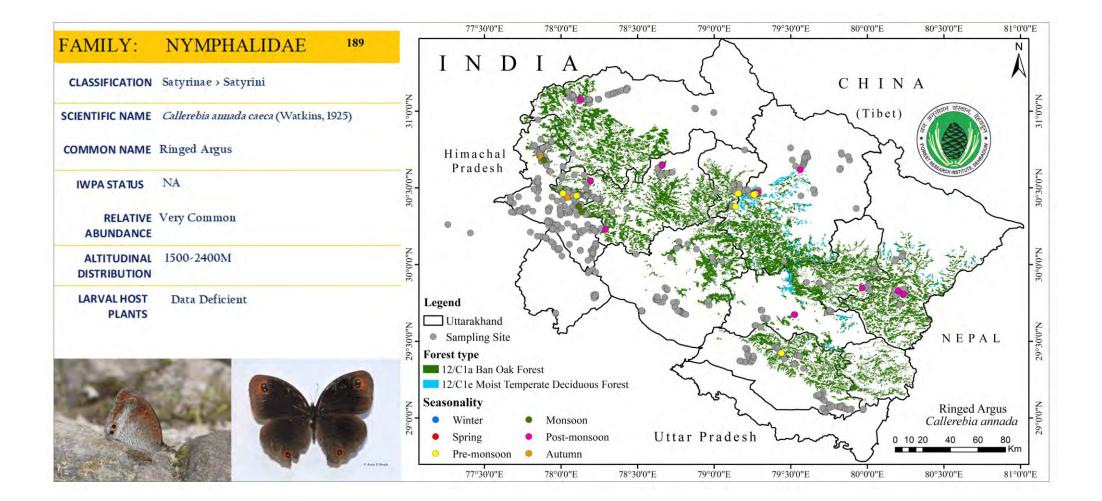


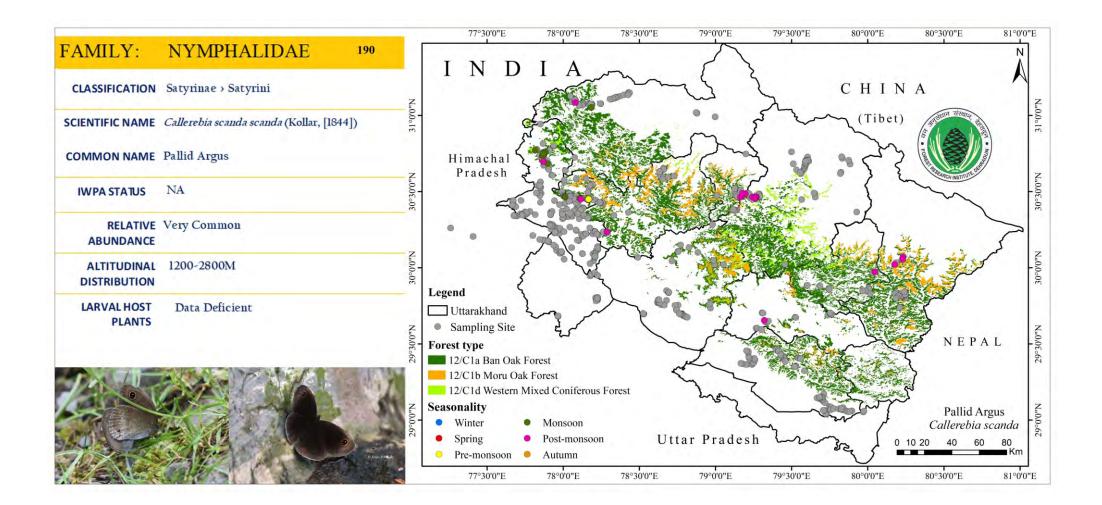


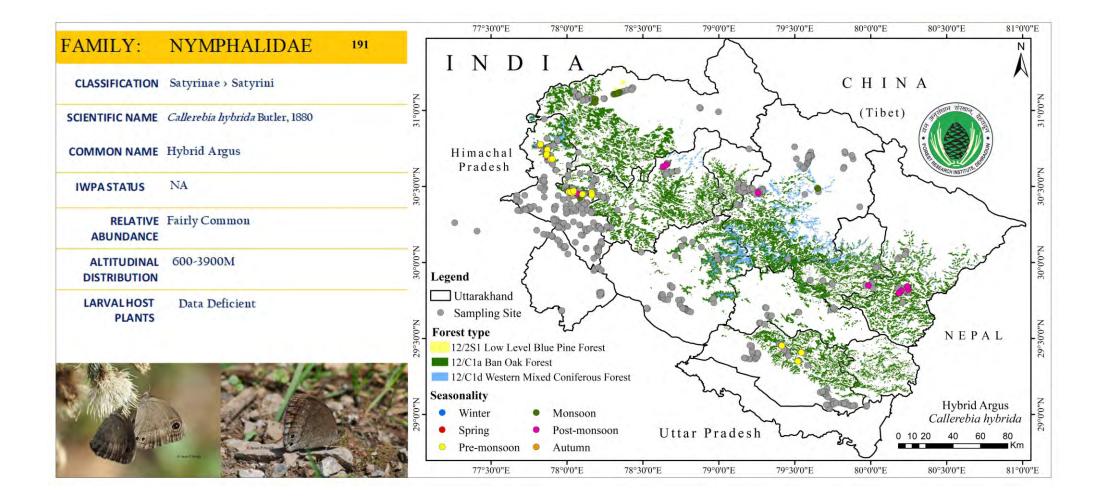


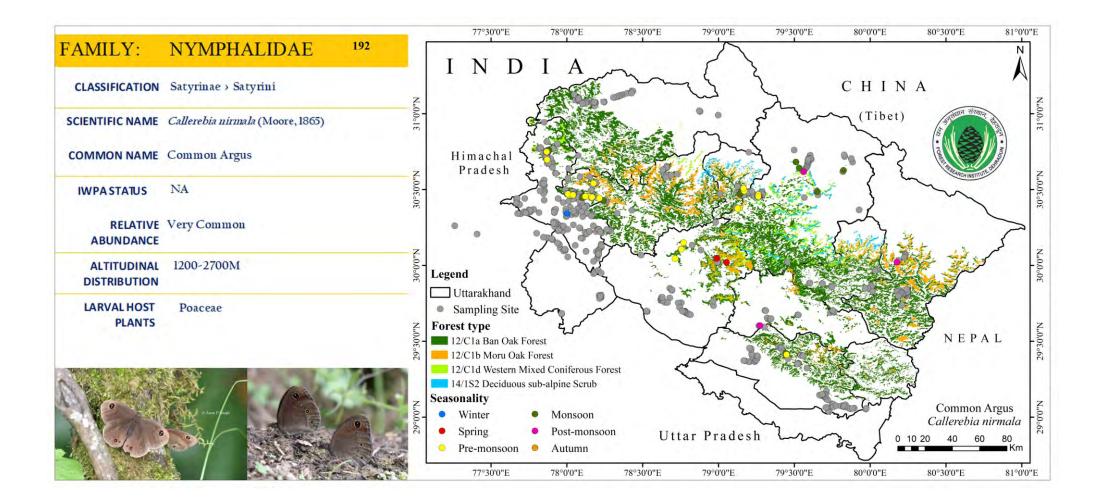


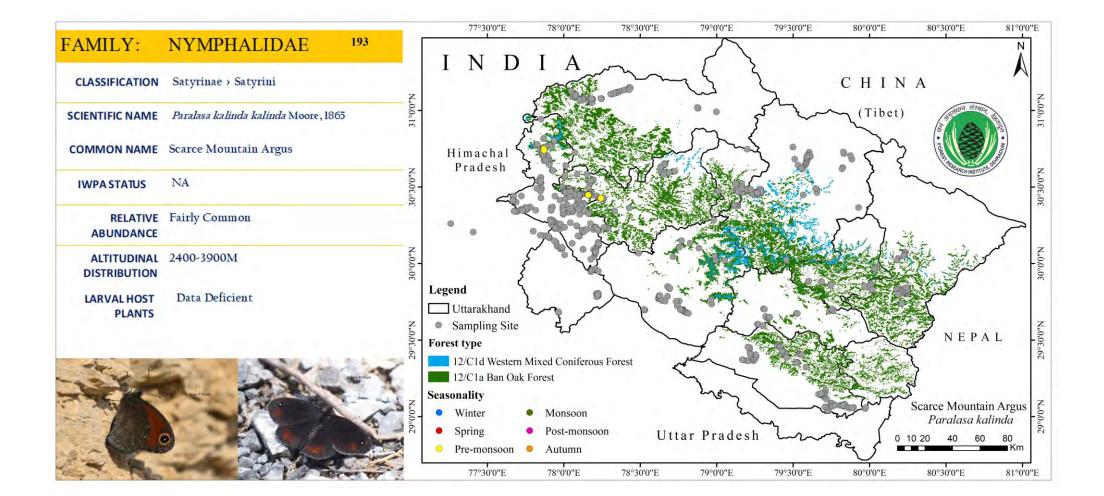


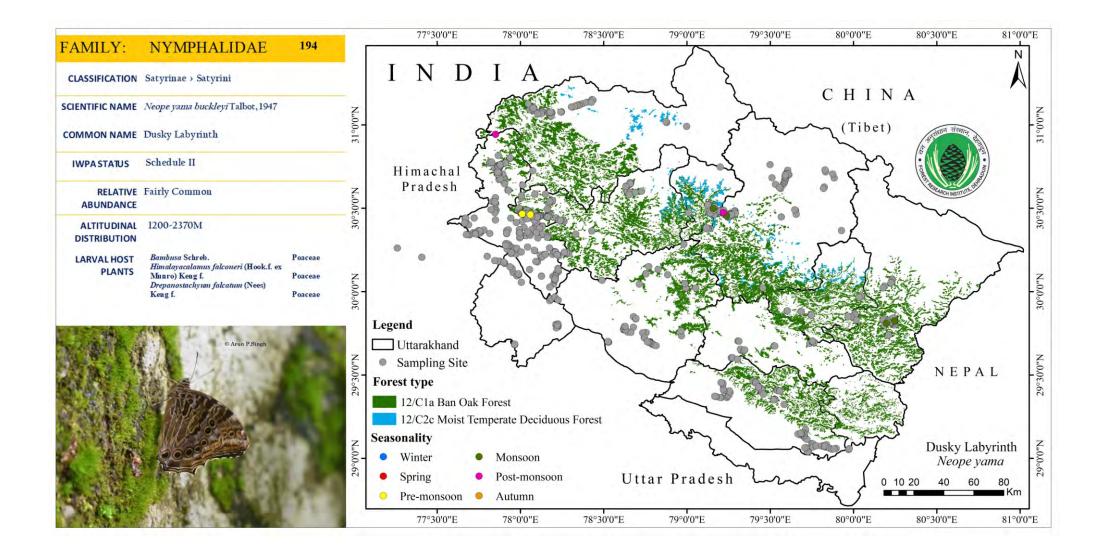


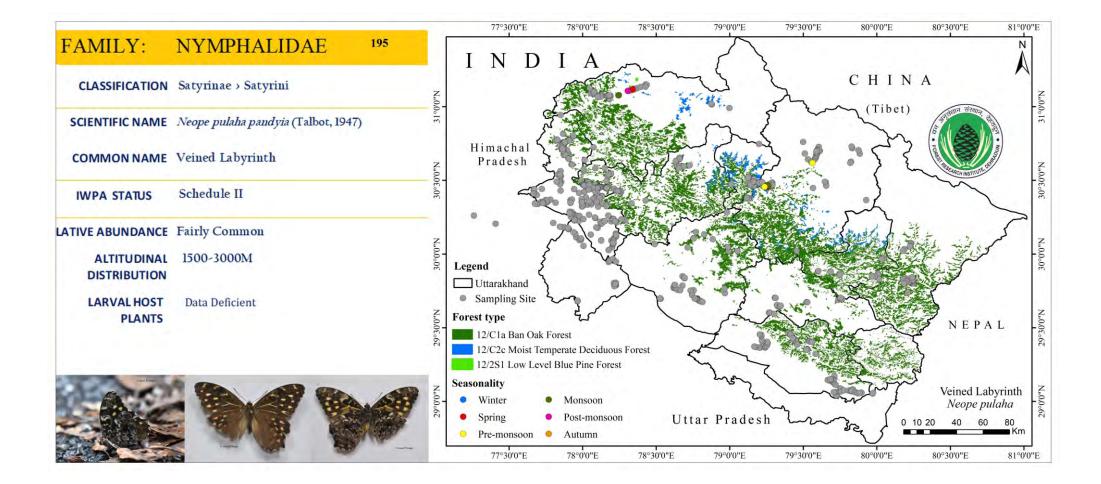


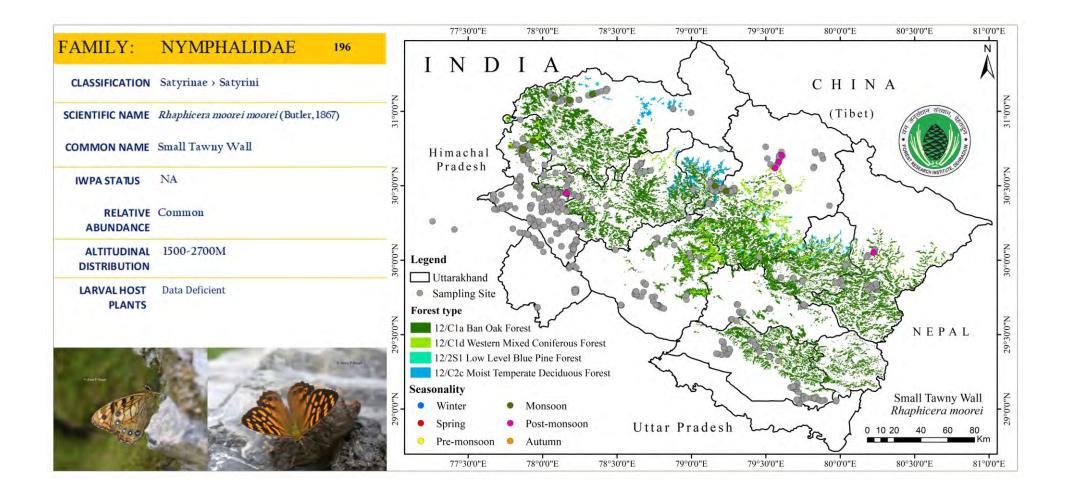


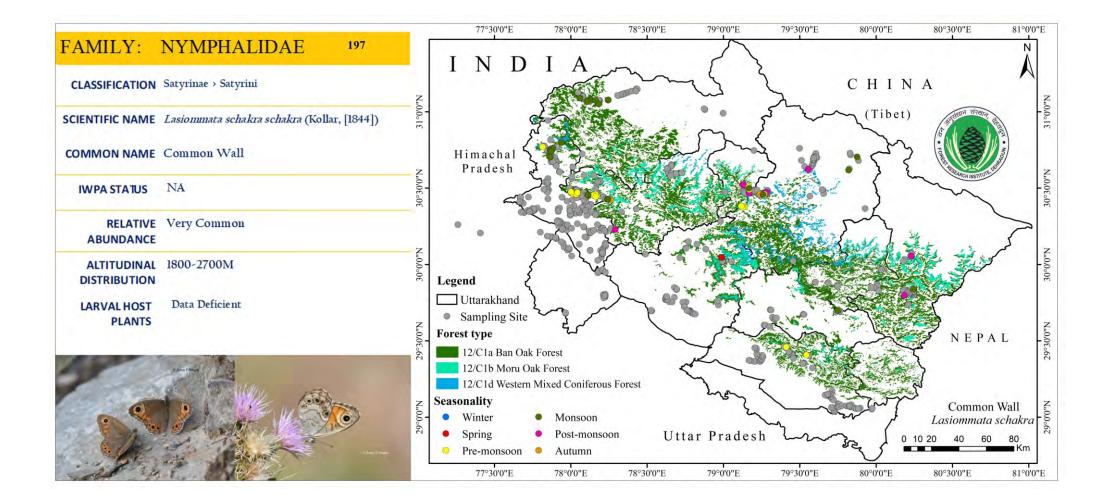


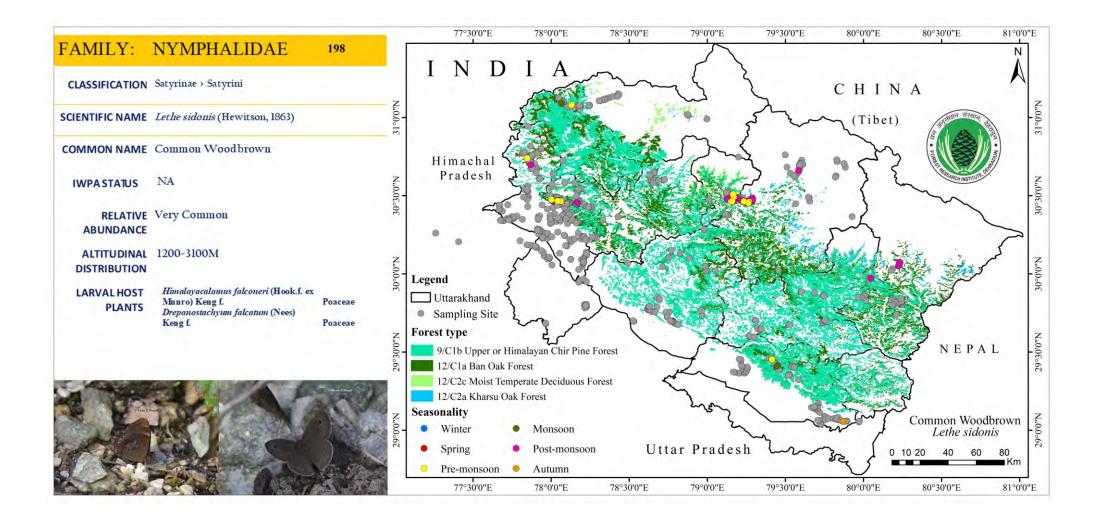


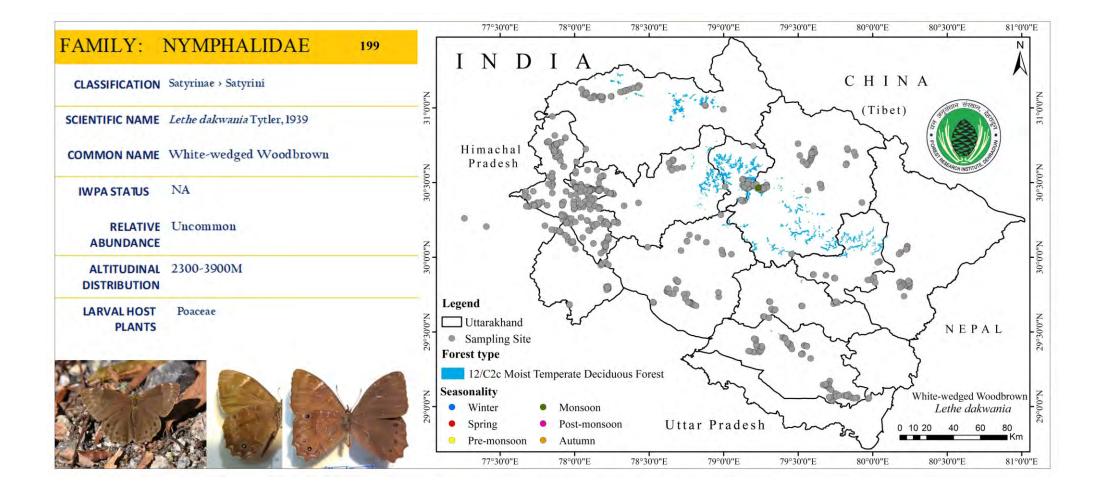


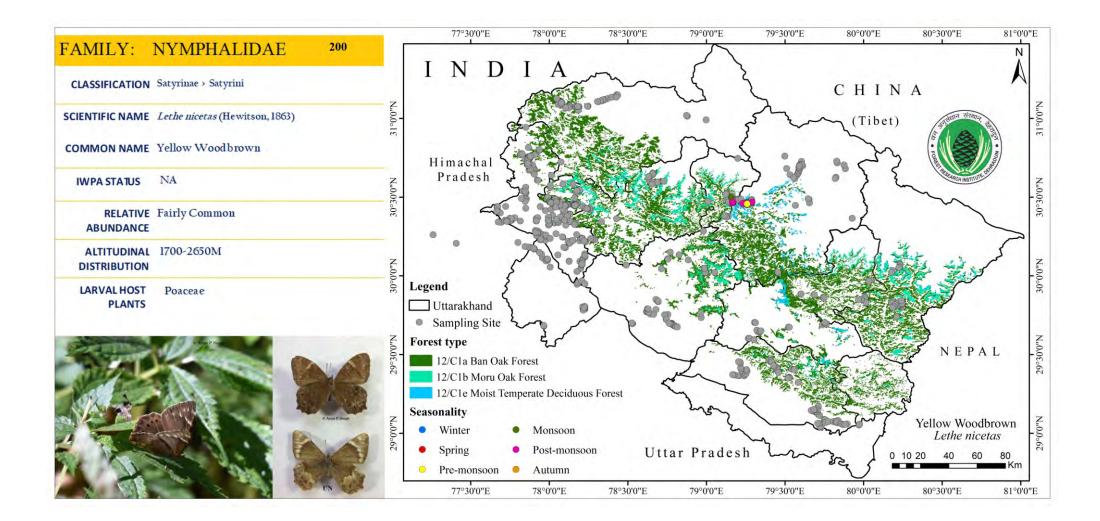


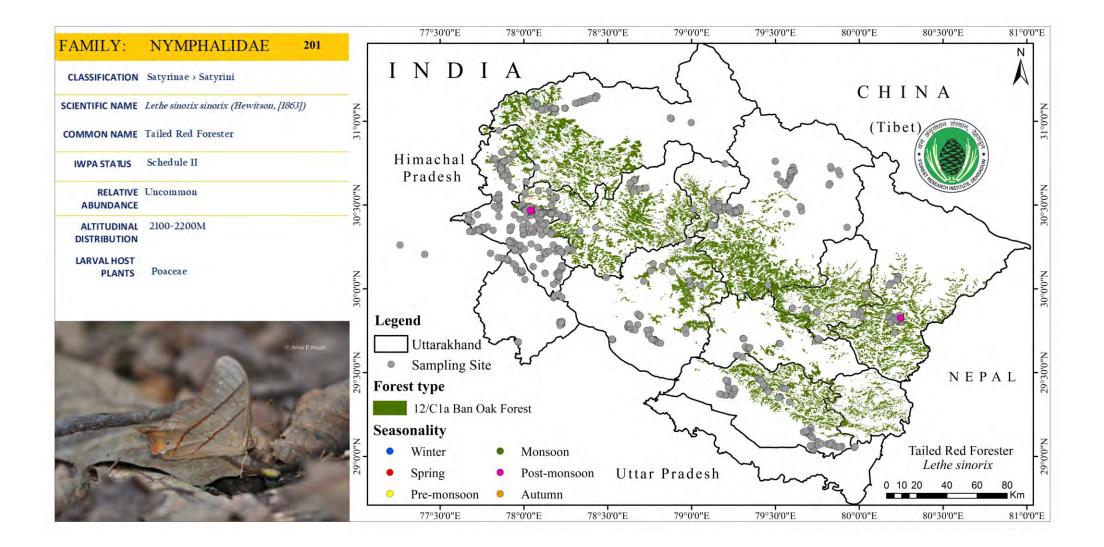


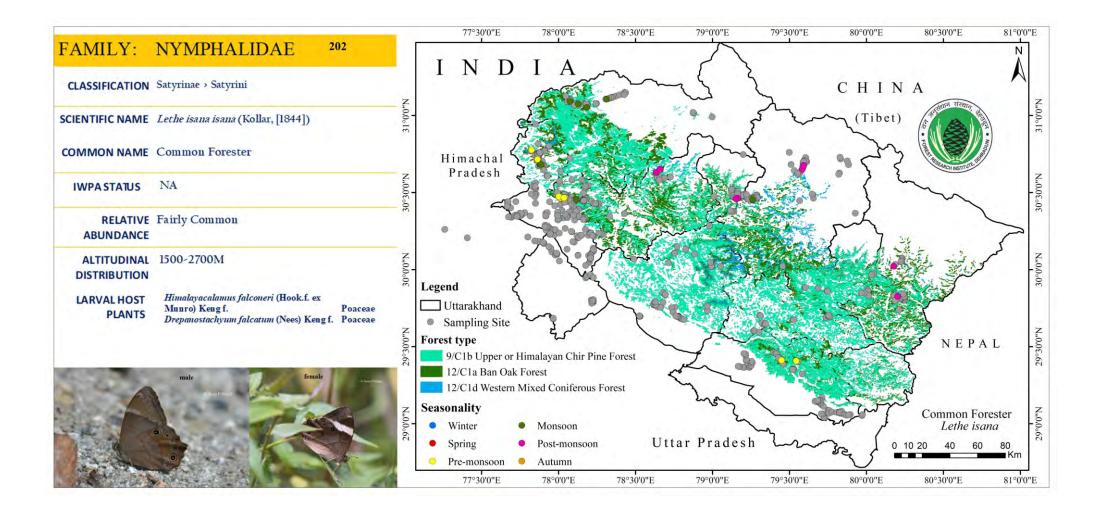


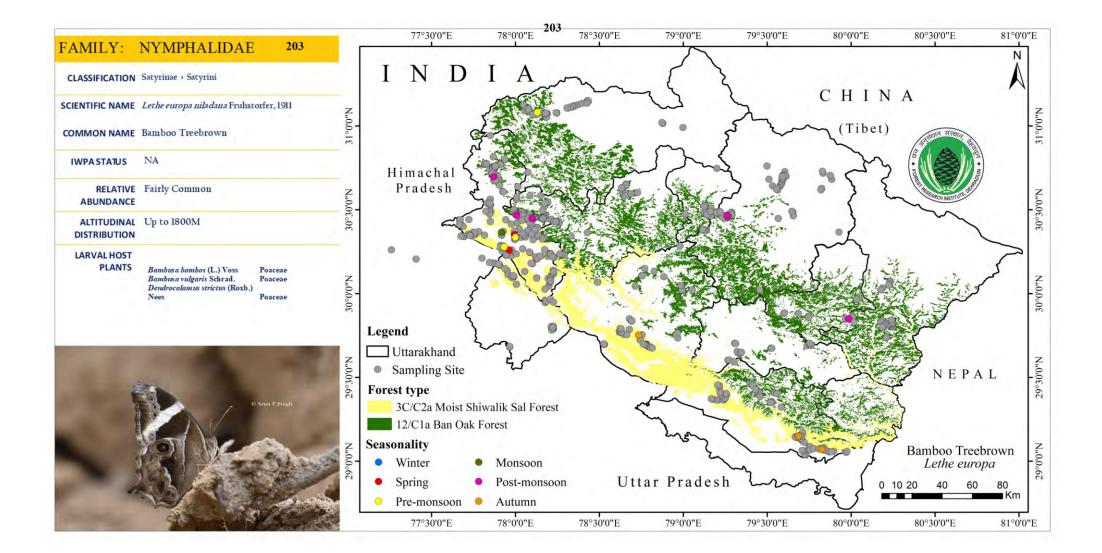


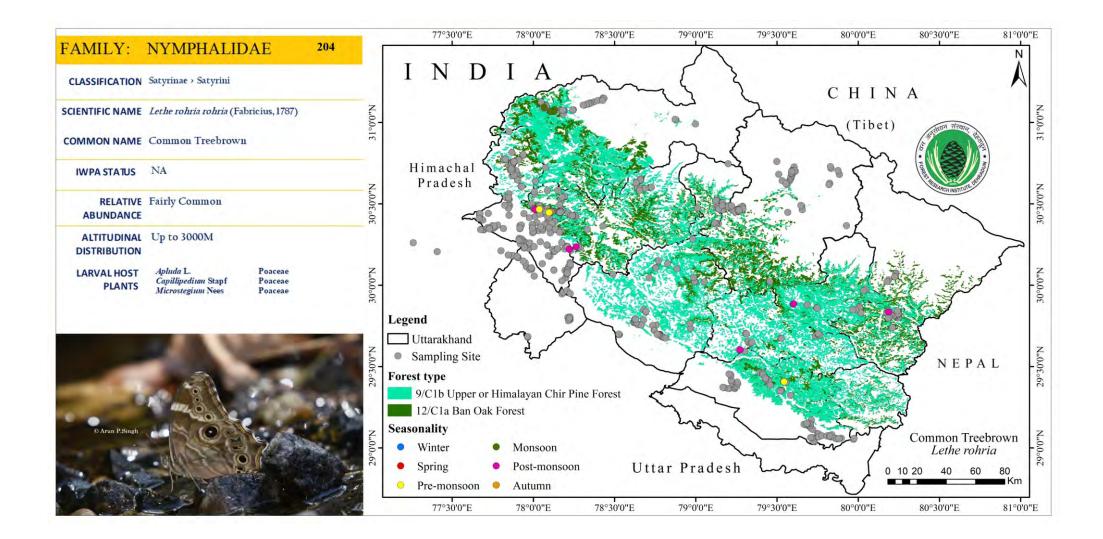


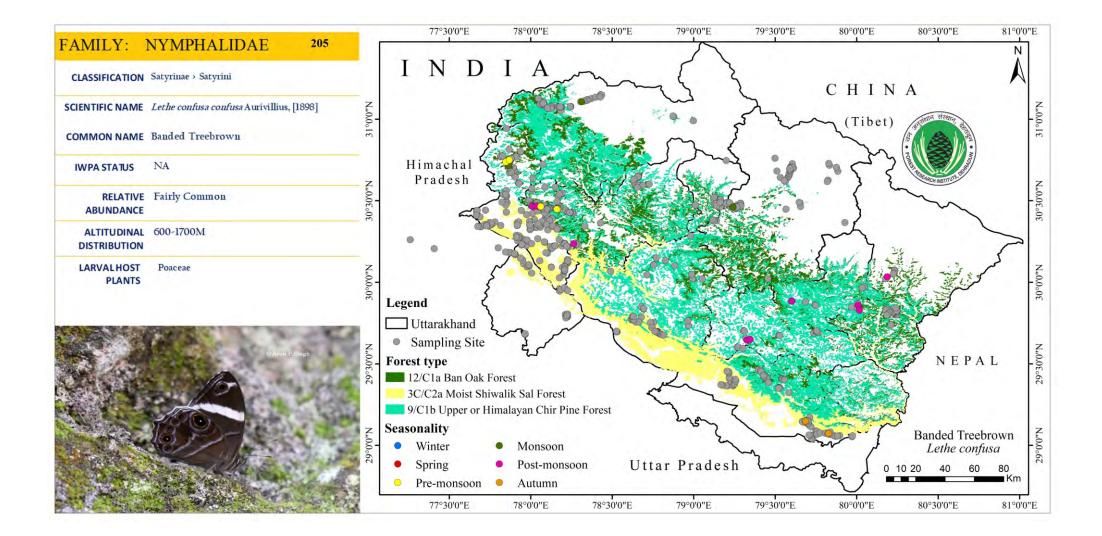


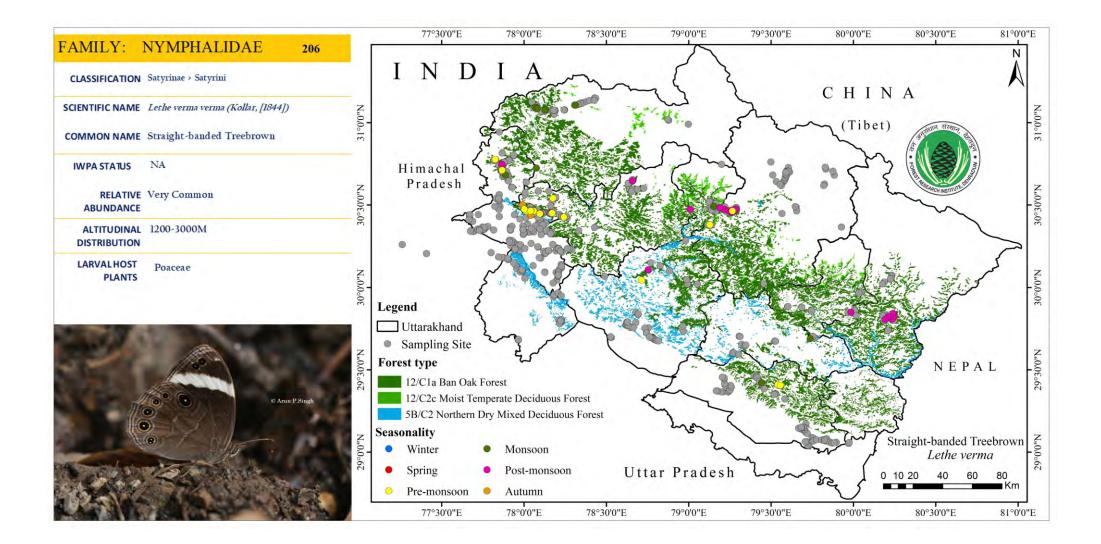


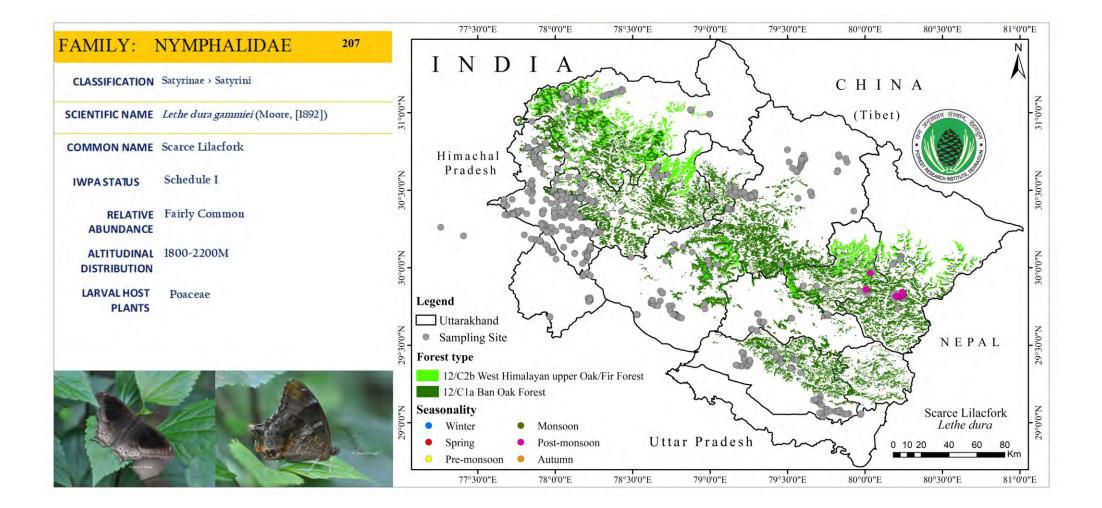


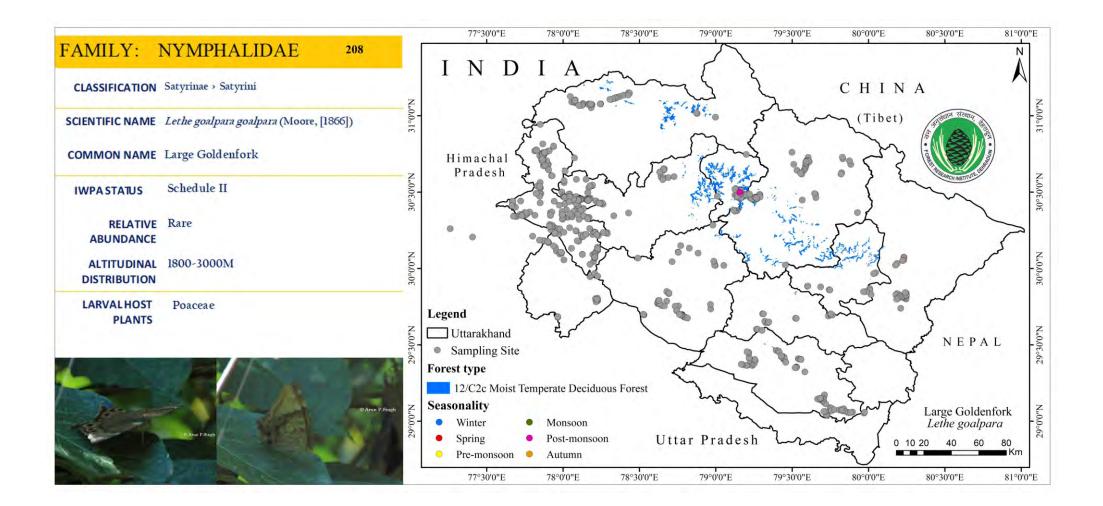


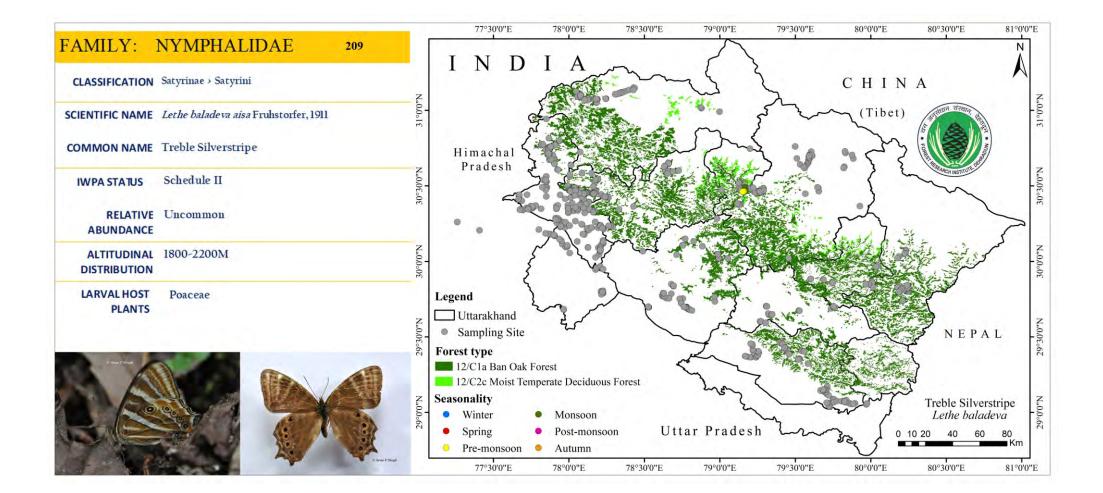


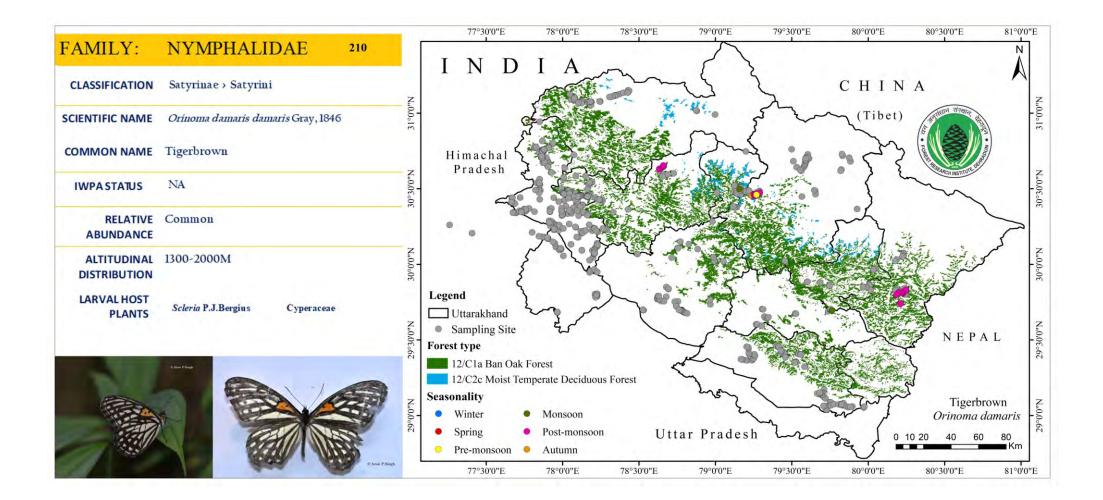


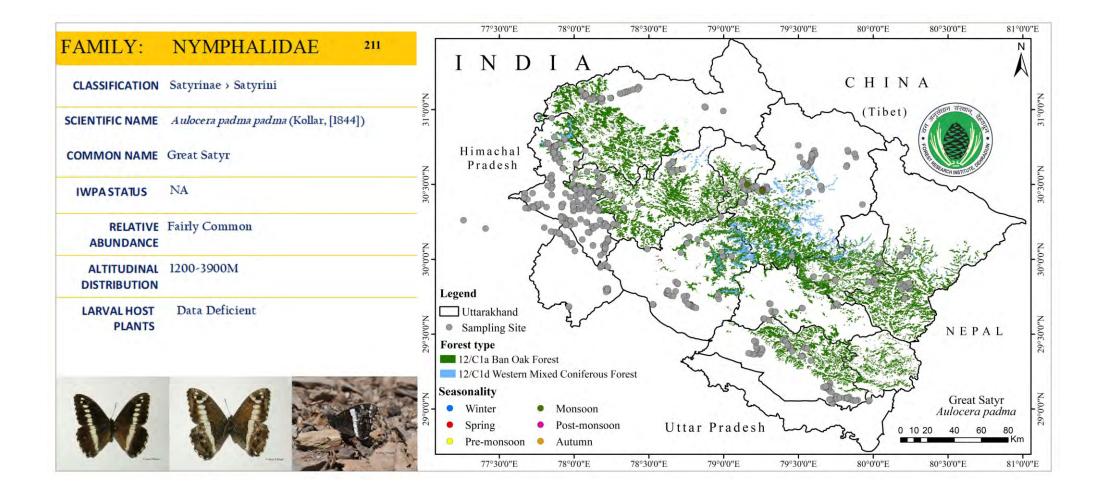


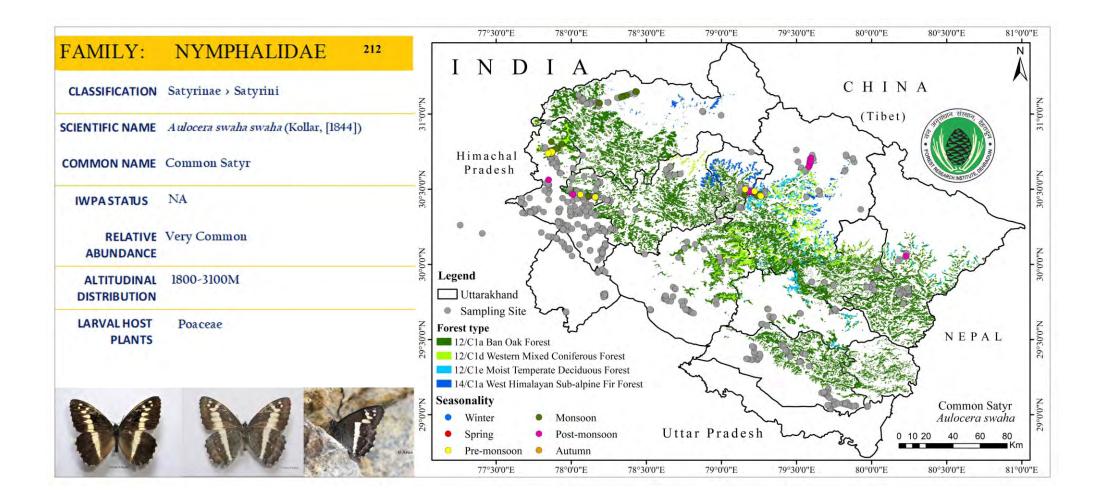


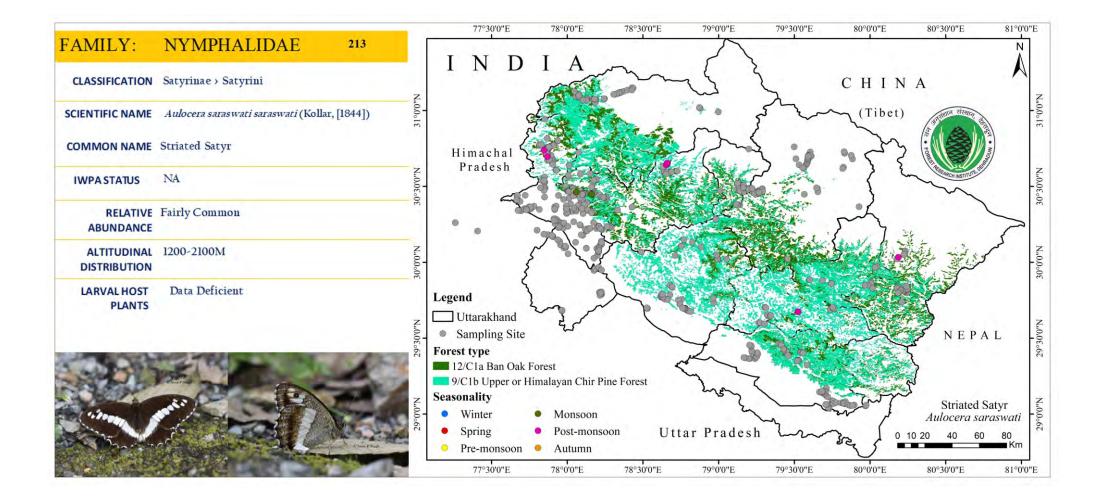


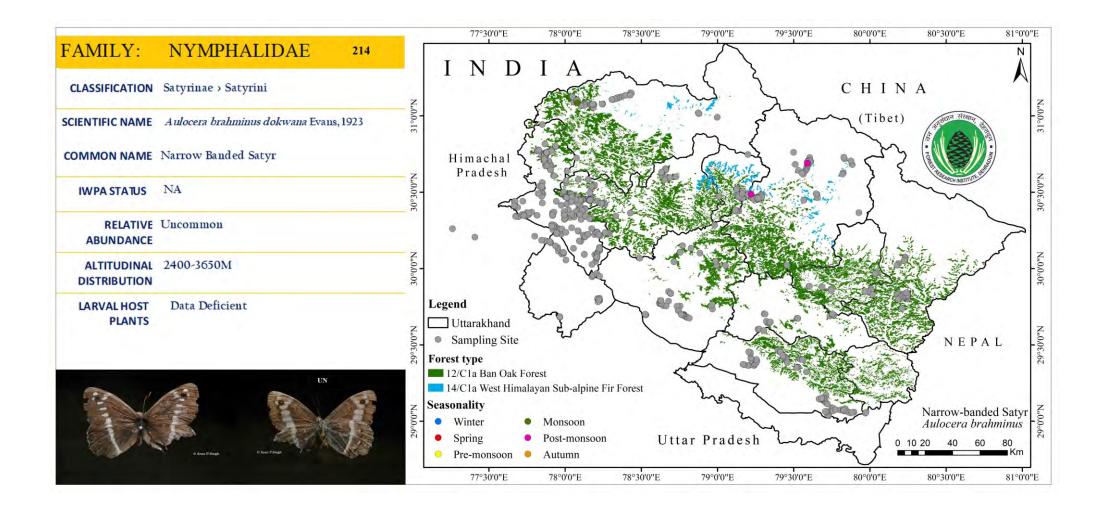


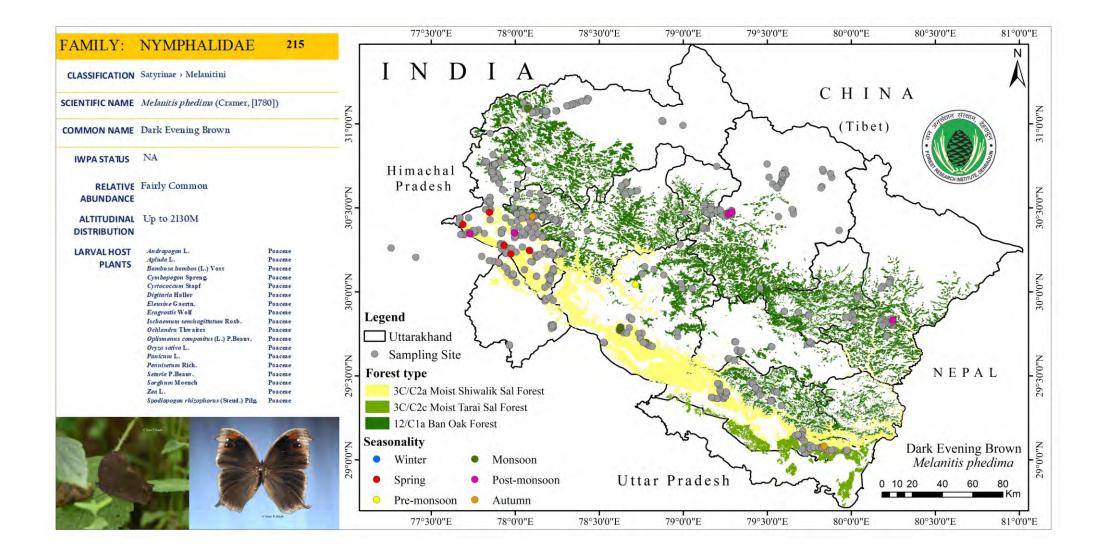


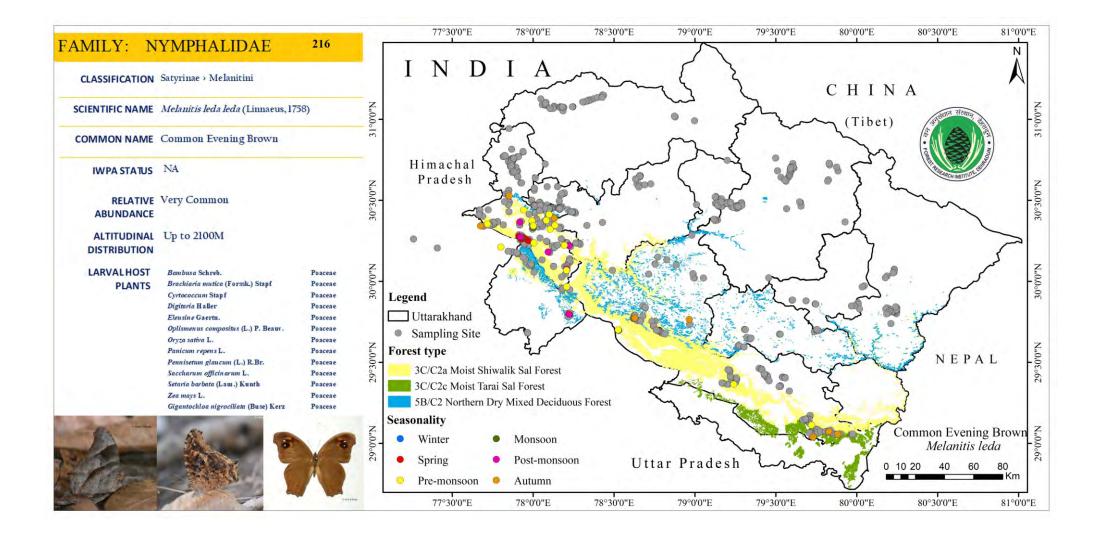


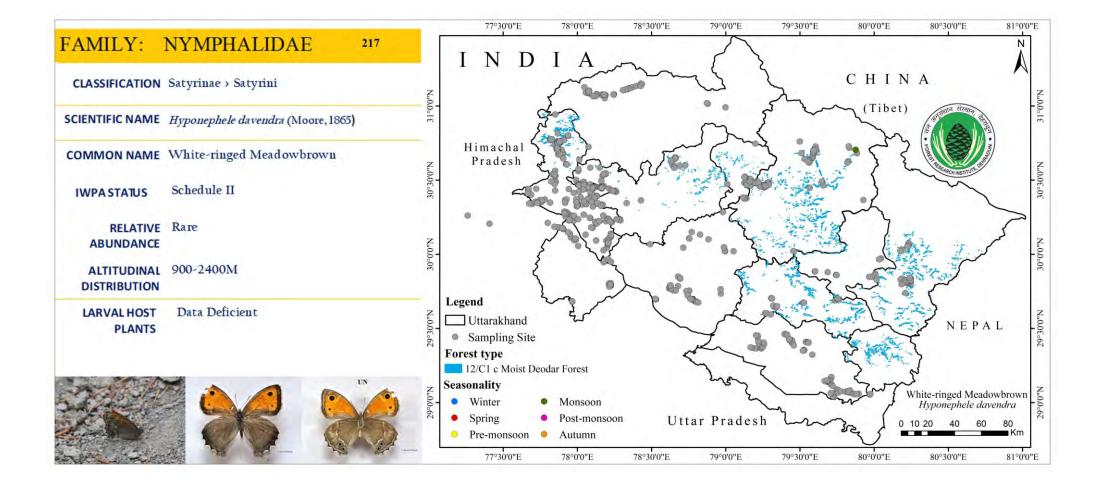


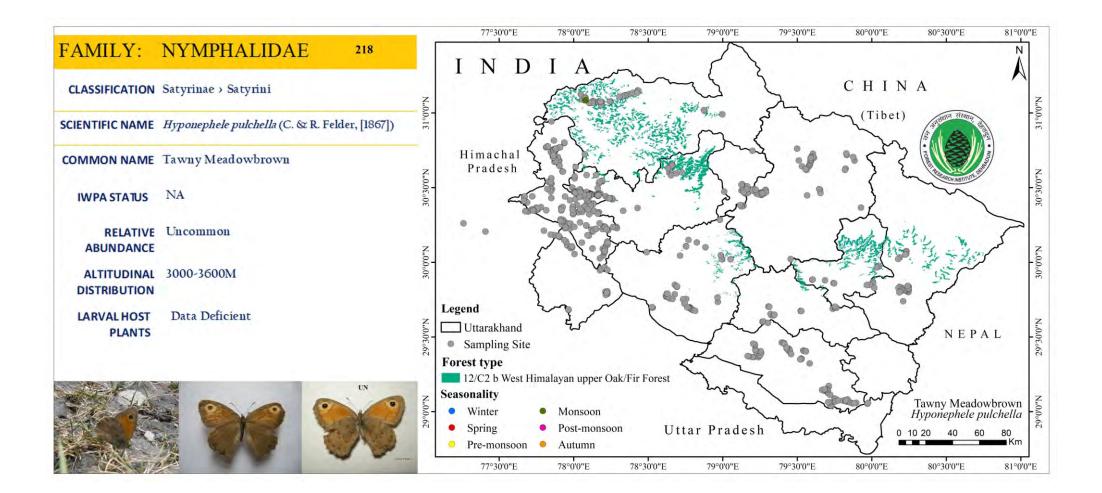


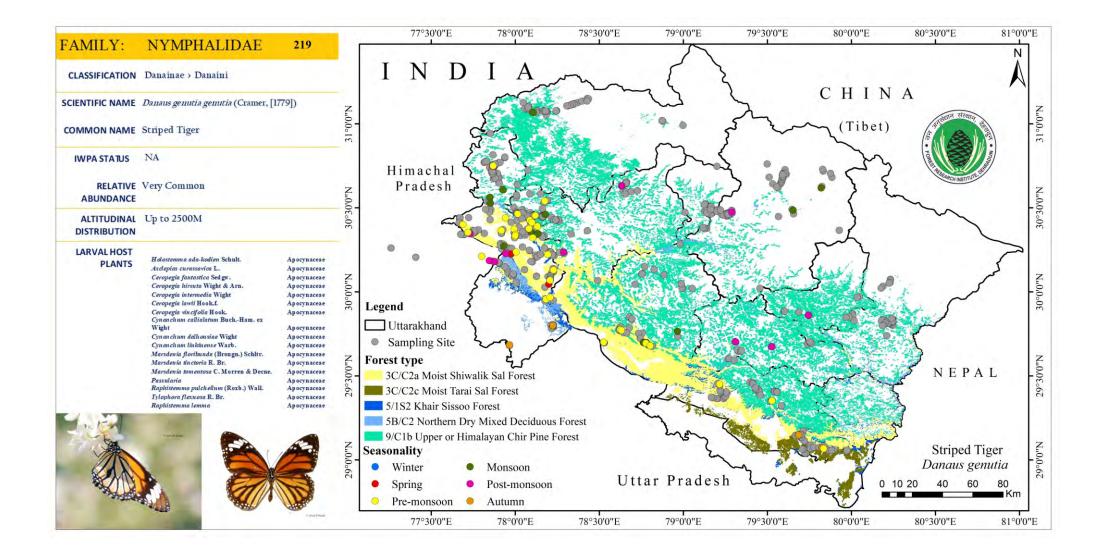


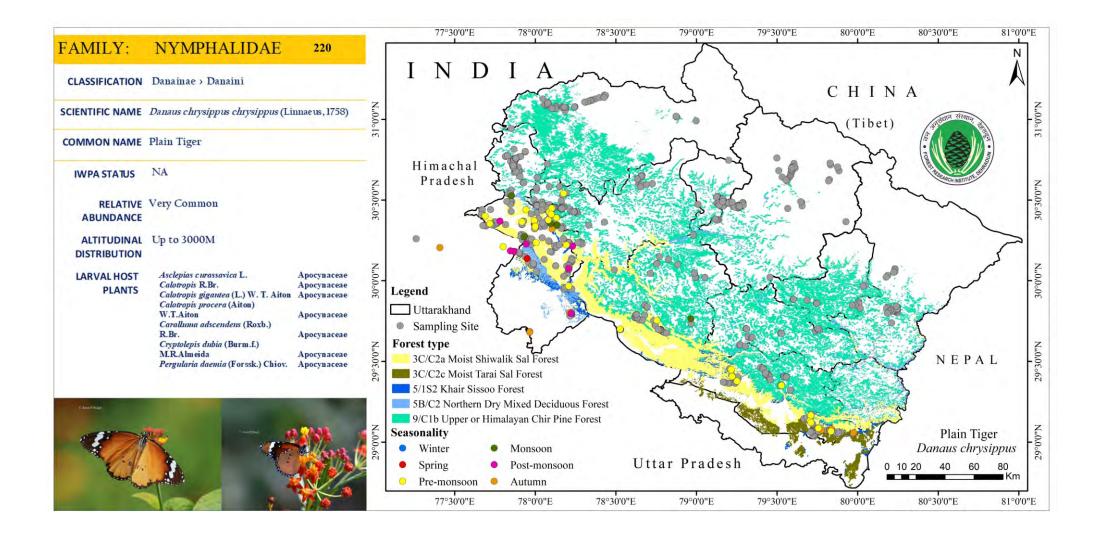


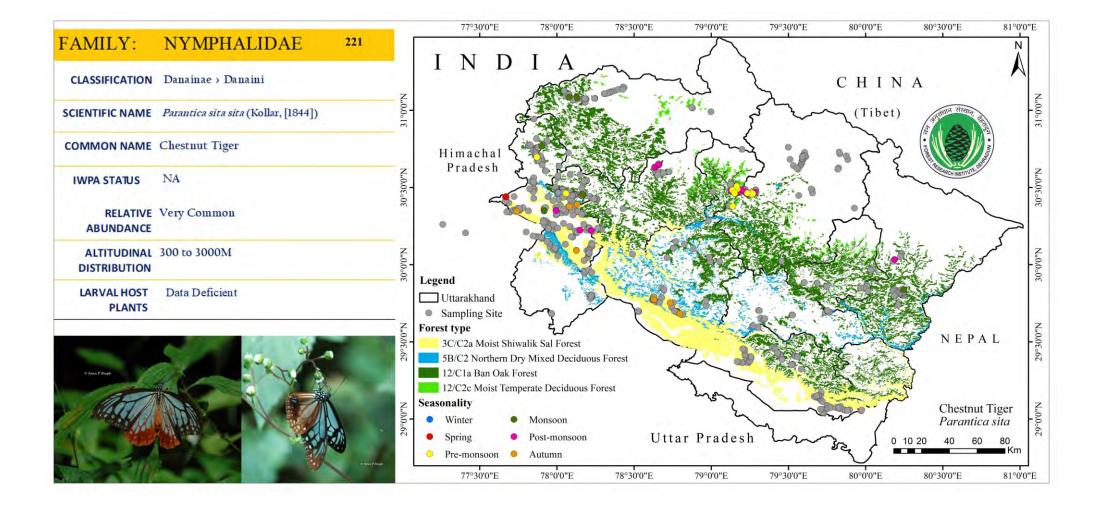


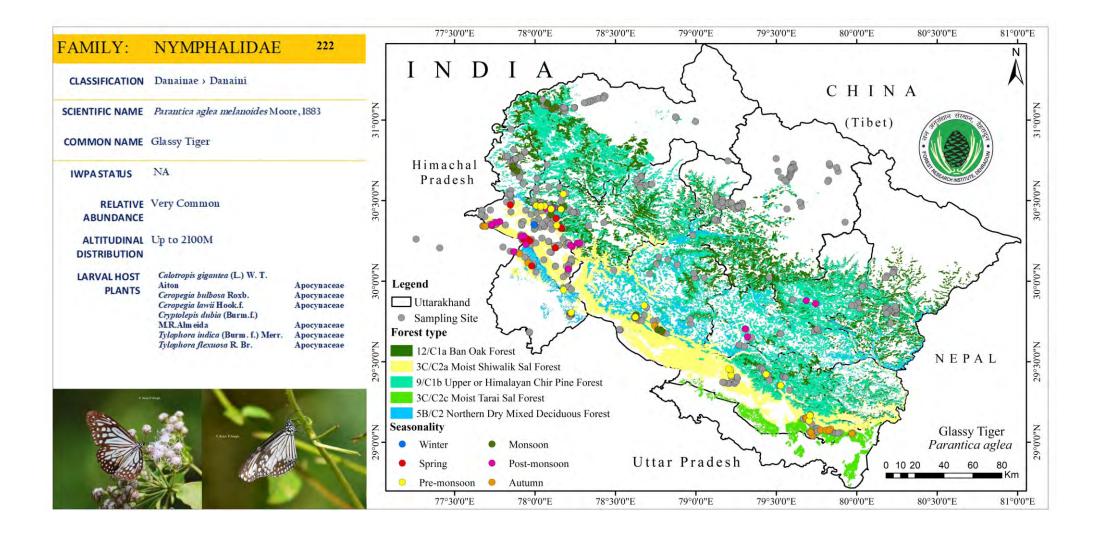


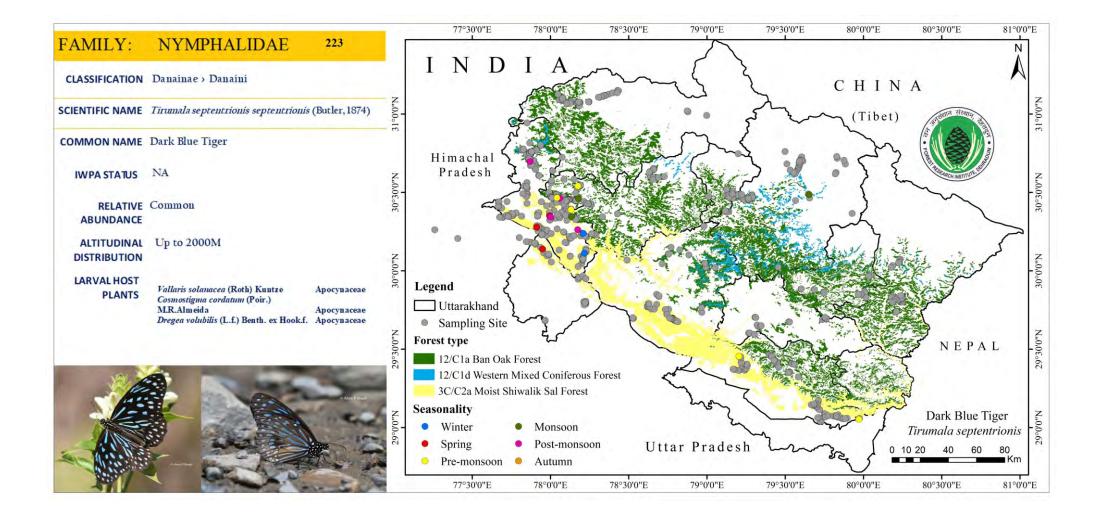


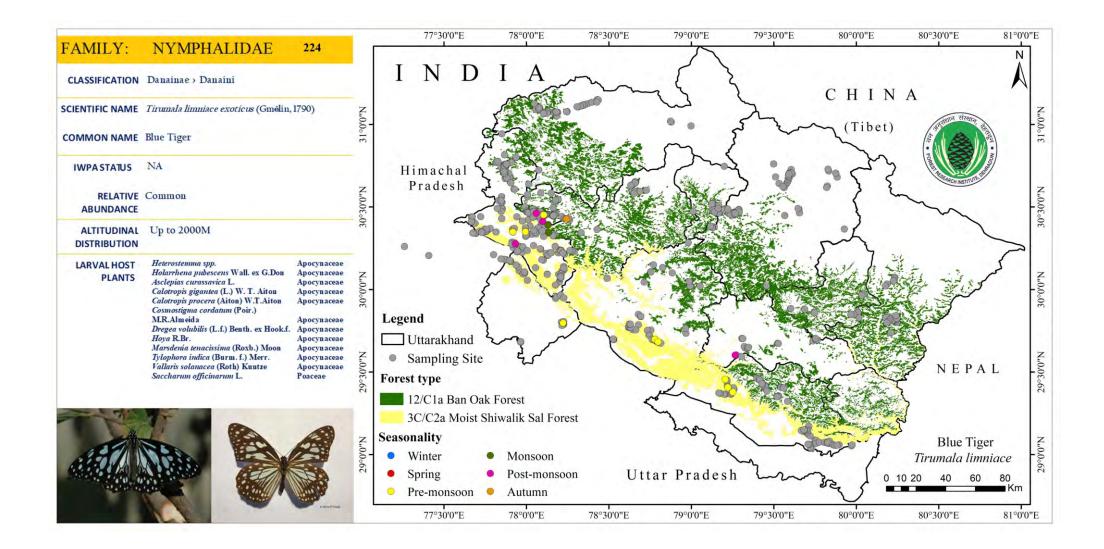


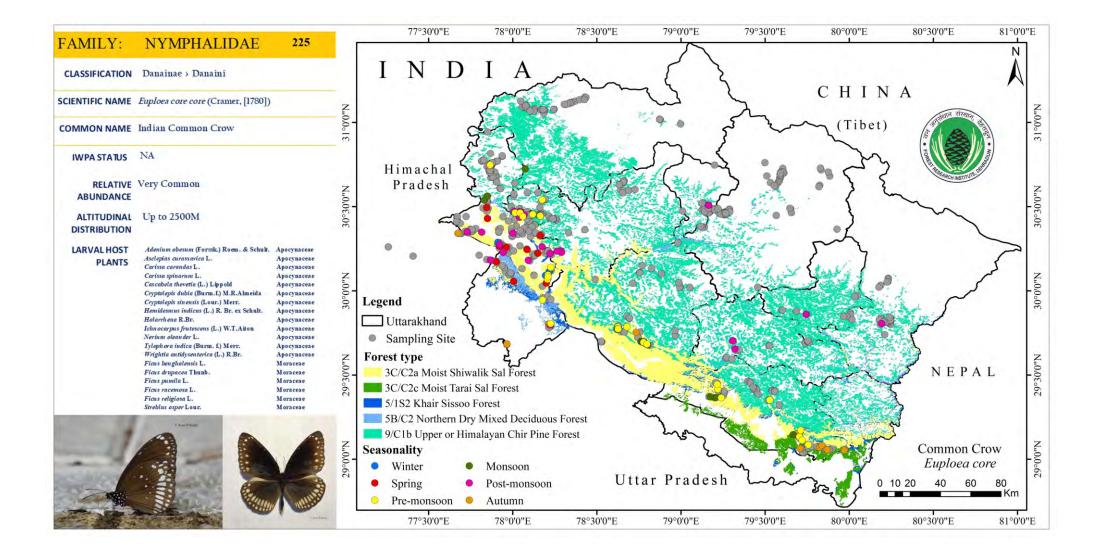


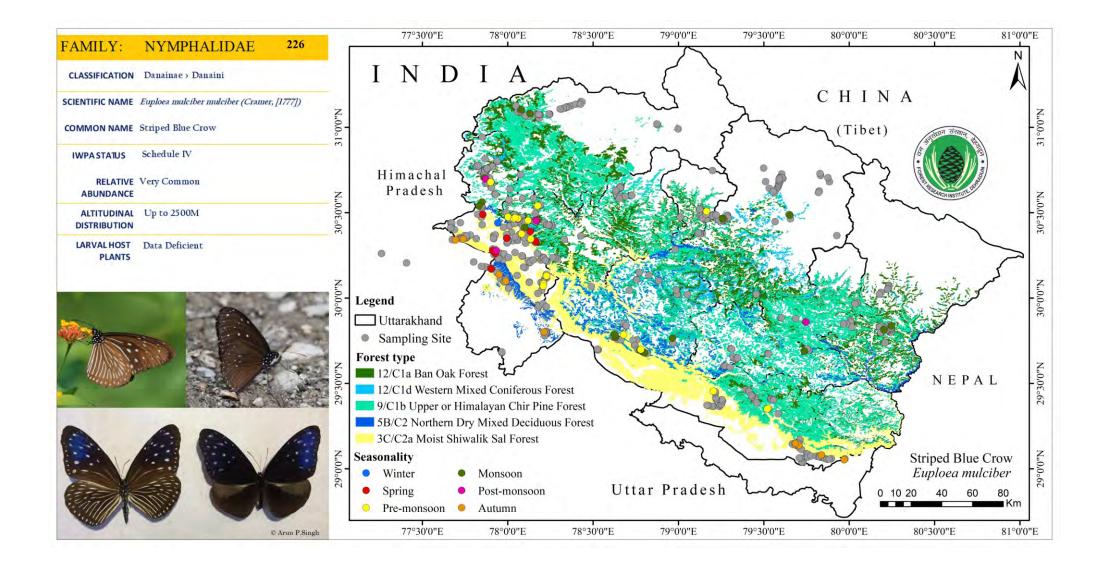


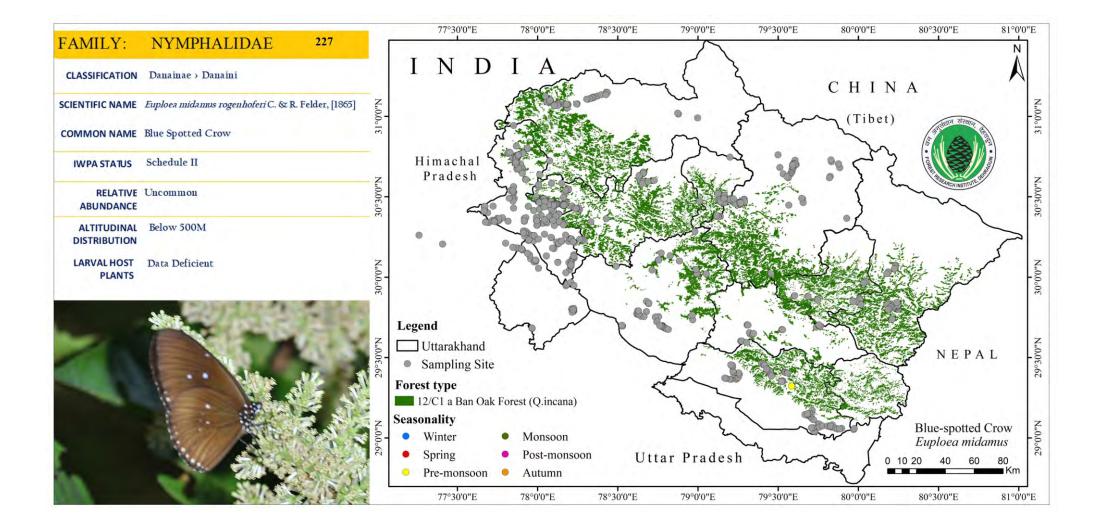


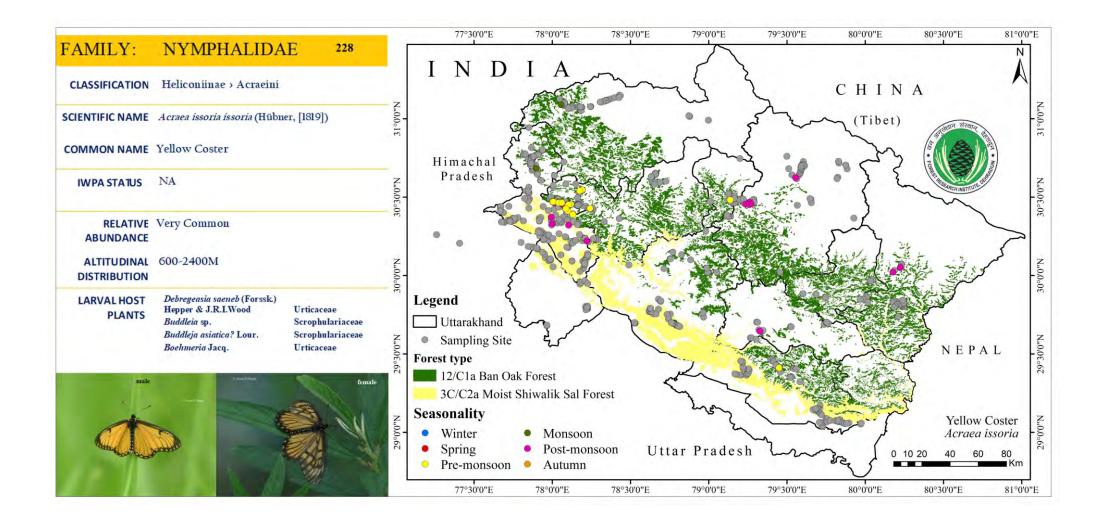


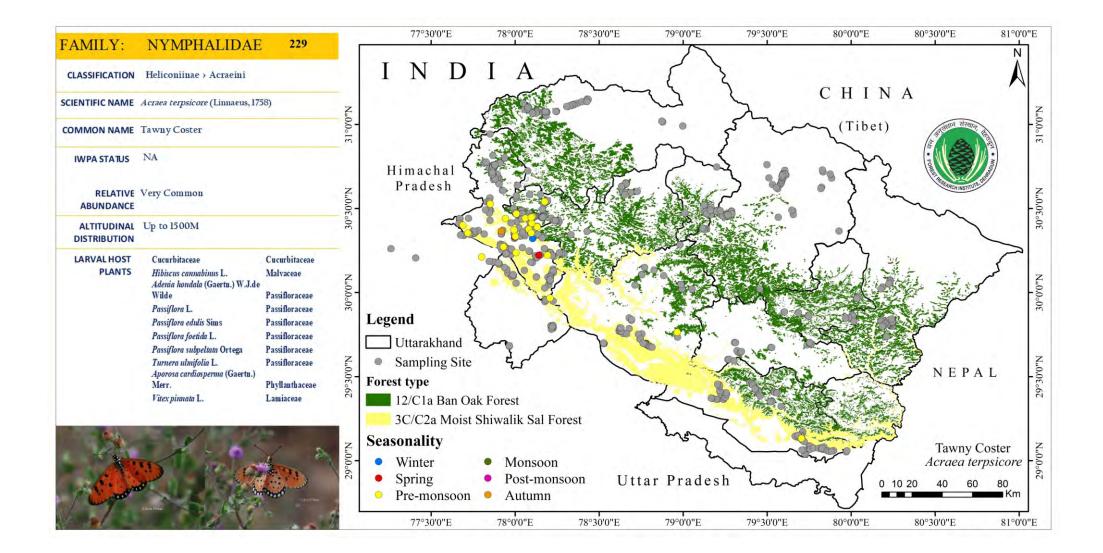


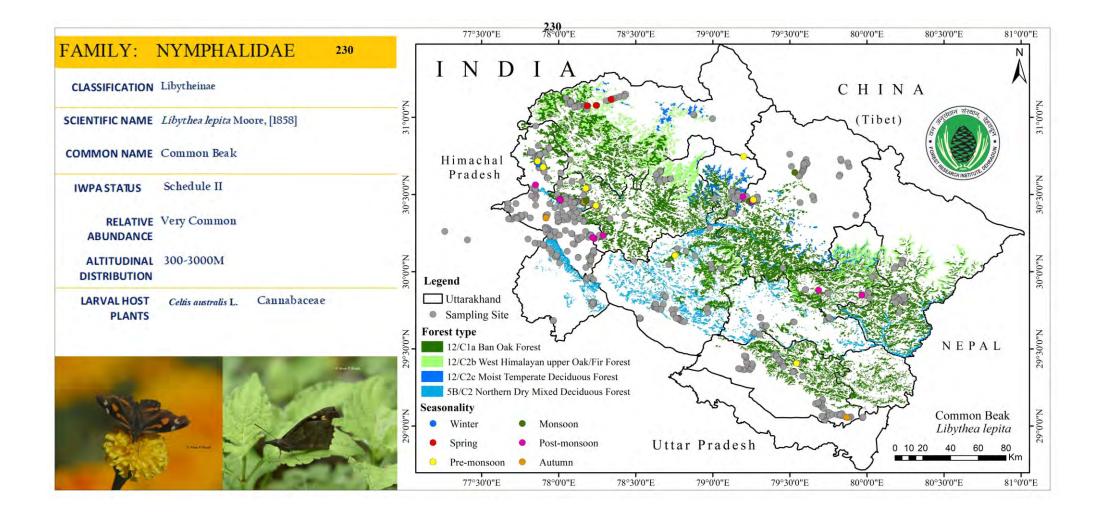


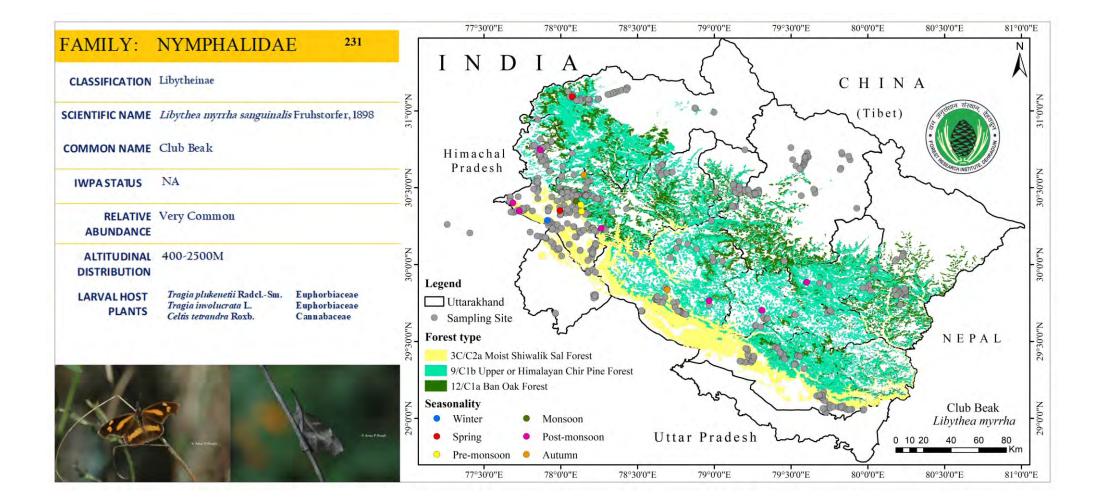


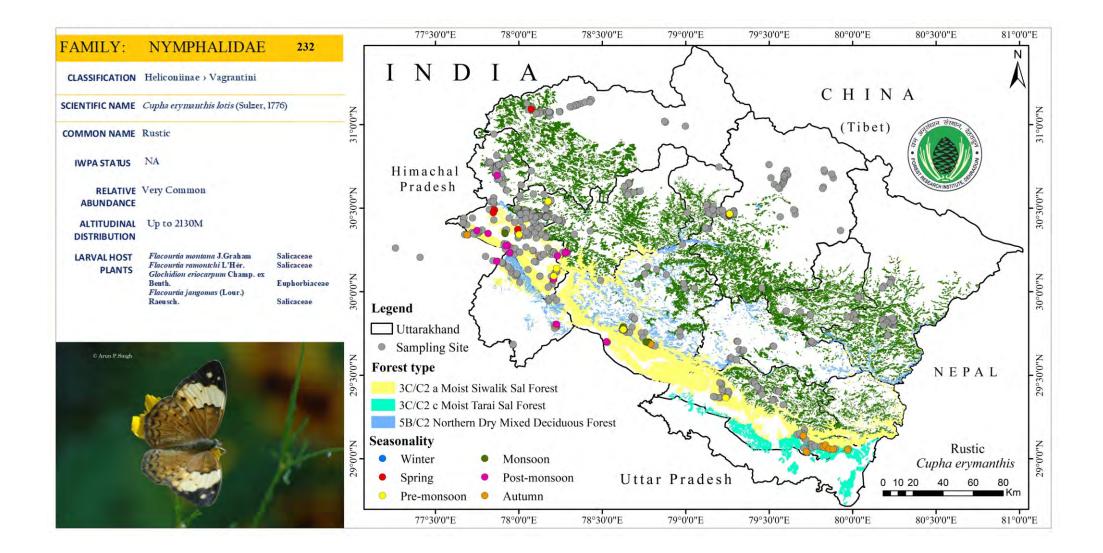


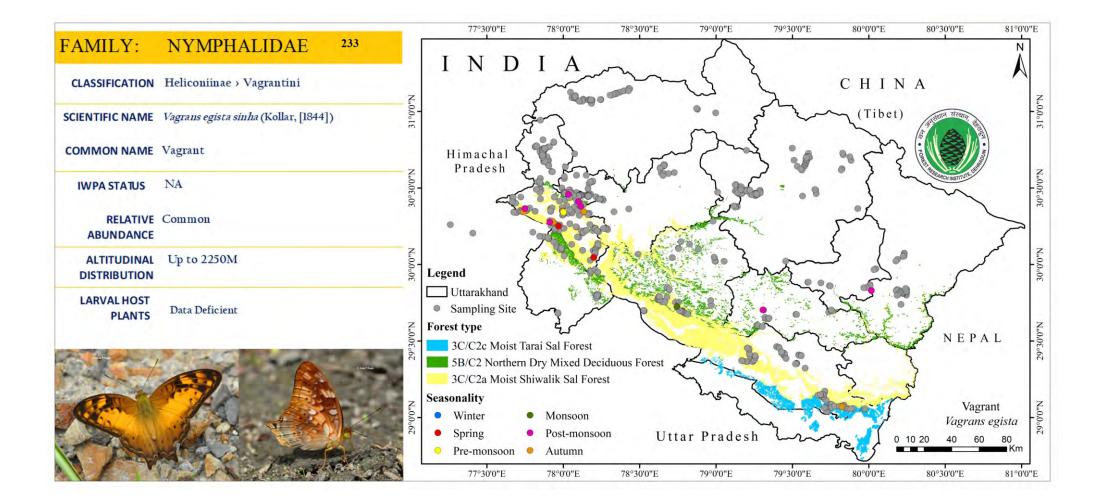


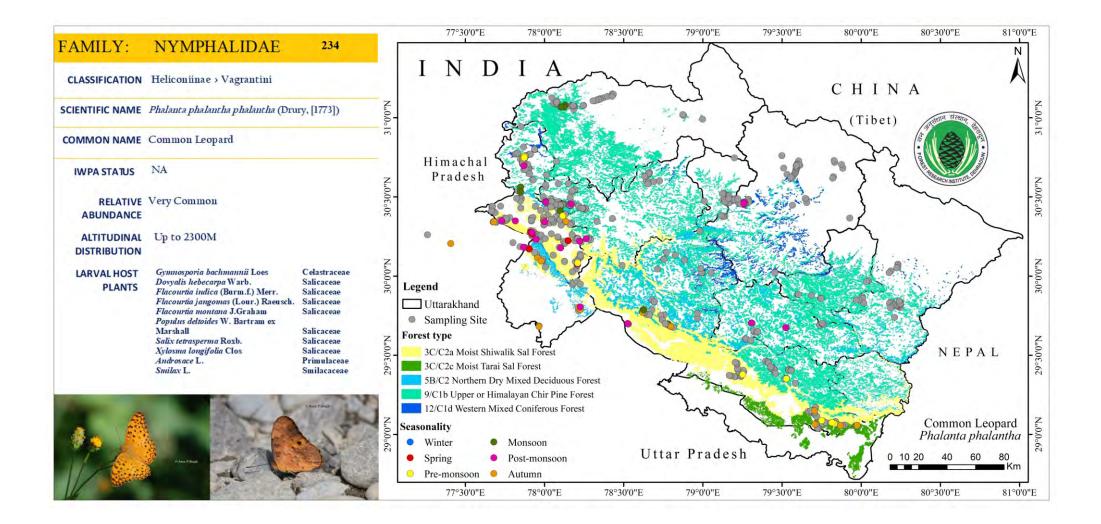


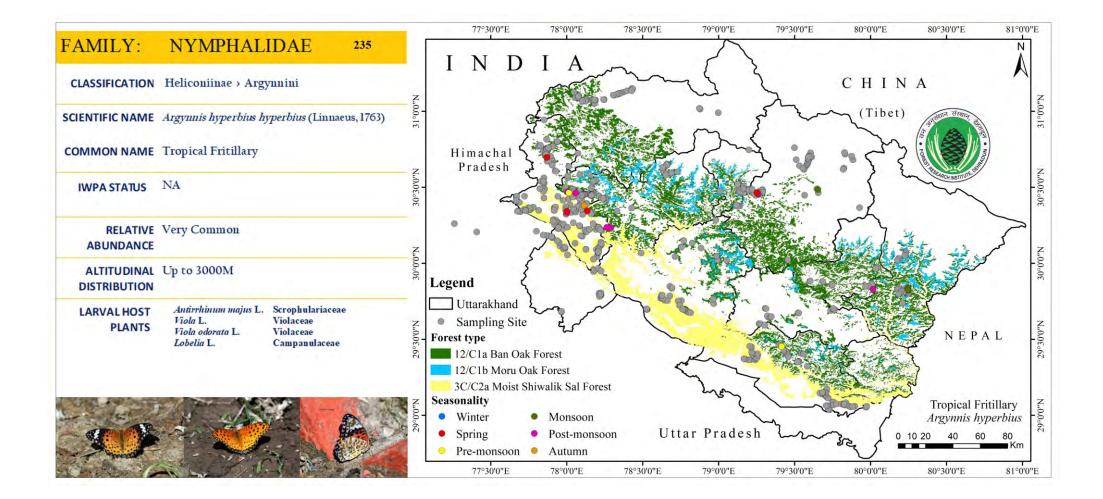


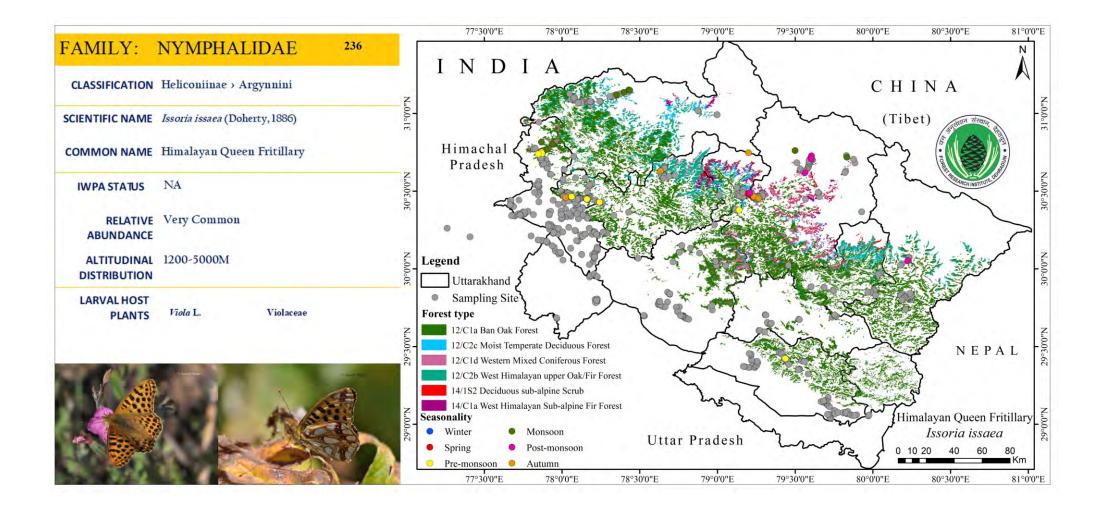


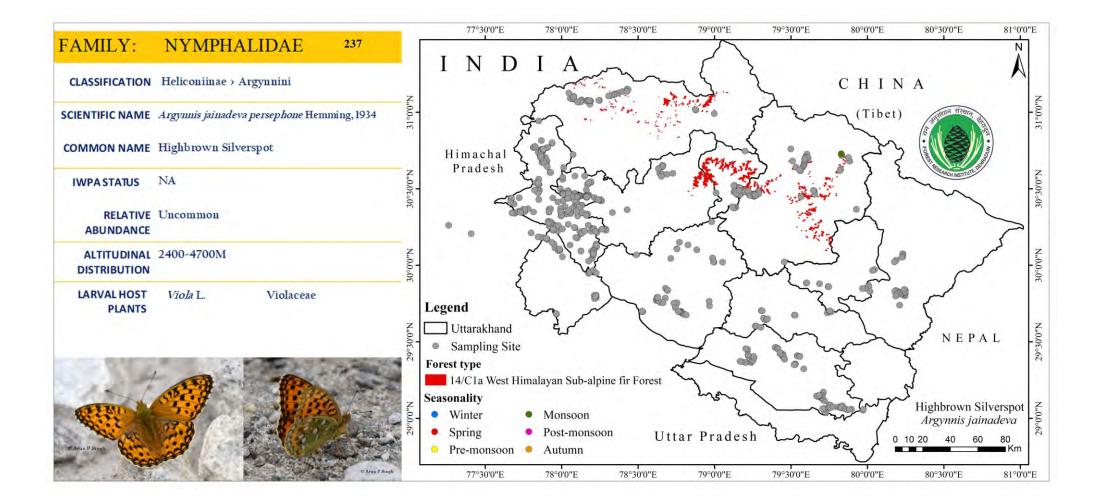


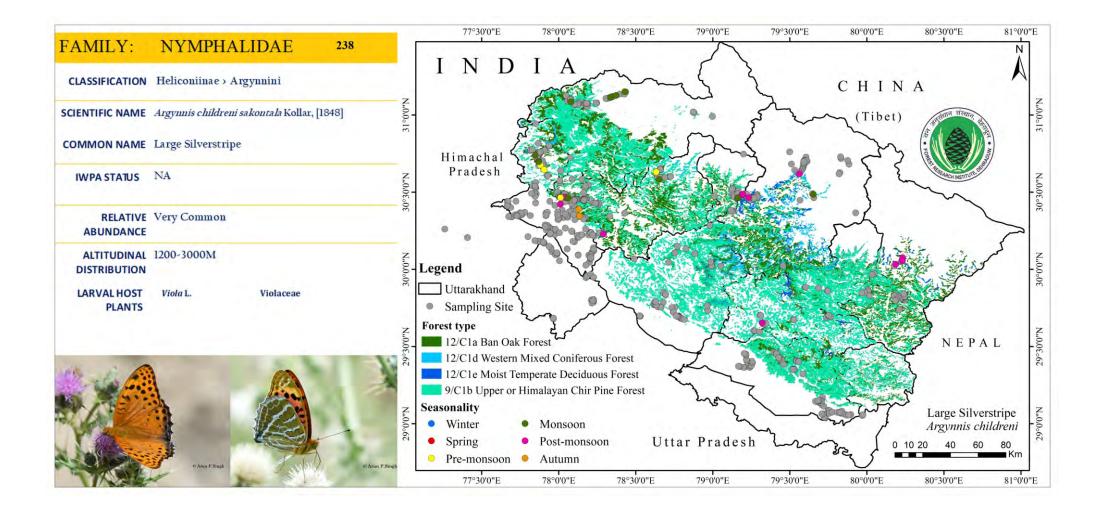


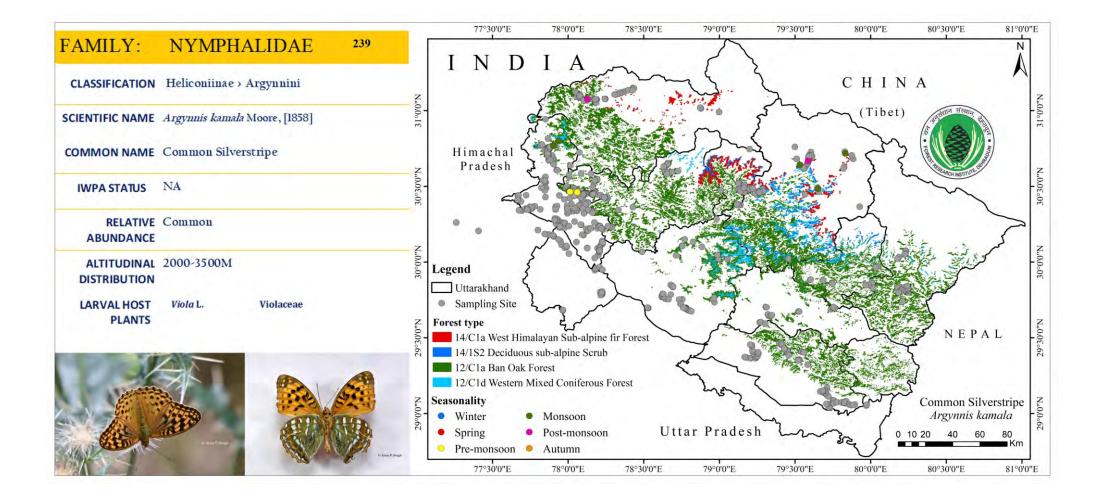


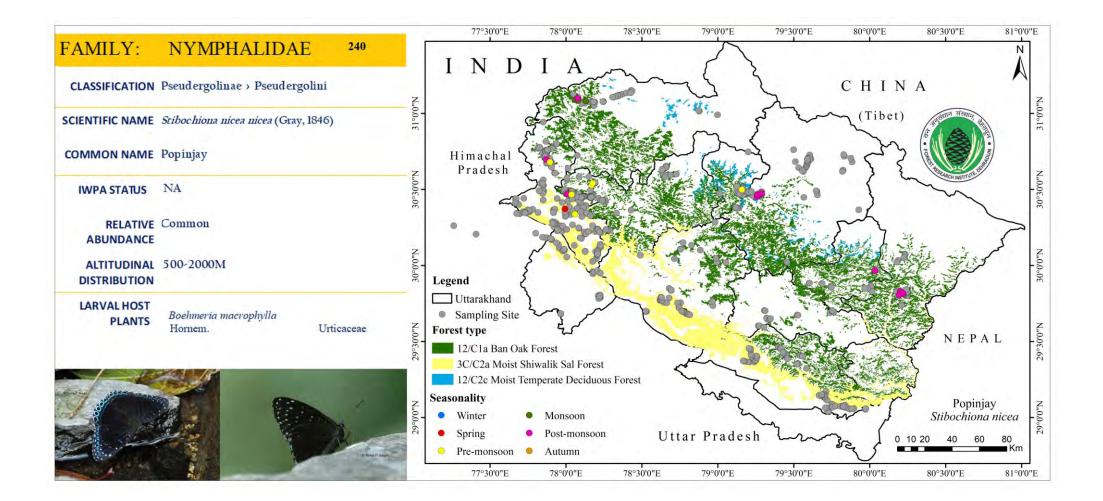


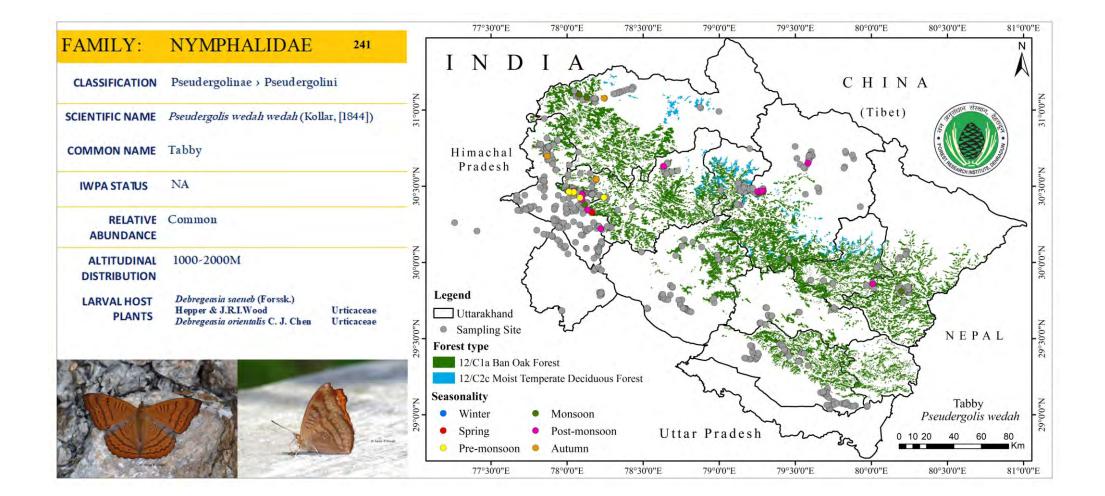


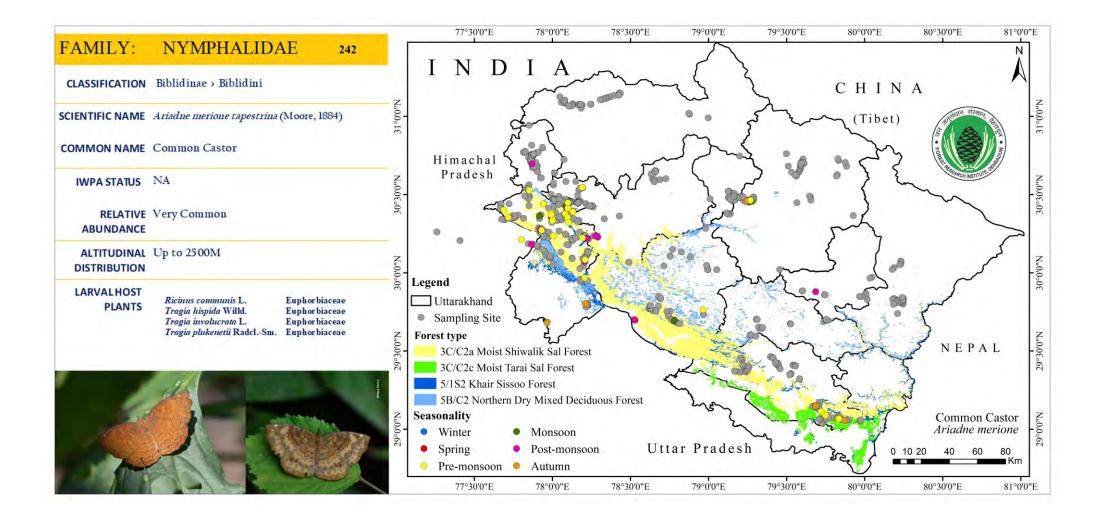


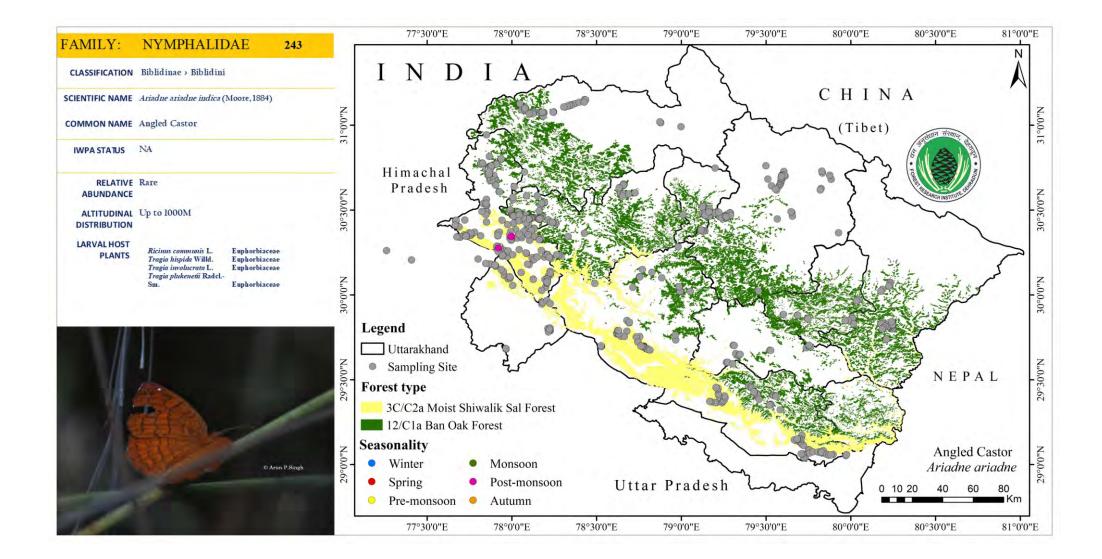


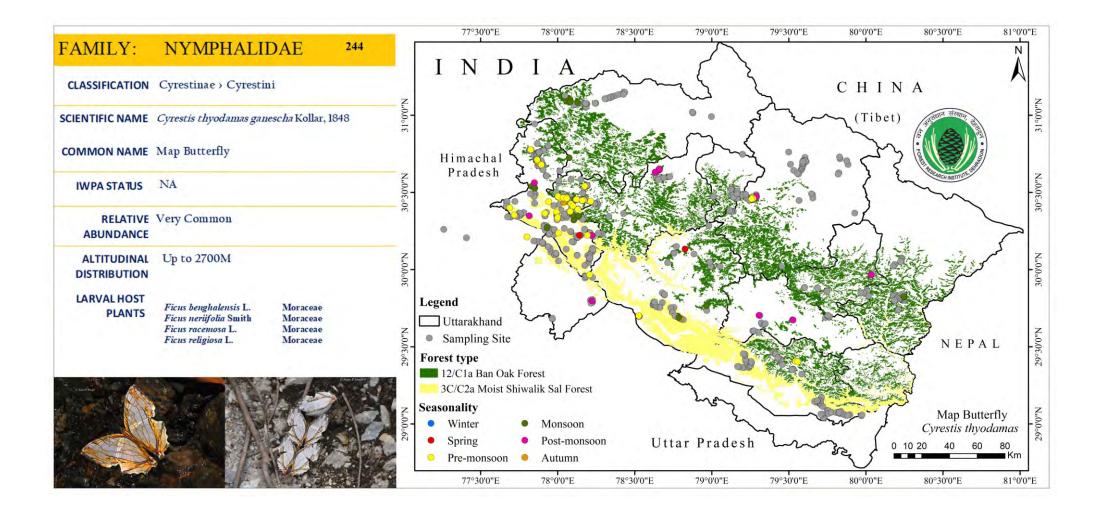


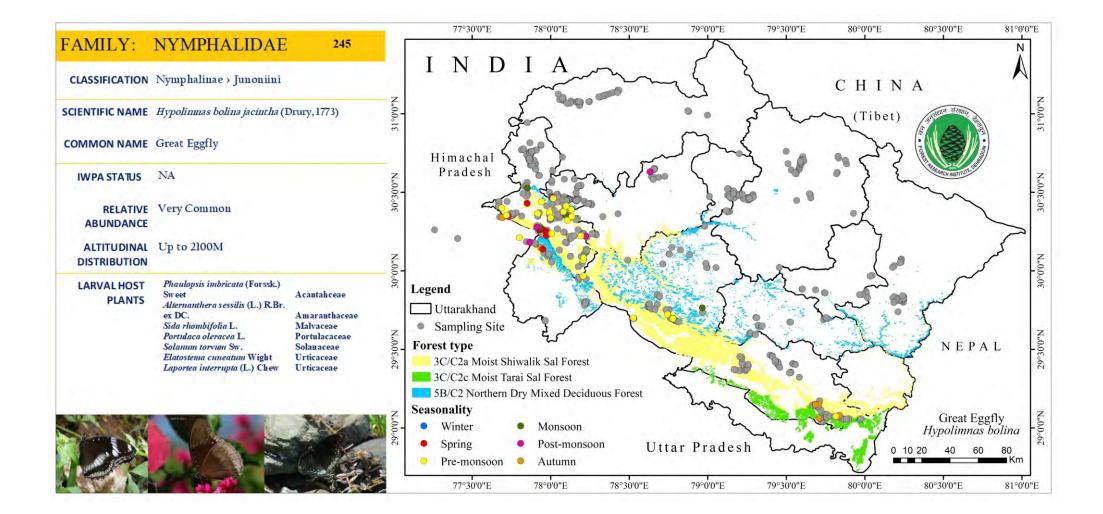


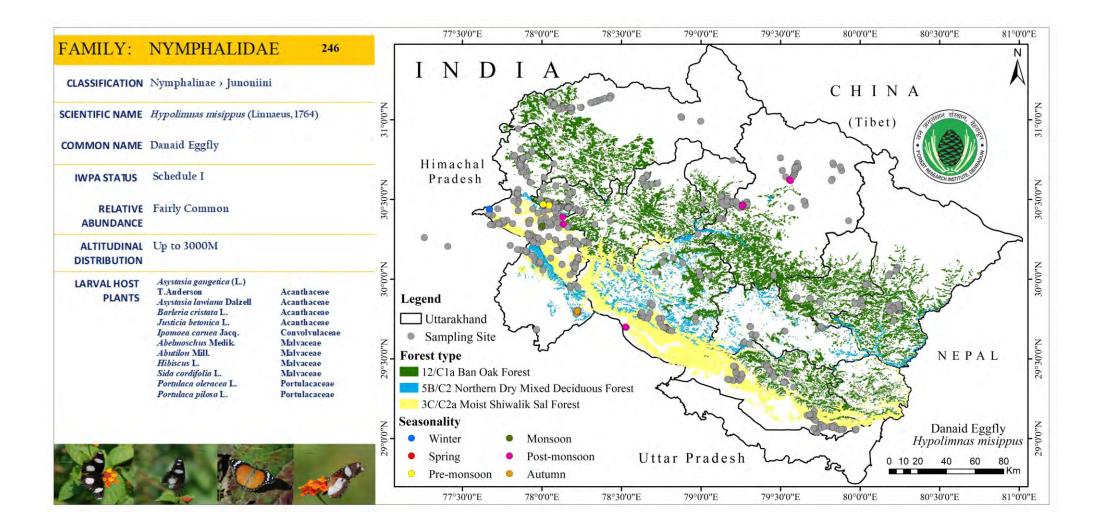


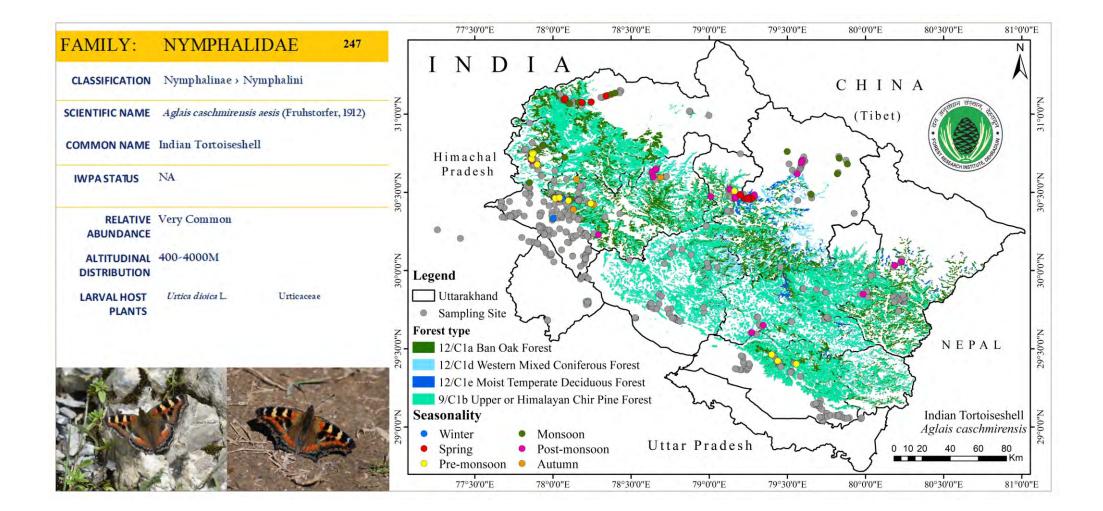


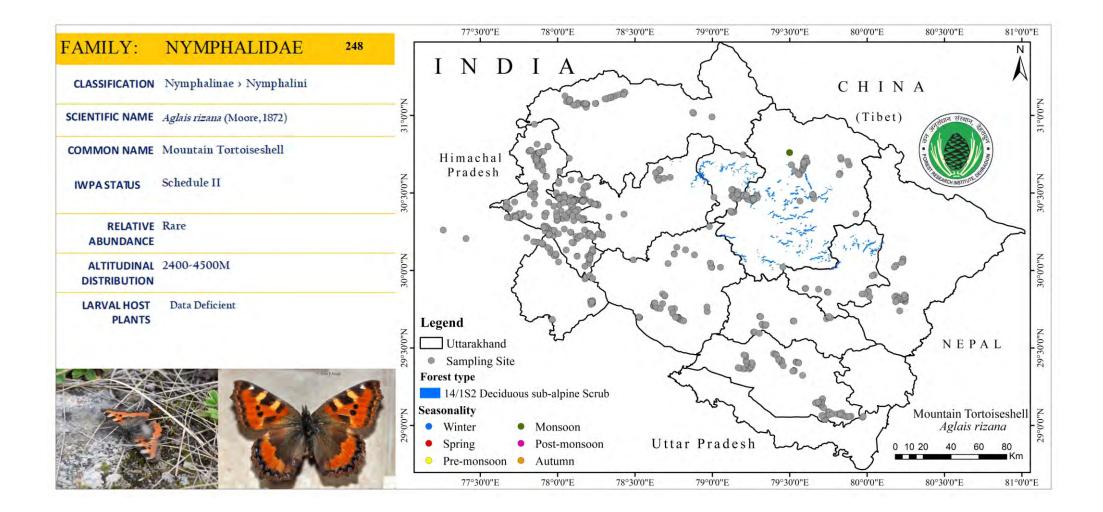


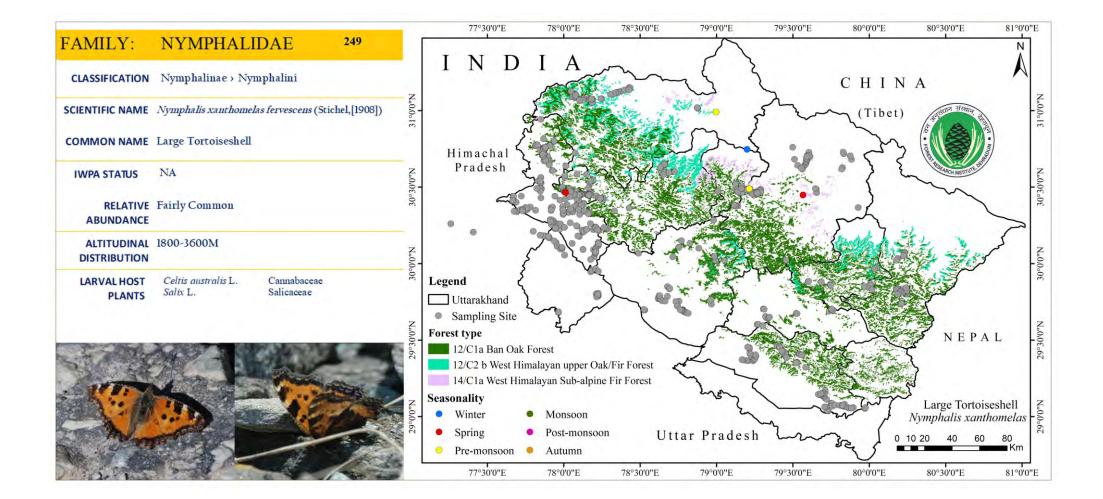


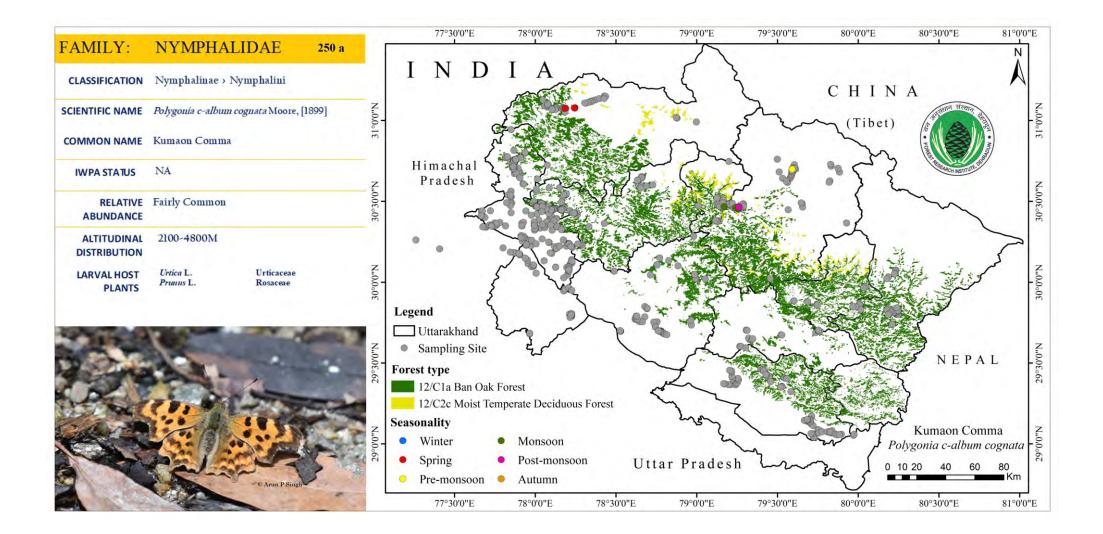


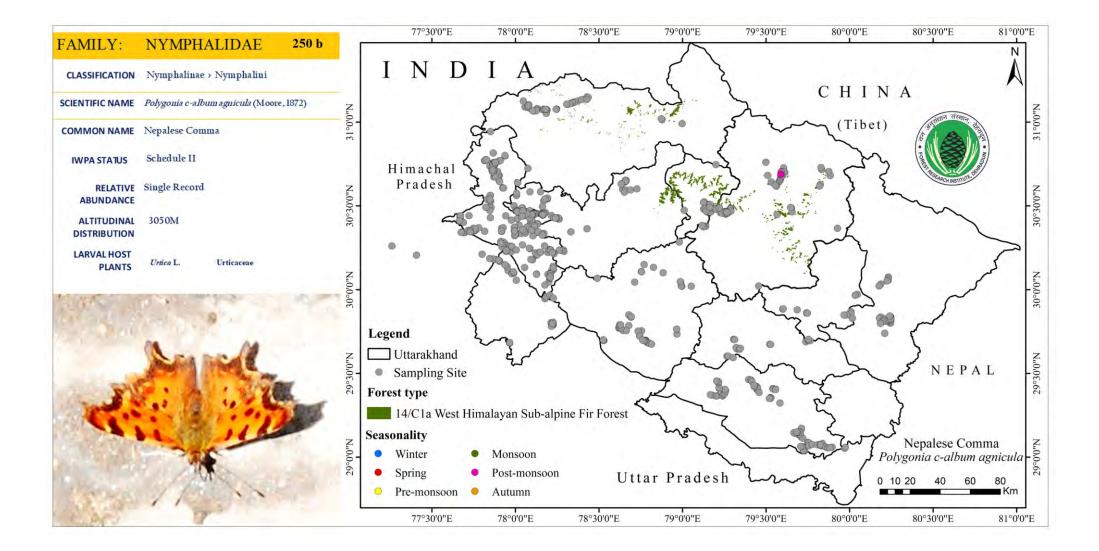


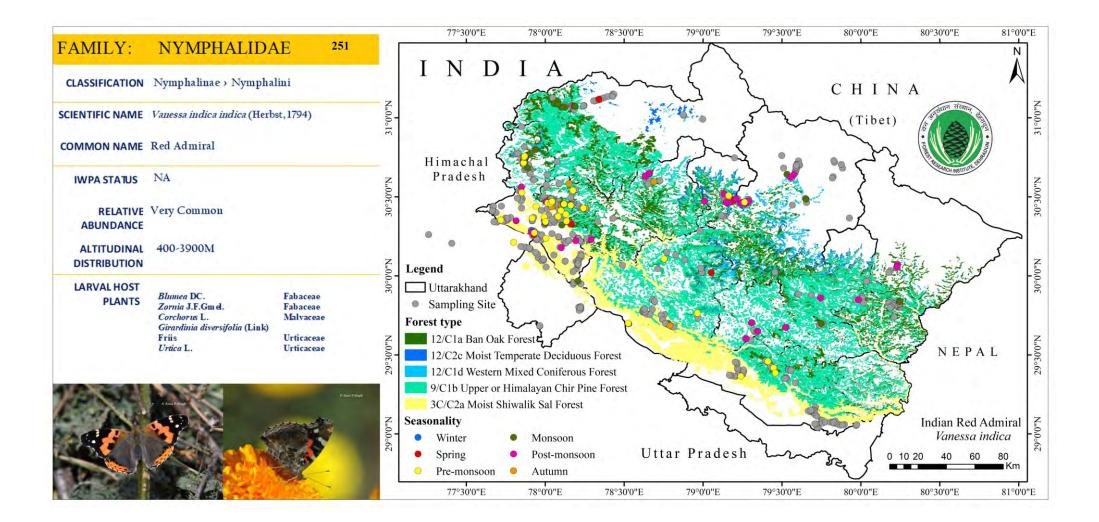


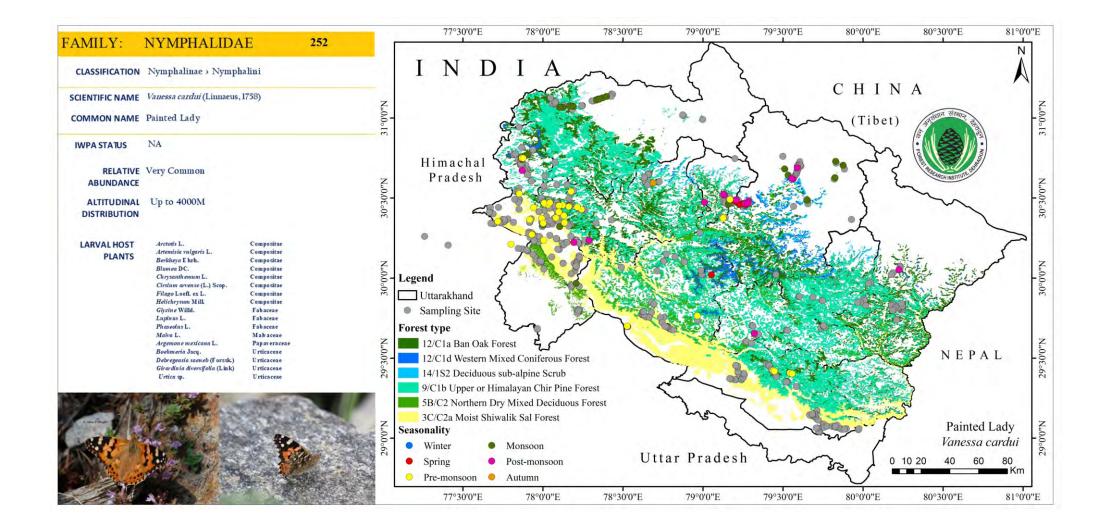


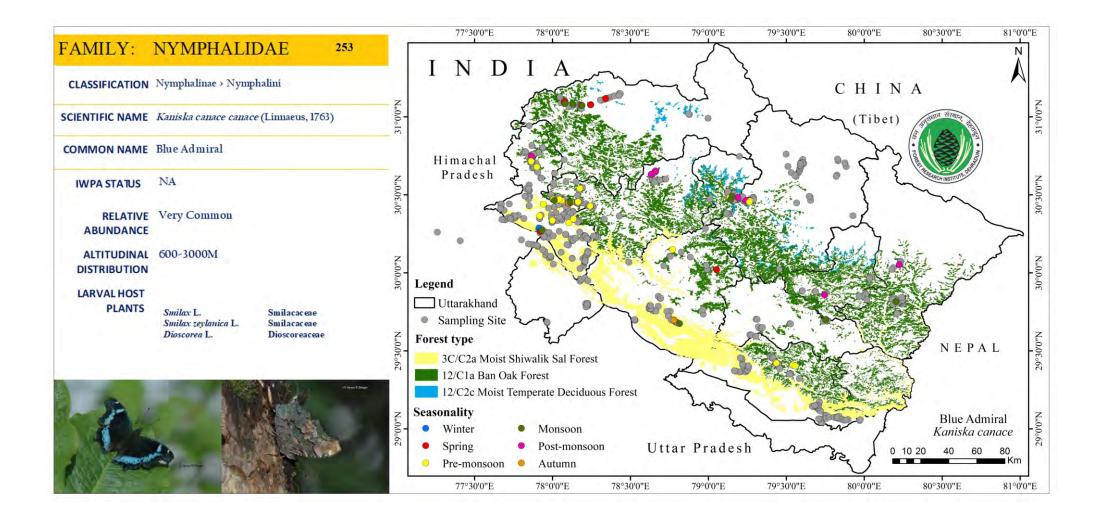


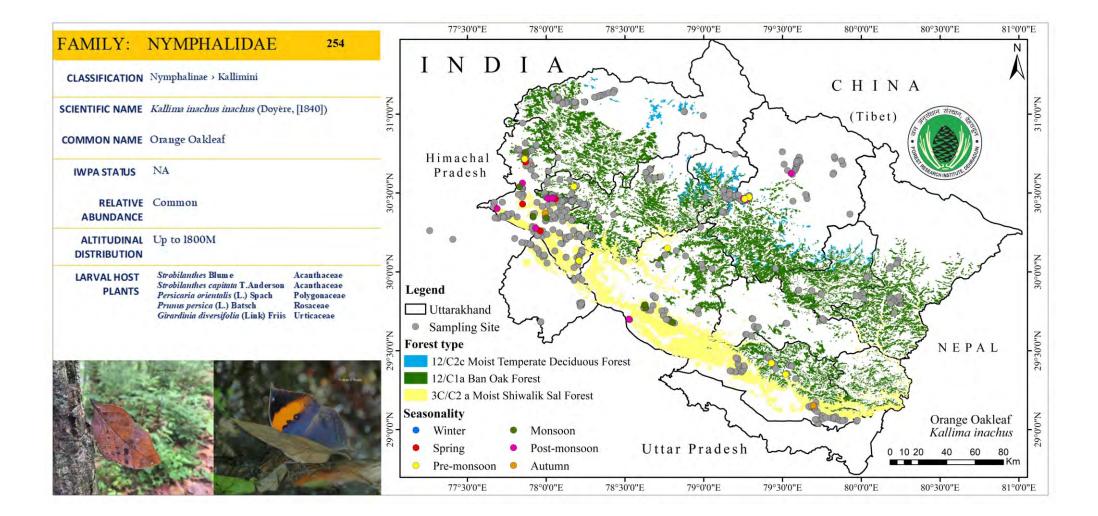


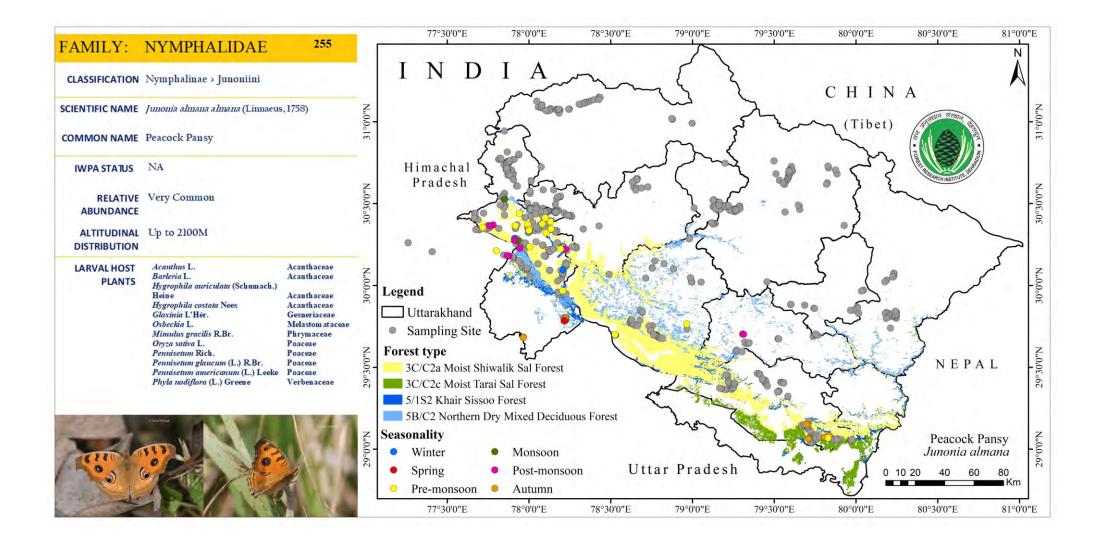


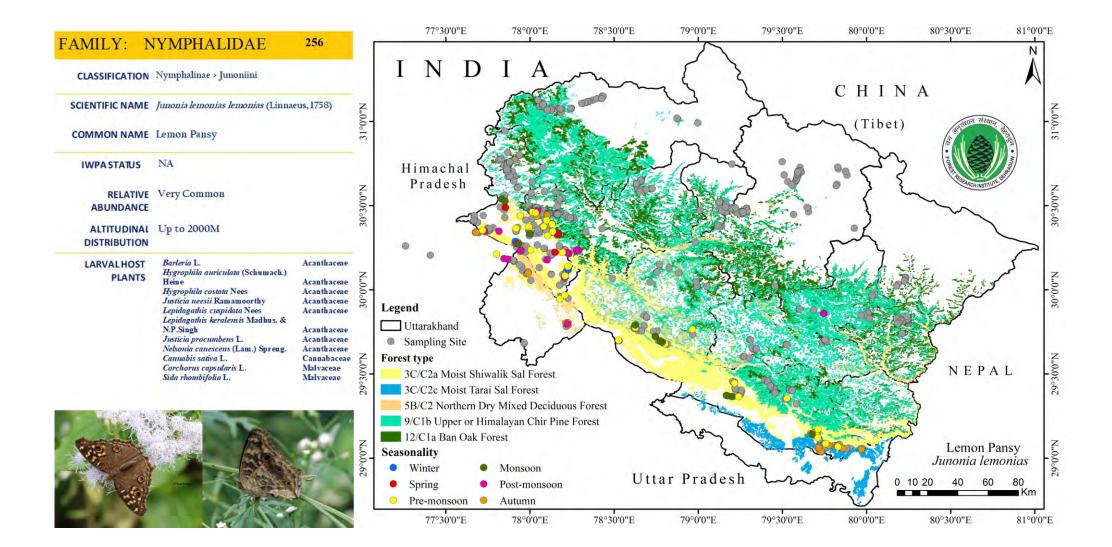


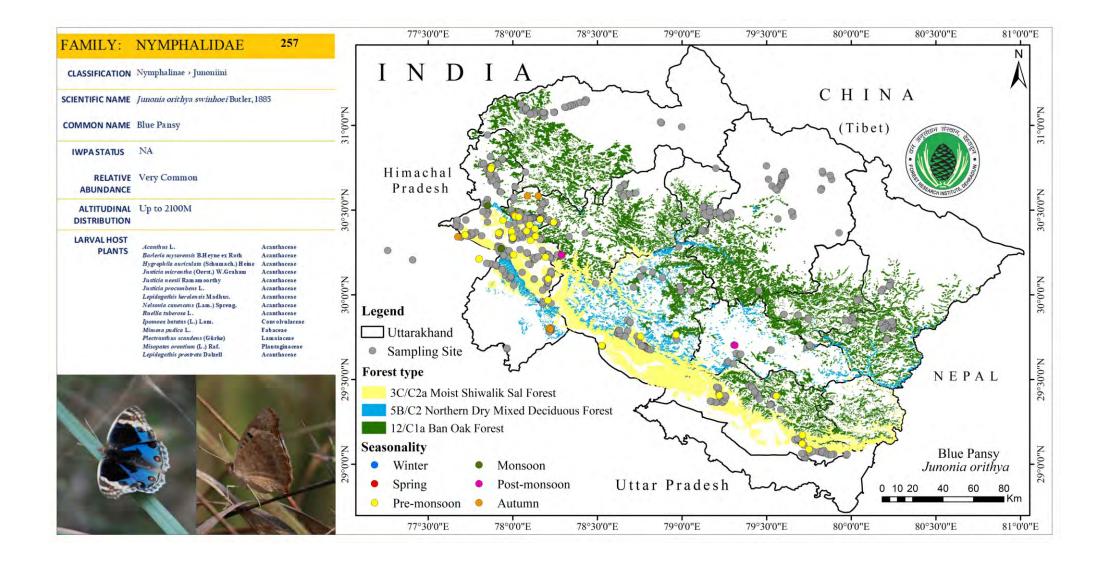


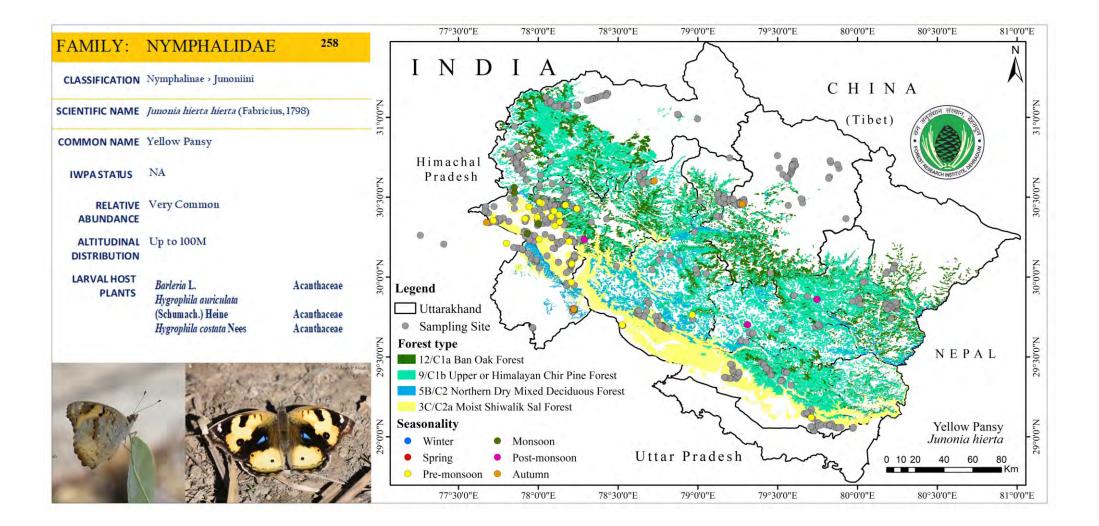


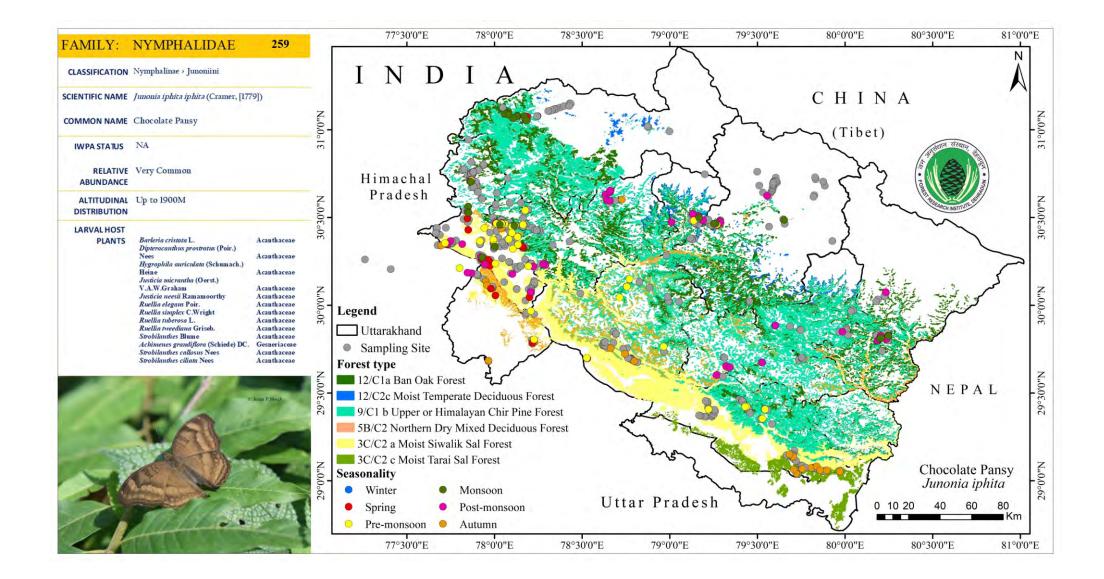


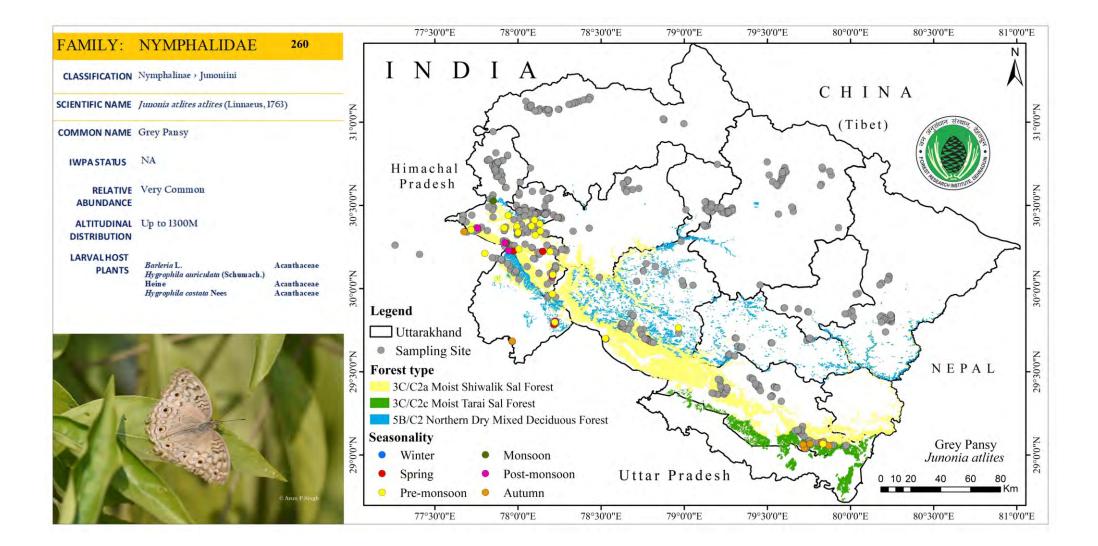


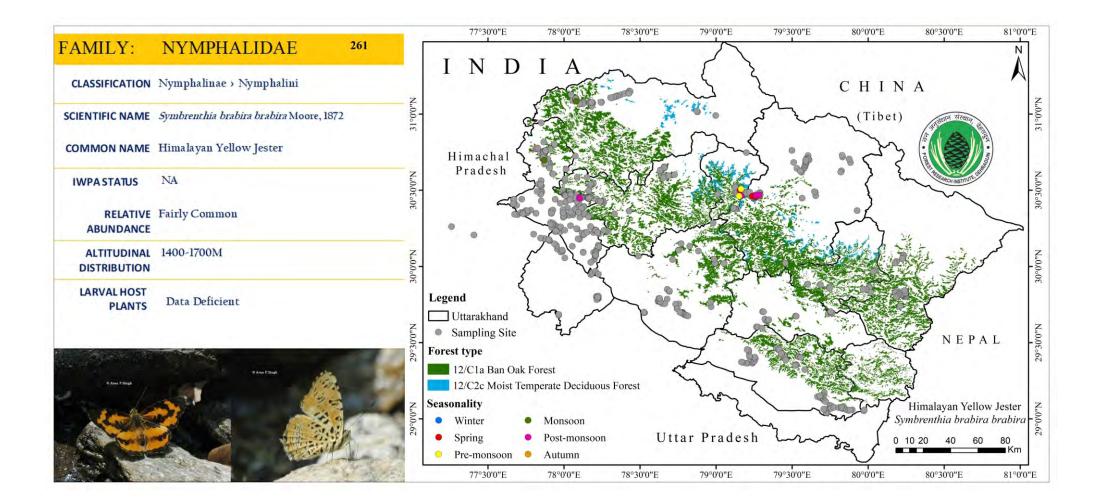


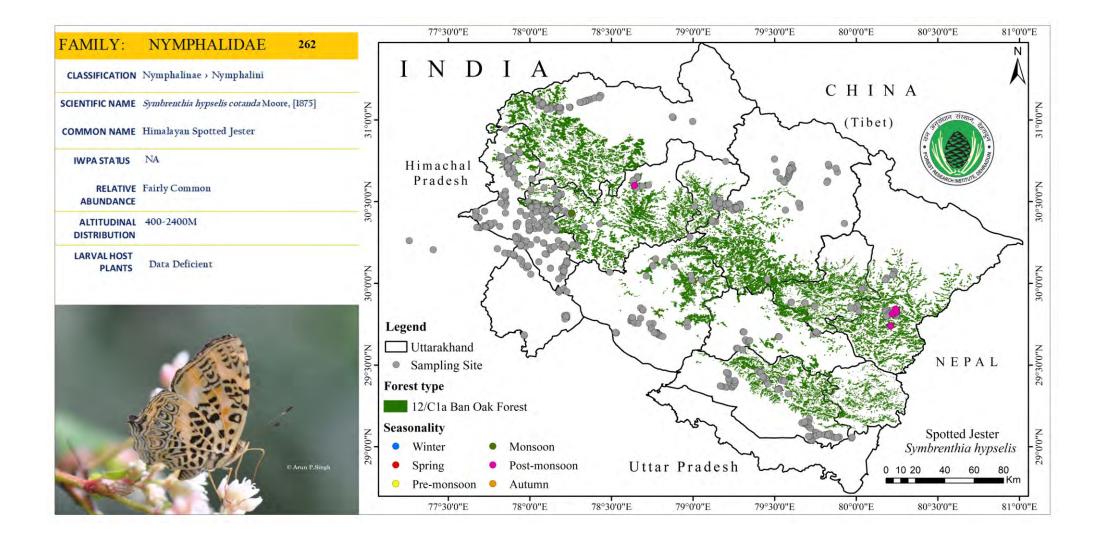


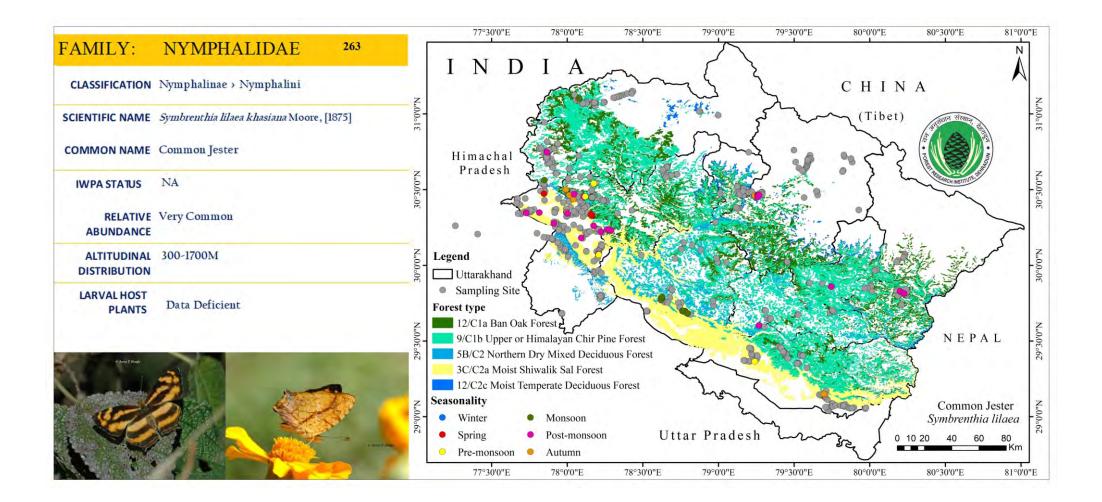


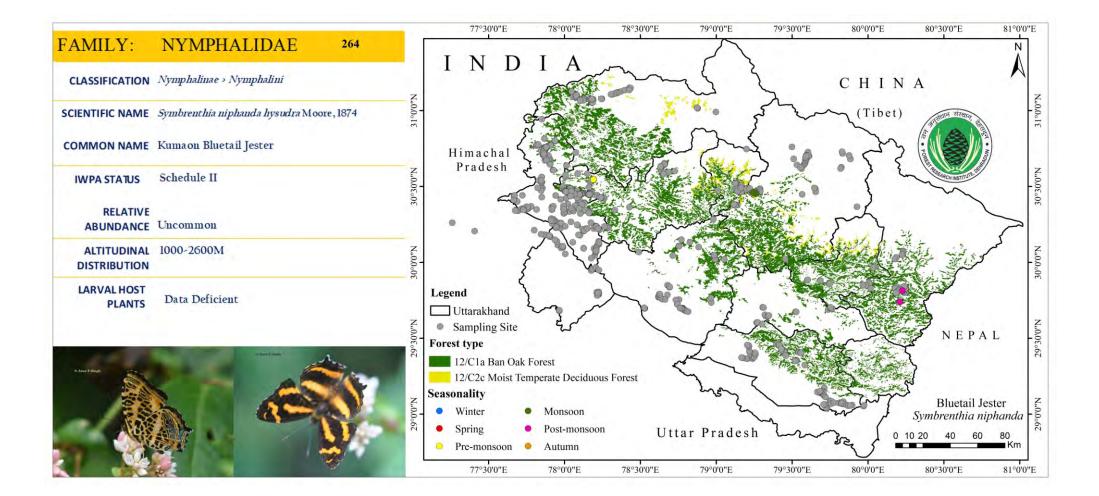


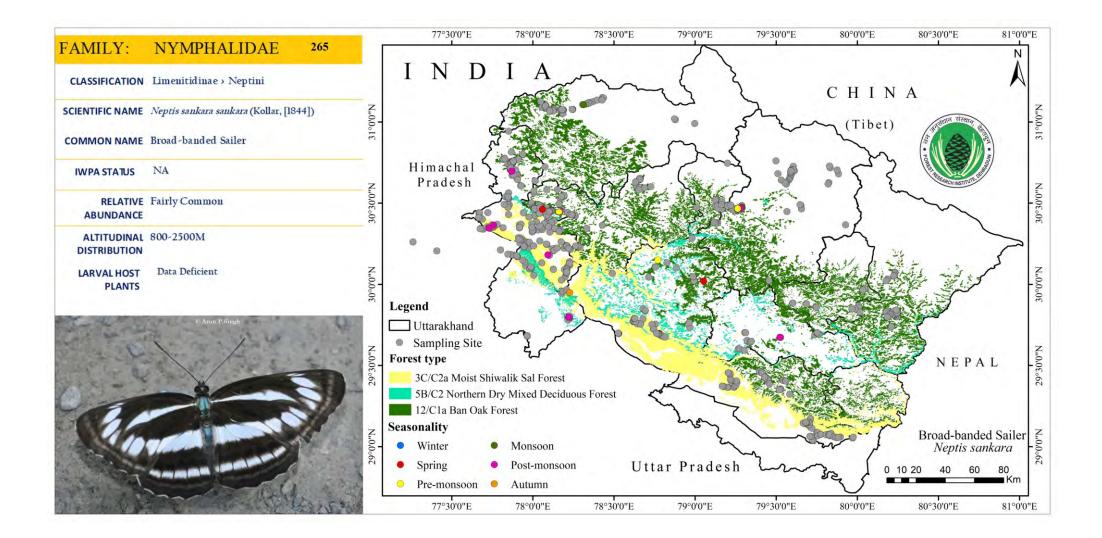


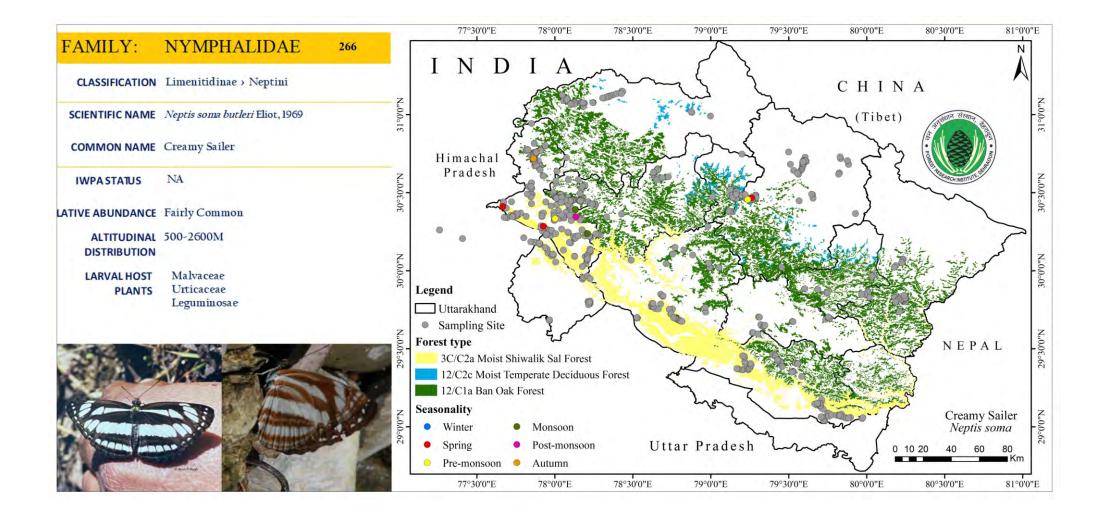


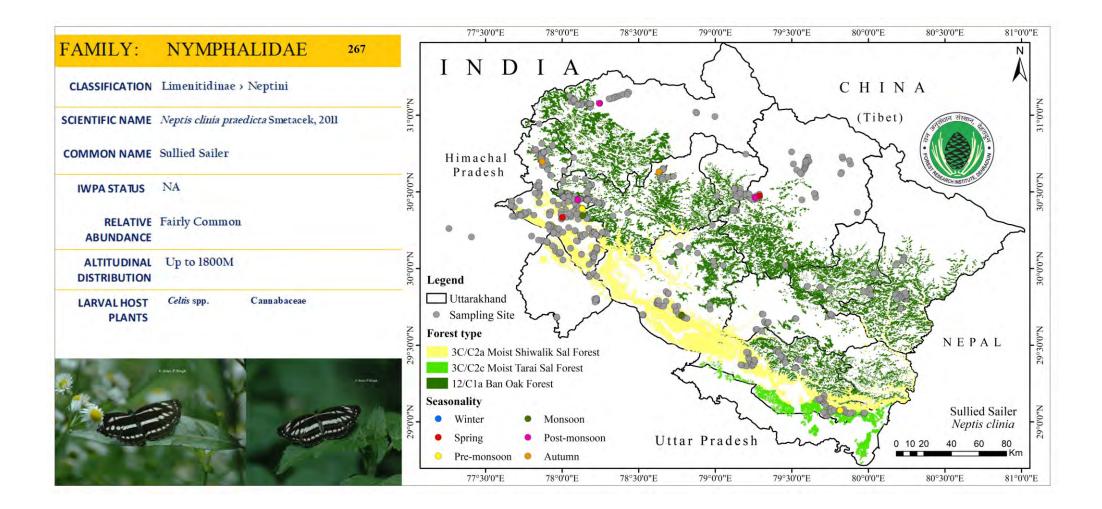


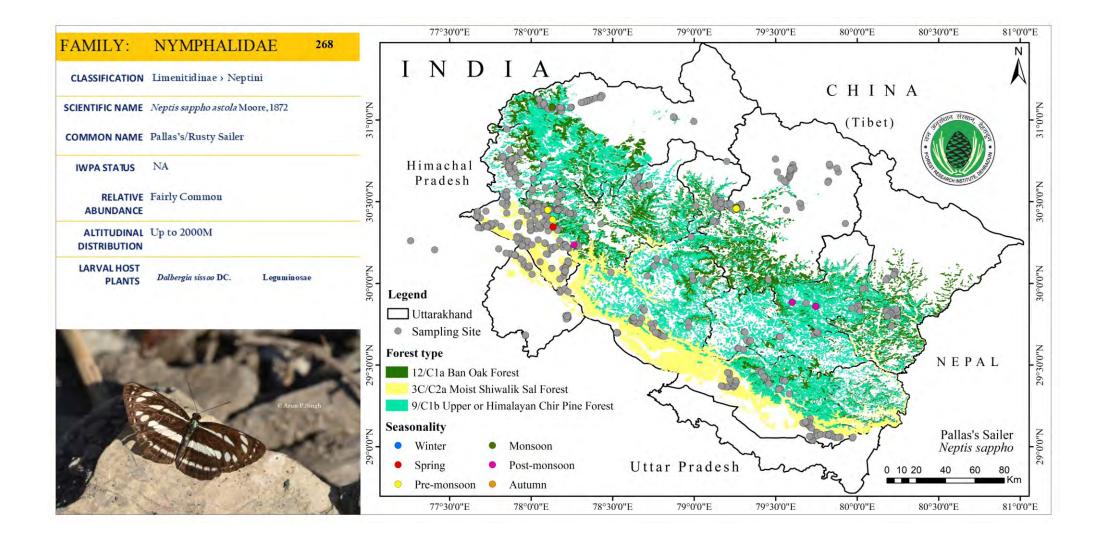


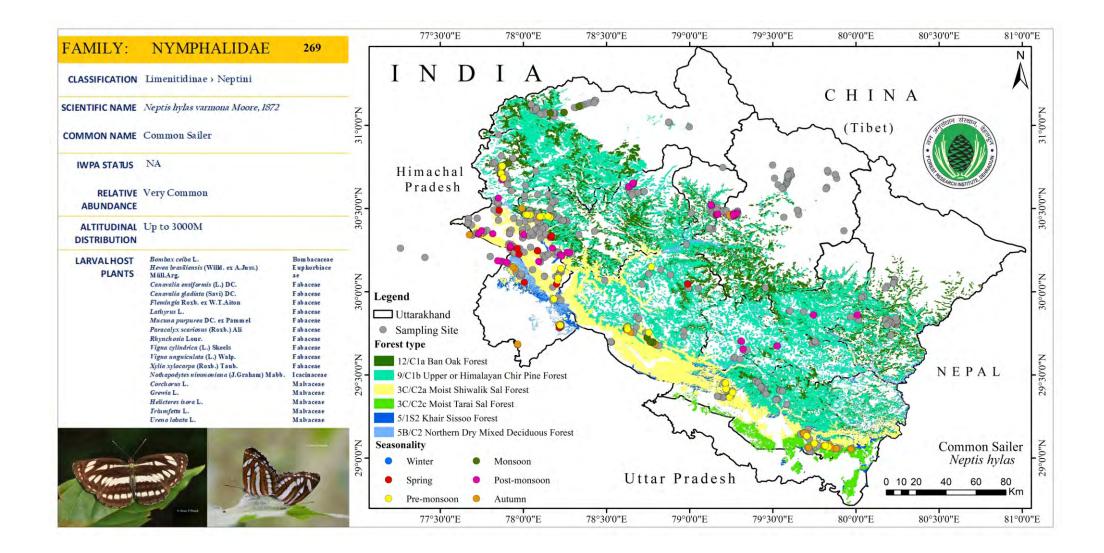


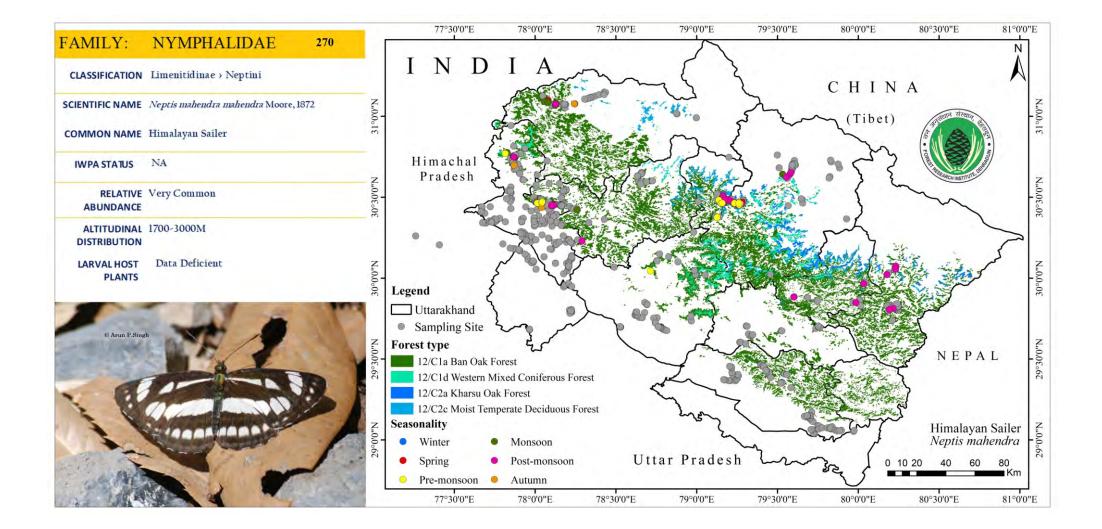


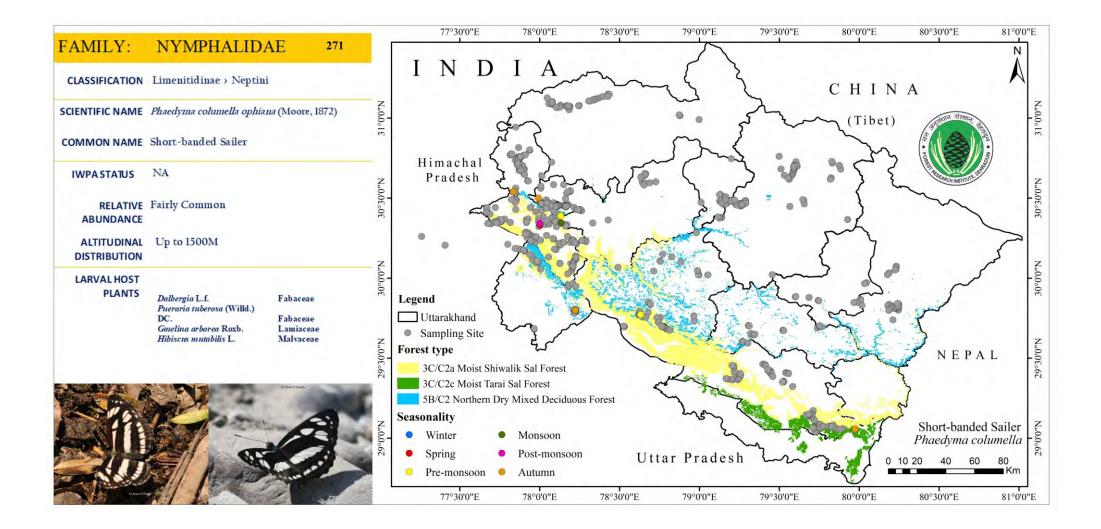


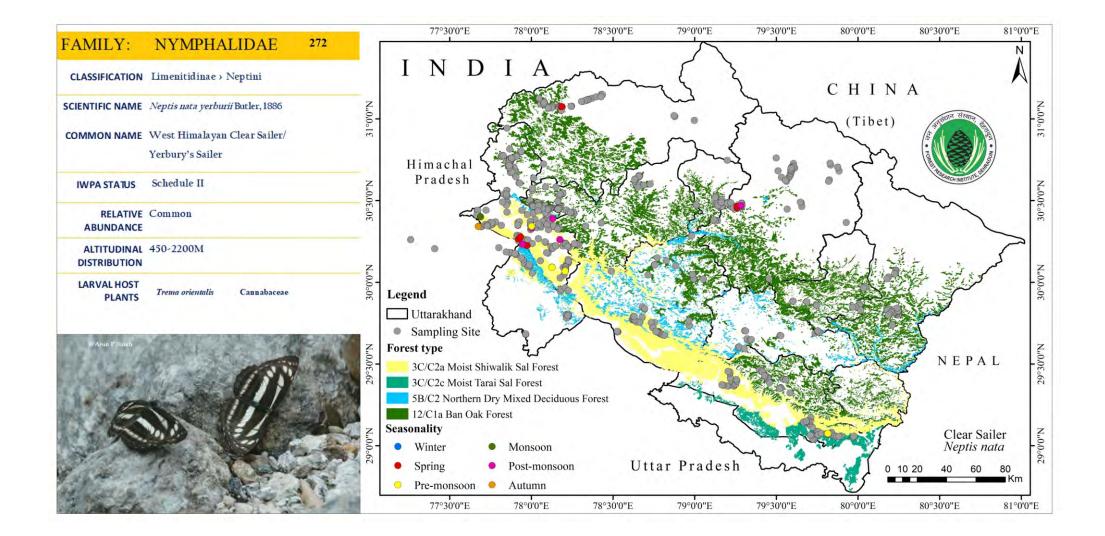


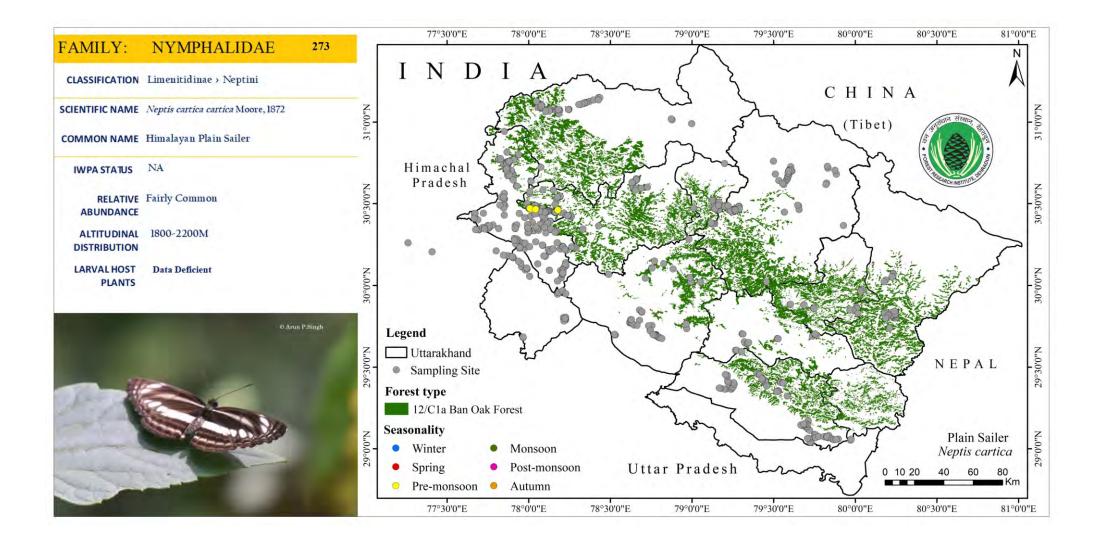


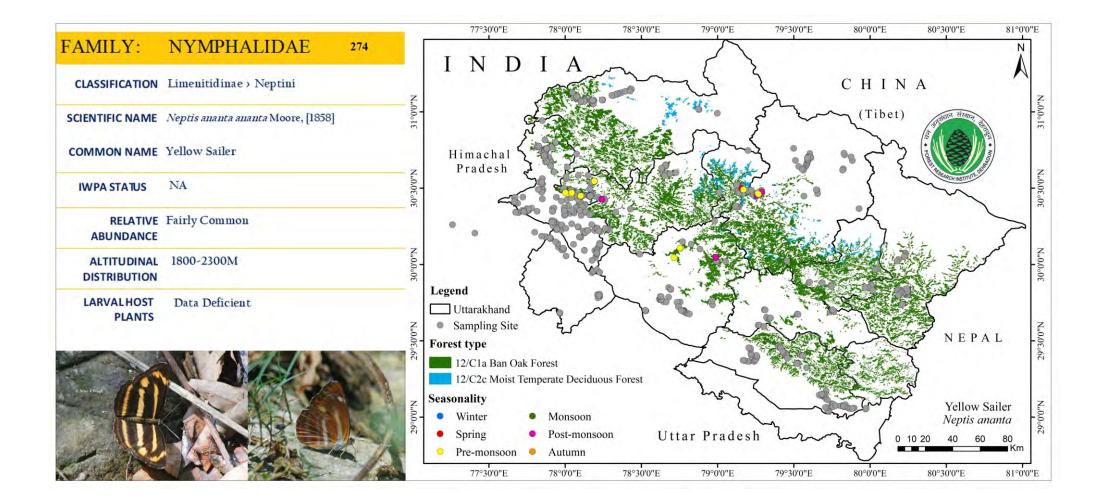


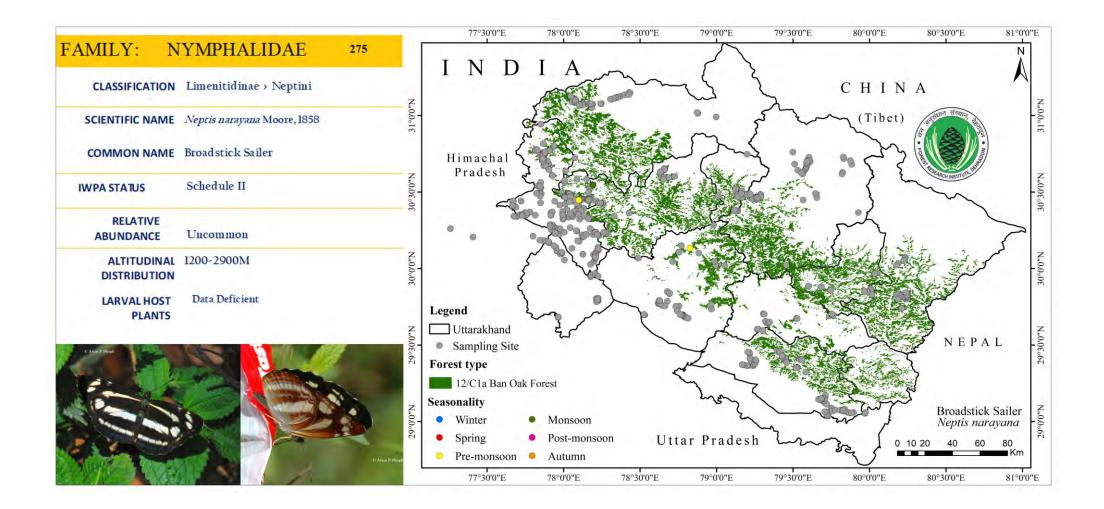


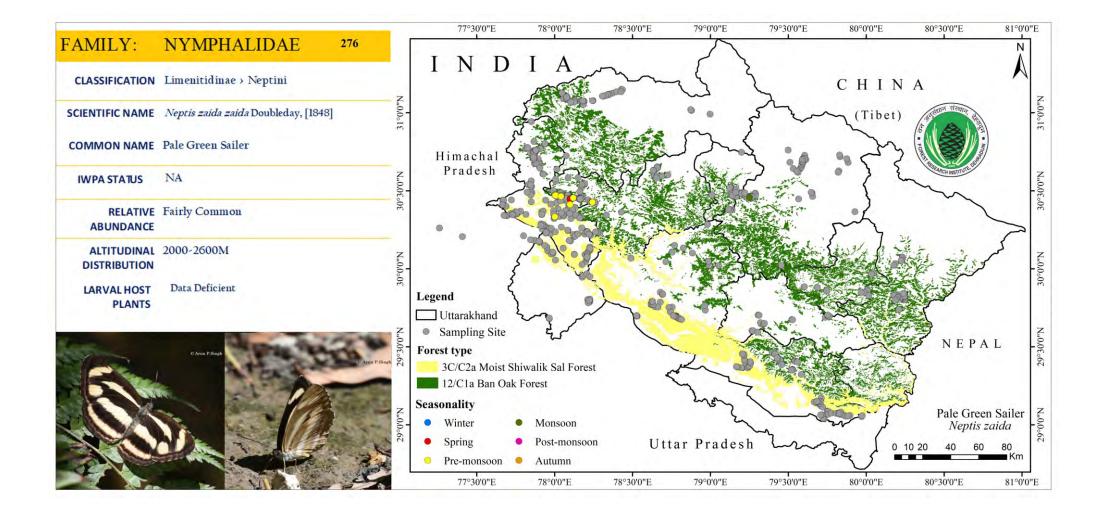


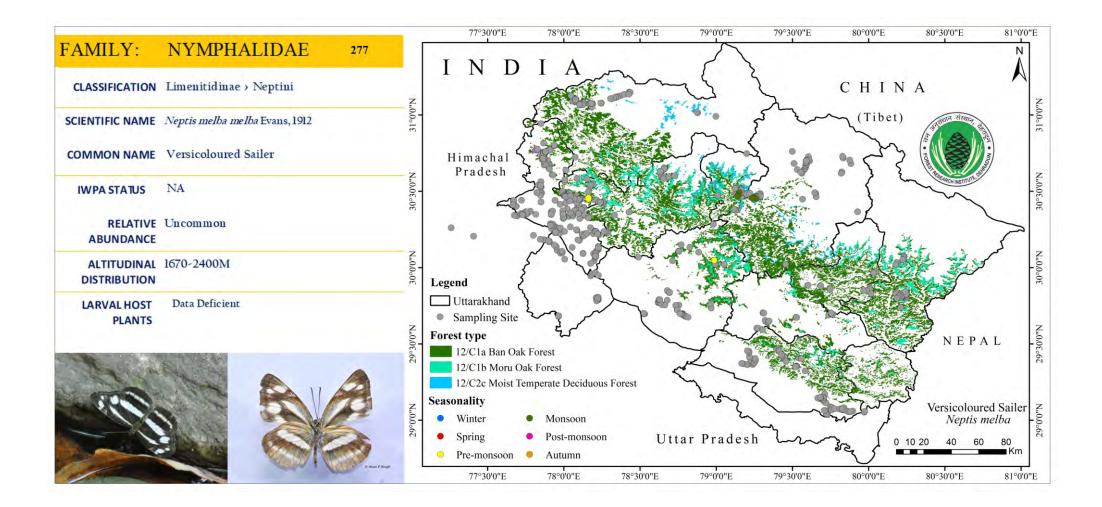


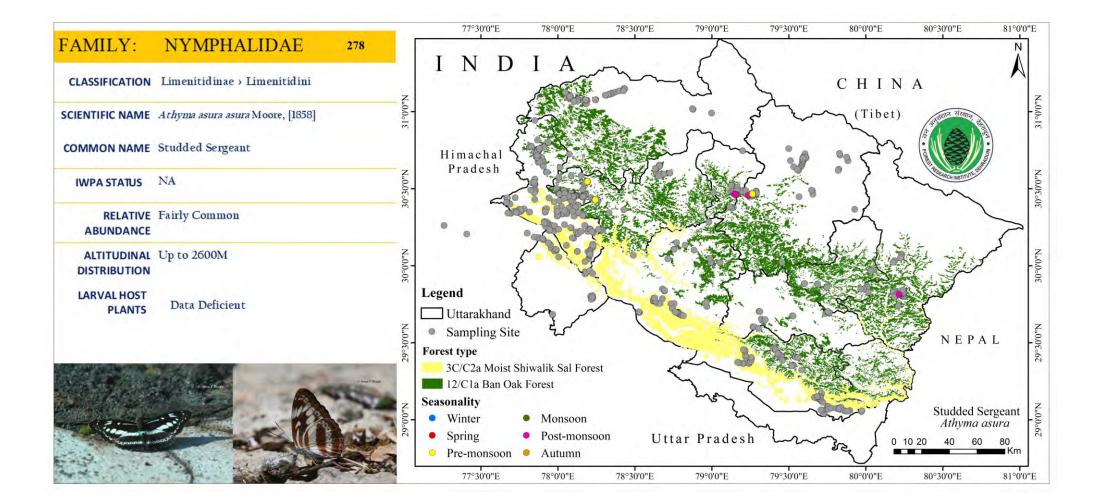


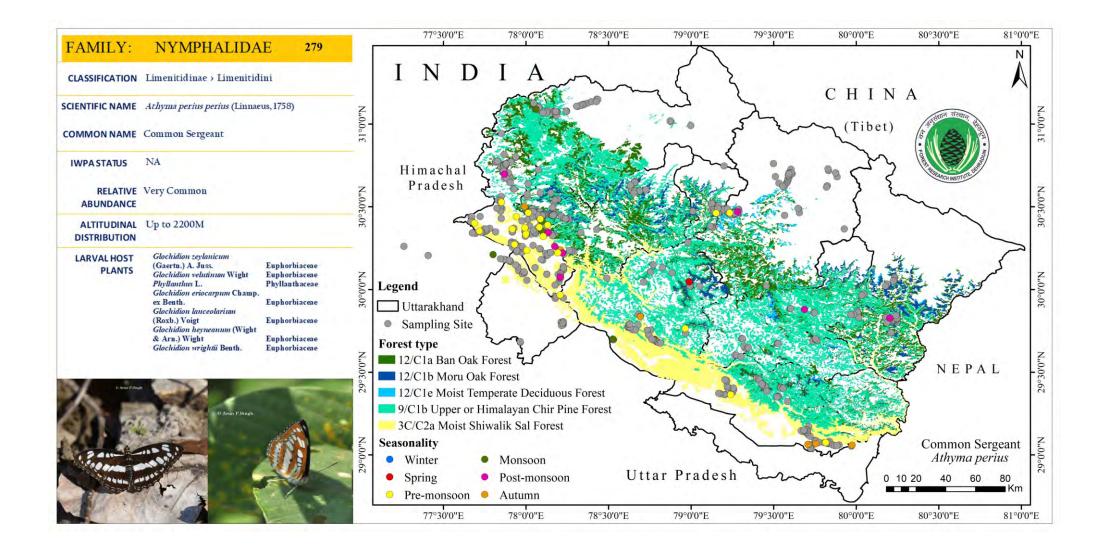


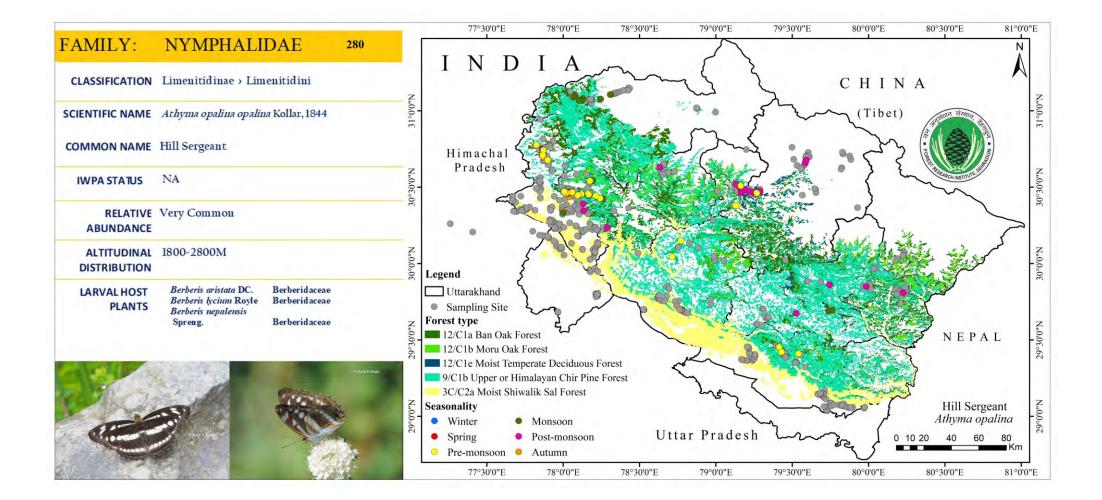


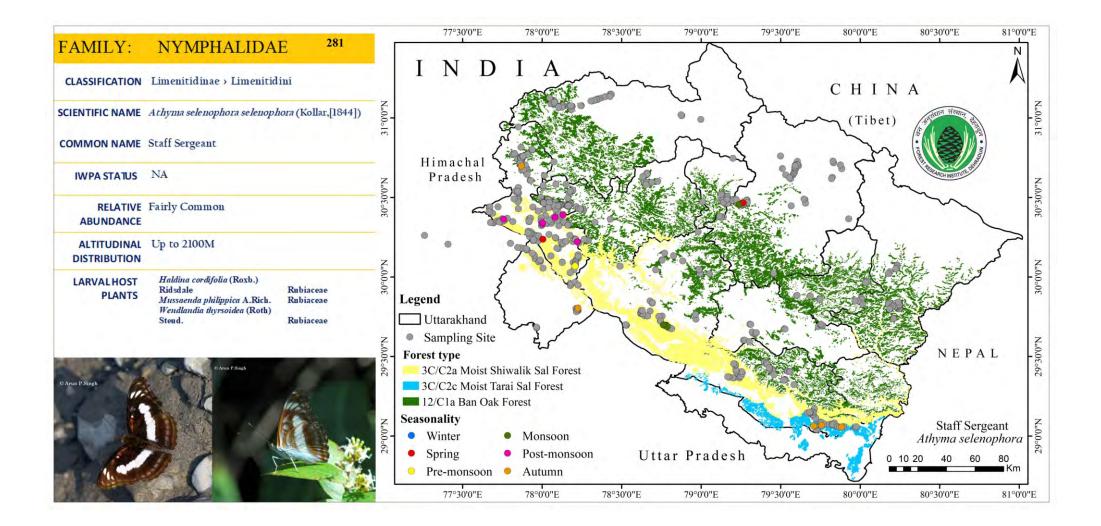


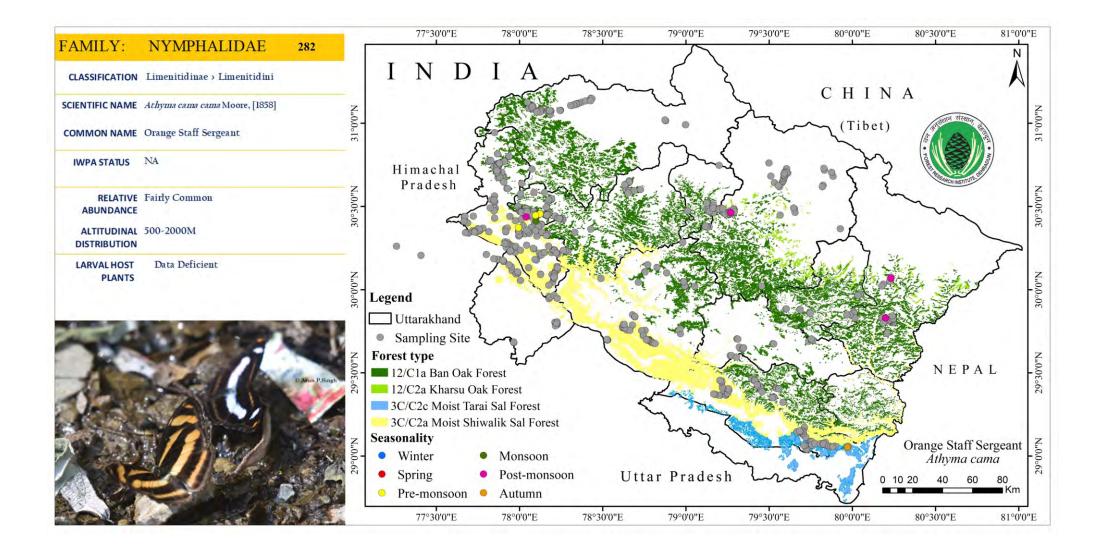


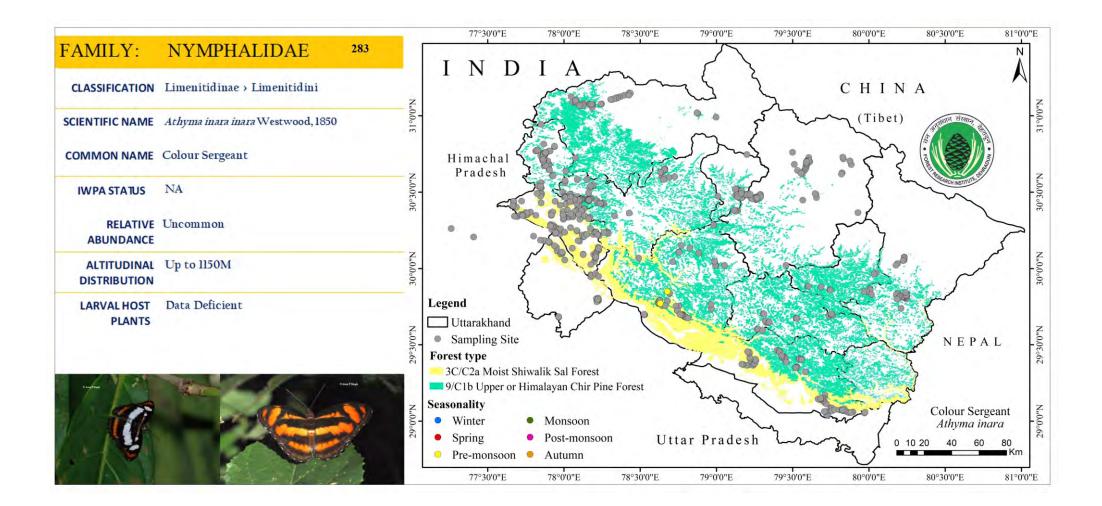


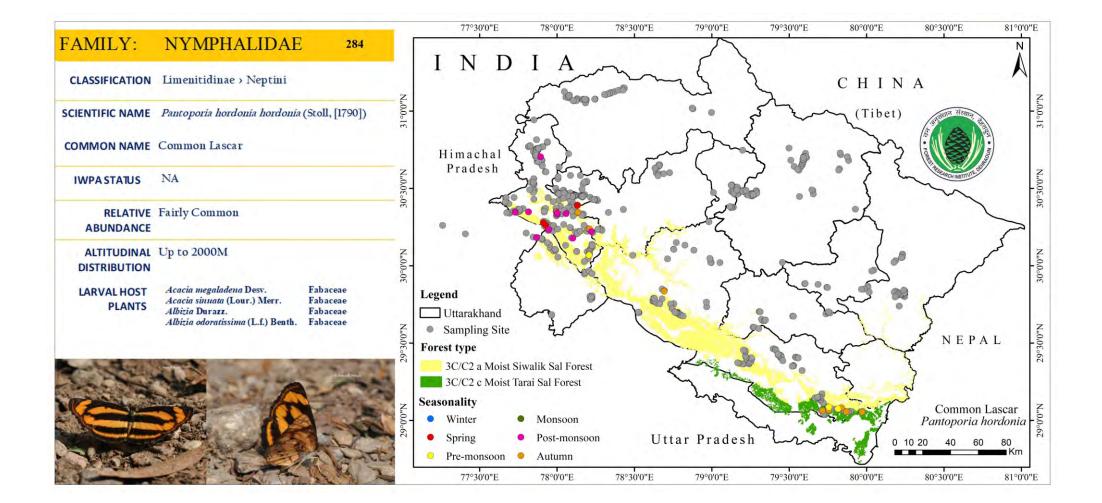


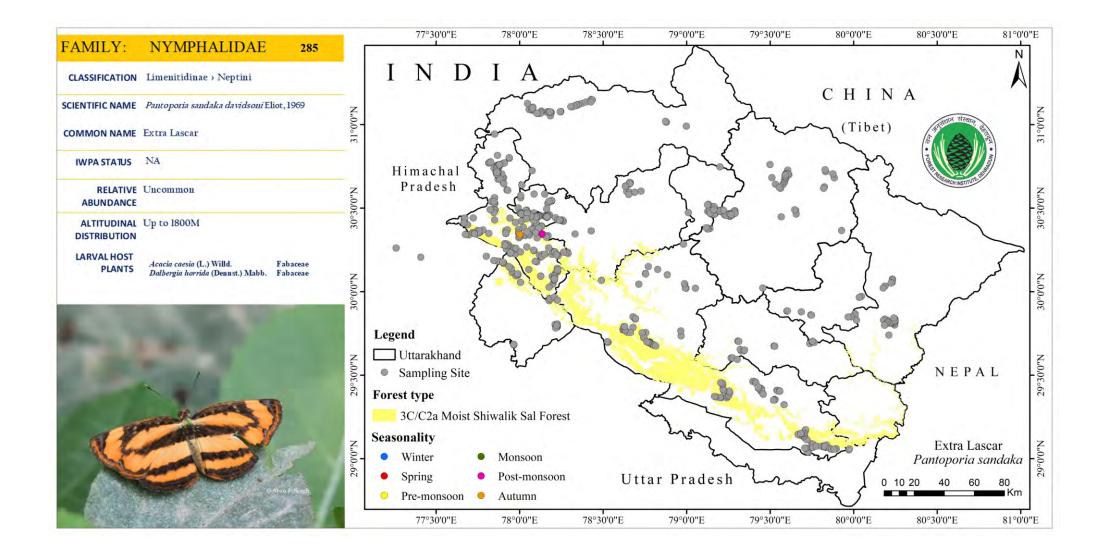


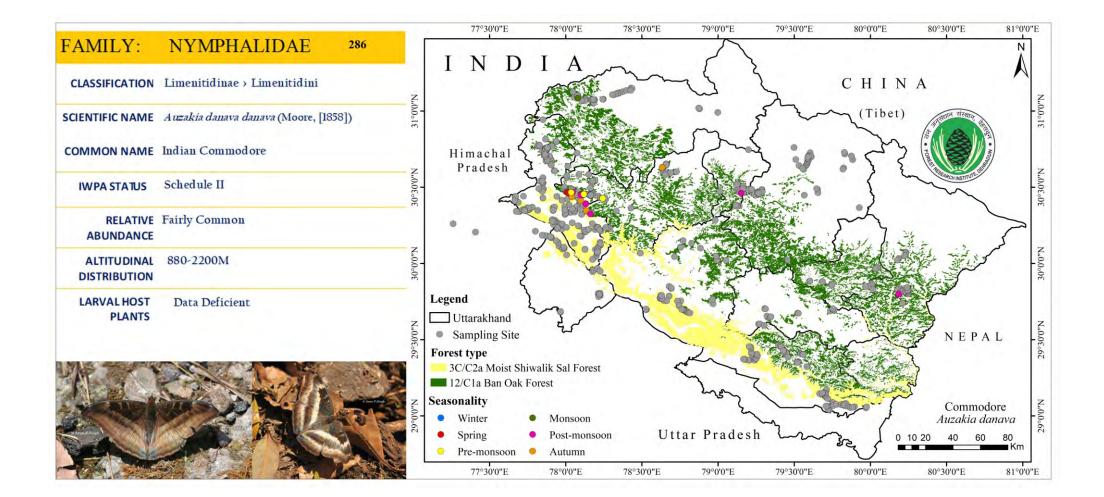


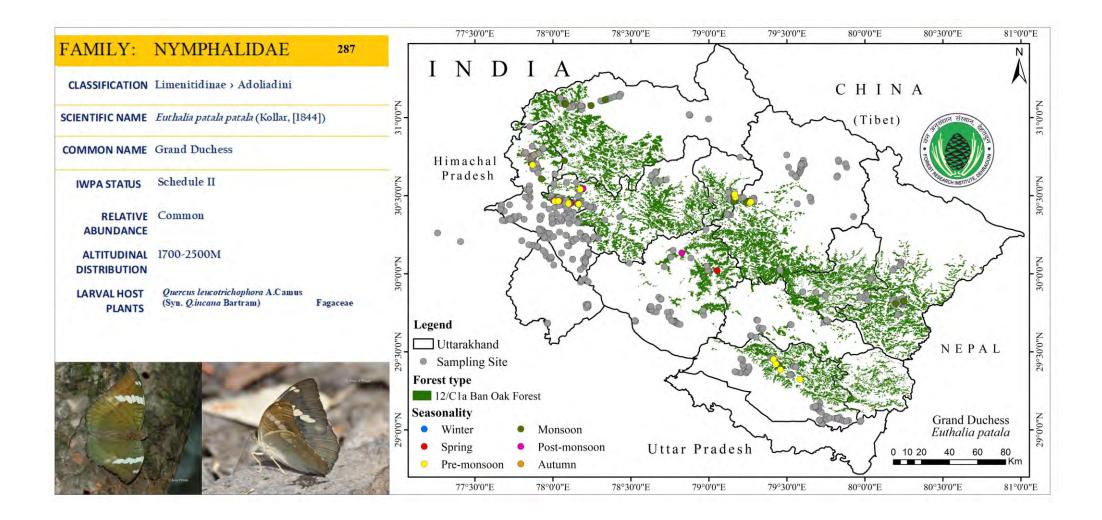


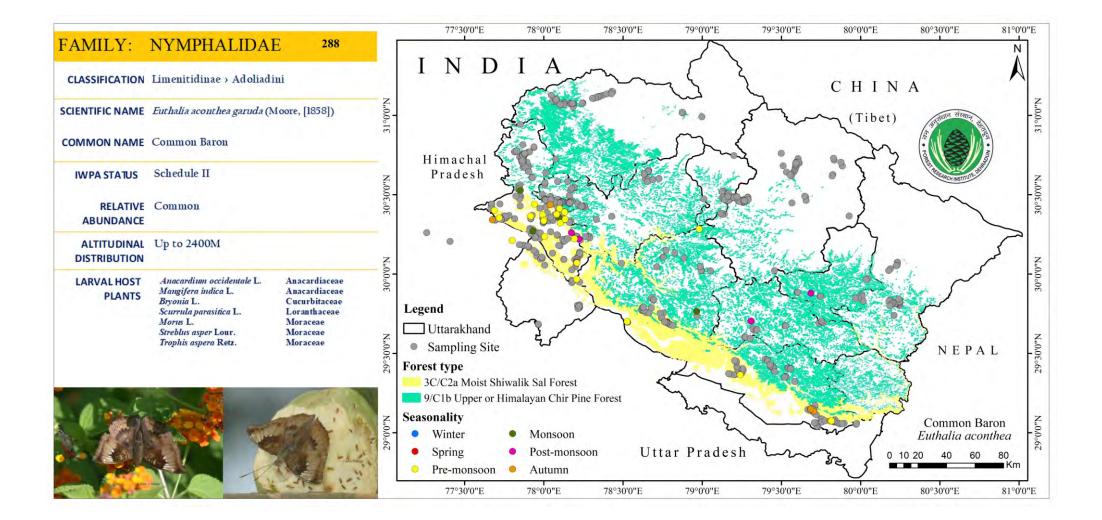


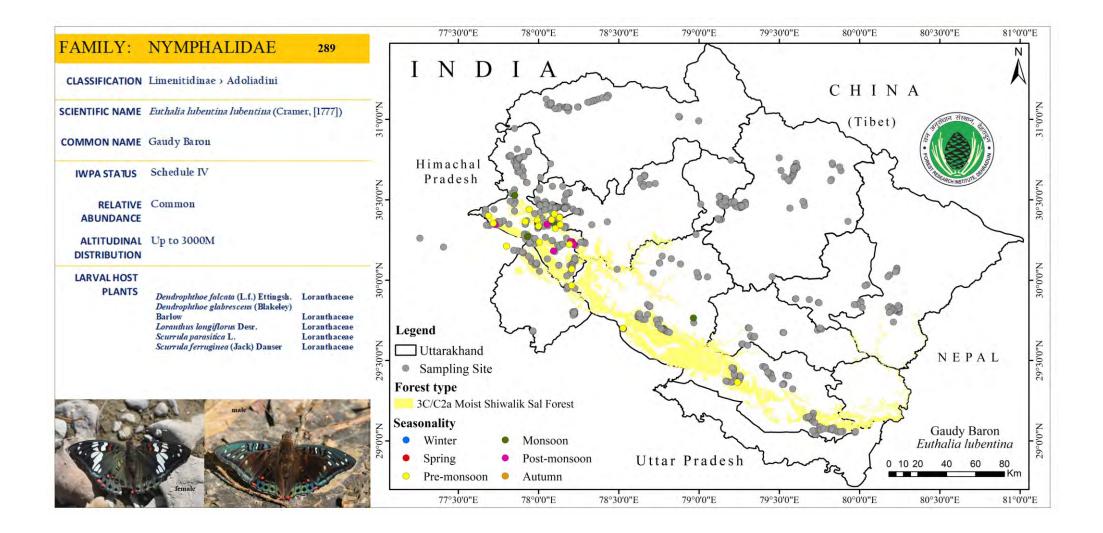


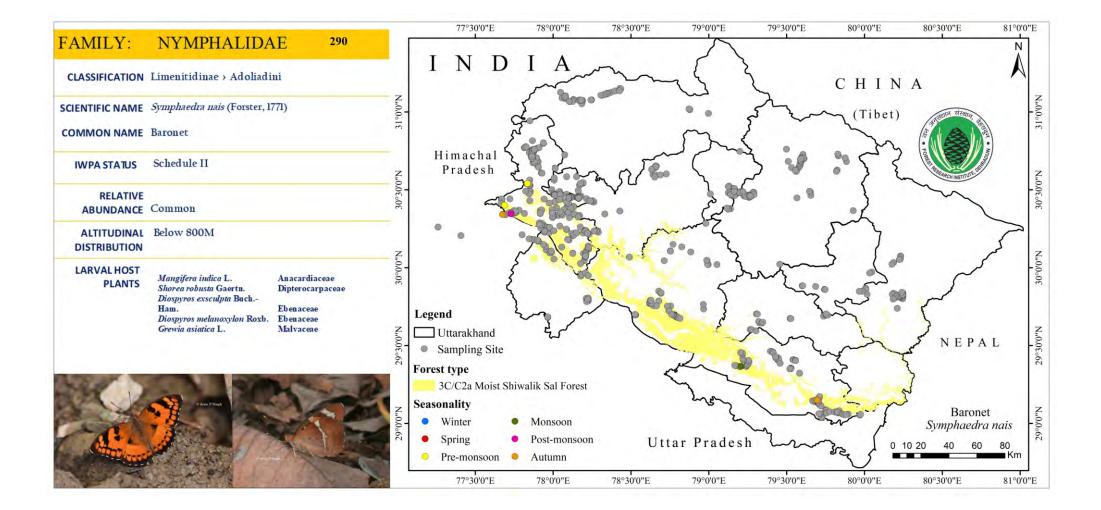


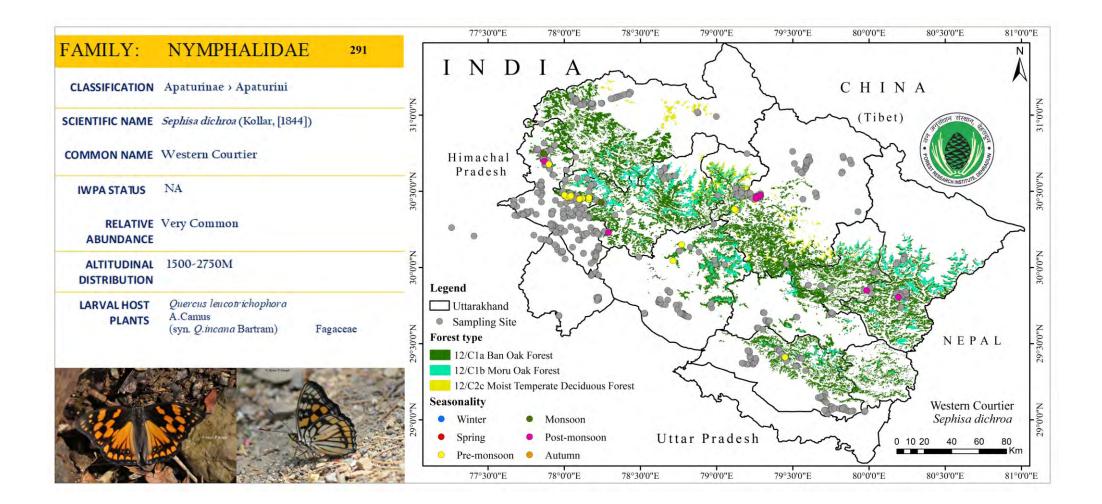


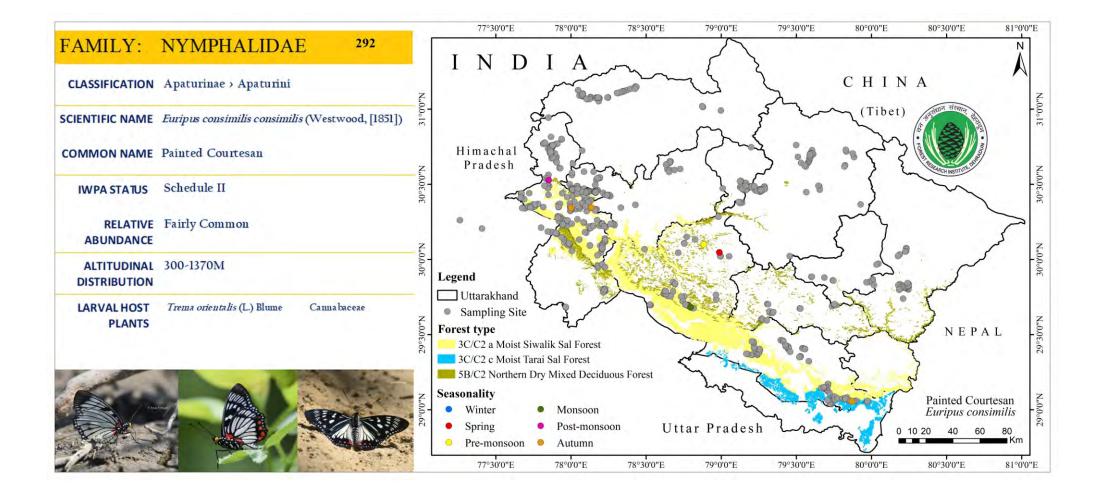


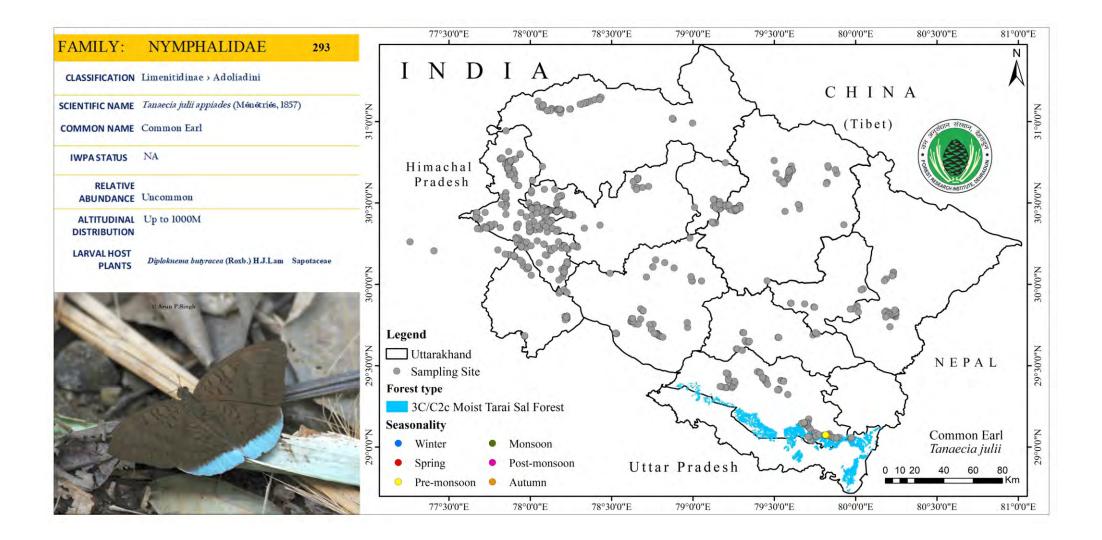


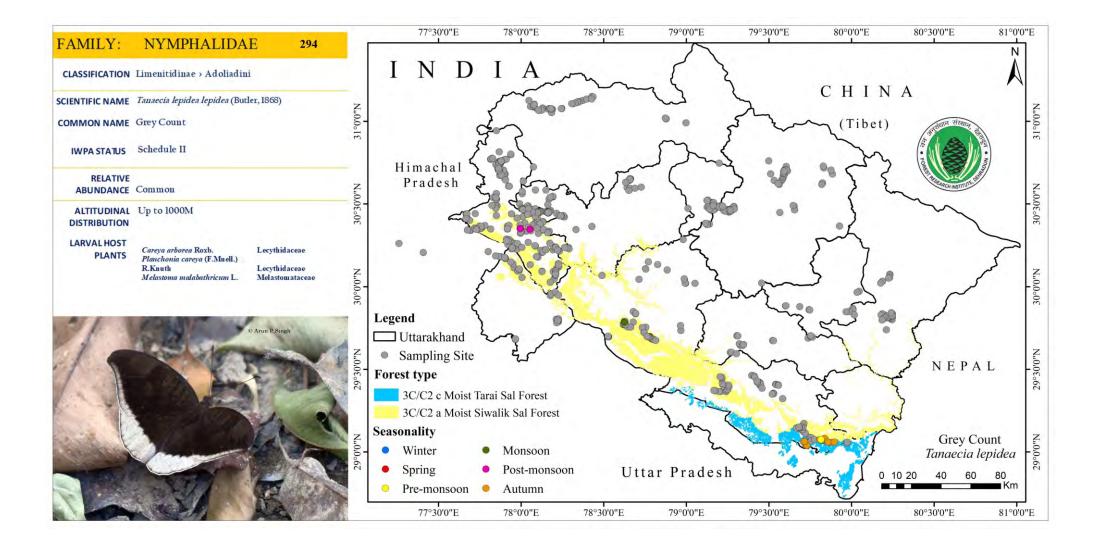


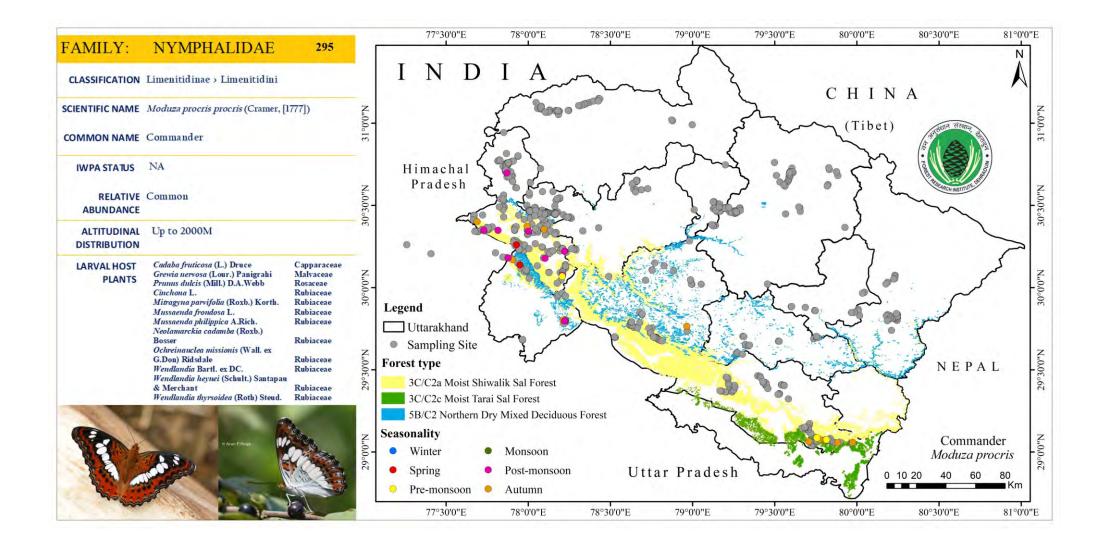


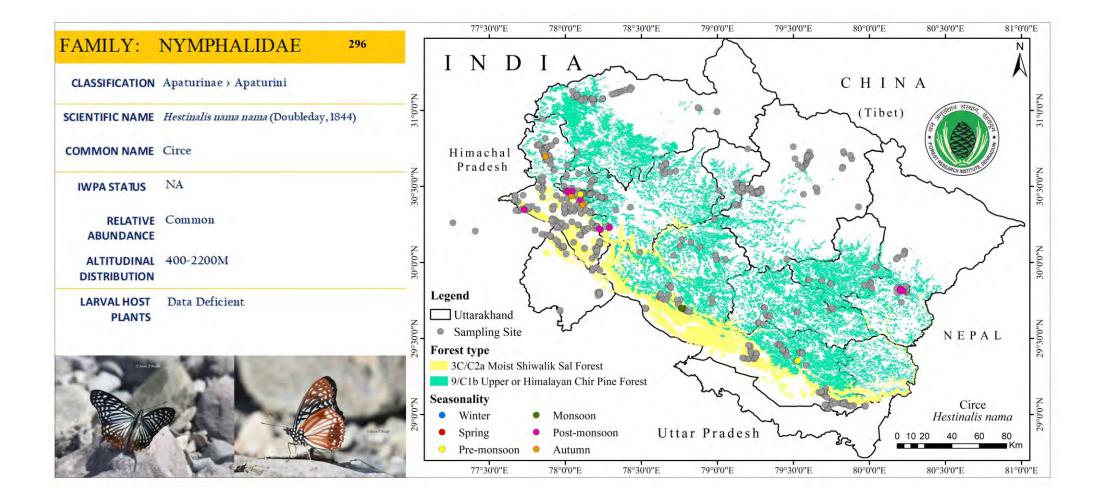


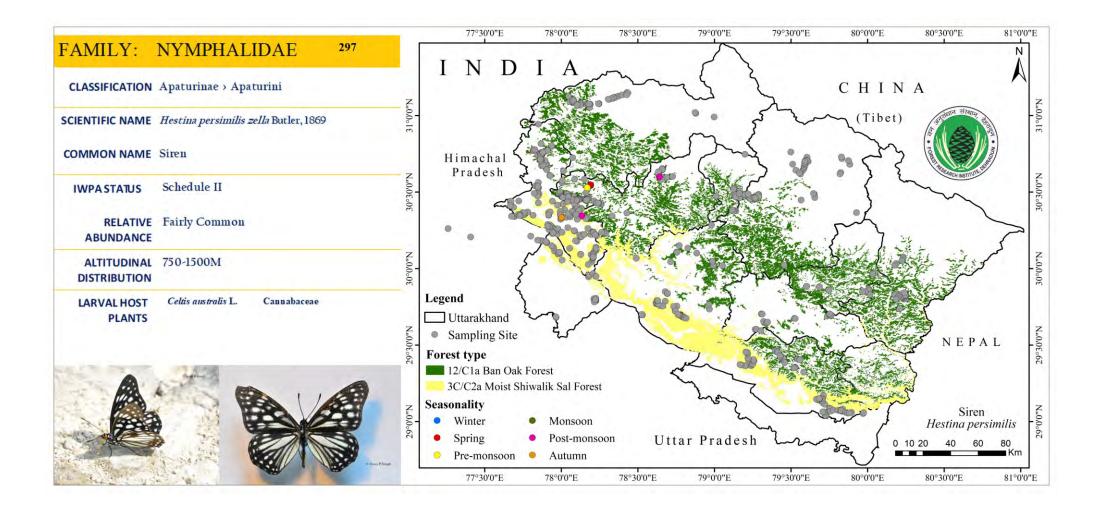


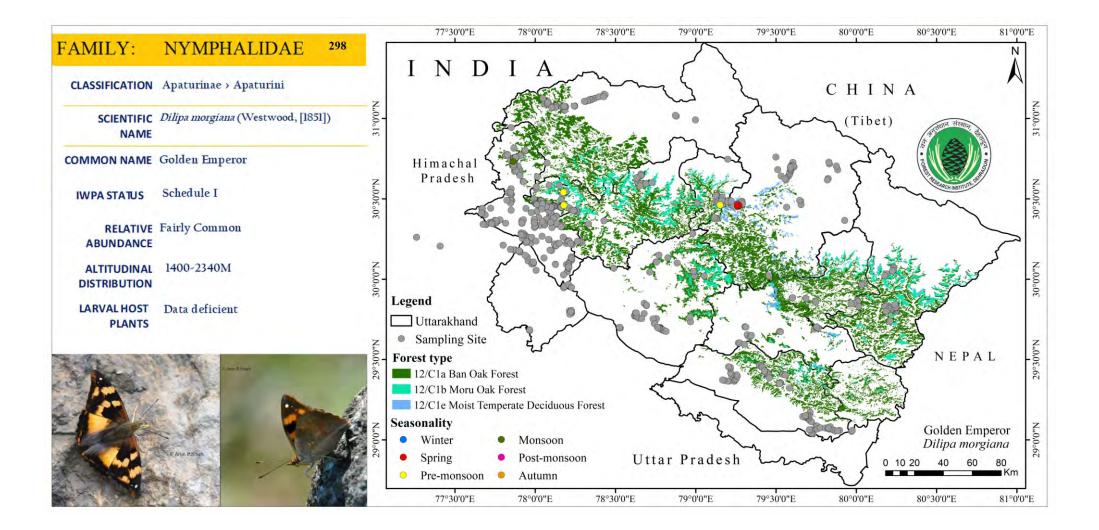


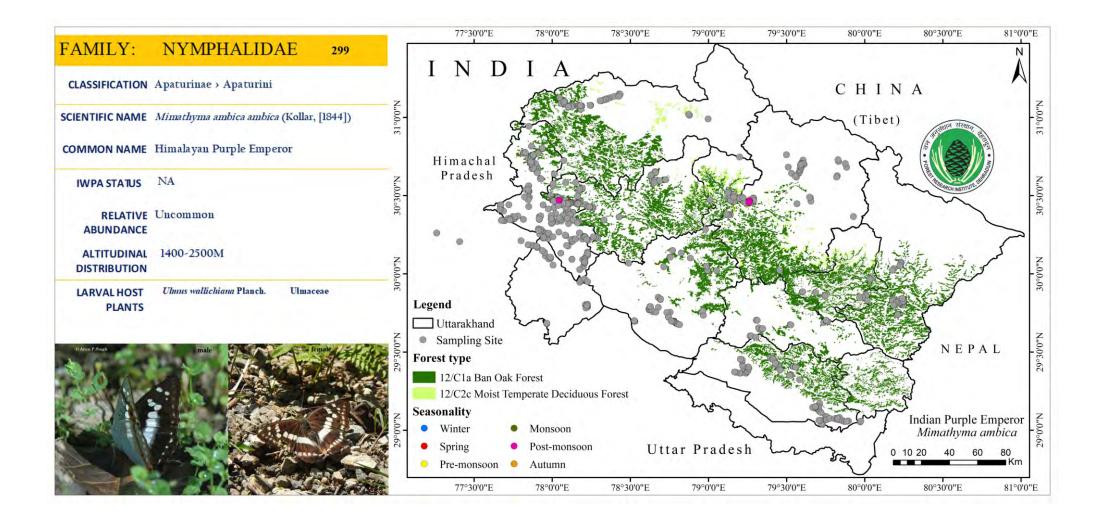


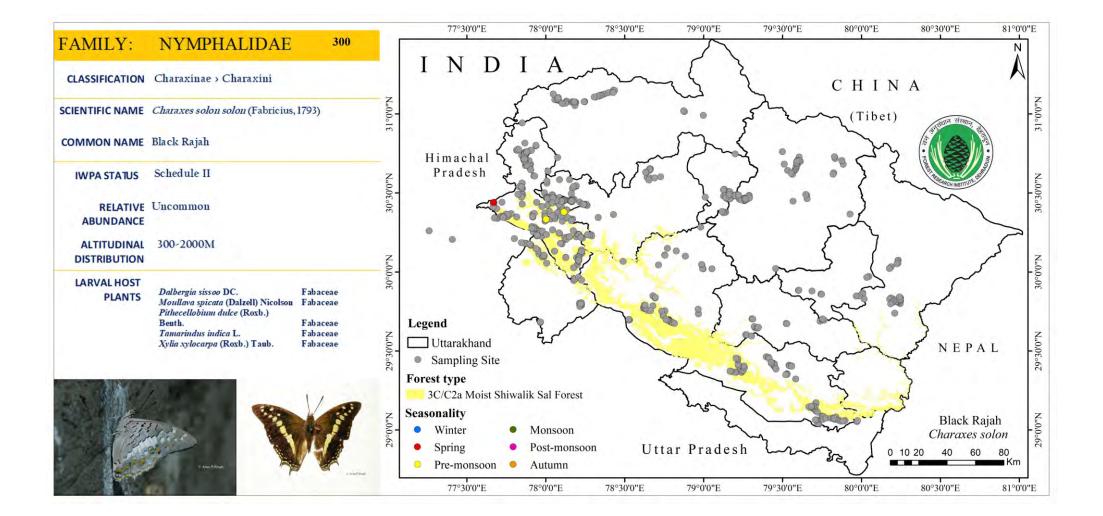


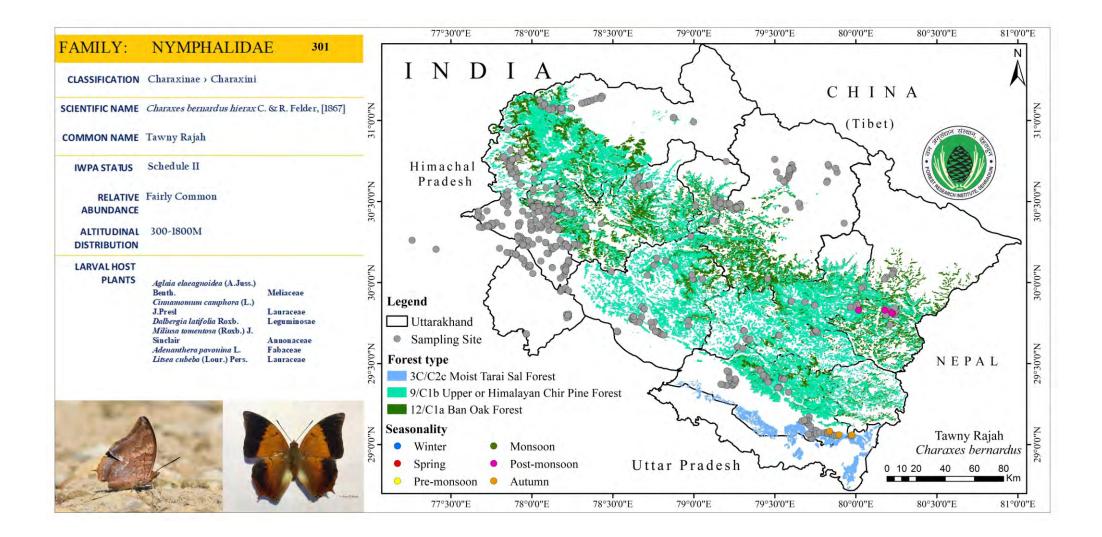


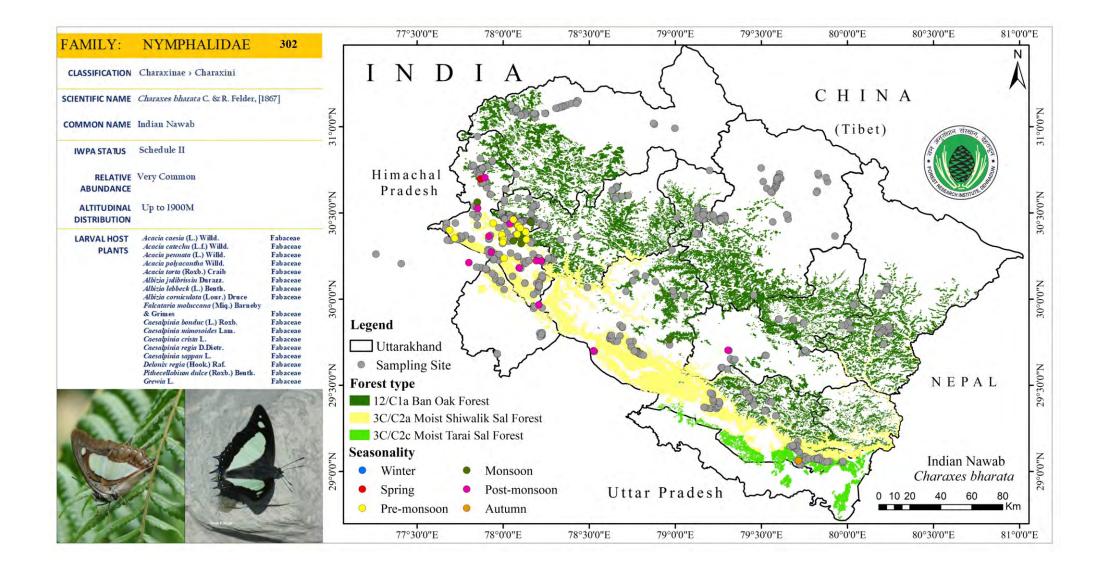


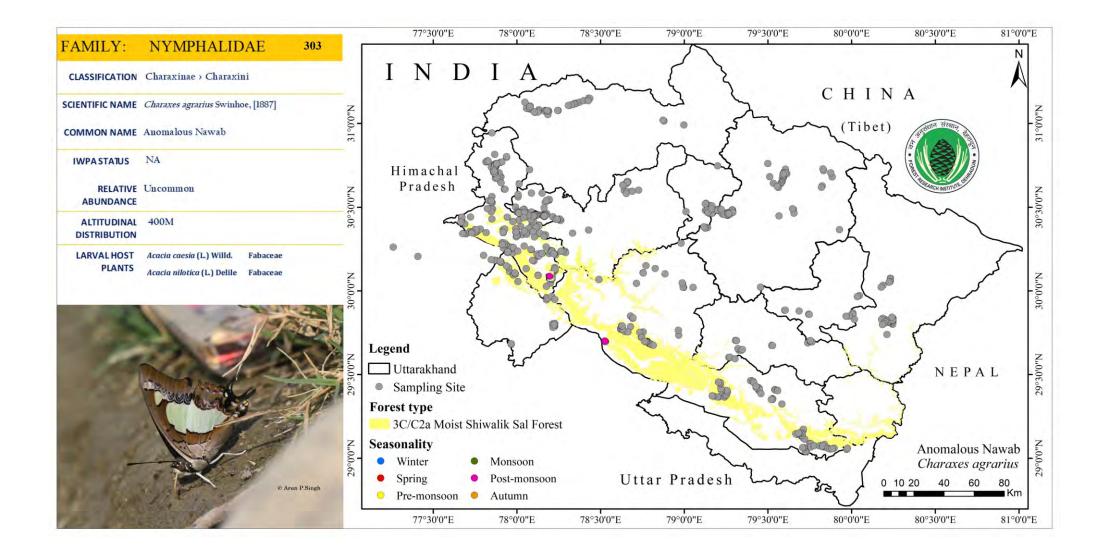


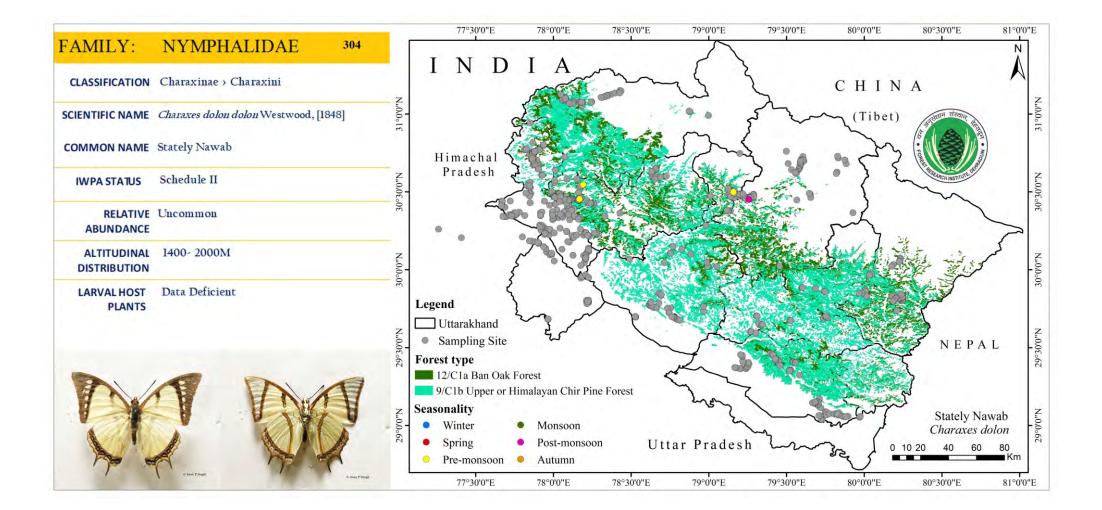








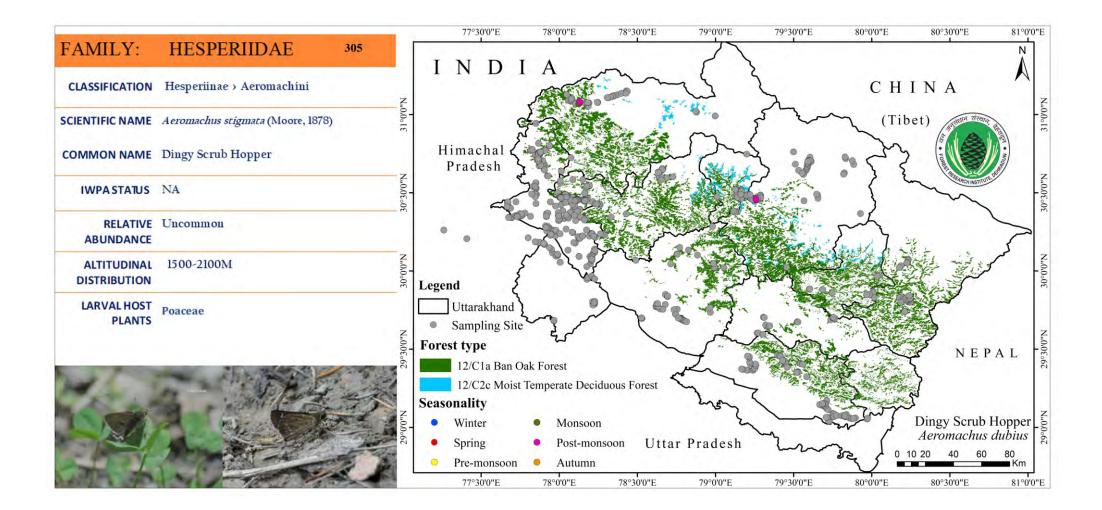


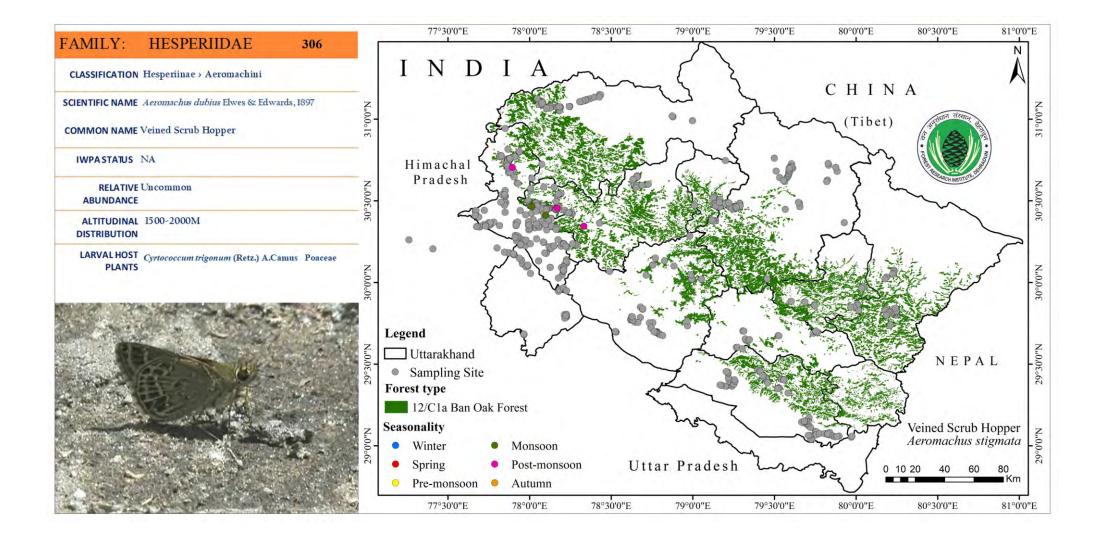


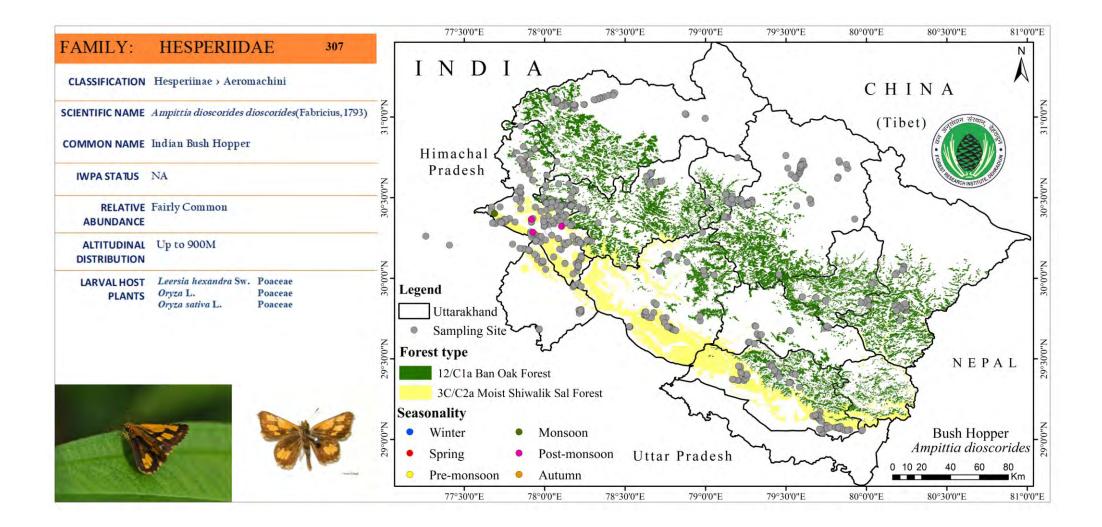
6.HESPERIIDAE (Skippers) (305-365)

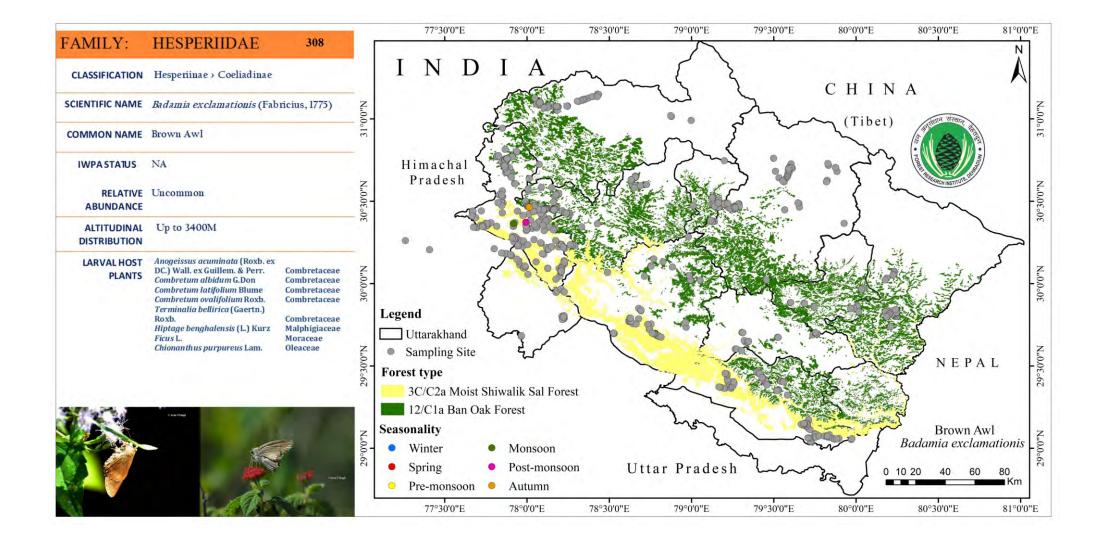


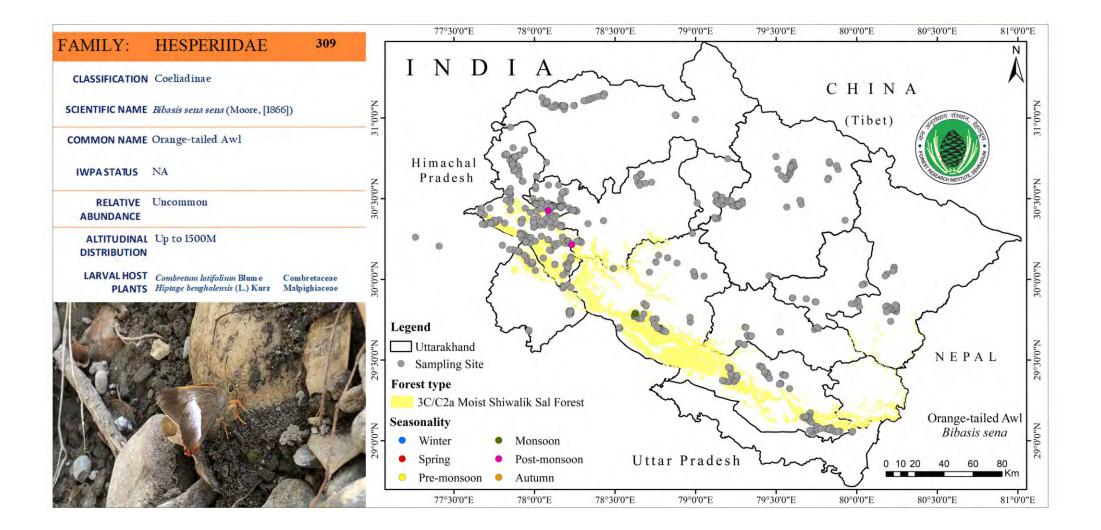
West Himalayan Upper Oak-Fir Forest

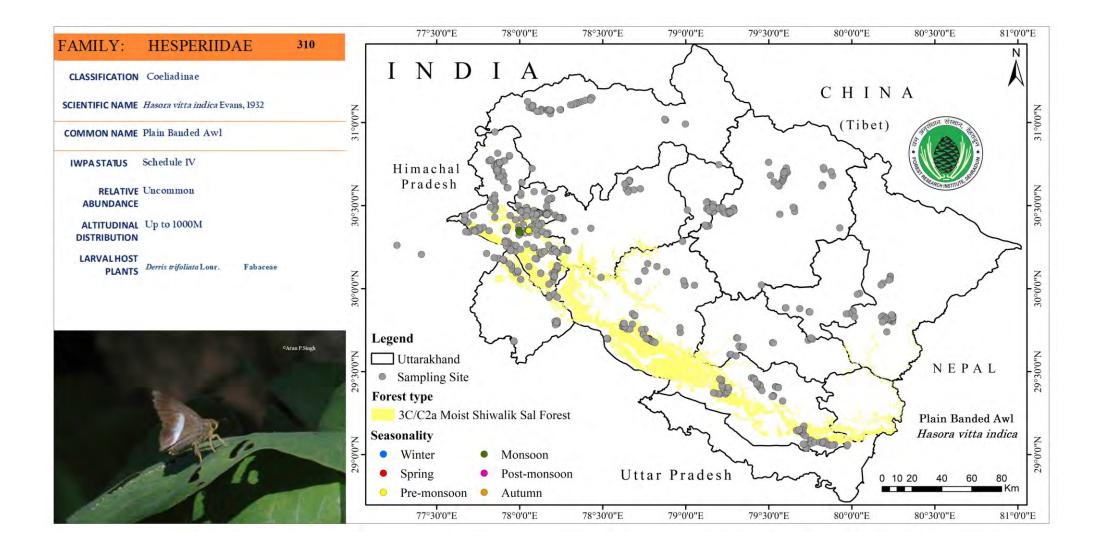


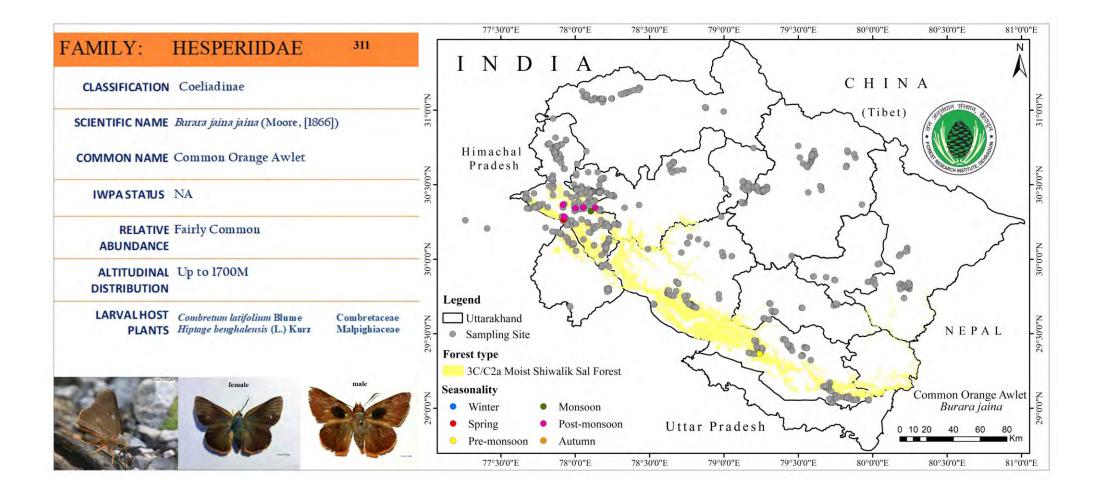


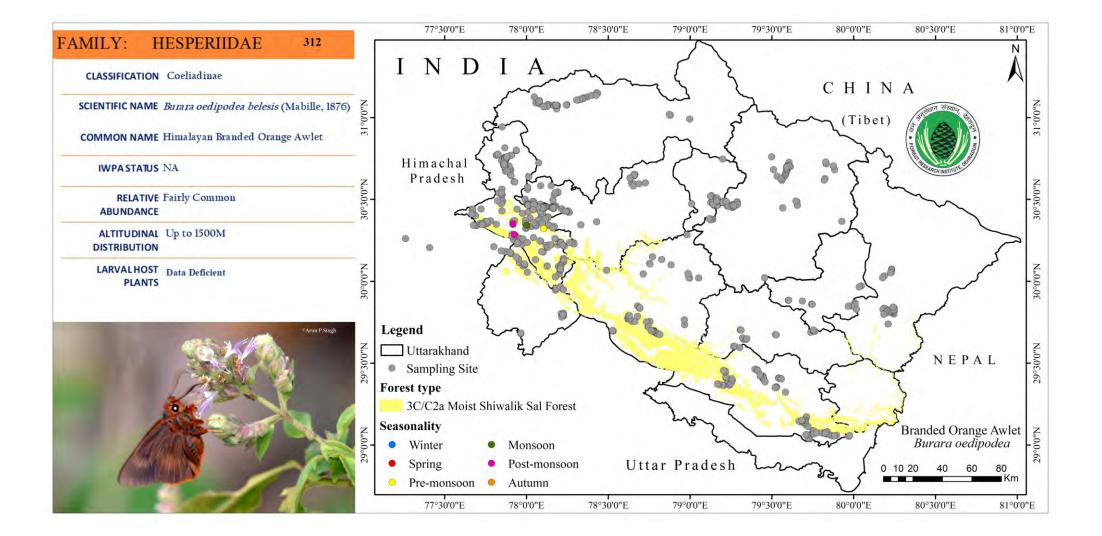


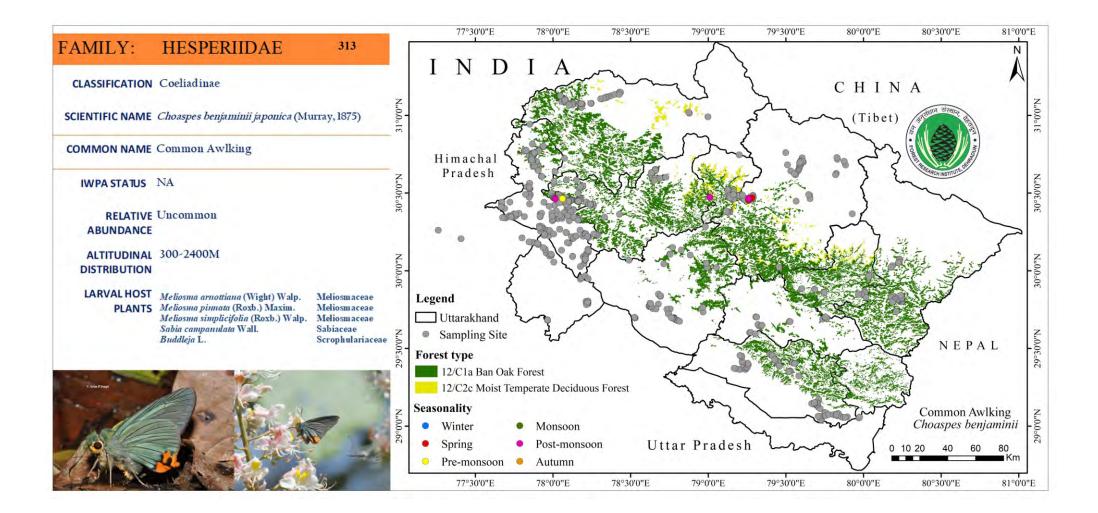


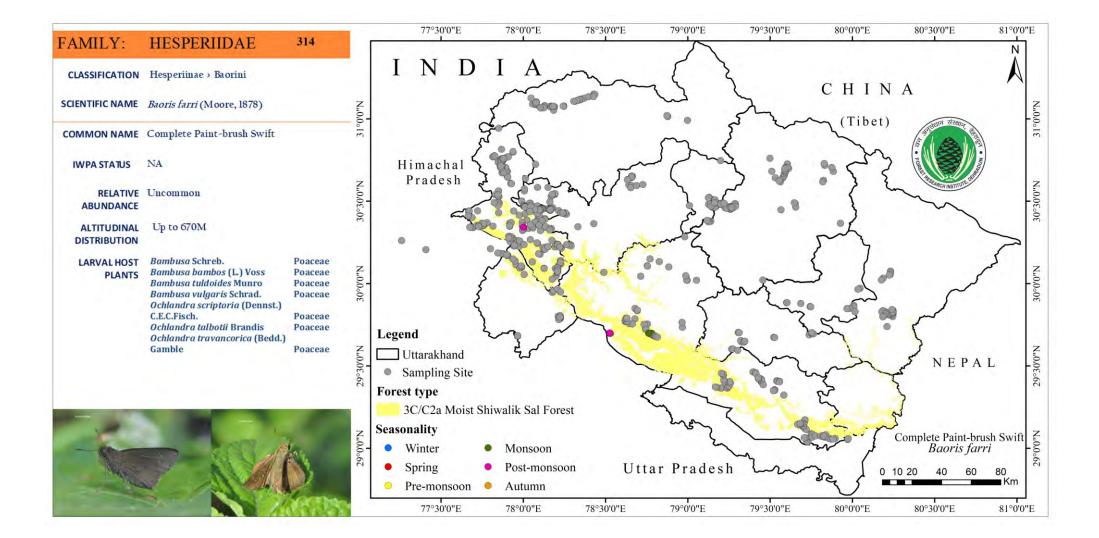


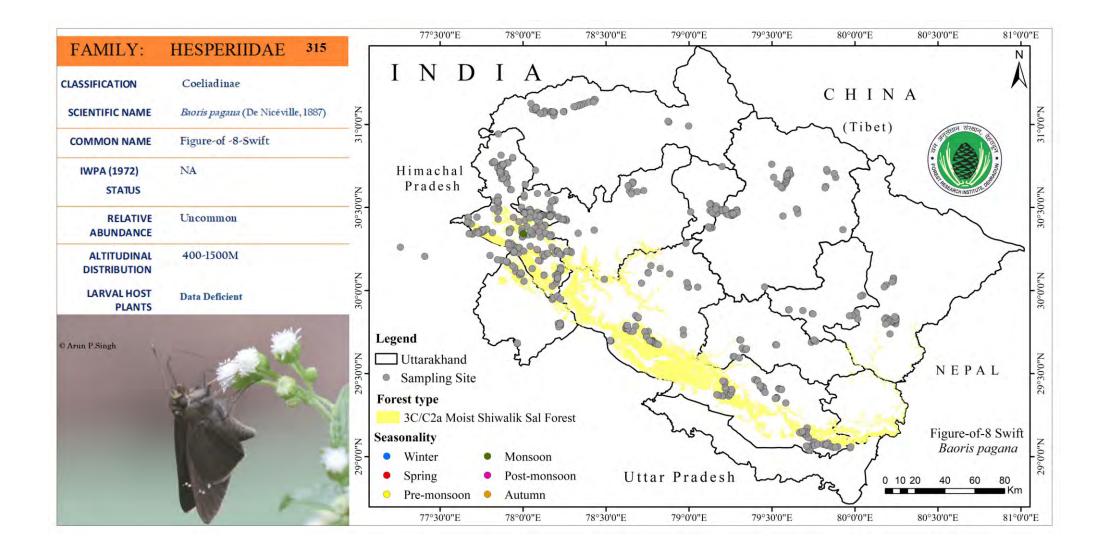


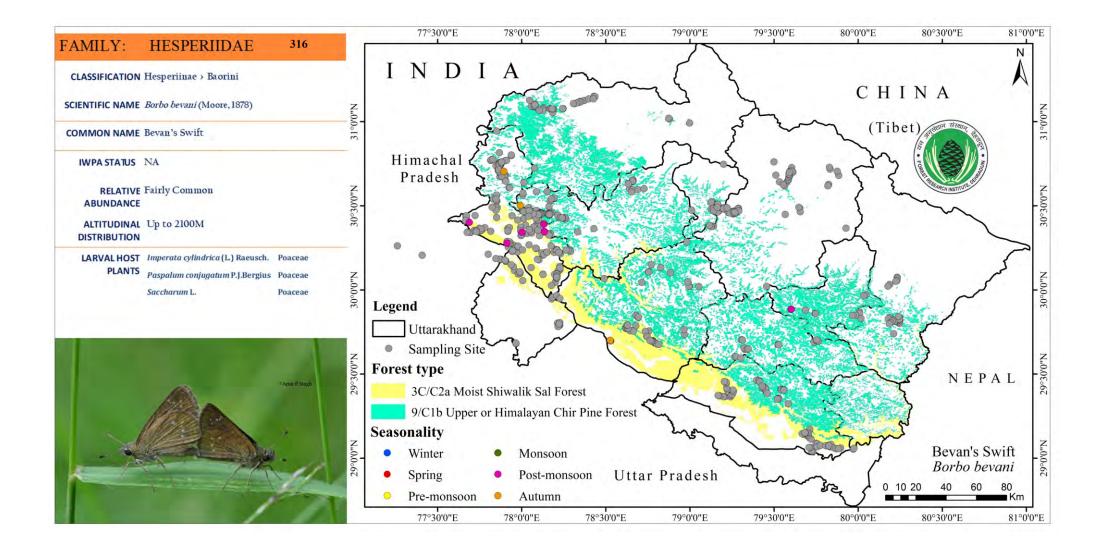


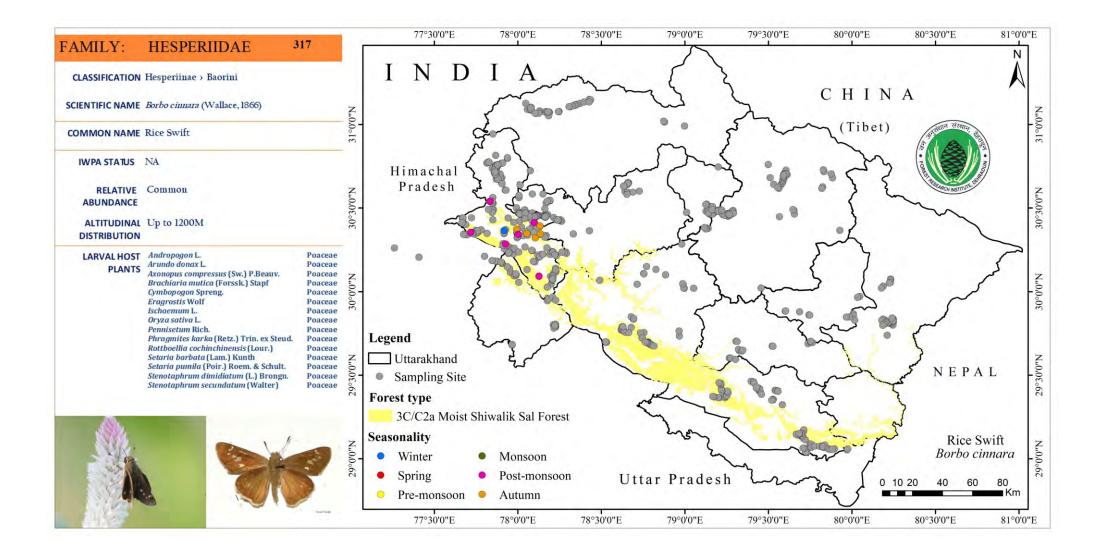


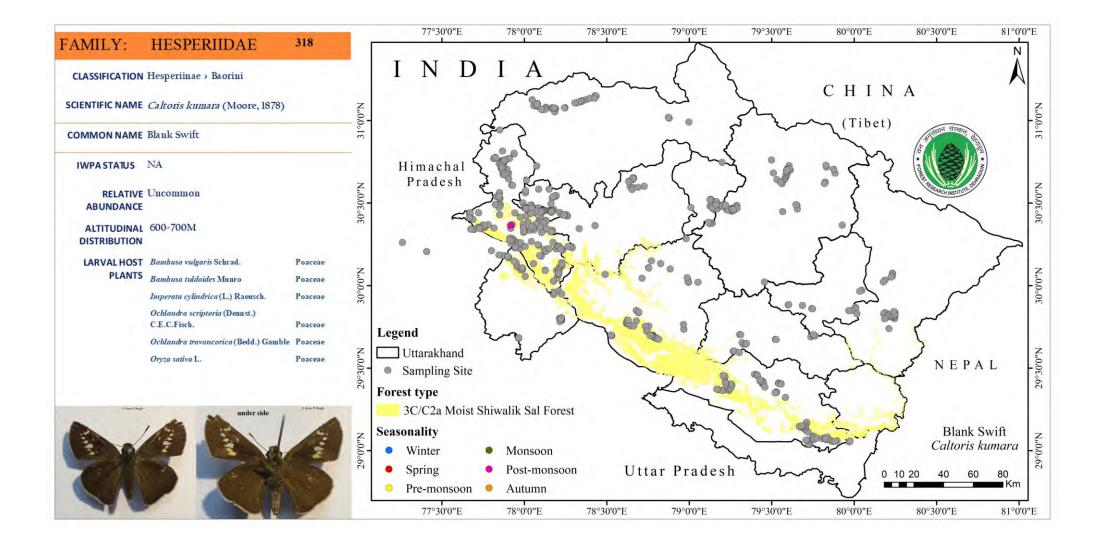


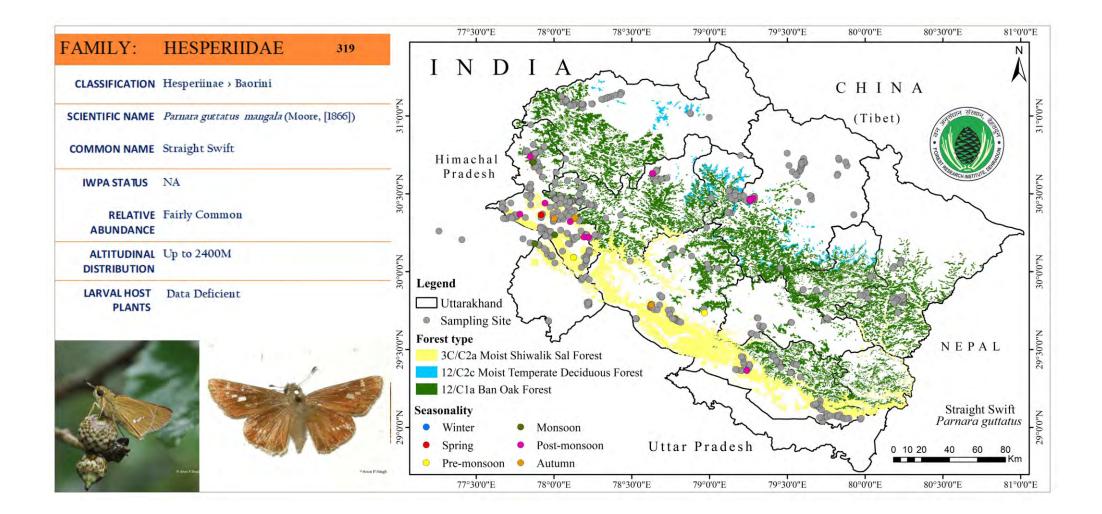


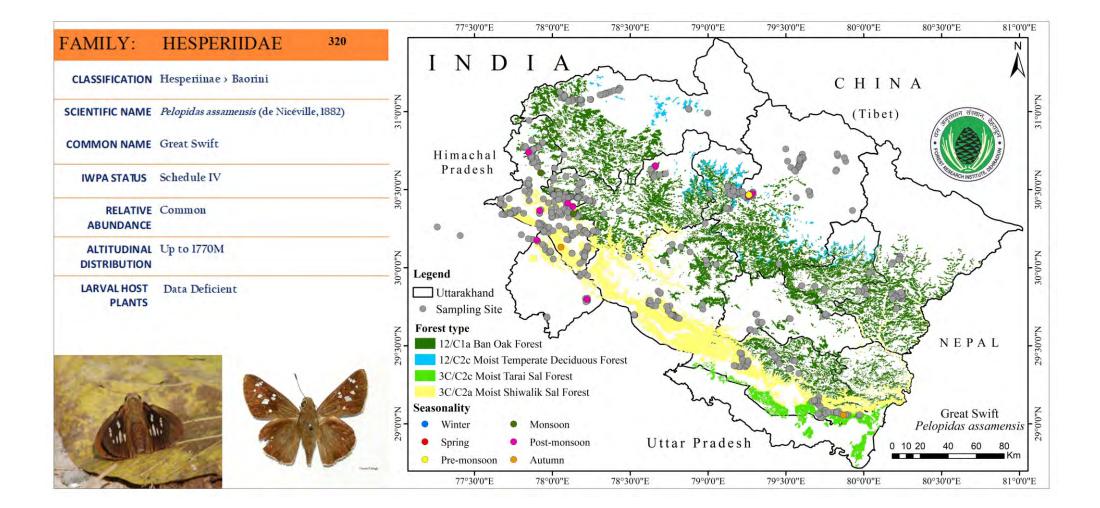


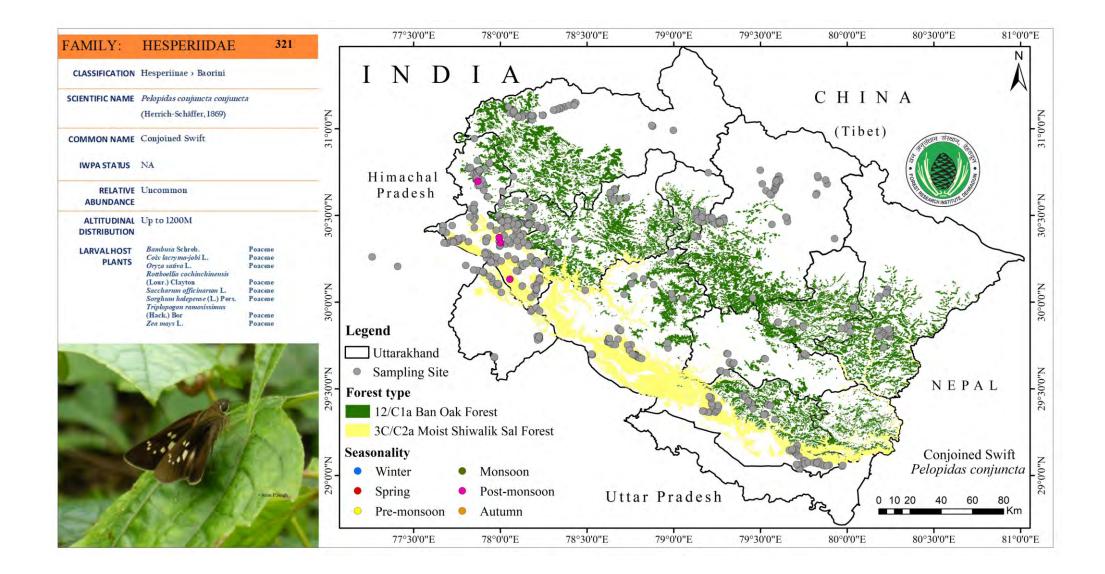


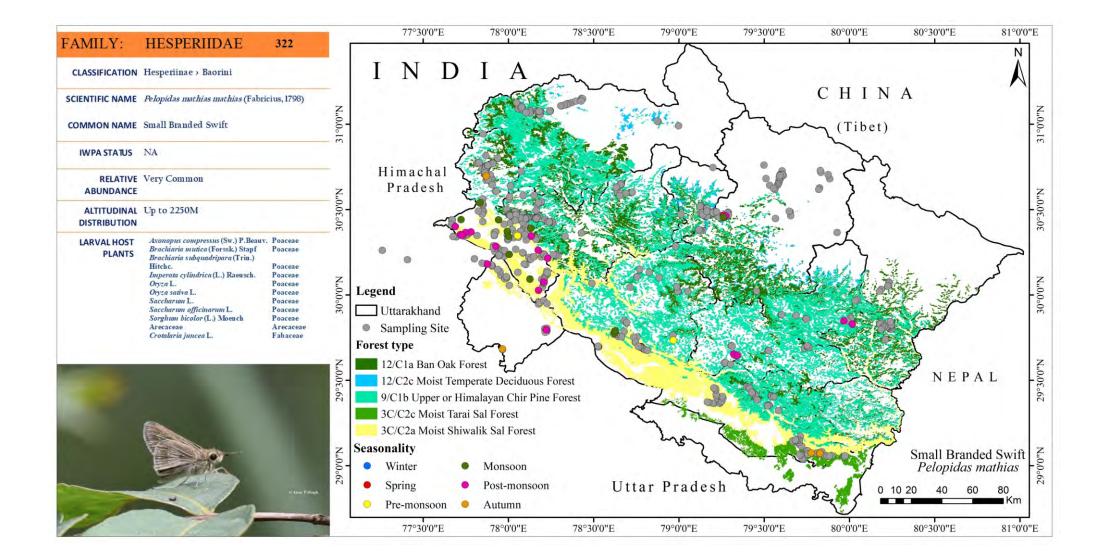


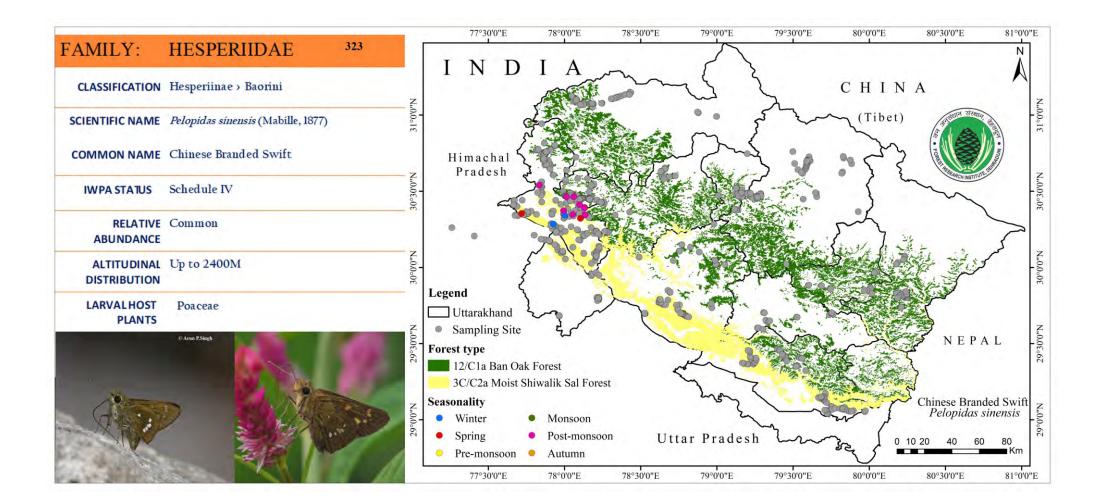


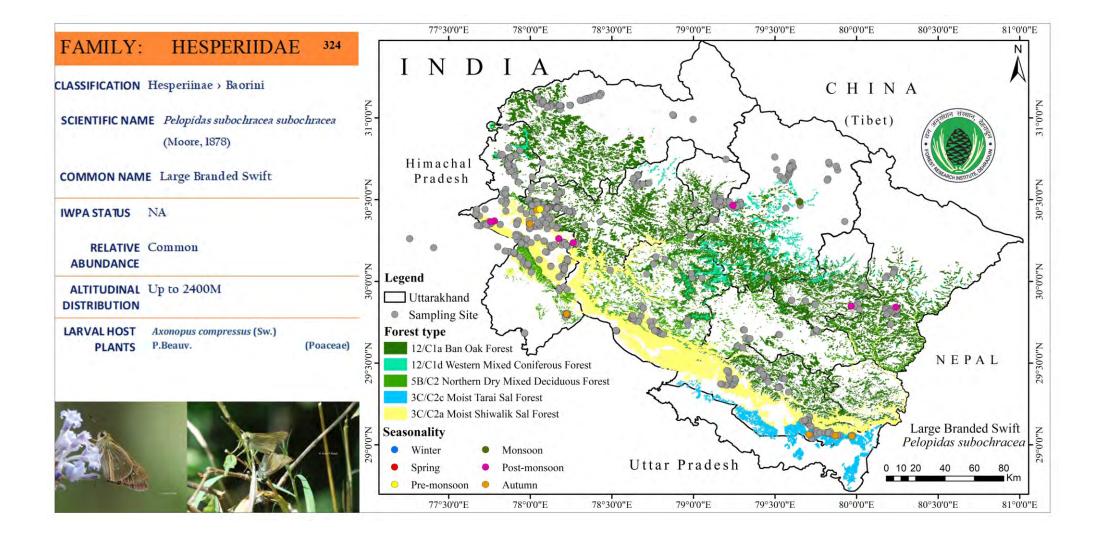


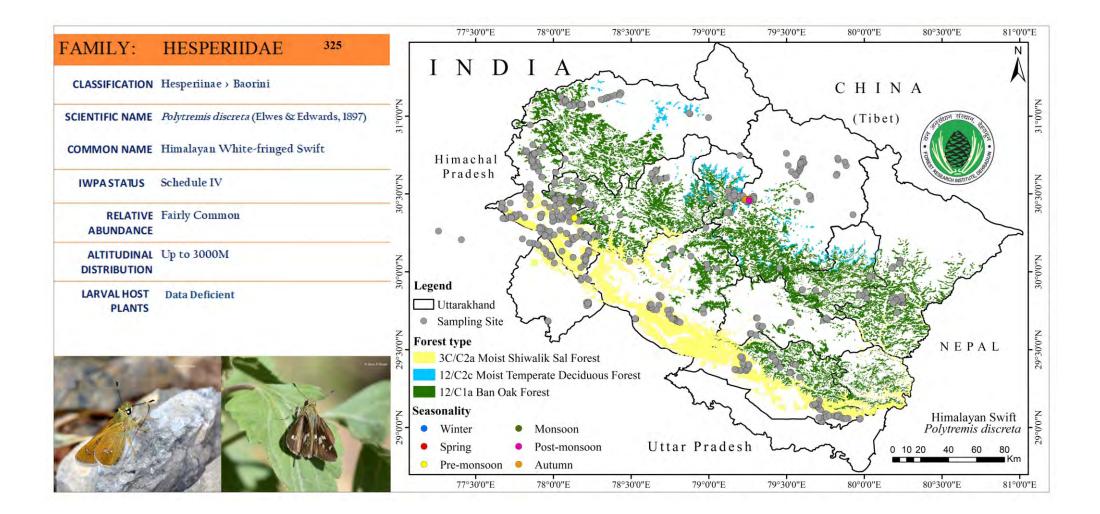


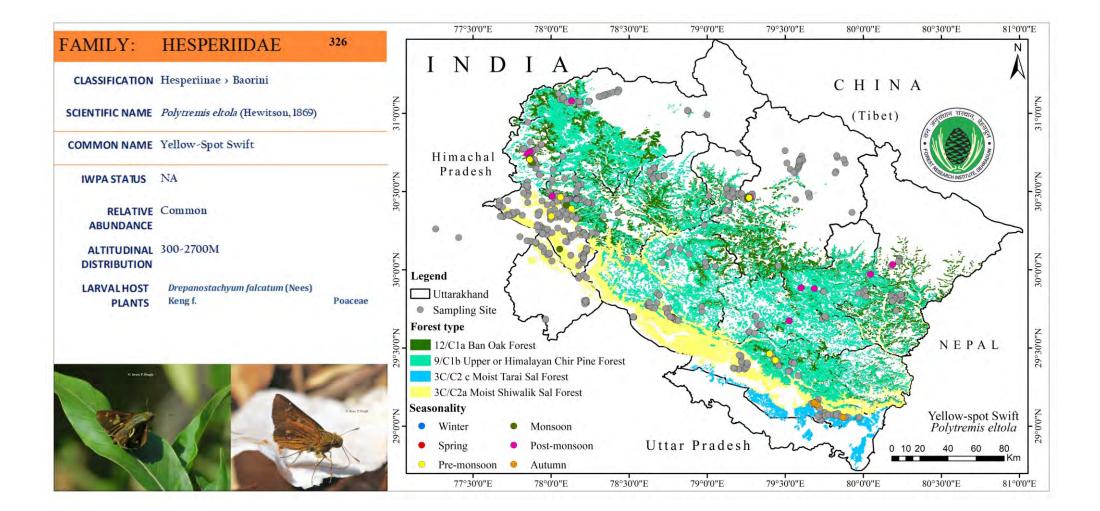


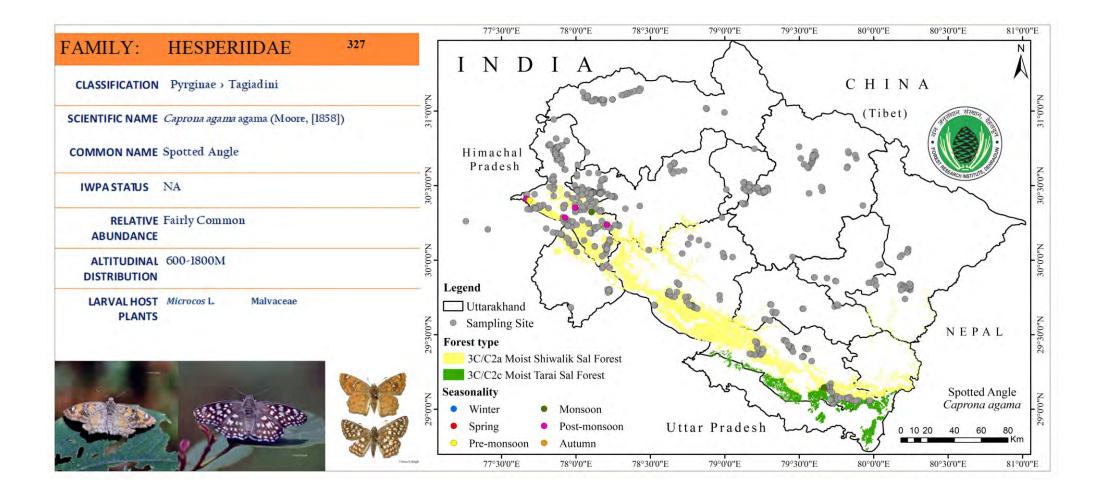


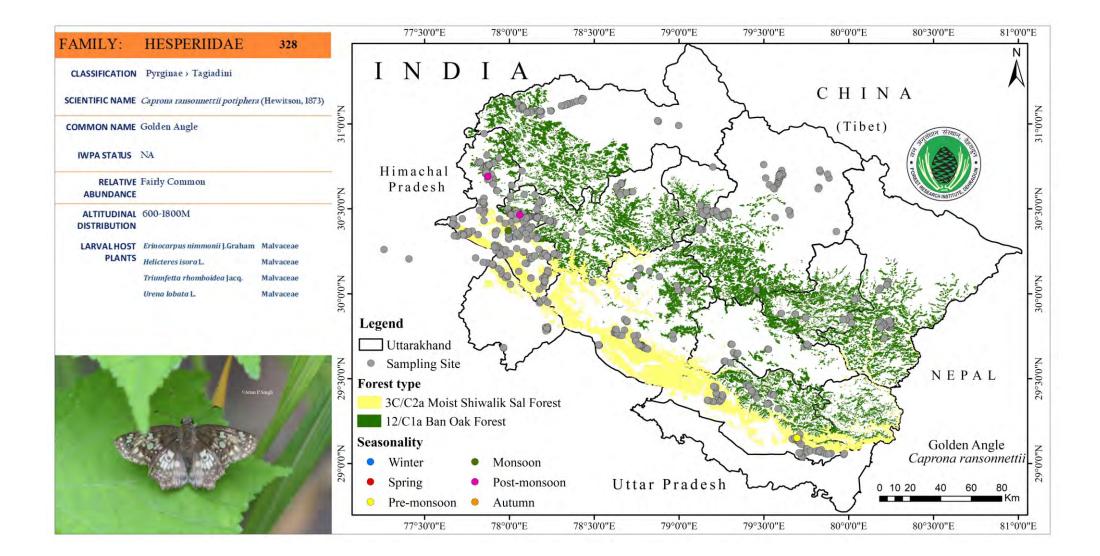


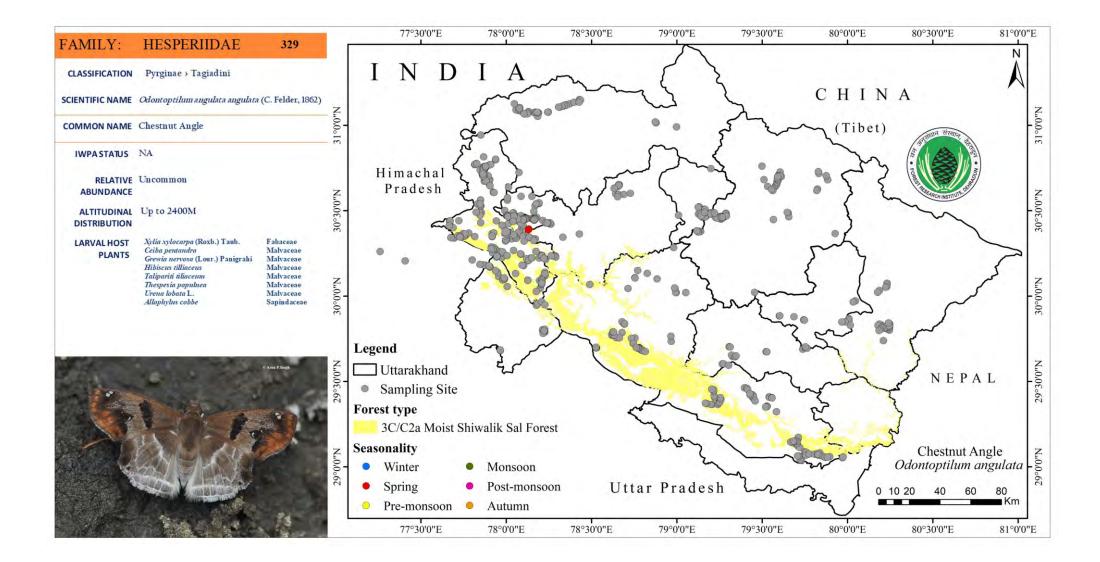


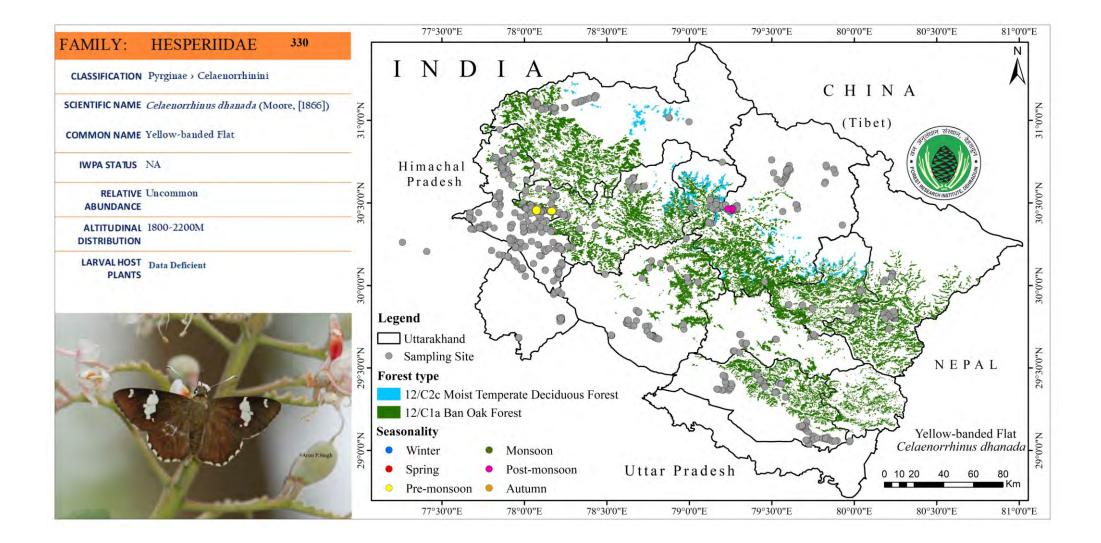


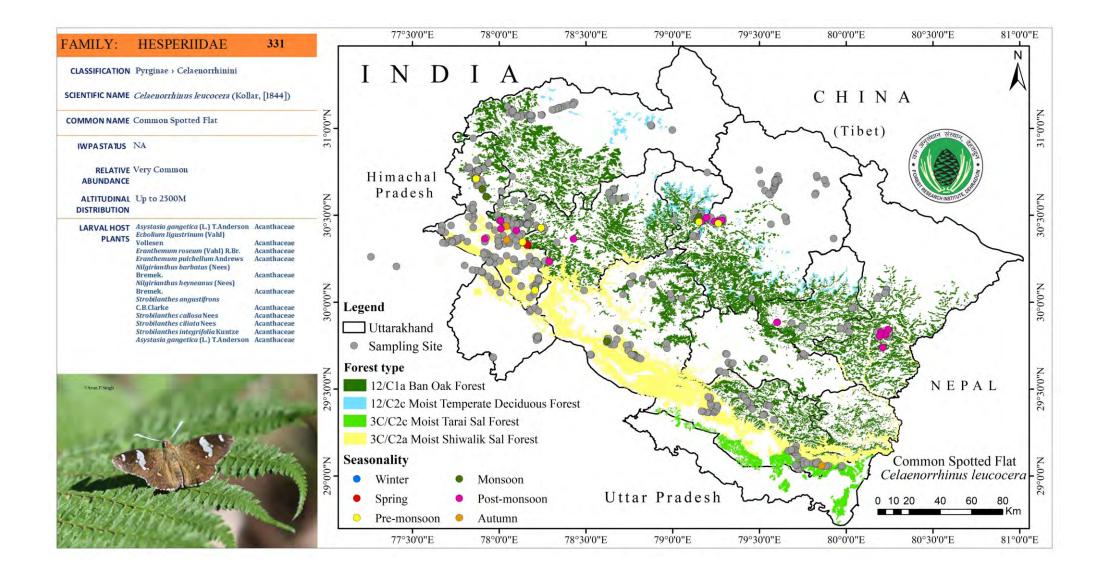


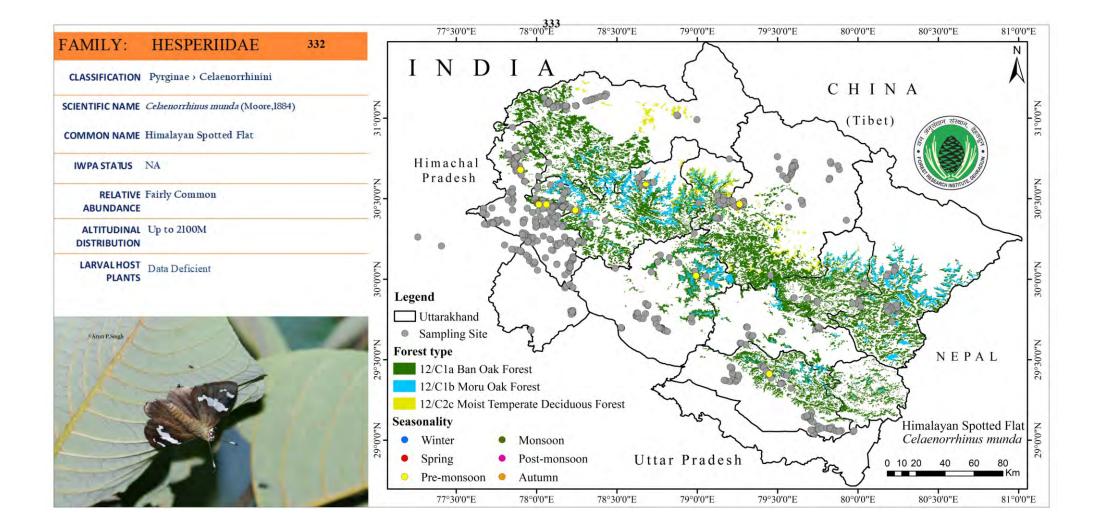


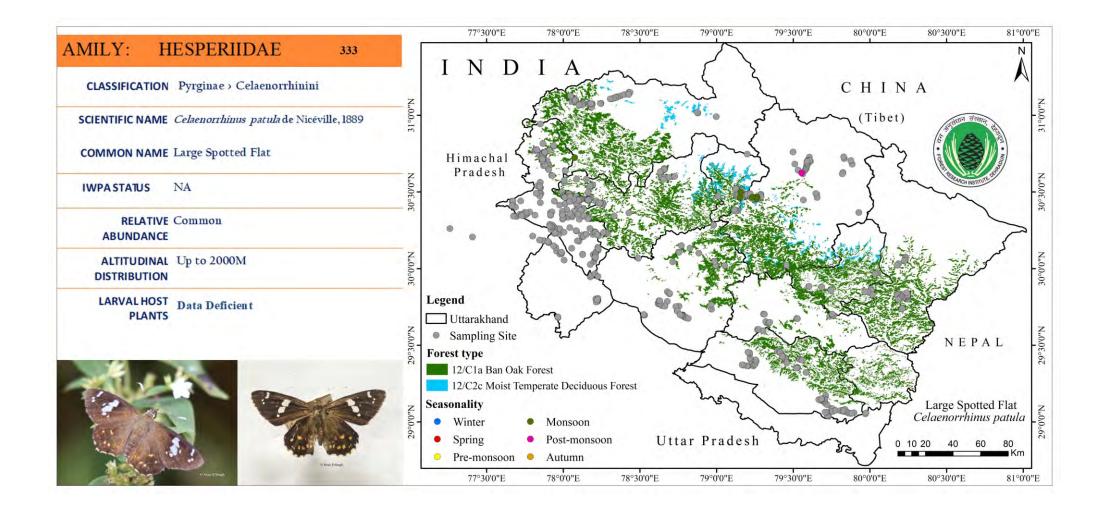


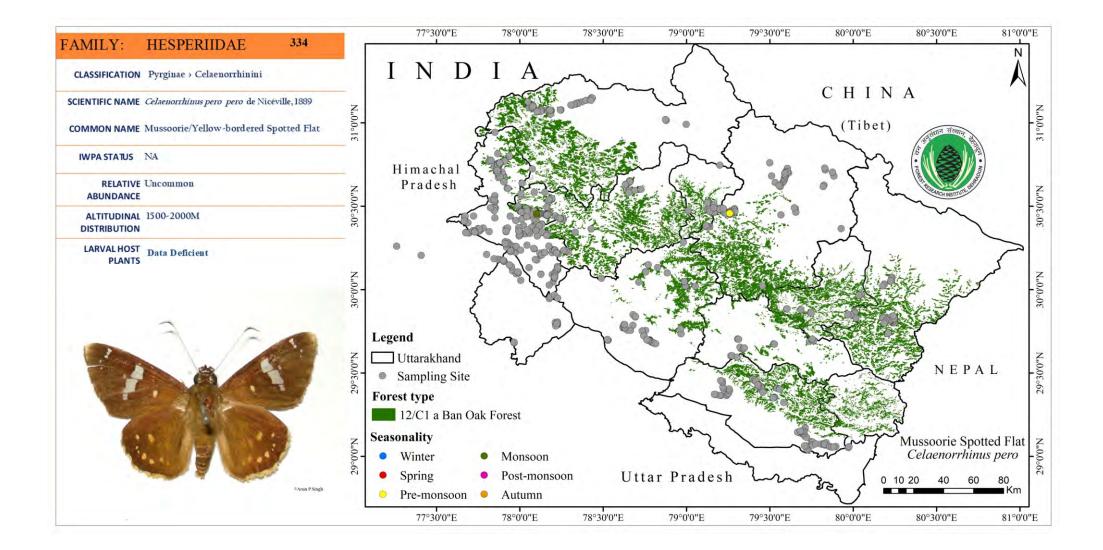


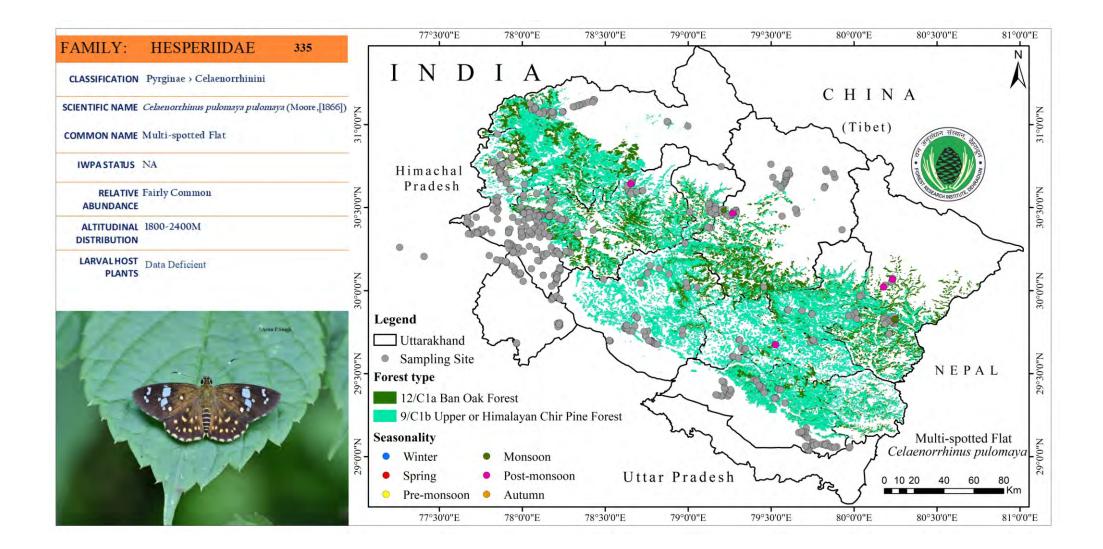


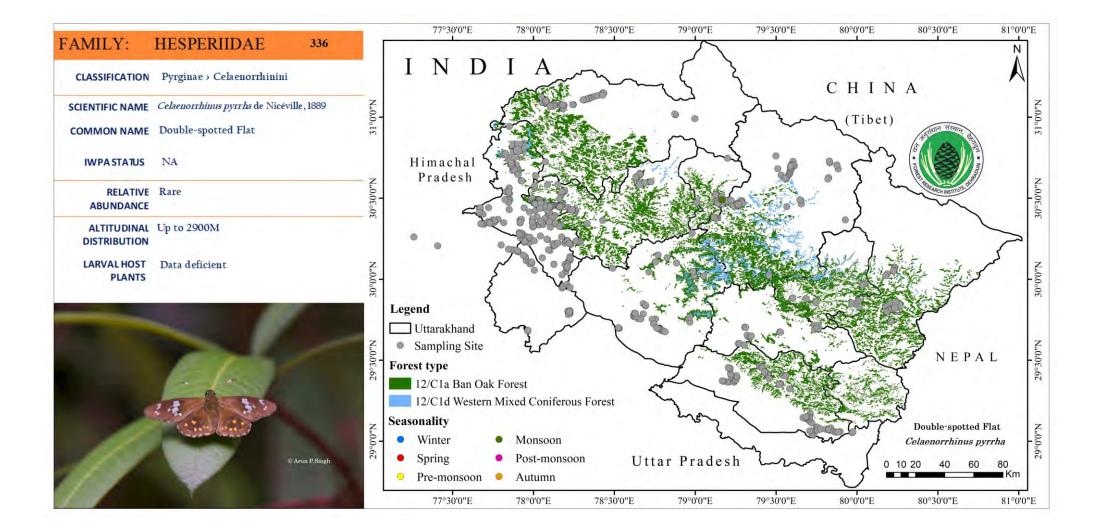


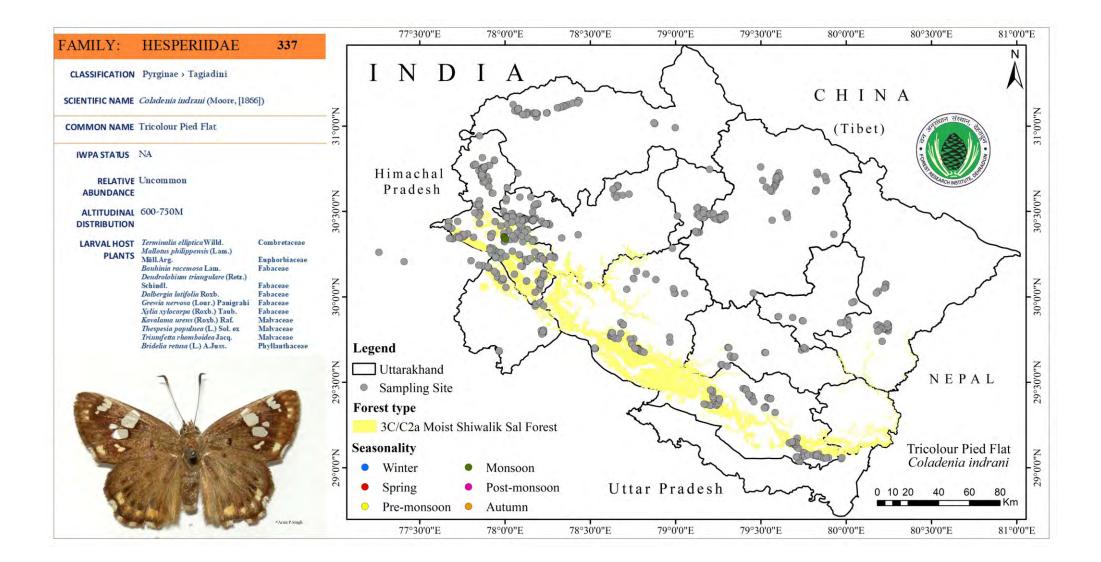


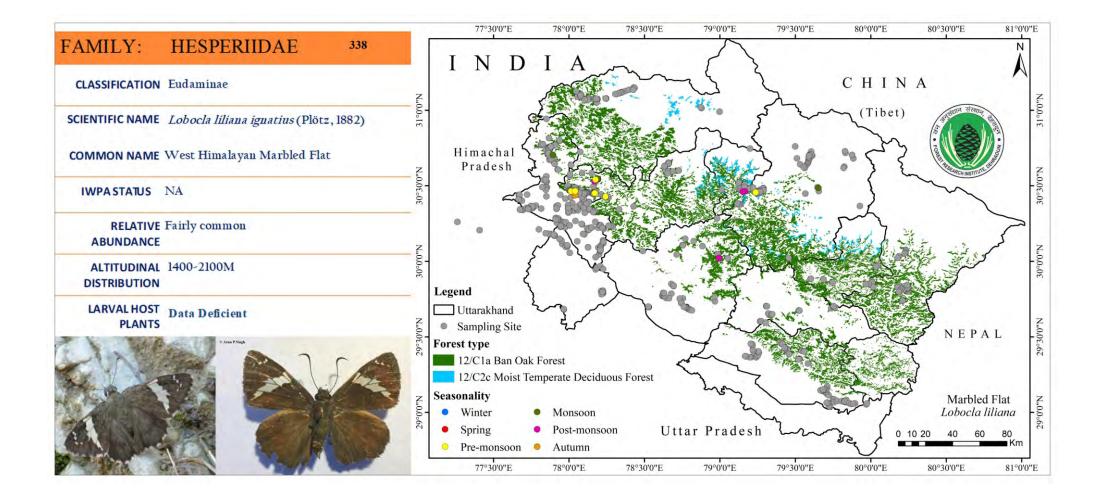


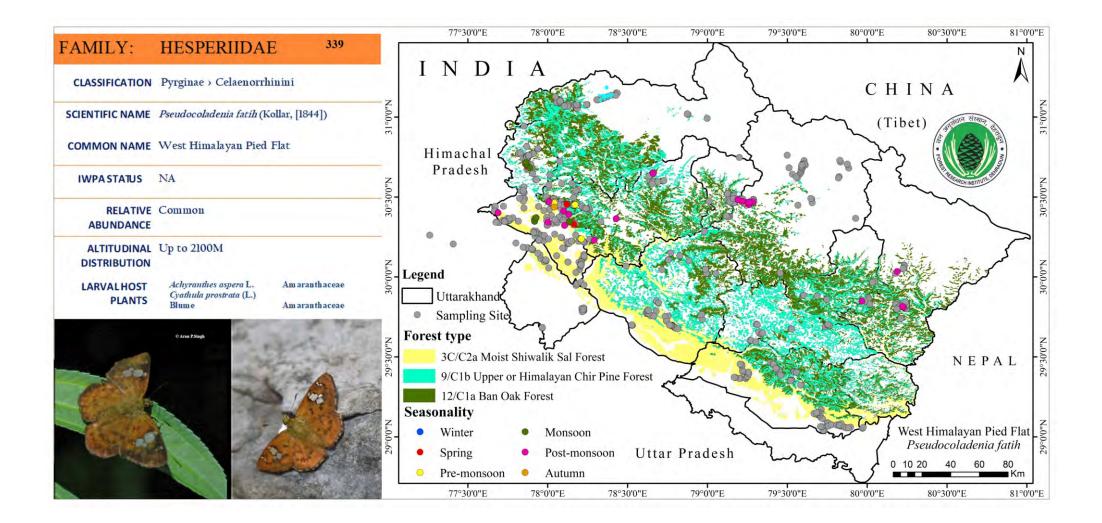


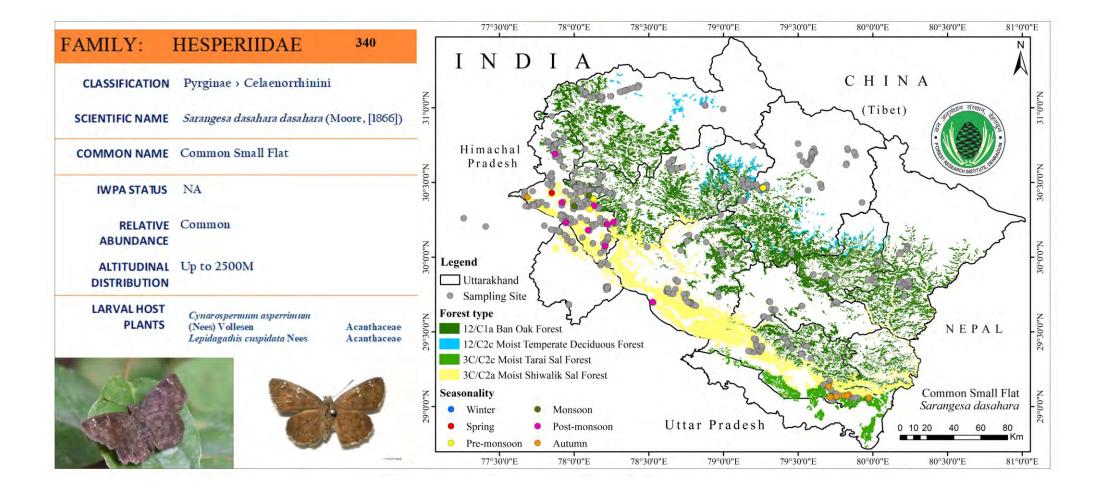


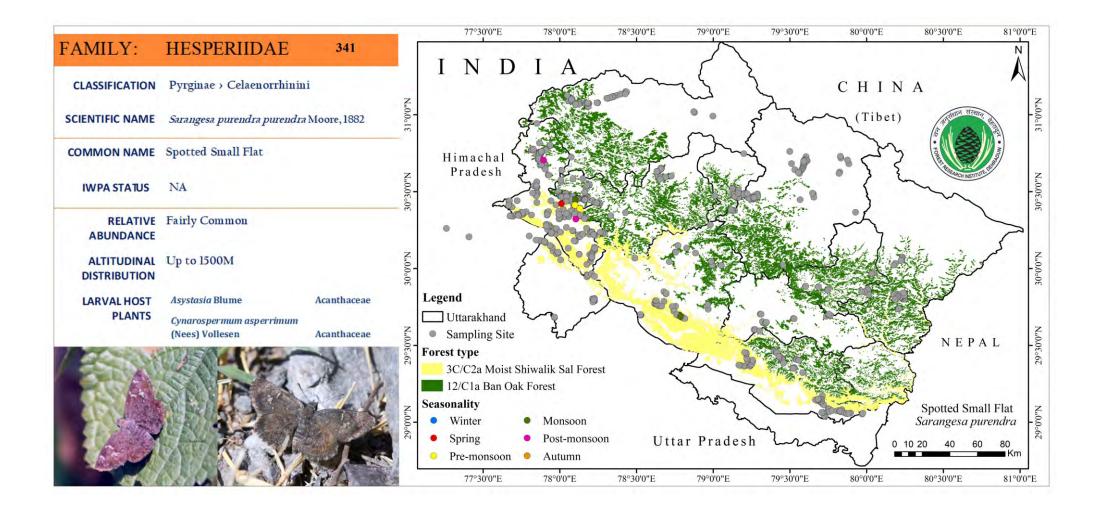


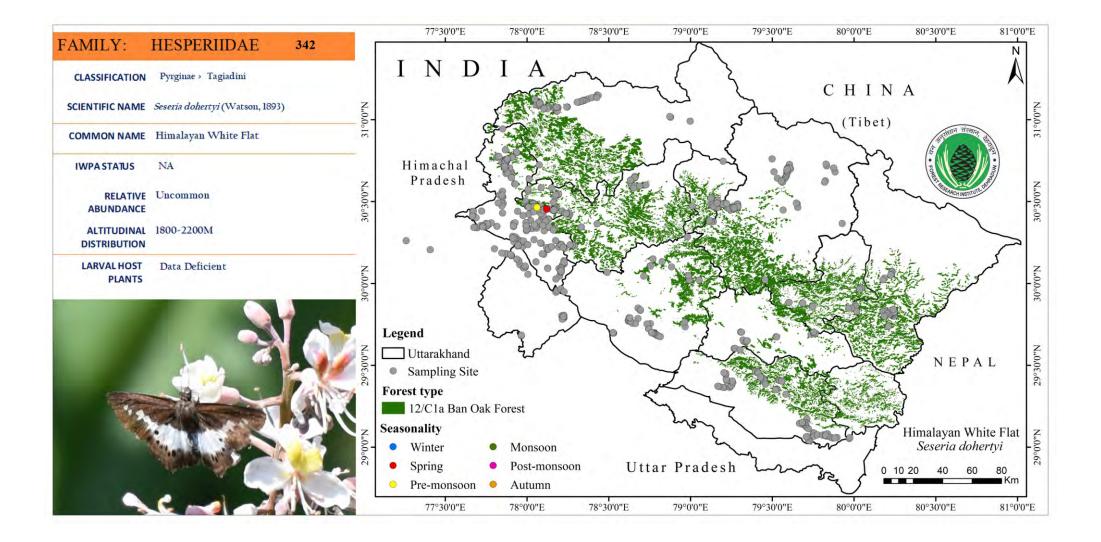


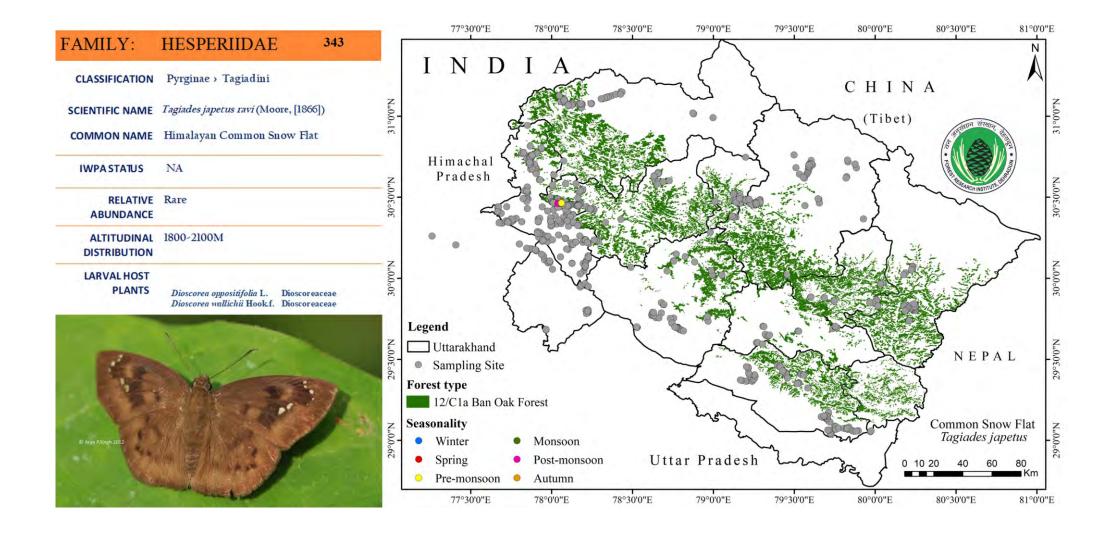


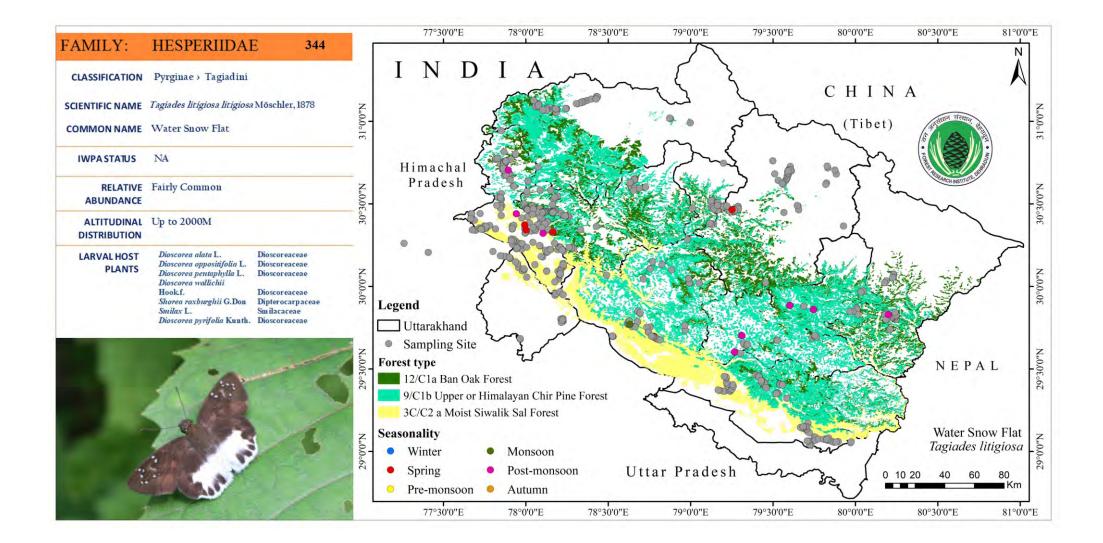


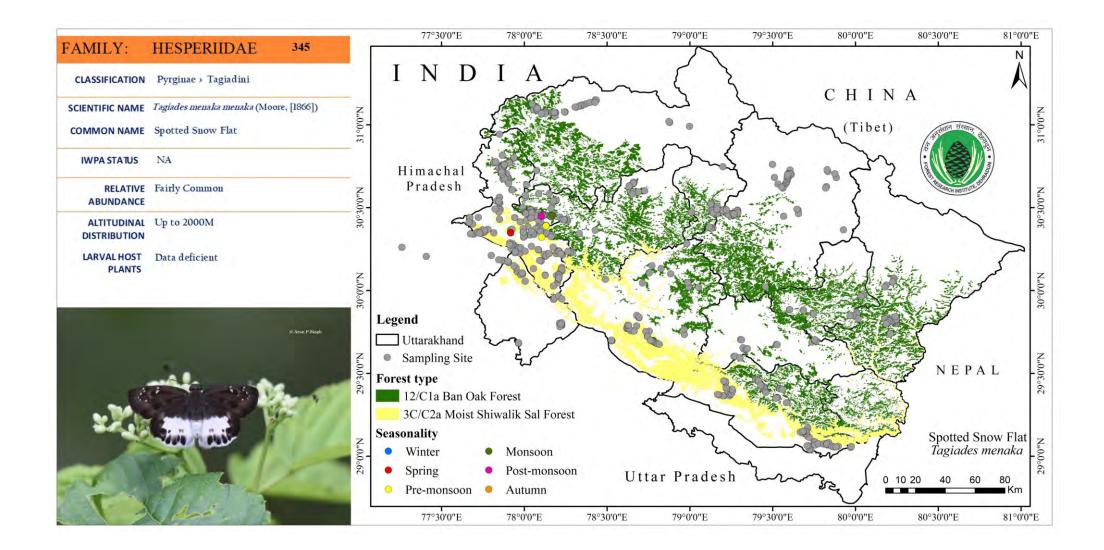


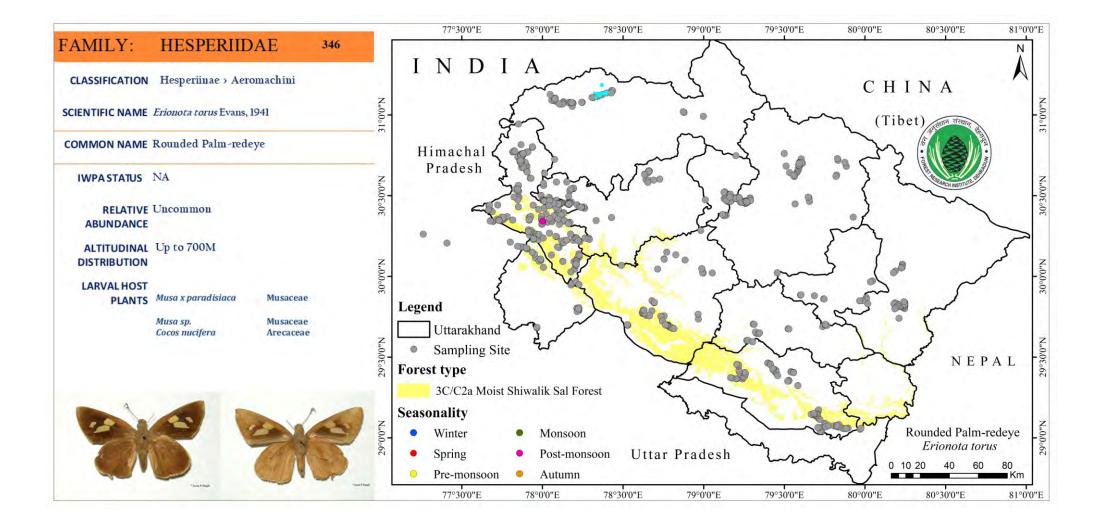


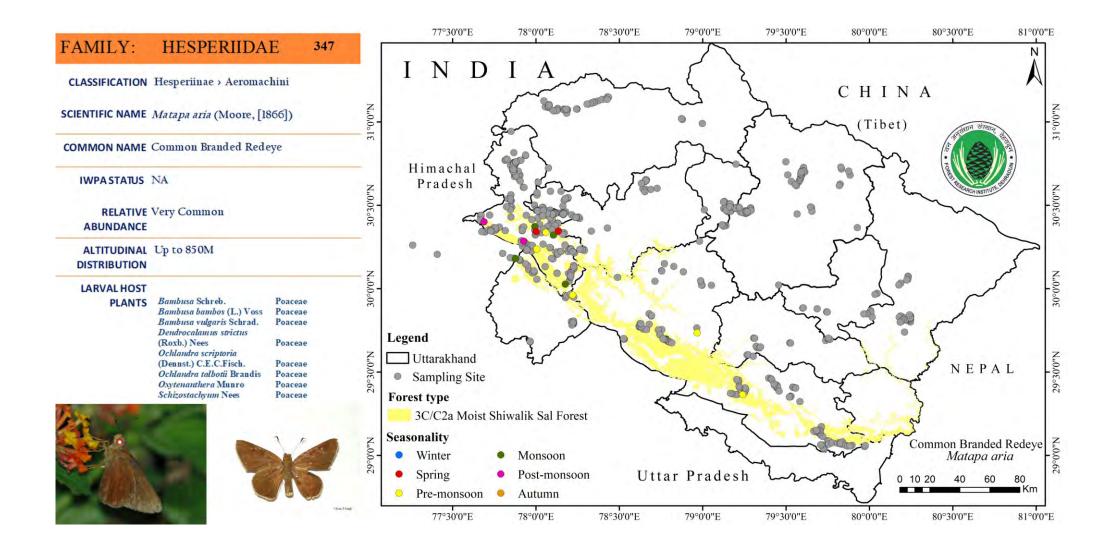


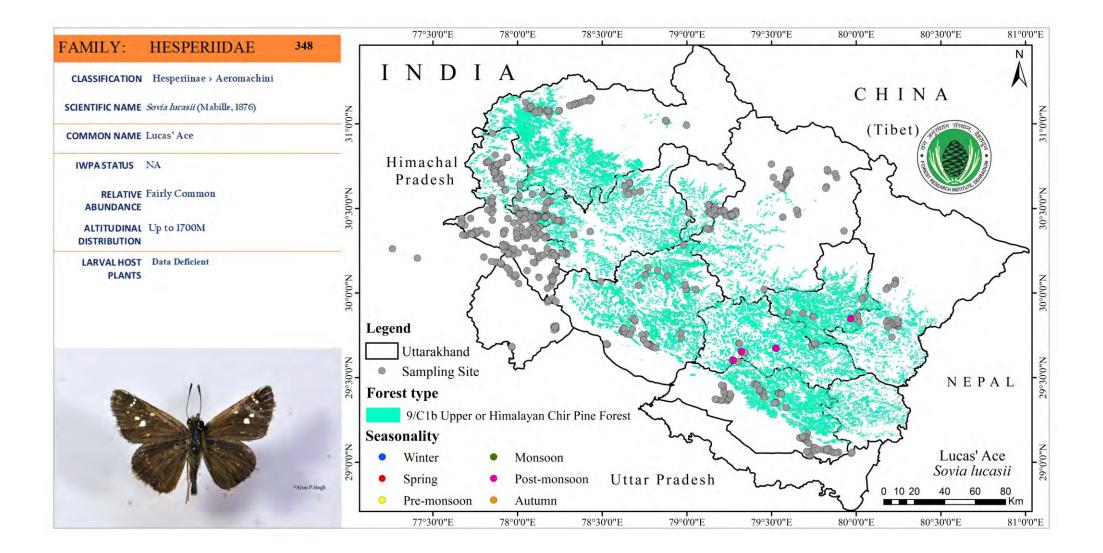


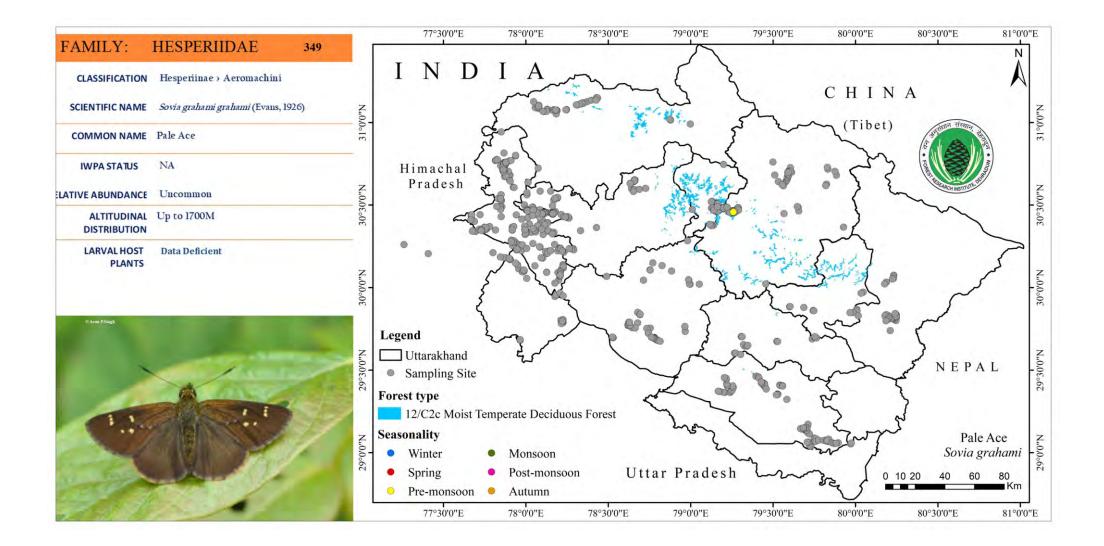


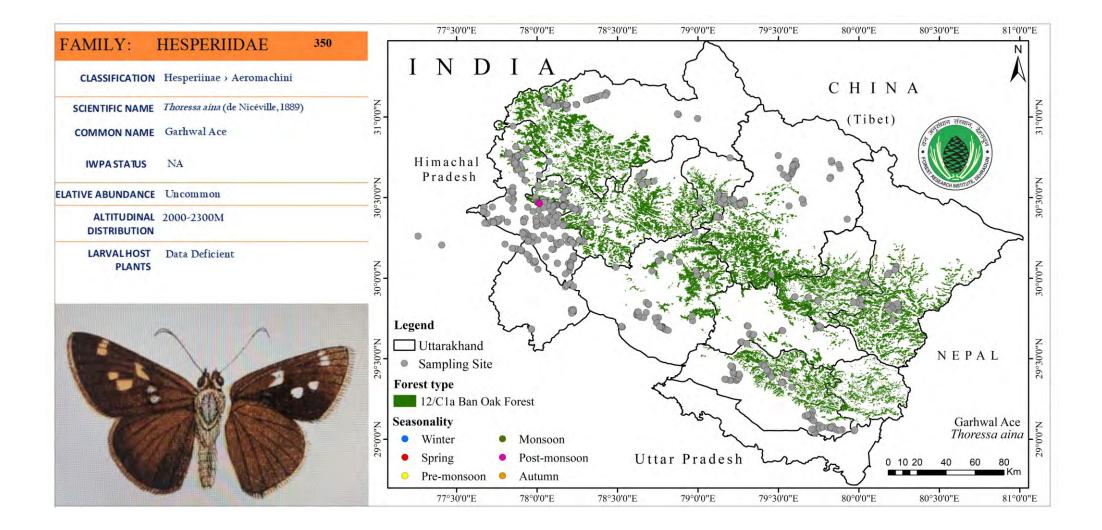


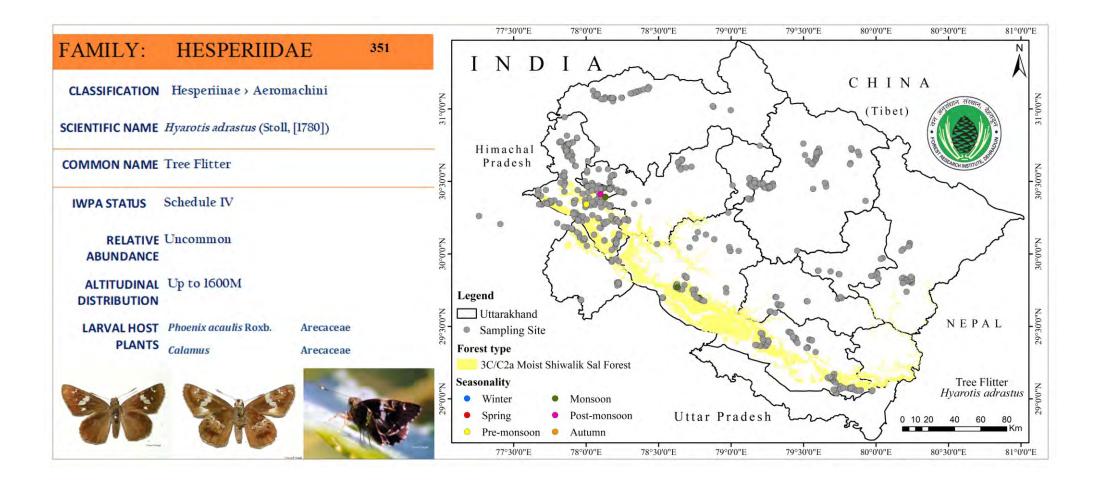


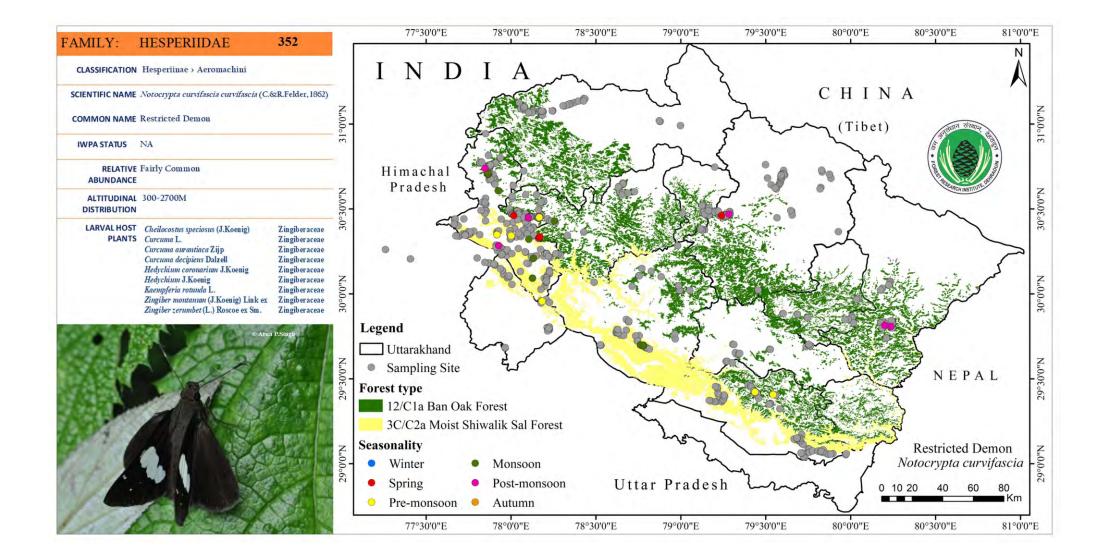


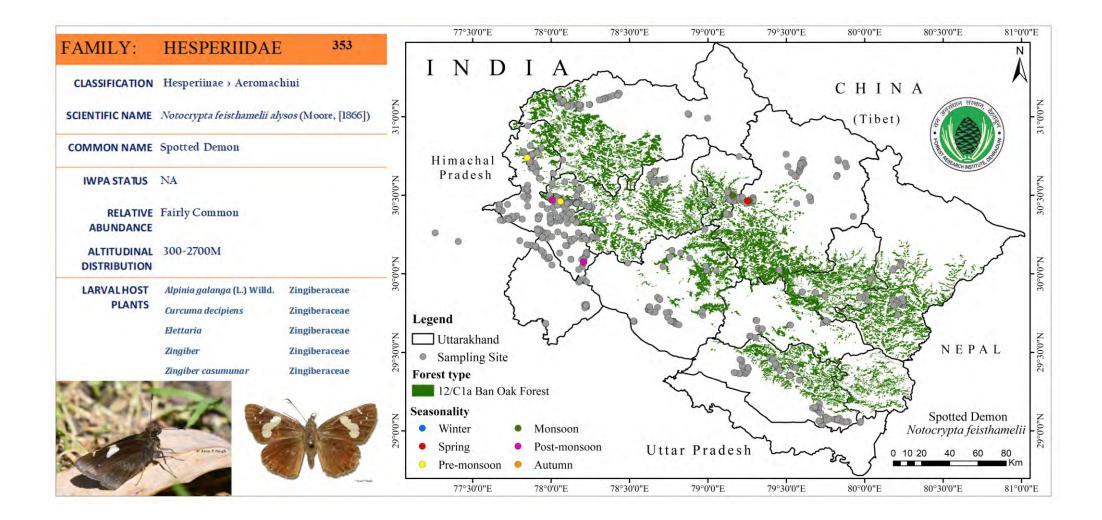


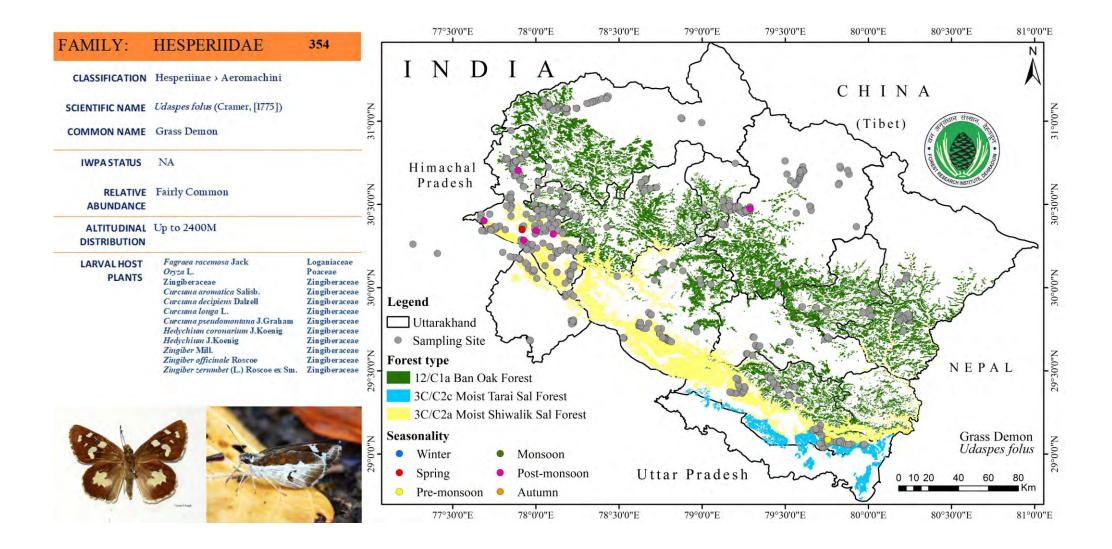


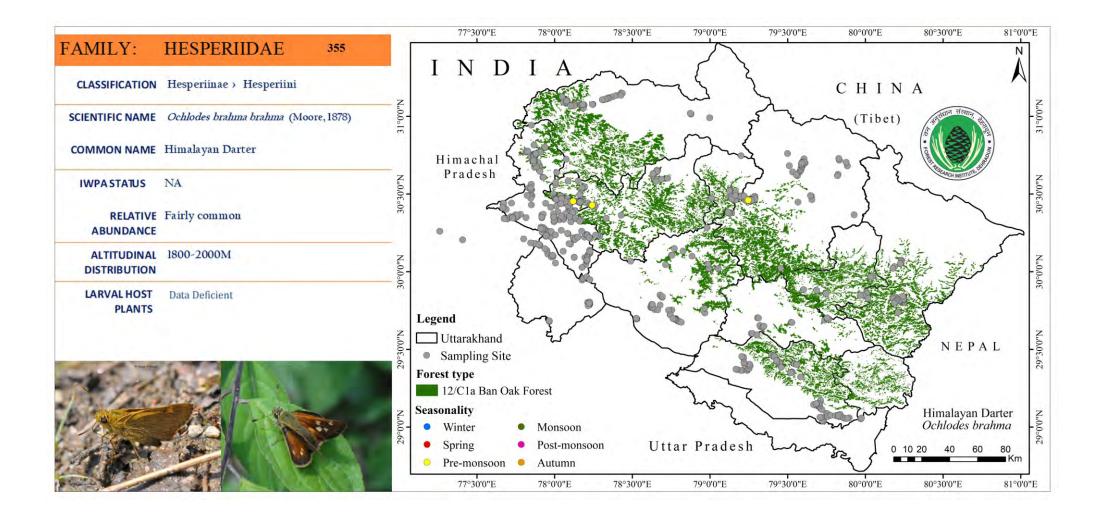


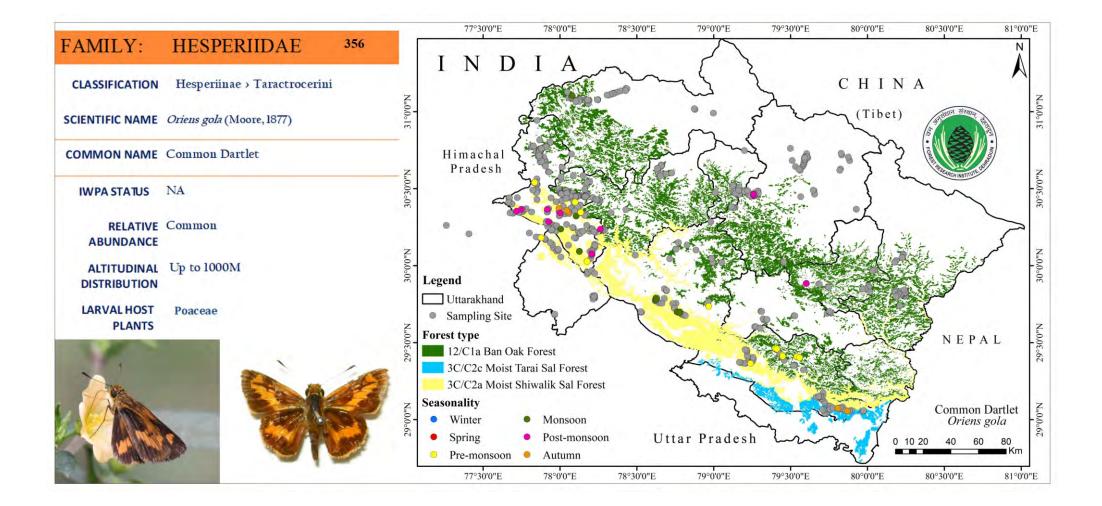


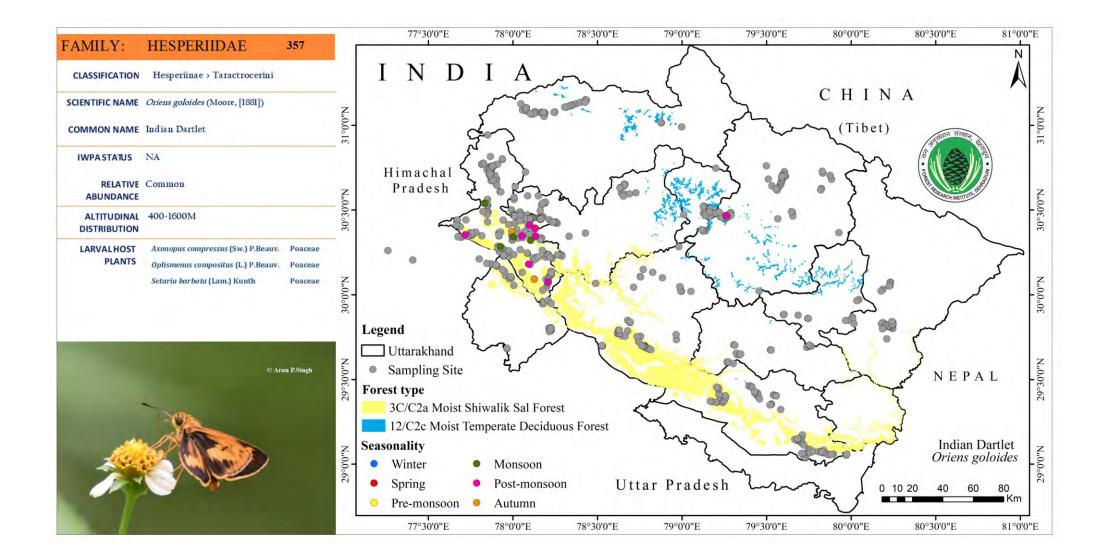


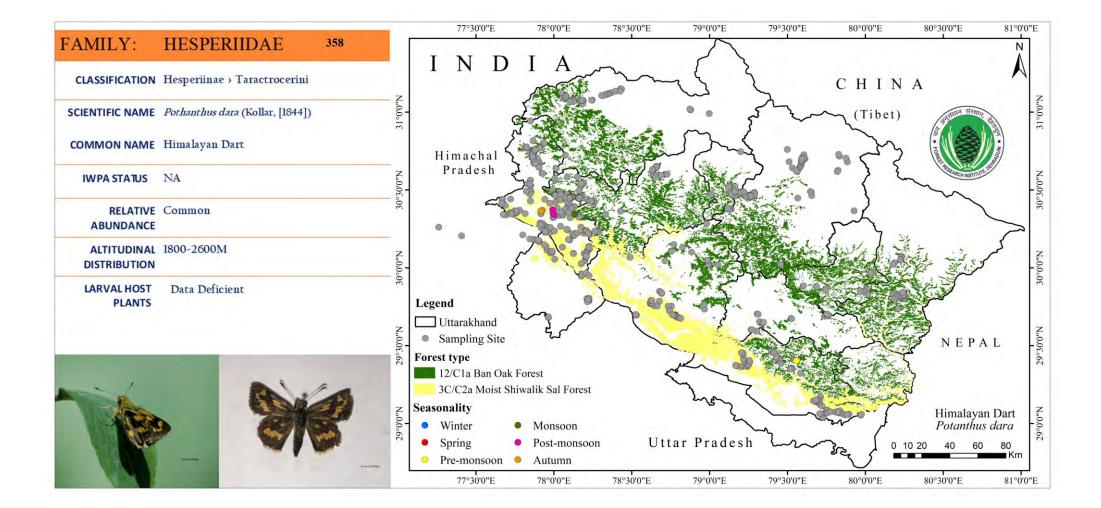


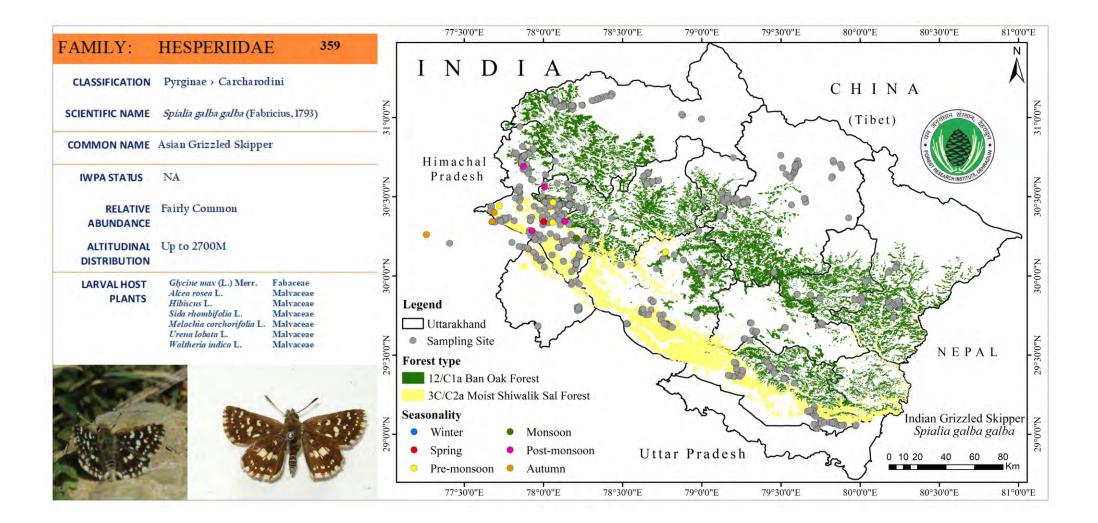


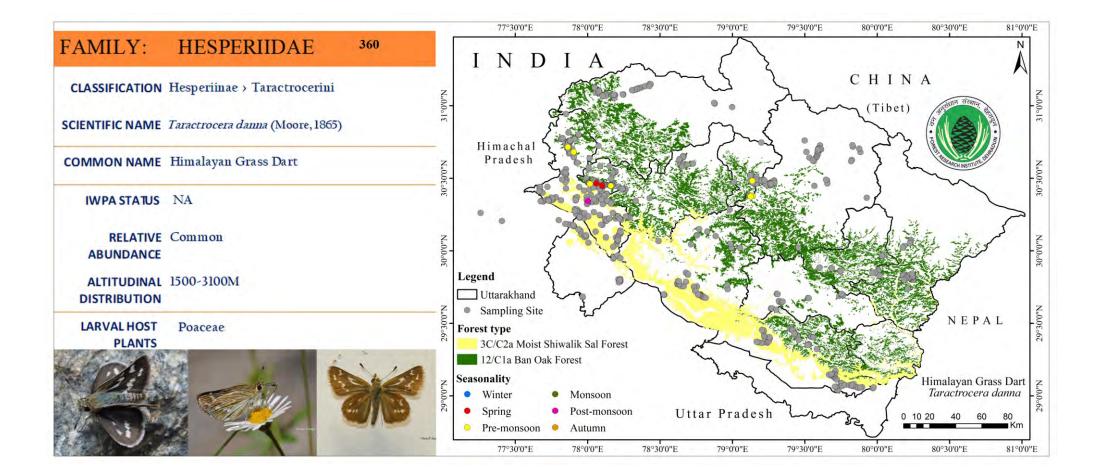


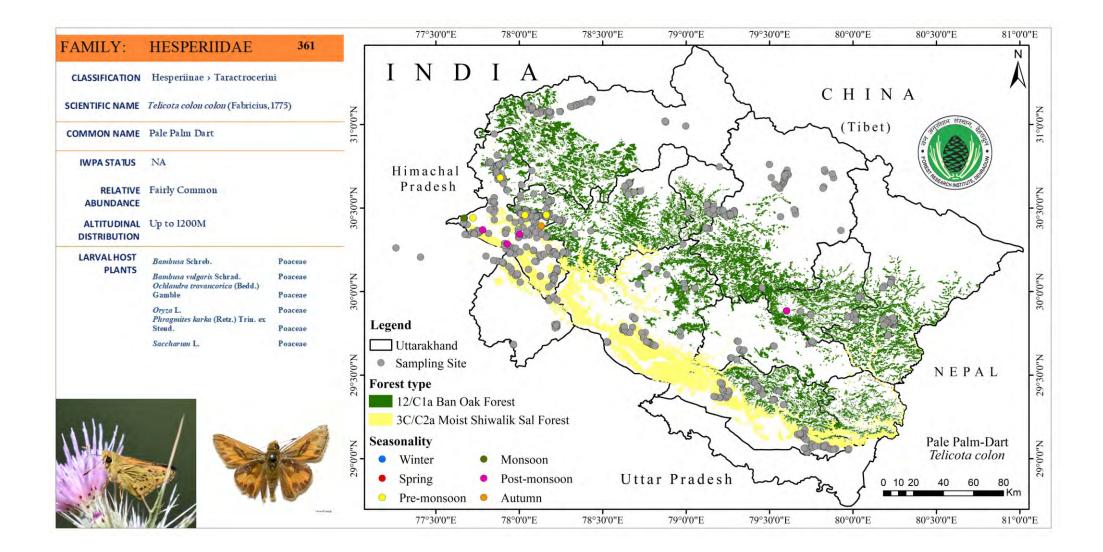


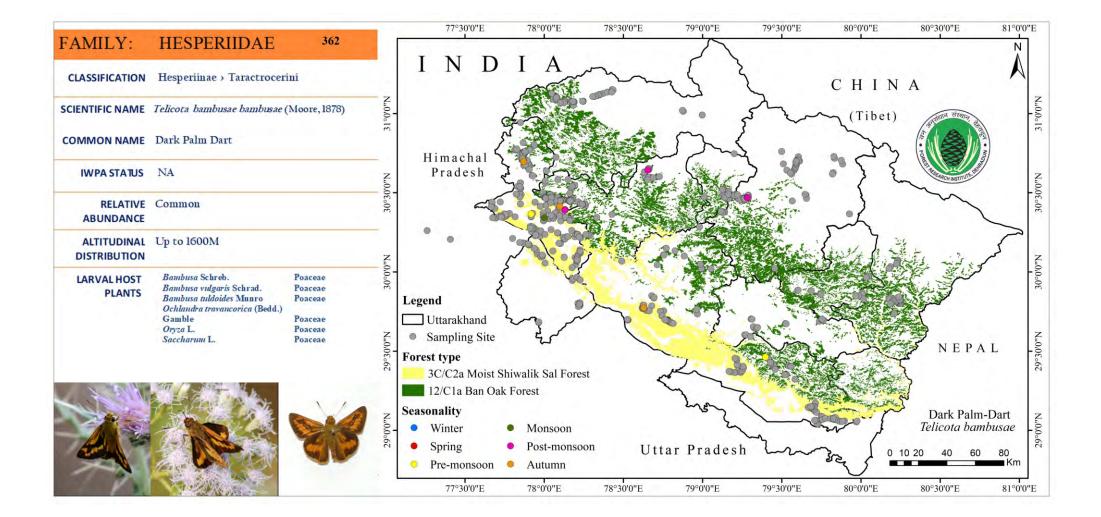


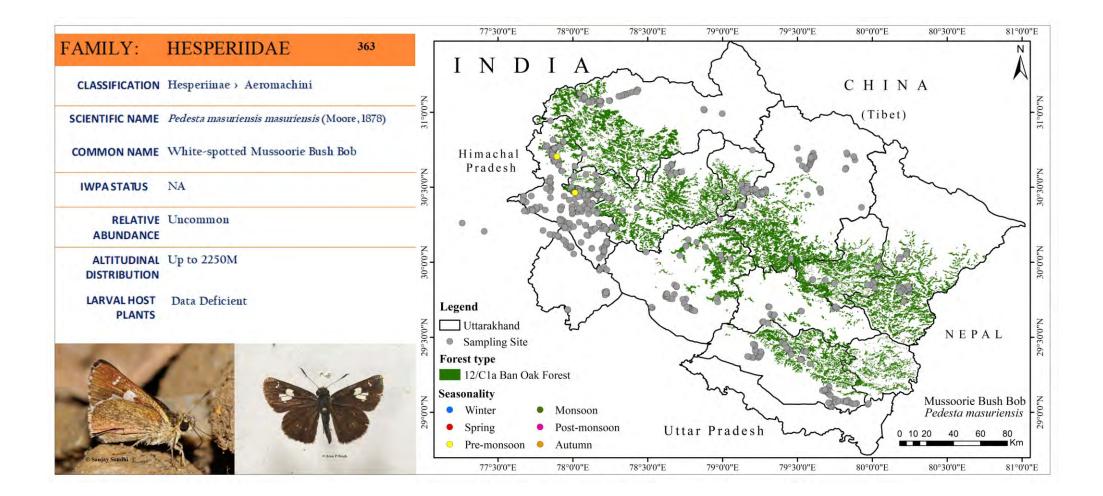


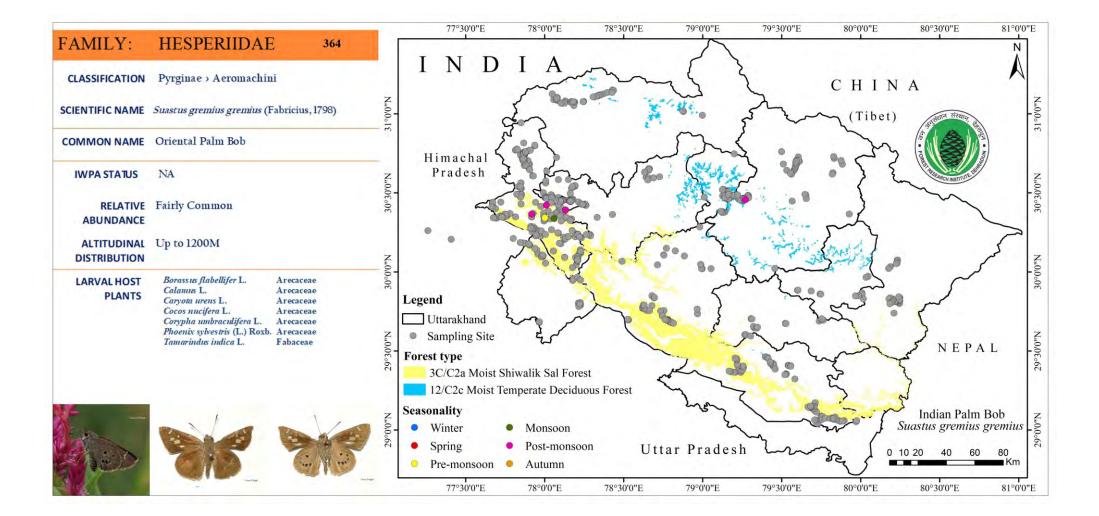


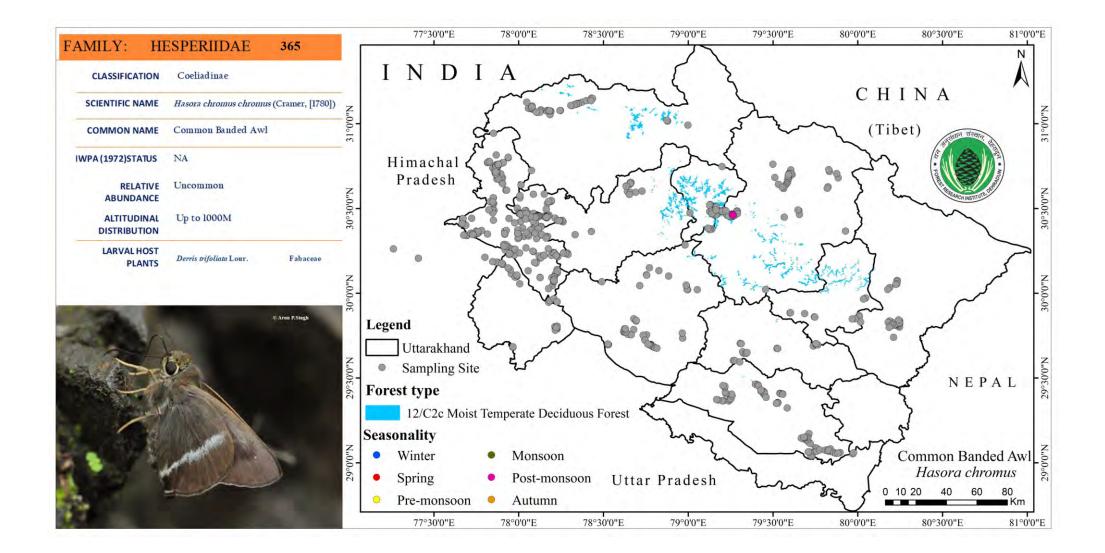














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Scientific Name	Common Name	Page
Abisara bifasciata suffusa Moore, 1882	Suffused Double-banded	No.
Abisara bijasetata sujjasa Moore, 1882	Judy	188
Abisara fylla (Westwood, [1851])	Dark Judy	189
Acraea issoria issoria (Hübner, [1819])	Yellow Coster	257
Acraea terpsicore (Linnaeus, 1758)	Tawny Coster	258
Acytolepis puspa (Horsfield, [1828])	Common Hedge Blue	149
Aeromachus dubius Elwes & Edwards, 1897	Veined Scrub Hopper	338
Aeromachus stigmata stigmata (Moore, 1878)	Dingy Scrub Hopper	337
Aglais caschmirensis aesis (Fruhstorfer, 1912)	Indian Tortoiseshell	276
Aglais rizana (Moore, 1872)	Mountain Tortoiseshell	270
Ampittia dioscorides dioscorides	Indian Bush Hopper	339
(Fabricius, 1793)	Indian Bush Hopper	559
Ancema ctesia ctesia (Hewitson, [1865])	Bi-Spot Royal	110
Anthene emolus emolus (Godart,[19824])	Common Ciliate Blue	160
Aporia agathon caphusa (Moore, 1872)	Garhwal Great Blackvein	53
Aporia agathon phryxe (Boisduval, 1836)	Kashmir Great Blackvein	54
Aporia leucodice (Eversmann, 1843)	Himalayan Blackvein	55
	Spot Puffin	56
Appias lalage (Doubleday, 1842)	1	57
Appias libythea (Fabricius, 1775)	Western Striped Albatross	
Argynnis childreni sakontala Kollar, [1848]	Large Silverstripe	267 264
Argynnis hyperbius hyperbius (Linnaeus, 1763)	Tropical Fritillary	
Argynnis jainadeva jainadeva Moore, 1864	Highbrown Silverspot	266
Argynnis kamala Moore, [1858]	Common Silverstripe	268
Arhopala amantes apella (Swinhoe, 1886)	Large Oakblue	128
Arhopala atrax (Hewitson, 1862)	Indian Oakblue	127
Arhopala dodonaea (Moore, [1858])	Pale Himalayan Oakblue	129
Arhopala ganesa ganesa (Moore, [1858])	Tailless Bushblue	132
Arhopala paraganesa paraganesa	Dusky Bushblue	131
(de Nicéville, 1882)		
Arhopala rama rama (Kollar, [1844])	Himalayan Dark Oakblue	130
Ariadne ariadne pallidior (Fruhstorfer, 1899)	Angled Castor	272
Ariadne merione tapestrina (Moore, 1884)	Common Castor	271

INDEX TO SCIENTIFIC NAMES

Aricia agestis nazira (Moore, [1866])	Orange-bordered	
	Brown Argus	177
Athyma asura asura Moore, [1858]	Studded Sergeant	308
Athyma cama cama Moore, [1858]	Orange Staff Sergeant	312
Athyma inara inara Westwood, 1850	Colour Sergeant	313
Athyma opalina opalina Kollar, 1844	Hill Sergeant	310
Athyma perius perius (Linnaeus, 1758)	Common Sergeant	309
Athyma selenophora selenophora	Staff Sergeant	311
(Kollar, [1844])		
Atrophaneura aidoneus (Doubleday, 1845)	Lesser Batwing	19
Atrophaneura varuna astorion	Common Batwing	20
(Westwood, 1842)		
Aulocera brahminus (Blanchard, 1853)	Narrow Banded Satyr	243
Aulocera padma padma (Kollar, [1844])	Great Satyr	240
Aulocera saraswati saraswati (Kollar, [1844])	Striated Satyr	242
Aulocera swaha swaha (Kollar, [1844])	Common Satyr	241
Auzakia danava danava (Moore, [1858])	Indian Commodore	316
Azanus ubaldus (Stoll, [1782])	Bright Babulblue	169
Badamia exclamationis (Fabricius, 1775)	Brown Awl	340
Baoris farri (Moore, 1878)	Complete Paint-brush Swift	346
Baoris pagana (de Nicéville, 1887)	Figure-of-8-Swift	347
Belenois aurota aurota (Fabricius, 1793)	Pioneer	58
Bibasis sena sena (Moore, [1866])	Orange -tailed Awl	341
Borbo bevani (Moore, 1878)	Bevan's Swift	348
Borbo cinnara (Wallace, 1866)	Rice Swift	349
Burara jaina jaina (Moore, [1866])	Common Orange Awlet	343
Burara oedipodea belesis (Mabille, 1876)	Himalayan Branded	
	Orange Awlet	344
Byasa dasarada ravana (Moore, [1858])	West Himalayan Great	
	Windmill	21
Byasa latreillei latreillei (Donovan, 1826)	Himalayan Rose Windmill	22
Byasa polyeuctes letincius (Fruhstorfer, 1908)	West Himalayan Common	
	Windmill	23
Callerebia annada caeca (Watkins, 1925)	Ringed Argus	218
Callerebia hyagriva hyagriva (Moore, [1858])	Brown Argus	217
Callerebia hybrida Butler, 1880	Hybrid Argus	220

<i>Callerebia nirmala</i> (Moore, 1865)	Common Argus	221
<i>Callerebia scanda scanda</i> (Kollar, [1844])	Pallid Argus	219
Caltoris kumara (Moore, 1878)	Blank Swift	350
Caprona agama agama (Moore, [1858])	Spotted Angle	359
Caprona ransonnettii potiphera	Golden Angle	360
(Hewitson, 1873)		
Castalius rosimon rosimon (Fabricius, 1775)	Common Pierrot	180
Catochrysops strabo strabo (Fabricius, 1793)	Forget-me-not	156
Catopsilia pomona (Fabricius, 1775)	Common Emigrant	59
Catopsilia pyranthe (Linnaeus, 1758)	Mottled Emigrant	60
Celaenorrhinus dhanada (Moore, [1866])	Yellow-banded Flat	362
Celaenorrhinus leucocera (Kollar, [1844])	Common Spotted Angle	363
Celaenorrhinus munda (Moore, 1884)	Himalayan Spotted Flat	364
Celaenorrhinus patula de Nicéville, 1889	Large Spotted Flat	365
Celaenorrhinus pero pero de Nicéville, 1889	Mussoorie Spotted Flat	366
Celaenorrhinus pulomaya pulomaya	Multi-spotted Flat	367
(Moore, [1866])		
Celaenorrhinus Pyrrha de Niceville,1889	Double-spotted Flat	368
Celastrina argiolus kollari (Westwood, [1852])	Hill Hedge Blue	147
Celastrina gigas (Hemming, 1928)	Silver Hedge Blue	153
Celastrina huegeli huegeli (Moore, 1882)	Large Hedge Blue	148
Celastrina lavendularis limbatus	Plain Hedge Blue	150
(Moore, 1879)		
Celatoxia marginata marginata	Margined Hedge Blue	152
(de Nicéville, [1884])		
Cepora nerissa phryne (Fabricius, 1775)	Common Gull	61
Chaetoprocta odata peilei Forster, 1980	Mussoorie Walnut Blue	107
Charaxes agrarius Swinhoe, [1887]	Anomalous Nawab	333
Charaxes bernardus hierax C. & R. Felder,	Tawny Rajah	331
[1867]		
Charaxes bharata C. & R. Felder, [1867]	Indian Nawab	332
Charaxes dolon dolon Westwood, [1848]	Stately Nawab	334
Charaxes solon solon (Fabricius, 1793)	Black Rajah	330
<i>Chilades lajus lajus</i> (Stoll, [1780])	Lime Blue	171
<i>Chilades pandava pandava</i> (Horsfield, [1829]	Plains Cupid	176
<i>Choaspes benjaminii japonica</i> (Murray, 1875)	Common Awlking	345
1 5 5 F (6	-

Chrysozephyrus birupa Moore, 1877	Fawn Hairstreak	103
Chrysozephyrus syla Kollar, 1848	Silver Hairstreak	104
Coladenia indrani indrani (Moore, [1866])	Tricolour Flat	369
Colias erate (Esper, 1805)	Pale Clouded Yellow	62
Colias fieldii Ménétriés, 1855	Dark Clouded Yellow	63
Colotis etrida (Boisduval, 1836)	Little Orange-tip	56
Cupha erymanthis lotis (Sulzer, 1776)	Rustic	261
Curetis acuta dentata Moore, 1879	Acute Sunbeam	88
Curetis bulis bulis (Westwood, [1851])	Bright Sunbeam	87
Cyrestis thyodamas ganescha Kollar, 1848	Map Butterfly	273
Danaus chrysippus chrysippus (Linnaeus, 1758)	Plain Tiger	249
Danaus genutia genutia (Cramer, [1779])	Striped Tiger	248
Delias acalis pyramus (Wallace, 1867)	Redbreast Jezebel	64
Delias belladonna horsfieldi (Gray, 1831)	Hill Jezebel	66
Delias eucharis (Drury, 1773)	Indian Jezebel	65
Delias sanaca sanaca(Moore, [1858])	Pale Jezebel	67
Deudorix epijarbas epijarbas (Moore, [1858])	Cornelian	93
Dilipa morgiana (Westwood, [1851])	Golden Emperor	328
Dodona dipoea nostia Fruhstorfer, 1912	Lesser Punch	191
Dodona durga durga (Kollar, [1844])	Common Punch	190
Dodona eugenes Bates, [1868]	Tailed Punch	192
Dodona ouida phlegra Fruhstorfer, 1914	Mixed Punch	193
Elymnias hypermnestra undularis (Drury, 1773)	Common Palmfly	197
Erionota torus Evans, 1941	Rounded Palm-redeye	378
Esakiozephyrus icana icana (Moore, [1875])	Dull Green Hairstreak	109
Euaspa milionia milionia (Hewitson, [1869])	Water Hairstreak	108
Euchrysops cnejus cnejus (Fabricius, 1798)	Gram Blue	173
Euploea core core (Cramer, [1780])	Indian Common Crow	254
Euploea midamus rogenhoferi	Blue Spotted Crow	256
C.&R.Felder,[1865]		
Euploea mulciber mulciber (Cramer, [1777])	Striped Blue Crow	255
Eurema andersonii jordani Corbet &	One Spot Grass Yellow	69
Pendlebury, 1932		
Eurema blanda silhetana (Wallce,1867)	Three Spot Grass Yellow	71
Eurema brigitta rubella (Wallace, 1867)	Small Grass Yellow	70
Eurema hecabe (Linnaeus, 1758)	Common Grass Yellow	68

Eurema laeta laeta (aeta (Boisduval, 1836)Spotless Grass Yellow72Euripus consimilis consimilisPainted Courtesan322(Westwood, [1851])Common Baron318Euthalia aconthea garuda (Moore, [1858])Gaudy Baron319Euthalia patala patala (Kollar, [1844])Grand Duchess317Everes argiades diporides Chapman, 1908Tailed Cupid175Everes angiades diporides Chapman, 1908Tailed Cupid174Everes lacturmus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria puti (Kollar, [1844])Spangled Plushblue168Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstoneGraphium agamemnon agamemnonBrimstone74Graphium agamemnon agamemnonGlassy Blue Bottle27(Westwood, 1841)Graphium cloanthus cloanthusGasy Blue Bottle27(Westwood, 1841)Swordtail29Graphium doson axionideKeyer, 1759)Swordtail30Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sonomus (Cramer, [1780])Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus moorei coruscans (Moore, [1852) <td< th=""><th></th><th></th><th></th></td<>			
(Westwood, [1851])Common Baron318Euthalia aconthea garuda (Moore, [1858])Common Baron319Euthalia lubentina lubentina (Cramer, [1777])Gaudy Baron319Euthalia patala patala (Kollar, [1844])Grand Duchess317Everes argiades diporides Chapman, 1908Tailed Cupid175Everes hugelii hugelii (Gistel, 1857)Dusky Blue Cupid174Everes lacturnus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel166Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan Common74Graphium agamemnon agamemnonTailed Jay24(Linnaeus, 1758)Galasy Blue Bottle27(Westwood, 1841)Garahuiu aconthus cloanthusGlassy Blue Bottle27(Rothschild, 1895)Swordtail28Graphium adica (Katayama, 1988)Garhwal Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora vitta indica Evans, 1932Plain Banded Awl397Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brah	Eurema laeta laeta (Boisduval, 1836)	Spotless Grass Yellow	72
Euthalia aconthea garuda (Moore, [1858])Common Baron318Euthalia lubentina lubentina (Cramer, [1777])Gaudy Baron319Euthalia patala patala (Kollar, [1844])Grand Duchess317Everes argiades diporides Chapman, 1908Tailed Cupid175Everes lugelii hugelii (Gistel, 1857)Dusky Blue Cupid174Everes lacturmus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel166Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstoneGraphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Rothschild, 1895)Swordtail20Graphium agarhwalica (Katayama, 1988)Garhwal Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Swordtail26Graphium sarpedon sarpedon (Linnaeus, 1758)Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Purple Sapphire141H	Euripus consimilis consimilis	Painted Courtesan	322
Euthalia lubentina lubentina (Cramer, [1777])Gaudy Baron319Euthalia patala patala (Kollar, [1844])Grand Duchess317Everes argiades diporides Chapman, 1908Tailed Cupid175Everes lacturmus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel166Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser167Graphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium quankay, 2014)Garhwal Swordtail29Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedor (Linnaeus, 1758)Common Blue Bottle26Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Indian Spot Swordtail3030Graphium sarpedon sarpedor (Linnaeus, 1758)Common Blue Bottle26Hasora vitta indica Evans, 1932Plain Banded Awl397Haina Barded Awil397Plain Banded Awil397Hainalayan Coles latilimbataHimalayan Purple Sapphire141<	(Westwood, [1851])		
Euthalia patala patala (Kollar, [1844])Grand Duchess317Everes argiades diporides Chapman, 1908Tailed Cupid175Everes hugelii hugelii (Gistel, 1857)Dusky Blue Cupid174Everes lacturnus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel166Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstone74Graphium agamemnon agamemnonBrimstone74Graphium agamemnon agamemnonGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Rothschild, 1895)Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium nomius (Cramer, [1780])Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus sindicus (Fruhstorfer, 1908)Dark Saphire142Heliophorus moorei coruscans (Moore, [1852])Dark Saphire142	Euthalia aconthea garuda (Moore, [1858])	Common Baron	318
Everes argiades diporides Chapman, 1908Tailed Cupid175Everes hagelii hugelii (Gistel, 1857)Dusky Blue Cupid174Everes lacturnus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstone75Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan CommonBrimstone74Graphium agamemnon agamemnonTailed Jay(Linnaeus, 1758)Glassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Rothschild, 1895)Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora vitta indica Evans, 1932Plain Banded Awl397Hasora vitta indica Evans, 1932Himalayan Golden Sapphire414Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire414Heliophorus indicus (Fruhstorfer, 1908)Dark Saphire142Heliophorus moorei coruscans (Moore, 1882)Azure Saphire142	Euthalia lubentina lubentina (Cramer, [1777])	Gaudy Baron	319
Everes hugelii hugelii (Gistel, 1857)Dusky Blue Cupid174Everes lacturmus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel168Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstone75Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan CommonGraphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium eurous caschmirensisWest Himalayan Six-barRothschild, 1895)Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail29Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Graphium sonius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Plain Banded Awl397Hasora chromus (Cramer, [1780])Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Purple Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire142	Euthalia patala patala (Kollar, [1844])	Grand Duchess	317
Everes lacturnus assamica Tytler, 1915Indian Cupid173Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [1844])Black-spotted Grass jewel168Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass Jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser167Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan Common74Graphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium nomius nomius (Esper, 1799)Plain Banded Awl397Hasora chromus (Cramer, [1780])Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Dark Sapphire142	Everes argiades diporides Chapman, 1908	Tailed Cupid	175
Flos asoka (de Nicéville, [1884])Spangled Plushblue133Freyeria putli (Kollar, [184])Black-spotted Grass jewel168Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser8Brimstone7474Graphium agamemnon agamemnonBrimstone74(Linnaeus, 1758)Glassy Blue Bottle27(Westwood, 1841)Common Jay25(Page & Treadaway, 2014)Common Jay25Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Colden Sapphire141Himalayan Purple Sapphire140140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Dark Sapphire142	Everes hugelii hugelii (Gistel, 1857)	Dusky Blue Cupid	174
Freyeria pulli (Kollar, [1844])Black-spotted Grass jewel168Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser8Brimstone758Graphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Rothschild, 1895)Swordtail28Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Colden Sapphire141Himalayan Colden Sapphire141140Frustorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Dark Sapphire142	Everes lacturnus assamica Tytler, 1915	Indian Cupid	173
Freyeria trochylus orientalis Forster, 1980Orange-spotted Grass Jewel167Gandaca harina assamica Moore, 1906Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserBrimstoneGonepteryx rhamni nepalensis Doubleday, 1847Himalayan Common74Graphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium eurous caschmirensisWest Himalayan Six-bar(Rothschild, 1895)Swordtail28Graphium nomius nomius (Esper, 1799)Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Purple Sapphire140Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire142	Flos asoka (de Nicéville, [1884])	Spangled Plushblue	133
Gandaca harina assamica Moore, 1906 Gonepteryx mahaguru mahaguru Gistel, 1857Tree Yellow73Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan Lesser Brimstone75Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan CommonGraphium agamemnon agamemnon (Linnaeus, 1758)Brimstone74Graphium cloanthus cloanthus (Westwood, 1841)Glassy Blue Bottle27Westwood, 1841)Common Jay25Graphium eurous caschmirensis (Rothschild, 1895)West Himalayan Six-bar Swordtail28Graphium nomius nomius (Esper, 1799)Swordtail29Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Himalayan Golden Sapphire141Heliophorus brahma brahma (Moore, [1858])Himalayan Purple Sapphire140Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire142	Freyeria putli (Kollar, [1844])	Black-spotted Grass jewel	168
Gonepteryx mahaguru mahaguru Gistel, 1857Himalayan LesserGonepteryx rhamni nepalensis Doubleday, 1847Brimstone75Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan Common74Graphium agamemnon agamemnonBrimstone74Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)Common Jay25Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Himalayan Purple Sapphire140140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Freyeria trochylus orientalis Forster, 1980	Orange-spotted Grass Jewel	167
Brimstone75Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan CommonGraphium agamemnon agamemnonBrimstone(Linnaeus, 1758)Tailed JayGraphium cloanthus cloanthusGlassy Blue Bottle(Vestwood, 1841)Glassy Blue BottleGraphium doson axionideCommon Jay(Page & Treadaway, 2014)Common JayGraphium eurous caschmirensisWest Himalayan Six-bar(Rothschild, 1895)SwordtailGraphium nomius nomius (Esper, 1799)Indian Spot SwordtailGraphium sarpedon sarpedon (Linnaeus, 1758)Common Blue BottleHasora chromus (Cramer, [1780])Plain Banded AwlHasora vitta indica Evans, 1932Plain Banded AwlHeliophorus brahma brahma (Moore, [1858])Himalayan Golden SapphireHeliophorus indicus (Fruhstorfer, 1908)Dark SapphireHeliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Gandaca harina assamica Moore, 1906	Tree Yellow	73
Gonepteryx rhamni nepalensis Doubleday, 1847Himalayan Common Brimstone74Graphium agamemnon agamemnon (Linnaeus, 1758)Tailed Jay24Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Glassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionide (Page & Treadaway, 2014)Common Jay25(Rothschild, 1895)West Himalayan Six-bar28Graphium garhwalica (Katayama, 1988) Graphium nomius nomius (Esper, 1799)Swordtail29Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Purple Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire142	Gonepteryx mahaguru mahaguru Gistel, 1857	Himalayan Lesser	
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Graphium agamemnon agamemnon (Linnaeus, 1758)Tailed Jay24(Linnaeus, 1758)Glassy Blue Bottle27Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)West Himalayan Six-bar28Graphium eurous caschmirensisWest Himalayan Six-bar28(Rothschild, 1895)Swordtail29Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Gonepteryx rhamni nepalensis Doubleday, 1847	Himalayan Common	
(Linnaeus, 1758)Glassy Blue Bottle27(Westwood, 1841)Glassy Blue Bottle27(Westwood, 1841)Common Jay25(Page & Treadaway, 2014)Common Jay25(Rothschild, 1895)West Himalayan Six-bar28Graphium eurous caschmirensisWest Himalayan Six-bar28(Rothschild, 1895)Swordtail29Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137		Brimstone	74
Graphium cloanthus cloanthusGlassy Blue Bottle27(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)Common Jay25Graphium eurous caschmirensisWest Himalayan Six-bar28(Rothschild, 1895)Swordtail29Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium agamemnon agamemnon	Tailed Jay	24
(Westwood, 1841)Common Jay25Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)Common Jay25Graphium eurous caschmirensisWest Himalayan Six-bar28(Rothschild, 1895)Swordtail29Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	(Linnaeus, 1758)		
Graphium doson axionideCommon Jay25(Page & Treadaway, 2014)Graphium eurous caschmirensisWest Himalayan Six-bar(Rothschild, 1895)SwordtailGraphium garhwalica (Katayama, 1988)Garhwal SwordtailGraphium nomius nomius (Esper, 1799)Indian Spot SwordtailGraphium sarpedon sarpedon (Linnaeus, 1758)Common Blue BottleGraphium sarpedon sarpedon (Linnaeus, 1758)Plain Banded AwlHasora chromus (Cramer, [1780])Plain Banded AwlHasora vitta indica Evans, 1932Plain Banded AwlHeliophorus brahma brahma (Moore, [1858])Himalayan Golden SapphireHeliophorus indicus (Fruhstorfer, 1908)Dark SapphireHeliophorus moorei coruscans (Moore, 1882)Azure Sapphire	Graphium cloanthus cloanthus	Glassy Blue Bottle	27
Page & Treadaway, 2014)West Himalayan Six-barGraphium eurous caschmirensisWest Himalayan Six-bar(Rothschild, 1895)SwordtailGraphium garhwalica (Katayama, 1988)Garhwal SwordtailGraphium nomius nomius (Esper, 1799)Indian Spot SwordtailGraphium sarpedon sarpedon (Linnaeus, 1758)Common Blue BottleHasora chromus (Cramer, [1780])Plain Banded AwlHasora vitta indica Evans, 1932Plain Banded AwlHeliophorus brahma brahma (Moore, [1858])Himalayan Golden SapphireHeliophorus indicus (Fruhstorfer, 1908)Dark SapphireHeliophorus moorei coruscans (Moore, 1882)Azure Sapphire	(Westwood, 1841)		
Graphium eurous caschmirensisWest Himalayan Six-bar(Rothschild, 1895)Swordtail28Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium doson axionide	Common Jay	25
(Rothschild, 1895)Swordtail28Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	(Page & Treadaway, 2014)		
Graphium garhwalica (Katayama, 1988)Garhwal Swordtail29Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium eurous caschmirensis	West Himalayan Six-bar	
Graphium nomius nomius (Esper, 1799)Indian Spot Swordtail30Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans, 1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	(Rothschild, 1895)	Swordtail	28
Graphium sarpedon sarpedon (Linnaeus, 1758)Common Blue Bottle26Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans,1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium garhwalica (Katayama, 1988)	Garhwal Swordtail	29
Hasora chromus (Cramer, [1780])Plain Banded Awl397Hasora vitta indica Evans,1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium nomius nomius (Esper, 1799)	Indian Spot Swordtail	30
Hasora vitta indica Evans,1932Plain Banded Awl342Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Graphium sarpedon sarpedon (Linnaeus, 1758)	Common Blue Bottle	26
Heliophorus brahma brahma (Moore, [1858])Himalayan Golden Sapphire141Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus indicus (Fruhstorfer, 1908)Azure Sapphire137	Hasora chromus (Cramer, [1780])	Plain Banded Awl	397
Heliophorus epicles latilimbataHimalayan Purple Sapphire140(Fruhstorfer, 1908)Dark Sapphire142Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Hasora vitta indica Evans,1932	Plain Banded Awl	342
(Fruhstorfer, 1908)Dark Sapphire142Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire137Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Heliophorus brahma brahma (Moore, [1858])	Himalayan Golden Sapphire	141
Heliophorus indicus (Fruhstorfer, 1908)Dark Sapphire142Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	Heliophorus epicles latilimbata	Himalayan Purple Sapphire	140
Heliophorus moorei coruscans (Moore, 1882)Azure Sapphire137	(Fruhstorfer, 1908)		
	Heliophorus indicus (Fruhstorfer, 1908)	Dark Sapphire	142
Heliophorus oda (Hewitson, 1865)Eastern Blue Sapphire139	Heliophorus moorei coruscans (Moore, 1882)	Azure Sapphire	137
	Heliophorus oda (Hewitson, 1865)	Eastern Blue Sapphire	139

Heliophorus sena (Kollar, [1844])	Sorrel Sapphire	136
Heliophorus tamu tamu (Kollar, [1844])	Powdery Green Sapphire	138
Hesperiidae		335
Hestina persimilis zella Butler, 1869	Siren	327
Hestinalis nama nama (Doubleday, 1844)	Circe	326
Horaga onyx onyx (Moore, [1858])	Common Onyx	91
Horaga viola Moore, 1882	Brown Onyx	92
Hyarotis adrastus praba (Moore, [1866])	Tree Flitter	383
Hypolimnas bolina jacintha (Drury, 1773)	Great Eggfly	274
Hypolimnas misippus (Linnaeus, 1764)	Danaid Eggfly	275
Hypolycaena kina kina Hewitson, [1869]	Blue Tit	119
Hypolycaena othona othona Hewitson, [1865]	Oriental Orchid Tit	118
<i>Hyponephele davendra davendra</i> (Moore, 1865)	White-ringed Meadowbrown	246
Hyponephele pulchella (C. & R. Felder, [1867])	Tawny Meadowbrown	247
Iraota timoleon timoleon (Stoll, [1790])	Silverstreak Blue	126
Issoria issaea (Doherty, 1886)	Himalayan Queen Fritillary	265
Ixias marianne (Cramer, [1779])	White Orange-tip	76
Ixias pyrene (Linnaeus, 1764)	Yellow Orange-tip	77
Jamides bochus bochus (Stoll, [1782])	Dark Cerulean	159
Jamides celeno celeno (Cramer, [1775])	Common Cerulean	158
Junonia almana almana (Linnaeus, 1758)	Peacock Pansy	285
Junonia atlites atlites (Linnaeus, 1763)	Grey Pansy	290
Junonia hierta hierta (Fabricius, 1798)	Yellow Pansy	288
Junonia iphita iphita (Cramer, [1779])	Chocolate Pansy	289
Junonia lemonias lemonias (Linnaeus, 1758)	Lemon Pansy	286
Junonia orithya (Linnaeus, 1758)	Blue Pansy	287
Kallima inachus inachus (Doyère, [1840])	Orange Oakleaf	284
Kaniska canace canace (Linnaeus, 1763)	Blue Admiral	283
Lampides boeticus (Linnaeus, 1767)	Pea Blue	157
Lasiommata schakra schakra (Kollar, [1844])	Common Wall	226
Leptosia nina (Fabricius, 1793)	Psyche	80
Leptotes plinius plinius (Fabricius, 1793)	Zebra Blue	178
Lethe baladeva aisa Fruhstorfer, 1911	Treble Silverstripe	238
Lethe confusa confusa Aurivillius, [1898]	Banded Treenbrown	234
Lethe dakwania Tytler, 1939	White-wedged Woodbrown	228
Lethe dura gammiei (Moore, [1892])	Scarce Lilacfork	236

		222
Lethe europa niladana Fruhstorfer, 1911	Bamboo Treebrown	232
Lethe goalpara goalpara (Moore, [1866])	Large Goldenfork Common Forester	237 231
Lethe isana isana (Kollar, [1844])		
Lethe nicetas (Hewitson, 1863)	Yellow Woodbrown	229
<i>Lethe rohria rohria</i> (Fabricius, 1787)	Common Treebrown	233
Lethe sidonis (Hewitson, 1863)	Common Woodbrown	227
<i>Lethe sinorix sinorix</i> (Hewitson, [1863])	Tailed Red Forester	220
<i>Lethe verma verma</i> (Kollar, [1844])	Straight-Banded Treebrown	235
Libythea lepita lepita Moore, [1858]	Common Beak	259
Libythea myrrha sanguinalis Fruhstorfer, 1898	Club Beak	260
Lobocla liliana ignatius (Plötz, 1882)	West Himalayan Marbled	
	Flat	370
Loxura atymnus continentalis Fruhstorfer,	Yamfly	125
[1912]		
Lycaena panava (Westwood, 1852)	White-bordered Copper	143
Lycaena phlaeas indicus (Evans,1925)	Common Copper	144
Lycaenidae		85
Manea bhotea botea (Moore,1884)	Slate Royal	112
Matapa aria (Moore, [1866])	Common Banded Redeye	379
Meandrusa lachinus lachinus	Brown Gorgon	30
(Fruhstorfer, 1902)	C C	
Megisba malaya sikkima Moore, 1884	Malayan	146
Melanitis leda leda (Linnaeus, 1758)	Common Evening Brown	244
Melanitis phedima bela Moore, [1858]	Dark Evening Brown	245
Miletus chinensis assamensis (Doherty, 1891)	Common Mottle	90
Mimathyma ambica ambica (Kollar, [1844])	Himalayan Purple Emperor	329
Moduza procris (Cramer, [1777])	Commander	325
Mycalesis francisca sanatana Moore, [1858]	Lilacine Bushbrown	201
Mycalesis mineus mineus (Linnaeus, 1758)	Dark-Branded Bushbrown	199
Mycalesis perseus blasius Fabricius, 1798	Common Bush Brown	198
<i>Mycalesis suaveolens ranotei</i> Smetacek, 2012	West Himalayan Vanilla	- / -
	Bushbrown	202
<i>Mycalesis visala visala</i> Moore, [1858]	Long-Branded Bushbrown	202
Neope pulaha pandyia (Talbot, 1947)	Veined Labyrinth	200 224
Neope yama buckleyi Talbot, 1947	Dusky Labyrinth	224
Neopithecops zalmora zalmora (Butler, [1870])	Common Quaker	145
weopunecops 2000 a 2000 a 2000 a (Builei, [1870])		143

Neptis ananta ananta Moore, [1858]	Yellow Sailer	304
Neptis cartica cartica Moore, 1872	Himalayan Plain Sailer	303
Neptis clinia praedicta Smetacek, 2011	Sullied Sailer	297
Neptis hylas varmona Moore, 1872	Common Sailer	299
Neptis mahendra mahendra Moore, 1872	Himalayan Sailer	300
Neptis melba melba Evans, 1912	Versicoloured Sailer	307
Neptis narayana Moore, 1858	Broadstick Sailer	305
Neptis nata yerburii Butler, 1886	West Himalayan Clear	
	Sailer/ Yerbury's Sailer	302
Neptis sankara sankara (Kollar, [1844])	Broad-banded Salier	295
Neptis sappho astola Moore, 1872	Pallas's /Rusty Sailer	298
Neptis soma butleri Eliot, 1969	Creamy Sailer	296
Neptis zaida zaida Doubleday, [1848]	Pale Green Sailer	306
Notocrypta curvifascia curvifascia	Restricted Demon	384
(C. & R. Felder, 1862)		
Notocrypta feisthamelii alysos (Moore, [1866])	Spotted demon	385
Nymphalidae		195
Nymphalis xanthomelas fervescens	Large Tortoiseshell	278
(Stichel, [1908])		
Ochlodes brahma (Moore, 1878)	Himalayan Darter	387
Odontoptilum angulata angulata		
(C. Felder, 1862)	Chestnut Angle	361
Oreolyce vardhana vardhana (Moore, [1875])	Dusky Hedge Blue	154
Oriens gola pseudolus (Mabille, 1883)	Common Dartlet	388
Oriens goloides (Moore, [1881])	Indian Dartlet	389
Orinoma damaris damaris Gray, 1846	Tigerbrown	239
Pachliopta aristolochiae aristolochiae	Common Rose	32
(Fabricius, 1775)		
Pantoporia hordonia hordonia (Stoll, [1790])	Common Lascar	314
Pantoporia sandaka davidsoni Eliot, 1969	Extra Lascar	315
Papilio agestor govindra Moore, 1864	Tawny Mine	34
Papilio alcmenor alcmenor	Red-breasted Mormon	38
C. & R. Felder, [1864]		
Papilio arcturus arius Rothschild, 1908	Blue Peacock	37
Papilio bianor polyctor Boisduval, 1836	Common Peacock	35
Papilio bootes janaka Moore, 1857	Tailed Redbreast	39

Papilio clytia clytia Linnaeus, 1758	Common Mime	33
Papilio demoleus dmoleus Linnaeus,1758	Lime Swallowtail	45
Papilio helenus helenus Linnaeus, 1758	Red Helen	43
Papilio machaon Linnaeus, 1758	Common Yellow Swallowtail	44
Papilio memnon agenor Linnaeus, 1758	Great Mormon	40
Papilio paris paris Linnaeus, 1758	Paris Peacock	36
Papilio polytes romulus Cramer, [1775]	Common Mormon	42
Papilio protenor protenor Cramer, [1775]	Spangle	41
Papilionidae		17
Paralasa kalinda kalinda Moore, 1865	Scarce Mountain Argus	222
Parantica aglea melanoides Moore, 1883	Glassy Tiger	251
Parantica sita sita (Kollar, [1844])	Chestnut Tiger	250
Pareronia hippia (Fabricius, 1787)	Indian Wanderer	79
Parnara guttatus mangala (Moore, [1866])	Straight Swift	351
Parnassius charltonius Gray, [1853]	Regal Apollo	49
Parnassius epaphus Oberthür, 1879	Common Red Apollo	48
Parnassius hardwickei Gray, 1831	Common Blue Apollo	47
Pedesta masuriensis masuriensis	White-spotted Mussoorie	
(Moore, 1878)	Bush Bob	395
Pelopidas assamensis (de Nicéville, 1882)	Great Swift	352
Pelopidas conjuncta conjuncta	Conjoint Swift	353
(Herrich-Schäffer, 1869)		
Pelopidas mathias mathias (Fabricius, 1798)	Small Branded Swift	354
Pelopidas sinensis (Mabille, 1877)	Chinese Branded Swift	355
Pelopidas subochracea (Moore, 1878)	Large Branded Swift	356
Petrelaea dana (de Nicéville, [1884])	Dingy Line Blue	161
Phaedyma columella ophiana (Moore, 1872)	Short-banded Sailer	301
Phalanta phalantha phalantha (Drury, [1773])	Common Leopard	263
Pieridae		51
Pieris brassicae nepalensis Gray,1846	Large Cabbage White	81
Pieris canidia indica Evans, 1926	Himalayan Cabbage White	82
Pieris melete Menetries,1857	Himalayan Green-veined	
	White	83
Polygonia c-album agnicula (Moore, 1872)	Nepalese Comma	280
Polygonia c-album cognata Moore, [1899]	Kumaon Comma	279
Polytremis discreta discreta	Himalayan White-fringed	
	I	

(Elwes & Edwards, 1897)Swift357Polytremis eltola eltola (Hewitson, 1869)Yellow -Spot Swift358Pontia daplidice moorei (Röber, [1907])Himalayan Bath White84Portita hewitsoni hewitsoni Moore, [1866]Common Gem135Potanthus dara (Kollar, [1844])Himalayan Dart390Pratapa deva lila Moore, [1884]White Tufted Royal116Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudocoladenia fatih (Kollar, [1844])Tabby270Pseudocizeeria maha maha (Kollar, [1844])Tabby270Pseudocizeeria maha maha (Kollar, [1844])Vest Himalayan Pied Flat371Pseudozizeeria maha mata (Kollar, [1844])Oriental Red Flash97Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala nanea schistacea (Moore, 1879)Slate Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sorangesa dusahara dasahara (Moore, 1882)Spotted Small Flat373Seprita dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, [1865])Himalayan White Flat374Shituyaozephyrus ziha (Hewitson, [1865])Himalayan White Flat374Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia grahami			
Pontia daplidice moorei (Röber, [1907])Himalayan Bath White84Poritia hewitsoni hewitsoni Moore, [1866]Common Gem135Potanthus dara (Kollar, [1844])Himalayan Dart390Pratapa deva lila Moore, [1884]White Tufted Royal116Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudoroladenia fatih (Kollar, [1844])Tabby270Pseudozladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Vest Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Oriental Red Flash97Rapala nissa nissa (Kollar, [1844])Oriental Red Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala nea schistacea (Moore, 1879)Slate Flash102Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei (Butler, 1867)Small Tawny Wall225Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spindasis elima uniformis (Moore, 1882)Scare Shot Silverline123 <t< td=""><td>(Elwes & Edwards, 1897)</td><td>Swift</td><td>357</td></t<>	(Elwes & Edwards, 1897)	Swift	357
Poritia hewitsoni hewitsoni Moore, [1866]Common Gem135Potanthus dara (Kollar, [1844])Himalayan Dart390Pratapa deva lila Moore, [1884]White Tufted Royal116Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Vest Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Oriental Red Flash97Rapala nissa nissa (Kollar, [1844])Oriental Red Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Indigo Flash102Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei (Butler, 1867)Small Tawny Wall225Sidoinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Seseria dohertyi dohertyi (Watson, 1882)Spotted Small Flat373Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sindhusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spindasis elima uniformis (Moore, 1882)Scare Shot Silverline123Spindasis elima uniformis (Moore, 1882)<	Polytremis eltola eltola (Hewitson, 1869)	Yellow -Spot Swift	358
Potanthus dara (Kollar, [1844])Himalayan Dart390Pratapa deva lila Moore, [1884]White Tufted Royal116Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudocoladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Oriental Red Flash97Rapala insus arya (Kollar, [1844])Oriental Red Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala nissa nissa (Kollar, [1844])Common Flash102Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia lucasii (Mabille, 1876)Lucas' Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89 <tr <tr="">Spindasis elima uniformis</tr>	Pontia daplidice moorei (Röber, [1907])	Himalayan Bath White	84
Pratapa deva lila Moore, [1884]White Tufted Royal116Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudocizeeria maha maha (Kollar, [1844])Tabby270Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Vest Himalayan Pied Flat97Rapala insus orya (Kollar, [1844])Oriental Red Flash97Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi (Matson, 1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis lohita himalayamus (Moore, 1882) </td <td>Poritia hewitsoni hewitsoni Moore, [1866]</td> <td>Common Gem</td> <td>135</td>	Poritia hewitsoni hewitsoni Moore, [1866]	Common Gem	135
Pratapa icetas icetas (Hewitson, [1865])Dark Blue Royal111Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudozladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Oriental Red Flash97Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash99Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala nese a schistacea (Moore, 1876)Copper Flash101Rapala selira (Moore, 1874)Common Flash101Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small FlatSephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace381Sovia lucasii (Mabille, 1876)Common Shot Silverline123Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Common Shot Silverline124Spindasis lohita	Potanthus dara (Kollar, [1844])	Himalayan Dart	390
Prosotas dubiosa indica (Evans, [1925])Tailless Lineblue163Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudocoladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Vest Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Oriental Red Flash97Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small FlatSarangesa purendra purendra Moore, [1866])Common Small Flat372Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia lucasi (Mabille, 1876)Lucas' Ace381Sovia lucasi (Mabille, 1876)Lucas' Ace380Spipidasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)<	Pratapa deva lila Moore, [1884]	White Tufted Royal	116
Prosotas nora ardates (Moore, [1875])Common Lineblue162Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudocoladenia fatih (Kollar, [1844])Tabby270Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Pale Grass Blue164Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash97Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala selira (Moore, 1874)Comper Flash102Rapala varuna orseis (Hewitson, [1863])Copper Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sperisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline121Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline124<	Pratapa icetas icetas (Hewitson, [1865])	Dark Blue Royal	111
Pseudergolis wedah wedah (Kollar, [1844])Tabby270Pseudocoladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Pale Grass Blue164Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash97Rapala maea schistacea (Moore, 1879)Slate Flash99Rapala pheretima petosiris (Hewitson, [1863])Common Flash101Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa dasahara dusahara (Moore, 1882)Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline124Spindasis lohita himalayanus (Moore	Prosotas dubiosa indica (Evans, [1925])	Tailless Lineblue	163
Pseudocoladenia fatih (Kollar, [1844])West Himalayan Pied Flat371Pseudozizeeria maha maha (Kollar, [1844])Pale Grass Blue164Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash97Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala pheretima petosiris (Hewitson, [1863])Common Flash101Rapala selira (Moore, 1874)Common Flash102Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small FlatSarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1865])Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia lucasii (Mabille, 1876)Lucas' Ace381Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline124Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline124	Prosotas nora ardates (Moore, [1875])	Common Lineblue	162
Pseudozizeeria maha maha (Kollar, [1844])Pale Grass Blue164Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash97Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala varuna orseis (Hewitson, [1863])Copper Flash100Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small FlatSarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialai galba galba (Fabricius, 1793)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline121	Pseudergolis wedah wedah (Kollar, [1844])	Tabby	270
Rapala iarbus sorya (Kollar, [1844])Oriental Red Flash97Rapala manea schistacea (Moore, 1879)Slate Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Small Tawny Wall225Sarangesa dusahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spilaia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline124	Pseudocoladenia fatih (Kollar, [1844])	West Himalayan Pied Flat	371
Rapala manea schistacea (Moore, 1879) Rapala nissa nissa (Kollar, [1844])Slate Flash99Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225RiodinidaeSmall Tawny Wall225Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spila galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline121	Pseudozizeeria maha maha (Kollar, [1844])	Pale Grass Blue	164
Rapala nissa nissa (Kollar, [1844])Common Flash101Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Common Shot Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline121	Rapala iarbus sorya (Kollar, [1844])	Oriental Red Flash	97
Rapala pheretima petosiris (Hewitson, [1863])Copper Flash102Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, [1866])Common Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline124	Rapala manea schistacea (Moore, 1879)	Slate Flash	99
Rapala selira (Moore, 1874)Himalayan Red Flash98Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spindasis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline121	Rapala nissa nissa (Kollar, [1844])	Common Flash	101
Rapala varuna orseis (Hewitson, [1863])Indigo Flash100Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Rapala pheretima petosiris (Hewitson, [1863])	Copper Flash	102
Rhaphicera moorei moorei (Butler, 1867)Small Tawny Wall225Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Rapala selira (Moore, 1874)	Himalayan Red Flash	98
Riodinidae185Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Rapala varuna orseis (Hewitson, [1863])	Indigo Flash	100
Sarangesa dasahara dasahara (Moore, [1866])Common Small Flat372Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Rhaphicera moorei moorei (Butler, 1867)	Small Tawny Wall	225
Sarangesa purendra purendra Moore, 1882Spotted Small Flat373Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Riodinidae		185
Sephisa dichroa (Kollar, [1844])Western Courtier321Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Sarangesa dasahara dasahara (Moore, [1866])	Common Small Flat	372
Seseria dohertyi dohertyi (Watson, 1893)Himalayan White Flat374Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Sarangesa purendra purendra Moore, 1882	Spotted Small Flat	373
Shizuyaozephyrus ziha (Hewitson, [1865])White-spotted Hairstreak106Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Sephisa dichroa (Kollar, [1844])	Western Courtier	321
Sinthusa chandrana chandrana (Moore, 1882)Broad Spark117Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Silver-grey Silverline124Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline121	Seseria dohertyi dohertyi (Watson, 1893)	Himalayan White Flat	374
Sovia grahami grahami (Evans, 1926)Pale Ace381Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Shizuyaozephyrus ziha (Hewitson, [1865])	White-spotted Hairstreak	106
Sovia lucasii (Mabille, 1876)Lucas' Ace380Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Sinthusa chandrana chandrana (Moore, 1882)	Broad Spark	117
Spalgis epius epius (Westwood, [1851])Apefly89Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Sovia grahami grahami (Evans, 1926)	Pale Ace	381
Spialia galba galba (Fabricius, 1793)Asian Grizzled Skipper391Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	<i>Sovia lucasii</i> (Mabille, 1876)	Lucas' Ace	380
Spindasis elima uniformis (Moore, 1882)Scarce Shot Silverline123Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Spalgis epius epius (Westwood, [1851])	Apefly	89
Spindasis ictis ictis (Hewitson, 1865)Common Shot Silverline120Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Spialia galba galba (Fabricius, 1793)	Asian Grizzled Skipper	391
Spindasis lohita himalayanus (Moore, 1884)Long-banded Silverline124Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Spindasis elima uniformis (Moore, 1882)	Scarce Shot Silverline	123
Spindasis nipalicus (Moore, 1884)Silver-grey Silverline121Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Spindasis ictis ictis (Hewitson, 1865)	Common Shot Silverline	120
Spindasis vulcanus vulcanus (Fabricius, 1775)Common Silverline122	Spindasis lohita himalayanus (Moore, 1884)	Long-banded Silverline	124
	Spindasis nipalicus (Moore, 1884)	Silver-grey Silverline	121
Stibochiona nicea nicea (Gray, 1846)Popinjay269	Spindasis vulcanus vulcanus (Fabricius, 1775)	Common Silverline	122
	Stibochiona nicea nicea (Gray, 1846)	Popinjay	269

		1
Suastus gremius gremius (Fabricius, 1798)	Oriental Palm Bob	396
Surendra quercetorum quercetorum	Common Acacia Blue	134
(Moore, [1858])		
Symbrenthia brabira brabira Moore, 1872	Himalayan Yellow Jester	291
Symbrenthia hypselis cotanda Moore, [1875]	Himalayan Spotted Jester	292
Symbrenthia lilaea khasiana Moore, [1875]	Common Jester	293
Symbrenthia niphanda hysudra Moore, 1874	Kumaon Blue-tail jester	294
Symphaedra nais (Forster, 1771)	Baronet	320
Tagiades japetus ravi (Moore, [1866])	Himalayan Common	
	Snow Flat	375
Tagiades litigiosa litigiosa Möschler, 1878	Water Snow Flat	376
Tagiades menaka menaka (Moore, [1866])	Spotted Snow Flat	377
Tajuria cippus cippus (Fabricius, 1798)	Peacock Royal	113
Tajuria diaeus diaeus (Hewitson, [1865])	Straight line Royal	114
Tajuria jehana jehana Moore, [1884]	Plains Blue Royal	115
Talicada nyseus nyseus	Red Pierrot	179
(Guérin-Méneville, 1843)		
Tanaecia julii appiades (Menetries, 1857)	Common Earl	323
Tanaecia lepidea lepidea (Butler, 1868)	Grey Count	324
Taractrocera danna (Moore, 1865)	Himalayan Grass Dart	392
Tarucus callinara (Butler,1886)	Spotted Pierrot	182
Tarucus indica Evans, 1932	Indian/Transparent Pierrot	184
Tarucus nara (Kollar, 1848)	Rounded/ Striped Pierrot	183
Tarucus venosus Moore, 1882	Himalayan/Veined Pierrot	181
Telicota bambusae bambusae (Moore, 1878)	Dark Palm Dart	394
Telicota colon colon (Fabricius, 1775)	Pale Palm Dart	393
Telinga heri (Moore, [1858])	Large-eyed Bushbrown	203
<i>Telinga lepcha lepcha</i> (Moore, 1880)	Lepcha Bushbrown	205
Telinga nicotia (Westwood, [1850])	Bright-eyed Bushbrown	204
Thermozephyrus ataxus ataxus	Wonderful Hairstreak	105
(Westwood, [1851])		
Thoressa aina (de Nicéville, 1889)	Garhwal Ace	382
Tirumala limniace exoticus (Gmelin, 1790)	Blue Tiger	253
Tirumala septentrionis septentrionis	Dark Blue Tiger	252
(Butler, 1874)		

Troides aeacus (C. & R. Felder, 1860)	Golden Birdwing	46
Udara albocaeruleus albocaeruleus	Albocerulean	155
(Moore, 1879)		
Udara dilectus dilectus (Moore, 1879)	Pale Hedge Blue	151
Udaspes folus (Cramer, [1775])	Grass Demon	386
Vagrans egista sinha (Kollar, [1844])	Vagrant	262
Vanessa cardui (Linnaeus, 1758)	Painted Lady	282
<i>Vanessa indica indica</i> (Herbst, 1794)	Indian Red Admiral	281
Virachola isocrates (Fabricius, 1793)	Common Guava Blue	94
Virachola perse perse (Hewitson, [1863])	Large Guava Blue	95
<i>Ypthima asterope mahratta</i> Moore, 1884	Common Three-ring	208
<i>Ypthima avanta</i> Moore, [1875]	Jewel Five-ring	213
Ypthima baldus baldus (Fabricius, 1775)	Common Five-ring	210
Ypthima hannyngtoni hannyngtoni Eliot, 1967	Garhwal Large-branded	
	Five-ring	215
Ypthima huebneri Kirby, 1871	Common Four-ring	209
<i>Ypthima inica</i> Hewitson, [1865]	Lesser Three-ring	206
Ypthima kedarnathensis Singh, 2007	Garhwal Five-ring	216
<i>Ypthima nareda</i> (Kollar, [1844])	Large Three-ring	207
<i>Ypthima nikaea</i> Moore, [1875]	Western Himalayan	
	Five-ring	211
<i>Ypthima parasakra</i> Eliot, 1987	Dubious Five-ring	214
<i>Ypthima sakra sakra</i> Moore, [1858]	Himalayan Five-ring	212
Zemeros flegyas flegyas (Cramer, [1780]	Punchinello	187
Zesius chrysomallus Hübner, [1819]	Redspot	96
Zizeeria karsandra (Moore, 1865)	Dark Grass Blue	165
Zizina otis otis (Fabricius, 1787)	Lesser Grass Blue	166
Zizula hylax hylax (Fabricius, 1775)	Tiny Grass Blue	170

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The book provides information on 365 butterfly species found across the Western Himalayan state of Uttarakhand along with their classification, seasonality, geographical & altitudinal distribution, forest type associations on a GIS platform, larval host plants, Wildlife Protection Act status and images of both ecotourism and identification field guide managers, NGO's, and students.





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