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Diversity of Epiphytic Fern and Fern Allies in Darjeeling Region of Eastern Himalaya, India

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***Abstract*:** Pteridophytes represent a diverse group of plants which forms an interesting and conspicuous part of the forest ecosystem. In this context, the present study examines the species diversity and composition of epiphytic fern and fern allies in Darjeeling eastern Himalaya. Altogether, 73 species were recorded under 22 genera belonging to 10 families. Polypodiaceae was the most dominant and diverse followed by Pteridaceae. The number of species was plotted against different altitudinal gradients which resulted in hump-shaped species distribution pattern. Maximum number of species richness was recorded from the mid-altitudinal range. Host tree diameter and bark texture had the greatest influence on species diversity. Our finding suggests that bigger host trees having rough bark texture generally sheltered maximum species compared to trees having smooth bark. Additionally, the life form and threat status of fern and fern allies have also been assessed.

Keywords: Ferns, Epiphytes, Diversity, Host tree, Conservation

Pteridophytes or vascular cryptogams also traditionally known as fern and fern allies are the first terrestrial plants that originated during the Silurian period and flourished in the Carboniferous (Anderson 2021). Although angiosperms are the most dominant flora in the present world, earlier studies collated around 13,600 extant species of pteridophytes distributed worldwide encompassing around 1200 species with 70 families and 192 genera in India (Hassler and Swale 2001, Moran 2008, Patil et al 2016, Mukhopadhyay 2018, Krishnan and Rekha 2021). Many of the pteridophytic species can be seen as epiphytes on trees, lithophytes on rocks or hydrophytes (Krishnan and Rekha 2021). Ferns and fern allies have flourished in areas of high topographic complexity and are well adapted in diverse habitats from tropical to sub-alpine climatic zones (Page 1979, Dixit 2000, Chowdhury et al 2016, Anderson 2021). Although fern richness and abundance can be seen in moist and shady forests, they also thrive in dry habitats (Alien and Daniel 2019). The pteridophytes perform several critical ecological functions as indicator plants for habitat loss and fragmentation (Silva et al 2018), improving soil conditions (Walker 1994) and also in removing inaccessible arsenic from mined wastelands (Tu and Ma 2005). Furthermore, they are known to adapt to various disturbances and accumulate toxins from the environment (Meh et al 2010). The pteridophytes are not distributed randomly, rather their distribution is completely related to abiotic variables influencing microhabitat characteristics, such as soil texture and fertility, atmospheric temperature and humidity, precipitation and light intensity (Nobrega et al 2011, Patil et al 2016). Ferns are often used by human beings for several purposes and many earlier works have highlighted their use in ethnobotanical and pharmacological explorations (Singh et al 2001, Gogoi 2002, Chen et al 2005, Singh et al 2008a, 2008b). Their antifungal and antimicrobial properties both from the gametophytes and sporophytes are well documented (Guha et al 2004, 2005, Ganguly et al 2011, Goswami et al 2016). The foliage of ferns in the international florist market is highly valued for its long post-harvest life, low cost, year-round availability and versatile design in form, texture and colour (Safeena 2013, Deepa et al 2017). In addition, with certain exceptions ferns have also been used as food globally (Mannan et al 2008). Several botanical explorations have been carried out in Darjeeling Himalayan region over the past one and a half centuries, however, there is no any concise effort highlighting the distribution and ecology of vascular epiphytes from the region. This paper makes an effort to elaborate the diversity and distribution of epiphytic pteridophytes along different elevational gradient. The present investigation also presents a list of ferns and fern allies that occurs in diverse habitats of the study area. Concurrently, species conservation status and life forms have also been assessed.

MATERIAL AND METHODS

Study area: The present study was conducted in Darjeeling Himalaya- an integral part of the eastern Himalayan ecosystem. Geographically, the area extends between 27°2'9.62"N latitude to 88°15'45"E longitude covering an altitudinal range between 98m to 3636m asl (Fig. 1). The area

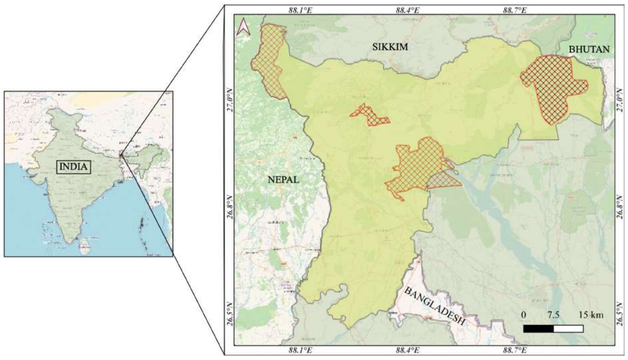

Fig. 1. Study area (Shaded portions indicate protected areas)

remains bordered by Sikkim, Nepal and Bhutan in the north, west and east respectively. Due to the altitudinal variation that ranges from tropical plain to sub-alpine zone, different climatic setup is available in the region which offers a conducive environment for the growth and development of diverse plant species with rich vegetation (Das 2004). The region exhibits a typical monsoon climate, with wet summers and dry winters within four recognized seasons (i) Spring and summer from March to May (ii) Monsoon from June to August (iii) Autumn from September to November and (iv) Winter from December to February (Bhujel 1996). The area consists of a complex terrain system, with varied aspects with an abrupt altitudinal variation that brings about distinct changes in rainfall and precipitation. The temperature varies with a minimum of 2.4°C to a maximum of 9.6°C during winter, 8.3°C to 19.1°C during spring and summer and 12°C to 18°C during autumn season with an average annual precipitation of about 337.3mm. Two National Park and two Wildlife Sanctuaries have been established which occupy a total area of 332.74km^2. Besides these, there are several reserved, un-reserved and social forests in the region.

Field sampling: A field survey was carried out in different forest types of Darjeeling Himalaya keeping in mind the fertile period of fern and fern allies with process of random sampling. Data on the abundance of epiphytic ferns were collected in the field with the assistance of a local tree climber. The reproductive period of the taxa was also noted through field visits in different seasons. Host tree species with >15cm CBH (circumference at breast height) were identified and sampled based on epiphyte abundance and accessibility including bark texture which was classified into smooth and rough (Wyse and Burns 2011). Due to the complex tree architecture encountered in the field, the host trees were divided into two zones (Johansson 1974), the trunk zone covering the area below the first branching till the base and inner crown zone covering the remaining area above the first branching. The epiphytic ferns were classified into different categories holoepiphytes (no contact with the ground), facultative (can grow both on host tree and ground) and accidental (for plants that occasionally grow as epiphytes) (Klein et al 2022). The voucher specimens collected were mounted into herbarium sheets following the conventional methodology (Jain and Rao 1977). The proper identification of the taxa was made following suitable literature (Frazer-Jenkins 2008, Mehra and Bir 2008, Kholia 2010, Frazer-Jenkins et al 2017, 2018, 2021). Herbaria such as Lloyd Botanical Garden and Calcutta University Herbarium (CUH) were also consulted for proper identification. Correct nomenclature was maintained following World Flora Online (WFO 2022) and Global Biodiversity Information Facility (GBIF 2022). The conservation assessment of the taxa was determined following the online data source Threat Search (BGCI 2022). The Herbarium exsiccates were deposited at Calcutta University Herbarium (CUH) for future study. The location and altitude of the study sites were recorded by a global positioning system (GPS; Garmin Terex H) and the map was produced using QGIS version 3.20 (QGIS 2022).

RESULTS AND DISCUSSION

The topography and great altitudinal variation of the region facilitated the luxuriant growth of pteridophytes. A total of 73 species under 22 genera belonging to 10 families in different habitats within the study area were recorded. Polypodiaceae was the most diverse and abundant family with 42 species representing 58%, followed by Aspleniaceae (7 spp.; 10%) and Pteridaceae (6 spp.; 8%). Three families Davalliaceae, Hymenophyllaceae and Lycopodiaceae were represented by 4 species (5%) each. Dryopteridaceae and Oleandraceae had two species (3%) each while Hypodematiaceae and Nephrolepidaceae were monospecific (1%) (Fig. 2A). Amongst the genera, *Lepisorus* had the maximum number of species (8 species) followed by *Asplenium* (7 species), *Goniophlebium*, *Pyrrosia*, and *Loxogramme* (each 6 species) while *Vittaria* was represented by 5 species (Fig. 2B). Concerning life forms, holophytes (56 spp.) were dominant representing 77% followed by facultative species (16 spp.) which represents 22% whereas single species grew as epiphytes accidentally. All the pteridophytic taxa showed an ecological variation from lithophytes growing on rocks to epiphytes on the host tree trunk except *Lepisorus loriformis* and *Huperzia squarrosa* which were truly epiphytic. Majority of the pteridophytic species were herbaceous and perennial in nature. Similarly, the fern allies were represented by a single pendulous genus with 3 species *Huperzia squarrosa*, *H. hamiltonii* and *H. pulcherrima*. Furthermore, late monsoon to mid-autumn was observed to be the most fertile period for the taxa under study (Table 1). An earlier study on fern and fern allies from Western Ghats identified many epiphytes common to the fern and fern allies of Darjeeling Himalayas and some of them have also been identified in this communication too.

Distribution within the host tree: The morphological and physiological characteristics such as bark roughness, canopy soil chemistry and branch inclination including tree architecture have an impact on epiphytic community development (Ganguly and Mukhopadhyay 2008, Wang et al 2016). The forests in the study area were composed of dense multi-layered canopy with dominant host tree species like *Duabanga grandiflora, Callicarpa vestita, Tetrameles nudiflora, Schima wallichii*, *Lagerstroemia parviflora, Shorea robusta, Mallotus repandus, Bridelia retusa*, *Diploknema butyracea, Wrightia sikkimensis, Syzygium cumini, Castanopsis indica, Engelhardia spicata, Ficus neriifolia, Magnolia campbellii*, *Lithocarpus pachyphyllus*, *L. fenestratus*, *Alnus nepalensis, Quercus lamellosa, Saurauia nepaulensis, Ficus auriculata*, *Ostodes paniculata*, *Symplocos glomerata*, etc distributed in different vegetation zones. CBH of the host tree ranged from 20 to 400cm. Maximum numbers of species were found in the host tree having large CBH with rough bark as compared to the host tree with smaller CBH having smooth bark texture. This reflects a positive relationship between phorophyte size and abundance of epiphytes which supports the findings of other studies (Brown et al 2015). The availability of enough time and space for colonization and higher diversity of microhabitats are the main reason for more epiphytic species on large trees rather than on smaller trees (Neider et al 2001, Flores-Palacios and Garcia-Franco 2004, Wang et al 2017). In addition to that, the distribution and development of epiphytic fern and fern allies were affected by host bark traits, trees with coarse bark supported maximum species as they retain moisture for longer and seedling recruitment (Wyse and Burns 2011) while smoother bark sheltered only a few species. Previous studies highlight that epiphytes are related to crown height and orientation of the host tree in terms of climatic variables (Trembley and Castro 2009, Ganguly and Mukhopadhyay 2012a, Zhao et al 2015). The number of species significantly decreases from the trunk zone to the inner crown zone of all the host trees. About 88% of fern and fern allies were distributed in the trunk zone while only 12% occurred towards the inner crown zone (Fig. 3). The decrease in species number from the trunk zone to the inner crown zone may be due to an increase in ultraviolet radiation, decrease in humidity and increase in photon flux density along with the increasing canopy height of the hosts, lack of adaptation for high water stress in vertical canopy branches (Patino et al 1999, Mantovani 1999, Wang 2016). Host tree species such as *Saurauia nepaulensis, Ficus neriifolia, Engelhardia spicata, Duabanga grandiflora* and *Lithocarpus pachyphyllus* with maximum branching sheltered the majority of species and the distribution was contiguous. Other host trees such as *Macaranga denticulata, Schima wallichii* and *Bridelia retusa* with thin branching sheltered comparatively lesser species.

Species richness pattern along elevational gradient: The study suggests that pteridophytic species are morphologically more flexible which allows them to grow across the entire altitudinal gradient. The observed number of species was plotted against the altitudinal ranges which reflected a significant and positive correlation ($R^2=0.618$). The results showed a hump-shaped distribution pattern while the higher altitude gives a monotonically decreasing trend. Maximum species richness was found between 1850-2300m with steep increase up to 2300m, while it decreased gradually beyond that altitude. In the lowest altitudinal band upto 500m, species such as *Asplenium nidus, Drynaria quercifolia, Microsorum punctatum, Pyrrosia lanceolata* and *P. nuda* were most dominant. Some species like *Asplenium yoshinagae*, *A. planicaule*, *Arthromeris wallichiana, Drynaria mollis, Goniophlebium amoenum, Lepisorus sordidus,*

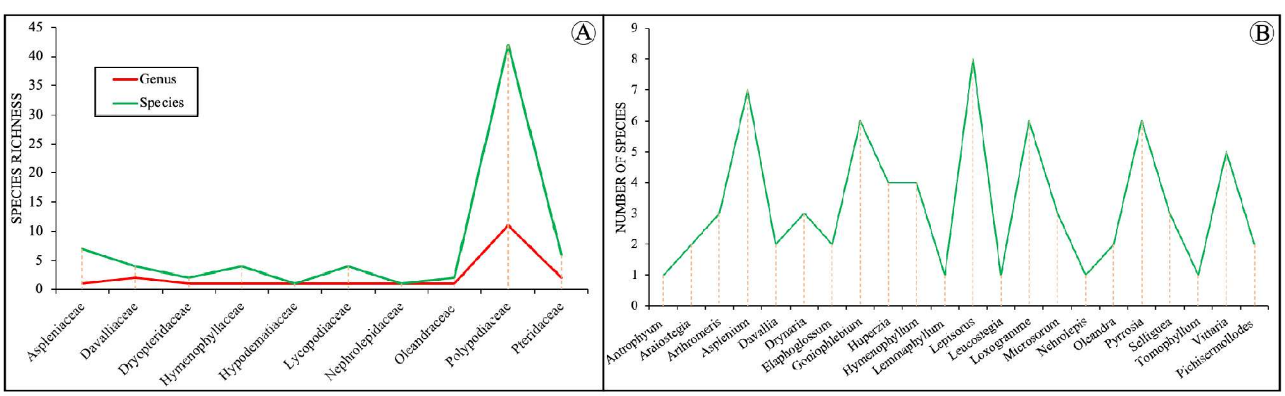

Fig. 2. A. Species richness under different families B. Number of species under each genus

Table 1. Status of epiphytic fern and fern allies in Darjeeling Himalaya

Taxa	Life form	Elevation (m)	Fertile period	Distribution	Conservation status
Aspleniaceae					
Asplenium ensiforme Wall. ex Hook. & Grev.	Hol	1800-2800	June-Sep	TZ	NT
A. laciniatum D.Don	Fac	1400-2100	Aug-Nov	TZ	NT
A. nidus L.	Fac	150-1500	Aug-Nov	ICZ	NT
A. phyllitidis D.Don	Hol	600-1600	Jul-Dec	TZ	LC
A. planicaule Wall. ex Mett.	Fac	1200-2400	Aug-Oct	ICZ	LC
A. tenuifolium D.Don	Fac	1200-2400	Aug-Dec	TZ	NT
A. yoshinagae Makino	Fac	1200-2400	Jun-Nov	TZ	LC
Davalliaceae					
Araiostegia dareiformis (Hook.) Copel.	Fac	2100- 2400	Jul-Oct	TZ	Unknown
A. multidentata (Wall. ex Hook.) Copel.	Hol	1400-2100	Jul-Dec	TZ	Unknown
Davallia bullata Wall.	Fac	900-1800	Jul-Oct	TZ	Unknown
D. pulchra D.Don	Fac	1600-2700	Jul-Nov	TZ	NT
Dryopteridaceae					
Elaphoglossum marginatum T.Moore	Hol	1400-2200	May-Jul	TZ	NT
E. stelligerum (Wall. ex Baker) T.Moore ex Salomon	Acc	500-1700	Jun-Aug	TZ	NT
Hymenophyllaceae					
Hymenophyllum badium Hook. &Grev.	Hol	2100-3000	Aug-Nov	TZ	Unknown
H. exsertum Wall. ex Hook.	Hol	900-1400	Aug-Nov	TZ	NT
H. simonsianum Hook.	Hol	1000-2400	Aug-Nov	TZ	NT
H. tenellum D.Don	Hol	500-1700	Aug-Nov	TZ	NT
Hypodematiaceae					
Leucostegia truncata (D.Don) Fraser-Jenk.	Hol	500-2200	Jul-Sep	TZ	NT
Lycopodiaceae					
Huperzia hamiltonii (Spreng.) Trevis.	Hol	2000-3200	Jul-Oct	TZ	EN
H. phlegmaria (L.) Rothm.	Hol	950-1450	Jul-Sep	TZ	EN
H. pulcherrima (Wall. ex Hook. & Grev.) Pic.Serm.	Hol	1400-2600	Jul-Oct	TZ	VU
H. squarrosa (G.Forst.) Trevis.	Hol	500-1600	Jun-Sep	ICZ	EN
Nephrolepidaceae					
Nephrolepis cordifolia (L.) C.Presl	Fac	500-2000	Aug-Nov	TZ	NT
Oleandraceae					
Oleandra pistillaris (Sw.) C.Chr.	Fac	1200-1700	Aug-Oct	TZ	DD
O. wallichii (Hook.) C.Presl	Fac	1100-3000	Aug-Oct	TZ	NT
Polypodiaceae					
Arthromeris himalovata Fraser-Jenk. & Kandel	Hol	2400-2700	Jun-Nov	TZ	NT
A. lehmannii (Mett.) Ching	Hol	1800-2700	Jun-Nov	TZ	NT
A. wallichiana (Spreng.) Ching	Hol	900-2700	Aug-Dec	TZ	NT
Drynaria mollis Bedd.	Hol	1500-2800	Jun-Aug	TZ	NT
D. propinqua (Wall. ex Mett.) J.Sm.	Hol	1600-2400	May-Oct	TZ	NT
D. quercifolia (L.) J.Sm.	Hol	400-1000	Jul-Dec	TZ	NT
Goniophlebium amoenum (Wall. ex Mett.) Bedd.	Hol	100-1600	Aug-Nov	TZ	NT
G. hendersonii (Atk.) Bedd.	Hol	1800-3000	Jul-Sep	TZ	Unknown
G. lachnopum (Wall. ex Hook.) Bedd.	Hol	1500-2400	Jun-Oct	TZ	VU

Cont...

Table 1. Status of epiphytic fern and fern allies in Darjeeling Himalaya

Taxa	Life form	Elevation (m)	Fertile period	Distribution	Conservation status
G. argutum (Wall. ex Hook.) Bedd.	Hol	1200-2200	Sep-Nov	TZ	NT
G. microrhizoma (C.B. Clarke ex Baker) Clarke ex Bedd.	Hol	1200-2400	Jul-Oct	TZ	EN
G. subamoenum (C.B. Clarke) Bedd.	Fac	1000-2400	Jun-Nov	TZ	VU
Lemmaphyllum rostratum (Bedd.) Tagawa	Hol	1200-2000	Mar-Jul	ICZ	NT
Lepisorus contortus Ching	Hol	2200-2600	Aug-Nov	TZ	NT
L. loriformis Ching	Hol	2000-3000	Jul-Sep	TZ	NT
L. mehrae Fraser-Jenk.	Hol	1500-2400	Jul-Nov	TZ	NT
L. normalis (D.Don) C.F.Zhao, R.Wei & X.C.Zhang	Hol	900-2600	Aug-Nov	TZ	NT
L. nudus Ching	Hol	1500-2400	Oct-Feb	TZ	NT
L. scolopendrium (Ching) Mehra & Bir	Hol	1400-2800	Jul-Sep	TZ	NT
L. sordidus (C.Chr.) Ching	Hol	1200-1400	Jul-Sep	TZ	VU
L. sublinearis Ching	Hol	1800-2400	Jul-Sep	TZ	NT
Loxogramme chinensis Ching	Hol	1000-1700	Sep-Nov	TZ	NT
L. cuspidata (Zenker) M.G.Price	Hol	1400-1900	Jun-Sep	TZ	DD
L. grammitoides (Baker) C. Chr.	Hol	800-1200	Jul-Nov	TZ	NT
L. involuta (D.Don) C.Presl	Hol	800-2200	Aug-Oct	TZ	NT
L. lanceolata (Sw.) C. Presl	Hol	1500-2400	Aug-Dec	TZ	NT
L. porcata M.G.Price	Hol	850-1200	Aug-Nov	TZ	NT
Microsorum cuspidatum (D.Don) Tagawa	Fac	1000-1850	Aug-Dec	TZ	VU
M. membranaceum (D.Don) Ching	Fac	500-2600	Aug-Dec	TZ	NT
M. punctatum (L.) Copel.	Fac	300-750	Aug-Nov	TZ	NT
Pichisermollodes ebenipes (Hook.) Fraser-Jenk.	Hol	300-1000	Jul-Sep	TZ	Unknown
P. stewartii (Bedd.) Fraser-Jenk.	Hol	1200-2000	July-oct	TZ	Unknown
Pyrrosia costata (Wall. ex C.Presl) Tagawa & K.Iwats.	Hol	1300-2200	Jul-Dec	ICZ	NT
P. heteractis (Mett. ex Kuhn) Ching	Fac	300-2000	Jul-Oct	TZ	NT
P. lanceolata (L.) Farw.	Hol	300-1800	Jul-Oct	ICZ	NT
P. mannii (Giesenh.) Ching	Hol	700-1400	Jul-Oct	TZ	VU
P. nuda (Giesenh.) Ching	Hol	400-1500	Jul-oct	ICZ	NT
P. porosa (C.Presl) Hovenkamp	Hol	1400-2200	May-Oct	TZ	DD
Selliguea griffithiana (Hook.) Fraser-Jenk.	Hol	1600-2800	Jun-Nov	TZ	Unknown
S. hastata (Thunb.) Fraser-Jenk.	Hol	1500-2500	Jun-Sep	TZ	NT
S. oxyloba (Wall. ex Kunze) Fraser-Jenk.	Hol	1200-2800	Jun-Oct	TZ	NT
Tomophyllum donianum (Spreng.) Fraser-Jenk. & Parris	Hol	1200-2530	Aug-Nov	TZ	NT
Pteridaceae					
Antrophyum coriaceum (D.Don) Wall. ex T. moore	Hol	600-1500	Aug-Dec	TZ	VU
Vittaria elongata Sw.	Hol	1400-2800	Jul-Oct	ICZ	LC
V. flexuosa Fee	Hol	1600-2500	Jul-Oct	ICZ	LC
V. himalayensis Ching	Hol	400-1500	Jul-Oct	TZ	Unknown
V. ophiopogonoides Ching	Hol	1350-3000	Aug-Nov	TZ	Unknown
V. sikkimensis Kuhn	Hol	1600-2500	Jul-Oct	TZ	Unknown

Abbreviations used: Hol-Holoepiphytes, Fac-Facultative epiphyte, Acc-Accidental epiphyte; TZ-Trunk zone, ICZ-Inner crown zone; NT-Not threatened, DD-Data deficient, LC-Least concern, VU-Vulnerable, EN- Endangered

Microsorum cuspidatum, *Huperzia pulcherrima*, *Lepisorus mehrae*, *Loxogramme cuspidata, Microsorum membranaceum, Pyrrosia costata*, *P. mannii*, *Vittaria elongata* and *V. flexuosa* were predominant at mid elevational ranges. *Arthromeris himalovata*, *A. lehmannii*, *Davallia pulchra, Goniophlebium hendersonii, Huperzia hamiltonii*, *Lepisorus loriformis, Oleandra wallichii, Selliguea griffithiana* and *Vittaria ophiopogonoides* were common pteridophytic epiphytes from higher altitudes (2500-3000 m) (Fig. 4). The study reveals that the mid-altitudinal zone that falls within the temperate forest represented higher species richness as the climatic condition of this zone makes it conducive for plant species to flourish (Ganguly and Mukhopadhyay 2012a, Zotz 2016, Dormann et al 2020). It may also be due to the large canopy cover which prevents penetration of light that makes the most favourable conditions for both fern and fern allies. In line with previous findings (Rezende et al 2015, Malik and Nautiyal 2016, Sinha et al 2018, Bhat et al 2020), our results showed a decreased number of species in the higher altitudinal zone. Extremely low temperature, short period of the growing season and geographical barriers (Chawla et al 2008, Rosa-Manzano et al 2019, Schroter and Obenhuber 2022), stunted forest vegetation near the treeline (Kromer et al 2005), decreased soil fertility (Halbritter 2018), uneven topography, and an increase in steepness and lesser top soil depth at high altitudes (Timsina et al 2021) could be the reason for the reduction in species richness towards higher altitudinal regions.

Conservation assessment: Considering the database for a conservation assessment of plants, the majority of the species have been categorized as not threatened (NT) representing 59% (Fig. 5). Further, three species (4%) were data deficient (*Loxogramme cuspidata, Oleandra pistillaris* and *Pyrrosia porosa*). Some of the species that were least concerned (7%), *Asplenium phyllitidis, A. planicaule*, *A. yoshinagae*, *Vittaria elongata* and *V. flexuosa*. Taxa like *Antrophyum coriaceum, Goniophlebium lachnopum*, *G. subamoenum*, *Huperzia pulcherrima*, *Lepisorus sordidus, Microsorum cuspidatum* and *Pyrrosia mannii* were

Fig. 3. Photo collage of fern and fern allies A. *Lemmaphyllum rostratum,* B. *Lepisorus sublinearis,* C. *Lepisorus scolopendrium,* D. *Pyrrosia nuda,* E. *Asplenium ensiforme,* F. *Pyrrosia costata,* G. *Goniophlebium amoenum,* H. *Selliguea griffithiana,* I. *Loxogramme involuta,* J. *Pyrrosia heteractis,* K. *Lepisorus normalis,* L. *Elaphoglossum stelligerum,* M. *Huperzia pulcherrima,* N. *Pyrrosia mannii*

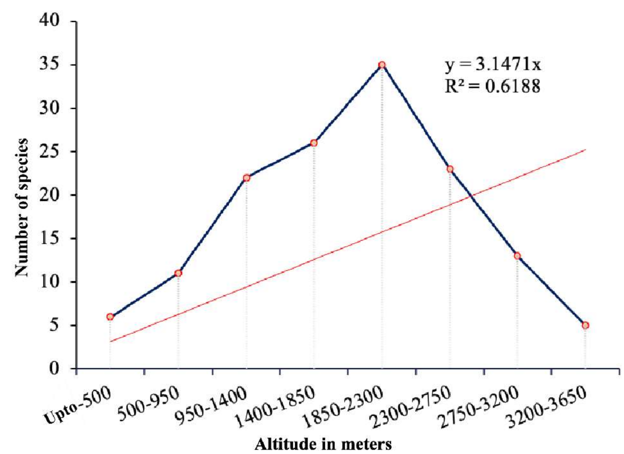

Fig. 4. Distribution along an elevational gradient

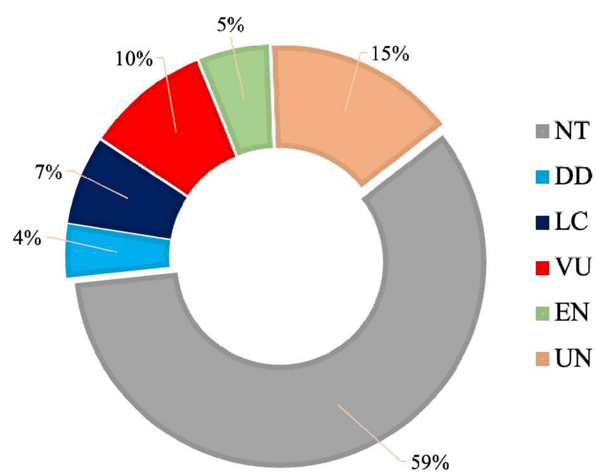

Fig. 5. Threat status of fern and fern allies

considered as vulnerable (10%). Concurrently, four species representing 5% of the taxa were categorized as endangered (*Goniophlebium microrhizoma*, *Huperzia hamiltonii*, *H. phlegmaria* and *H. squarrosa*). However, the threat status of the remaining 11 species is still unknown. Although a reasonably good number of taxa have been observed in the study, the plants are still under serious threat. Almost all forests are affected in the hilly region as the human population and habitat modification have been increasing at an alarming rate (Ganguly and Mukhopadhyay 2012b). Still many tribes and local people depend upon herbal medicines for their primary health care services (Mownika et al 2021), collection of plants for ethnobotanical practices and their commercial aspects by local inhabitants is also the reasons for the decline in the population of species at certain habitats (Uniyal and Shiva 2005, Thakur and Sidhu 2017). Some ethnomedicinal plants have also been identified that are widely used. For example, the rhizome of *Drynaria quercifolia* is used as an antibacterial, anti-inflammatory also treats typhoid, cough, dyspepsia and phthisis (Raha et al 2020, Ojha 2021), rhizome of *Nephrolepis cordifolia* is used against chest congestion, rheumatism and cough (Luitel et al 2014), the rhizome of *Oleandra wallichii* is reported to be used by aged as rejuvenating (Benniamin 2011, Malla 2018). Additionally, *Lepisorus mehrae* treats back pain, stomach problem and fever (Pradhan 2020) and *Loxogramme involuta* treats cuts and wounds (Malla 2018). Although the majority of these species (not threatened) were locally common, a large number of taxa have been exposed to anthropogenic threats regularly. Lack of inadequate conservation of taxa in the region has been identified. The rich diversity of the area is threatened due to deforestation, expansion of agriculture and many other developmental activities. Hence, it is noteworthy to focus on such species for future study and conservation approaches which will subsequently conserve the rich and diverse flora of the region.

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