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10.11609/jott.2026.18.2.28262-28454  
[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

26 February 2026 (Online & Print)  
18(2): 28262-28454  
ISSN 0974-7907 (Online)  
ISSN 0974-7893 (Print)



ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher  
**Wildlife Information Liaison Development Society**  
www.wild.zooreach.org

Host  
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www.zooreach.org

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continued on the back inside cover

Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.



## Floristic composition and conservation significance of vascular plants in Kalatop-Khajjia Wildlife Sanctuary, Himachal Pradesh, India

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**Abstract:** Kalatop–Khajjia Wildlife Sanctuary represents one of the ecologically significant forested landscapes of the northwestern Himalaya; however, updated and systematic documentation of its vascular flora has remained limited. In view of increasing anthropogenic pressures and climate variability, a comprehensive floristic survey was undertaken during 2023–2025 to assess the plant diversity and conservation status of the sanctuary. A total of 141 plant species representing 112 genera and 53 families were recorded. Out of these, 136 species belonged to angiosperms and five species to gymnosperms. Among dicotyledons, Asteraceae was the most dominant family, with 24 species. Among the monocotyledons, Orchidaceae was the most dominant family, with five species. The study area is dominated by native species, and only 9.93% of species were alien. The sanctuary hosts ten endangered plant species, including *Taxus contorta* and *Lilium polyphyllum*. The findings highlight the sanctuary as a reservoir of native and threatened plant diversity in the western Himalaya. The recorded baseline data serve as critical resources for biodiversity assessment, habitat management, and conservation strategy development. It is imperative to reinforce protective measures and support long-term ecological monitoring to safeguard this fragile ecosystem against emerging environmental challenges.

**Keywords:** Altitude gradient, angiosperms, conservation, endangered, endemism, flora, Himalayan plants, native, protected areas, threatened.

कलाटोप-खज्जियार वाइल्डलाइफ सैंक्चुअरी, उत्तर-पश्चिमी हिमालय रा इक बड़ा खास जंगली इलाका है, हालाँकि, इसदी संवहनी बूटियां री नोइ कने व्यवस्थित जानकारी घट है। बददे इंसानी दबाव कने बदलदे मौसमी हालातां जो दिखदे हुए, 2023 का लेई करी 2025 तिक इक बड़ा बड़ा पौध्यां रा सर्वे कीता गया ताकि सैंक्चुअरी रे पौध्यां कने तिना रे संरक्षण रे बारे पता लगी सके। इस अंदर कुल 141 पौध्यां री प्रजातियां, जे कि 112 जेनेरा ते 53 फैमिली कने संबंघित थीयां, दर्ज कीती गईयां। इनां बिच 136 प्रजातियां एंजियोस्पर्म ते पंज प्रजातियां जिन्मोस्पर्म री थीयां। डाइकोटाइलडॉन अंदर, एस्टेरेसी प्रमुख फैमिली थी, जिस अंदर 24 प्रजातियां थीयां। मोनोकोटाइलडॉन अंदर, ऑर्किडेसी प्रमुख फैमिली थी, जिस अंदर पंज प्रजातियां दर्ज कीतियां गईयां। इस इलाके अंदर देसी प्रजातियां ज्यादा हिन, कने सिर्फ 9.93% प्रजातियां बाहरे री थीयां। सैंक्चुअरी अंदर टैक्सस कॉन्टोर्टा कने लिलियम पॉलीफिलम समेत दस प्रजातियां संकटग्रस्त पाई गईयां। इनां नतीजेयां का पता लगदा कि ए सैंक्चुअरी पश्चिमी हिमालय अंदर देसी कने संकटग्रस्त पौध्यां रा खासमखास भंडार है। ए सर्वे इक जरूरी ते खास जानकारी दिन्दा, जिस कने आने वाले कल अंदर जैव विविधता रे मूल्यांकन कने आवास प्रबंधन ते सुरक्षा नीतियां बनाने अंदर मदद होई सकदी। इस नाजुक पारिस्थितिकी तंत्र जो पर्यावरण चुनौतियां का बचाणे ताहीं, बचाव के उपा जो मजबूत करणा कने लंबे समय ताहीं पारिस्थितिक निगरानी जो बढ़ावा देगा बड़ा जरूरी है।

**Editor:** Afroz Alam, Banasthali Vidyapith, Rajasthan, India.

**Date of publication:** 26 February 2026 (online & print)

**Citation:** Sumit, G. Kumar, S. Singh, K. Singh, T. Sheikh, P.V. Ahuja & A. Kumar (2026). Floristic composition and conservation significance of vascular plants in Kalatop-Khajjia Wildlife Sanctuary, Himachal Pradesh, India. *Journal of Threatened Taxa* 18(2): 28263–28274. <https://doi.org/10.11609/jott.10030.18.2.28263-28274>

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**Funding:** This research received no external funding.

**Competing interests:** The authors declare no competing interests.

**Author details, Author contributions & Acknowledgements:** See end of this article.



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## INTRODUCTION

A thorough knowledge of the floristic composition of a plant community is essential for understanding the overall structure and function of an ecosystem (Gairola et al. 2010). Even in the present day, floristic research holds significant value, especially in geographic regions with limited knowledge of their flora, within protected areas, and in biodiversity hotspots (Wagensommer 2023). Such studies also help us in understanding the changes that take place in forest plant communities (Lalithalakshmi et al. 2024). Moreover, such data are essential for formulating effective conservation strategies (Wani et al. 2023; Sherafu et al. 2024).

The Indian Himalayan Region (IHR) is one of the most ecologically significant and biologically rich areas in the world. It is globally recognized as a major biodiversity hotspot due to its extraordinary range of climatic conditions and diverse altitude gradients that span from subtropical foothills to alpine and glacial zones (Palni & Rawal 2010; Haq et al. 2023). Covering roughly 18% of India, the Indian Himalayan Region (IHR) stretches over 2,800 km and varies in width from 220–300 km, with its altitudes ranging 200–8,000 m, harbours nearly 8,000 species of flowering plants, about 40% of which are endemic (Samant 2021).

Himachal Pradesh holds a prominent position among the Indian states comprising the IHR, due to its expansive forest cover, rich flora, and diverse habitats. Notably, the Chamba District, which lies in the northwestern part of Himachal Pradesh, is characterized by its rugged terrain, high mountains, and deep valleys. The Chamba District is home to five designated Wildlife Sanctuaries: Gargol Siyabehi, Kalatop-Khajjiar, Kugti, Sech Tuan Nala, and Tundah (Kumar et al. 2018). Despite their ecological significance, these protected areas remain largely underexplored or, in some cases, completely unexplored in terms of their biodiversity and ecological potential. The Kalatop-Khajjiar Wildlife Sanctuary (KKWS) is the smallest sanctuary in the district and is an ecologically sensitive zone known for its scenic beauty and rich plant biodiversity. Khajjiar, 'Mini Switzerland' is a popular tourist destination that welcomes thousands of tourists annually (Verma & Kapoor 2011). This influx of vehicles on a daily basis leads to environmental pollution, posing a growing threat to the sanctuary's diverse flora due to both ecological and human-induced factors. Besides, a variety of abiotic and biotic factors, including pollution, deforestation, over-exploitation of forest resources, habitat destruction or fragmentation, and invasive species, significantly influence the ongoing transformation of

ecosystems (Haq et al. 2023). Consequently, it is essential to periodically update the floristic inventory to achieve a thorough understanding of species interactions within their environment and among themselves. Furthermore, these serve as important indicators of shifts in floristic composition, recent invasions, and the current status of endemic and threatened taxa in a given phytogeographical area (Ravi et al. 2016). Keeping this in view, the current study was conducted to investigate the floral diversity of KKWS. Information pertaining to the floristic diversity of KKWS is scanty. Verma & Kapoor (2011) studied the floristic composition of the Sanctuary. In continuation, the present communication describes and analyses the floristic composition and life forms of KKWS.

## MATERIALS AND METHODS

### Study area

The KKWS was founded in 1958. It currently spreads over an area of 17.17 km<sup>2</sup> (Kumar et al. 2014). The altitude ranges 1,850–2,750 m (Kumar et al. 2018). The sanctuary is divided into two blocks – Khajjiar and Lakkarmandi, and six beats – Khajjiar, Khajroth, Talai, Lakkarmandi, Kalatop, and Daikund (Kumar 2020). The area can be categorized into three ecosystems: dense forests of mixed fir, spruce and deodar with oak and rhododendron, a lake meadow-Khajjiar, surrounded on all sides by deodar trees, and a small portion of alpine pasture at the Daikund area. Precipitation is in the form of rain and snow. The temperature ranges from sub-zero in winters to 32 °C in summers. The sanctuary represents the flora of sub temperate to alpine climate (Verma & Kapoor 2011).

### Data collection

Extensive field surveys were conducted from 2023–2025 across various growing seasons to collect plant samples and to record data from various geographic locations of the study area. For each species, GPS coordinates (latitude, longitude, and altitude), as well as field data on plant habit, floral morphology, and phenology, along with other data such as date, location, voucher number, information about the flower colour and other features that are lost during pressing, were recorded in the field book. Plants that are uncommon or threatened were thoroughly examined, and data were documented. Digital photos of the collected vouchers were taken to record the presence of specific species in the specified regions. Voucher specimens were processed according to the methodologies outlined by Jain & Rao (1977) in their Herbarium Techniques, which involve pressing, drying,

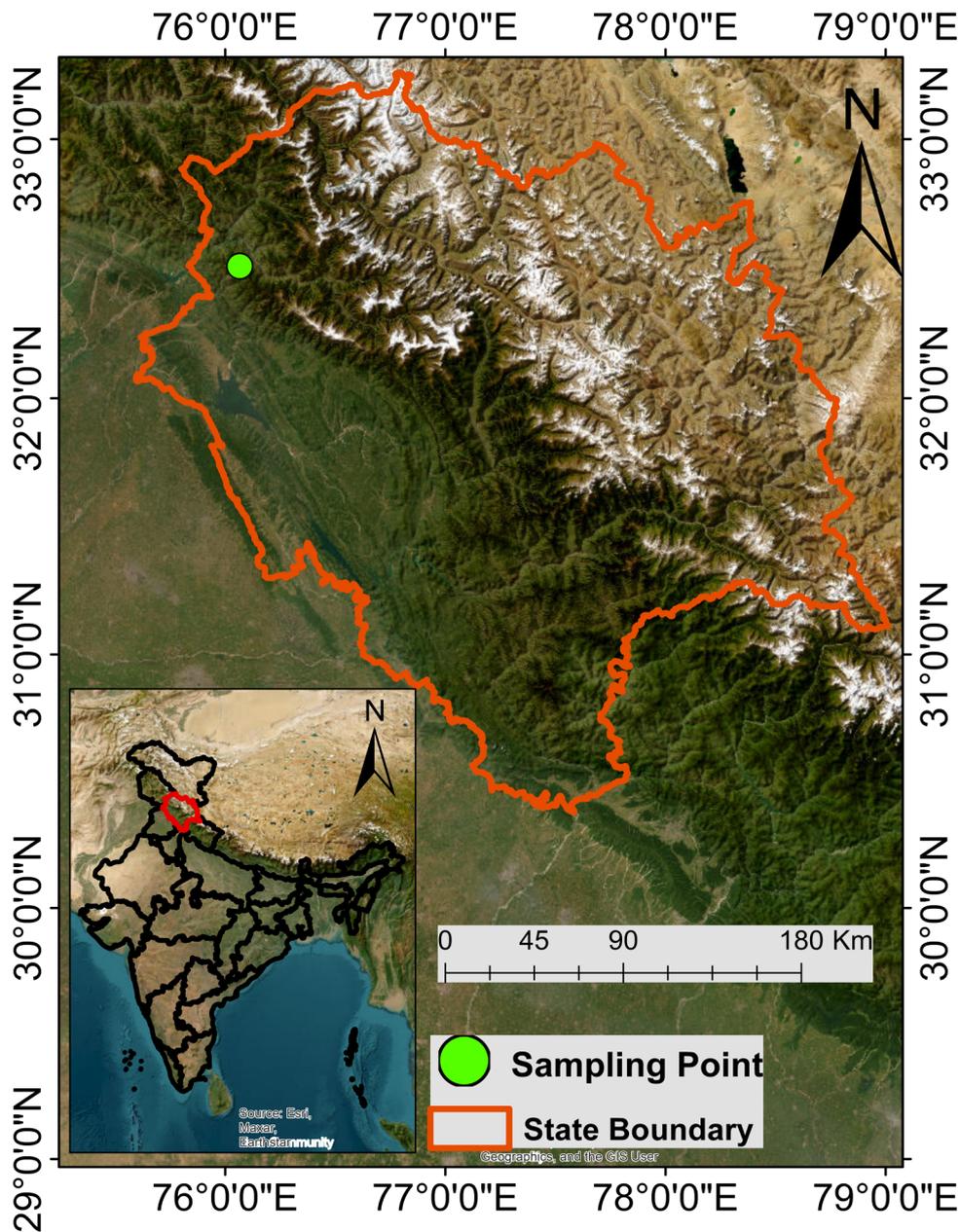


Figure 1. Map of the study area.

applying 1% mercuric chloride solution for preservation, mounting on standard-sized herbarium sheets of 28 x 42 cm, and subsequently stitching and labelling them. The identification of plant species was carried out using local and regional floras, including authoritative references such as Collett (1902); Chowdhery & Wadhwa (1984); Polunin & Stainton (1984); Stainton (1988); Aswal & Mehrotra (1994); Dhaliwal & Sharma (1999); Singh & Sharma (2006), scientific articles and herbarium of Career Point University Hamirpur. The collected plant specimens were deposited at the Herbarium of Career Point University,

Hamirpur. Voucher specimens marked with an asterisk (\*) were previously collected and deposited as a part of an earlier ethnomedicinal study in the same area (Sumit et al. 2025). These voucher specimens were included in the current research, and additional information for these species was collected during this investigation. Plant species identified for the first time in the present study were collected, processed, authenticated and assigned new accession numbers.

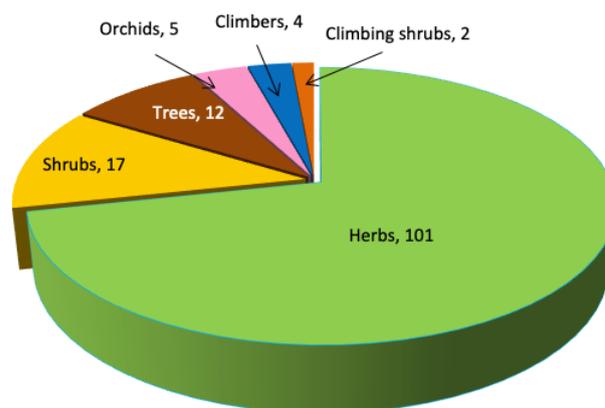
## RESULTS AND DISCUSSION

In the present study, a total of 141 plant species representing 112 genera and 53 families were documented (Table 1 & 3). This constitutes approximately 14.02% of the total flora of the Chamba District and about 4.33% of the overall flora of Himachal Pradesh. Native species dominated (90.07%); only 9.93% of species were found to be alien. Out of these, 136 species were angiosperms (115 species of dicotyledons and 21 species of monocotyledons), and five species were gymnosperms. Among the dicotyledons, Asteraceae was the most dominant family (24 species) followed by Lamiaceae (9 species), Rosaceae (8 species), Caryophyllaceae (6 species), Fabaceae (5 species), Polygonaceae (5 species), Apiaceae (4 species), Balsaminaceae (4 species), Berberidaceae (3 species), Primulaceae (3 species), Onagraceae (3 species), Acanthaceae (3 species). Amaranthaceae, Brassicaceae, Crassulaceae, Caprifoliaceae, Scrophulariaceae, Geraniaceae, Hydrangiaceae, Mazaceae, Urticaceae and Adoxaceae were represented by two species each. Rest of the dicot families, Apocynaceae, Aquifoliaceae, Campanulaceae, Cornaceae, Ericaceae, Euphorbiaceae, Fagaceae, Haloragaceae, Moraceae, Orobanchaceae, Phyllanthaceae, Plantaginaceae, Ranunculaceae, Rubiaceae, Sapindaceae, Saxifragaceae, Ulmaceae, and Vitaceae were represented by one species each. Among the monocotyledons, Orchidaceae was the most dominant family (5 species), followed by Zingiberaceae (3 species), Poaceae (2 species), Juncaceae (2 species), Asparagaceae (2 species), and Smilacaceae (2 species). Families Acoraceae, Araceae, Commelinaceae, Dioscoreaceae, Liliaceae, were represented by one species only. Pinaceae was found to be the most represented family with four species and Taxaceae was represented by one species only.

The overall diversity includes 101 herbs, 17 shrubs, two climbing shrubs, 12 trees, four climbers, and five orchids (Figure 2). *Chaerophyllum reflexum*, *Selinum vaginatum*, *Polygonatum verticillatum* (Image 2I), *Artemisia absinthium*, *Berberis lycium* (Image 2J), *Podophyllum hexandrum* (Image 1D), *Valeriana jatamansi*, *Dioscorea deltoidea* (Image 1C), *Rhododendron arboreum*, *Malaxis muscifera* (Image 1A), *Pyrus pashia*, *Rosa macrophylla* (Image 2H), *Ulmus wallichiana*, *Urtica dioica*, *Cautleya spicata* (Image 2K), *Hedychium spicatum* (Image 2L), *Roscoea alpina* (Image 1G), *Cedrus deodara* and *Taxus contorta* (Image 1F). Some exotic medicinal plants include *Acorus calamus*, *Vincetoxicum hirundinaria* and *Digitalis purpurea* (Image 1B). Some species were edible: leaves of

**Table 1. Number of families, genera, and species reported from the study area.**

Groups	Families total (% of the total)	Genera total (% of the total)	Species total (% of the total)
Angiosperms (i) Dicotyledons	40 (75.47)	89 (79.46)	115 (81.56)
(ii) Monocotyledons	11 (20.76)	18 (16.07)	21 (14.89)
Gymnosperms	02 (3.77)	05 (4.47)	05 (3.55)
Total	53 (100)	112 (100)	141 (100)



**Figure 2. Floristic composition of Kalatop-Khajjiar Wildlife Sanctuary (depicts the total floristic diversity (native as well as exotic)).**

*Stellaria media*, *Rumex nepalensis*, *Nasturtium officinale*, *Pilea scripta*, and *Urtica dioica* are cooked as vegetables, flowers of *Rhododendron arboretum* and *Berberis napaulensis* (Image 2M) are used to make chutney, Ripe fruits of *Berberis lycium*, *Berberis napaulensis*, *Pyrus pashia*, and *Rubus macilentus* are edible. Leaves of *Quercus leucotrichophora*, *Ficus hederacea*, *Polygonum plebeium*, *Rumex nepalensis*, and *Cornus macrophylla* are used as fodder.

## CONSERVATION STATUS

One-hundred-and-three of 114 species recorded from the study area are not assessed and 31 species as 'Least Concern' (LC) according to the IUCN Red List. Ten species from the study area were found to be threatened based on different assessment authorities. At the global level, as per IUCN Red List of Threatened Species, *Podophyllum hexandrum* and *Taxus contorta* are categorized as 'Endangered' (EN), while *Malaxis muscifera* and *Ulmus wallichiana* are listed as 'Vulnerable' (VU). *Lilium polyphyllum* is categorized as 'Critically Endangered' (CR) under the IUCN Red List.



Table 2. List of vascular flora of Kalatop-Khajjiar Wildlife Sanctuary, Chamba, Himachal Pradesh, India.

Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruitleting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
Acoraceae	<i>Acorus calamus</i> L.	CPUH14232*	Herb	Marshy area	June–September	1961	32.546°	76.058°	–	Alien
	<i>Dicliptera bupleuroides</i> Nees	CPUH14215	Herb	Road side	November–June	1993	32.549°	76.059°	LC	Native
Acanthaceae	<i>Strabianthes attenuata</i> (Wall. ex Nees) Jacq. ex Nees	CPUH14135	Shrub	Forest margin, Road side	June–October	2374	32.549°	76.018°	NA	Native
	<i>Strabianthes penstemonoides</i> (Nees) T.Anderson	CPUH14171	Shrub	Forest trail	July–October	2029	32.539°	76.053°	NA	Native
Adoxaceae	<i>Viburnum grandiflorum</i> Wall. ex DC.	CPUH14045	Shrub	Road side	March–June	2442	32.529°	76.033°	NA	Native
	<i>Viburnum mullaha</i> Buch.–Ham. ex D.Don	CPUH14100	Shrub	Forest area	May–October	2283	32.534°	76.044°	LC	Native
Amaranthaceae	<i>Cyathula capitata</i> Moq.	CPUH14133	Herb	Forest trail	July–October	2425	32.547°	76.019°	NA	Native
	<i>Cyathula tomentosa</i> (Schult.) Moq.	CPUH14177*	Herb	Forest margin	August–October	2198	32.535°	76.048°	NA	Native
	<i>Bupleurum longicaule</i> Wall. ex DC.	CPUH14137	Herb	Alpine slopes	June–September	2690	32.525°	76.026°	NA	Native
Apiaceae	<i>Chaerophyllum reflexum</i> Lindl.	CPUH14097*	Herb	Forest margin	May–September	2104	32.534°	76.054°	NA	Native
	<i>Sanicula elata</i> Buch.–Ham. ex D.Don	CPUH14075	Herb	Forest trail	June–October	2023	32.539°	76.054°	NA	Native
Apocynaceae	<i>Selinum vaginatum</i> (Edgew.) C.B.Clarke	CPUH14200	Herb	Alpine slopes	July–October	2662	32.525°	76.025°	VU (CAMP 2010)	Native
	<i>Vincetoxicum hirsutinaria</i> Medik.	CPUH14118*	Herb	Open meadow	April–August	2452	32.534°	76.044°	–	Alien
Aquifoliaceae	<i>Ilex diplyrena</i> Wall.	CPUH14223	Tree	Forest area	April–September	2080	32.534°	76.051°	LC	Native
Araceae	<i>Arisaema propinquum</i> Schott	CPUH14068	Herb	Forest margin	June–September	2372	32.529°	76.042°	NA	Native
	<i>Polygonatum govanianum</i> Royle	CPUH14040	Herb	Road side	May–August	2057	32.538°	76.054°	NA	Native
Asparagaceae	<i>Polygonatum verticillatum</i> (L.) All.	CPUH14041*	Herb	Forest margin	May–August	2029	32.539°	76.053°	EN (CAMP 2010)	Native
Asteraceae	<i>Anaphalis triplinervis</i> (Sims) C.B.Clarke	CPUH14178*	Herb	Forest margin	July–October	2365	32.529°	76.033°	NA	Native
	<i>Anaphalis busua</i> (Buch.–Ham.) DC.	CPUH14207	Herb	Mountain slopes	August–October	2730	32.522°	76.030°	NA	Native
	<i>Anaphalis nepalensis</i> (Spreng.) Hand.–Mazz.	CPUH14210	Herb	Mountain slopes	July–September	2690	32.524°	76.027°	NA	Native
	<i>Artemisia absinthium</i> L.	CPUH14099*	Herb	Road side	July–September	2265	32.534°	76.046°	LC	Native
	<i>Bidens pilosa</i> L.	CPUH14191*	Herb	Road side	July–October	1950	32.538°	76.052°	–	Alien
	<i>Bidens tripartita</i> L.	CPUH14198	Herb	Marshy area	August–October	1935	32.545°	76.059°	LC	Native
	<i>Carpesium abrotanoides</i> L.	CPUH14091	Herb	Road side	August–October	2034	32.534°	76.051°	NA	Native
	<i>Carpesium cernuum</i> L.	CPUH14078	Herb	Road side	August–October	2053	32.534°	76.053°	NA	Native

Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruitletting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
	<i>Carpesium trachelifolium</i> Less.	CPUH14230	Herb	Mountain slopes	August–October	2707	32.524°	76.028°	NA	Native
	<i>Cardiophantis flexuosa</i> (Royle ex Lindl.) G.L.Nesom	CPUH14197	Herb	Mountain slopes	July–September	2690	32.524°	76.027°	NA	Native
	<i>Erigeron acris</i> var. <i>multicaulis</i> (Wall. ex DC.) C.B.Clarke	CPUH14067	Herb	Forest trail	May–October	2323	32.531°	76.044°	NA	Native
	<i>Erigeron canadensis</i> L.	CPUH14186	Herb	Road side	June–October	2370	32.530°	76.039°	NA	Alien
	<i>Gamochaeta pennsylvanica</i> (Willd.) Cabrera	CPUH14047	Herb	Road side	March–October	1979	32.539°	76.065°	NA	Alien
	<i>Hypochaeris radicata</i> L.	CPUH14055	Herb	Open grassland	July–October	2206	32.536°	76.046°	NA	Alien
	<i>Jacobaea analoga</i> (DC.) Veldkamp	CPUH14132	Herb	Forest margin	July–October	2285	32.532°	76.035°	NA	Native
	<i>Leucanthemum vulgare</i> Lam.	CPUH14049	Herb	Mountain slopes	April–October	1993	32.538°	76.065°	–	Alien
	<i>Melanoseris brunoniana</i> (Wall. ex DC.) N.Kilian & Ze H.Wang	CPUH14173	Herb	Forest margin	July–October	2167	32.533°	76.048°	NA	Native
	<i>Myriactis wallichii</i> Less.	CPUH14131	Herb	Road side	June–October	2009	32.544°	76.054°	NA	Native
	<i>Oreoseris gossypina</i> (Royle) X.D.Xu & V.A.Funk	CPUH14053*	Herb	Rocky surface	April–June	2201	32.534°	76.047°	NA	Native
	<i>Pseudognaphalium affine</i> (D. Don)	CPUH14106	Herb	Forest margin	May–October	2298	32.534°	76.046°	NA	Native
	<i>Sigesbeckia orientalis</i> L.	CPUH14182	Herb	Forest margin	August–October	2370	32.532°	76.036°	NA	Native
	<i>Synotis rufinervis</i> (DC.) C.Jeffrey&L.Chen	CPUH14179	Herb	Forest margin	August–October	2365	32.531°	76.035°	NA	Native
	<i>Taraxacum parvulum</i> DC.	CPUH14023	Herb	Grassy open space	March–November	2029	32.539°	76.053°	NA	Native
	<i>Youngia japonica</i> (L.) DC.	CPUH14046	Herb	Shady places	March–August	2198	32.530°	76.039°	NA	Native
<b>Balsaminaceae</b>	<i>Impatiens amphorata</i> Edgew.	CPUH14170	Herb	Mountain slopes	July–September	1984	32.542°	76.061°	NA	Native
	<i>Impatiens brachycentra</i> Kar. & Kir.	CPUH14008	Herb	Road side	May–October	2019	32.540°	76.052°	NA	Native
	<i>Impatiens edgeworthii</i> Hook.f.	CPUH14082	Herb	Mountain slopes	July–September	2365	32.528°	76.041°	NA	Native
	<i>Impatiens sulcata</i> Wall.	CPUH14196*	Herb	Mountain slopes	June–September	2381	32.528°	76.041°	NA	Native
<b>Berberidaceae</b>	<i>Berberis lycium</i> Royle	CPUH14058*	Shrub	Mountain slopes	April–June	2206	32.536°	76.046°	LC	Native
	<i>Berberis napaulensis</i> (DC.) Spreng.	CPUH14005*	Shrub	Road side	January–April	2029	32.539°	76.053°	NA	Native
	<i>Podophyllum hexandrum</i> Royle	CPUH14025*	Herb	Forest trail	April–August	2057	32.538°	76.054°	EN	Native
<b>Brassicaceae</b>	<i>Nasturtium officinale</i> W.T.Aiton	CPUH14050*	Herb	Near water	April–September	1993	32.538°	76.065°	LC	Native
	<i>Nocca montana</i> (L.) Fk.Mey	CPUH14015	Herb	Forest trail	April–July	2198	32.529°	76.034°	–	Alien
<b>Campanulaceae</b>	<i>Campanula pallida</i> Wall.	CPUH14152	Herb	Road side	May–October	2249	32.534°	76.054°	NA	Native
<b>Caprifoliaceae</b>	<i>Leycesteria formosa</i> Wall.	CPUH14064	Shrub	Forest trail	June–October	2208	32.536°	76.044°	NA	Native
	<i>Valeriana jatamansi</i> Jones ex Roxb.	CPUH14021*	Herb	Forest trail	March–August	2009	32.544°	76.054°	CR (FRLHT)	Native



Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruiting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
Caryophyllaceae	<i>Schizotechium monospermum</i> (Buch.-Ham. ex D. Don) Pusalkar & S.K. Srivast.	CPUH14174	Herb	Mountain slopes	August–October	2167	32.533°	76.048°	NA	Native
	<i>Silene baccifera</i> (L.) Durande	CPUH14107	Herb	Road side	June–August	2172	76.044°	76.044°	NA	Native
	<i>Silene edgeworthii</i> Bocquet	CPUH14166	Herb	Road side	June–July	2330	76.054°	76.054°	NA	Native
Comelinaceae	<i>Spergularia rubra</i> (L.) J.Presl & C.Presl	CPUH14208	Herb	Alpine slopes	May–September	2730	76.048°	76.048°	–	Alien
	<i>Stellaria aquatica</i> (L.) Scop.	CPUH14044	Herb	Shady places	May–September	2029	76.044°	76.044°	NA	Native
	<i>Stellaria media</i> (L.) Vill.	CPUH14003	Herb	Shady places	March–October	1972	76.054°	76.054°	NA	Native
Cornaceae	<i>Cyanotis vaga</i> (Lour.) Schult. & Schult.f.	CPUH14154	Herb	Alpine slopes	July–October	2726	32.520°	76.034°	NA	Native
	<i>Cornus macrophylla</i> Wall.	CPUH14228	Tree	Road side	April–June	2076	32.534°	76.054°	LC	Native
	<i>Rosularia rosulata</i> (Edgew.) H. Ohba	CPUH14042*	Herb	Rocky surface	April–July	2029	32.535°	76.541°	NA	Native
Dioscoreaceae	<i>Sedum multicaule</i> Wall. ex Lindl.	CPUH14122	Herb	Shady places	July–September	1990	32.544°	76.054°	NA	Native
	<i>Dioscorea deltoidea</i> Wall. ex Griseb.	CPUH14059*	Climber	Mixed forest margin	May–September	2206	32.536°	76.046°	EN (CITES)	Native
	<i>Rhododendron arboreum</i> Sm.	CPUH14235*	Tree	Ban oak forest	March–June	1983	32.540°	76.071°	LC	Native
Euphorbiaceae	<i>Euphorbia cornigera</i> Boiss.	CPUH14066	Herb	Road side	May–September	2316	32.529°	76.042°	NA	Native
	<i>Campylotropis speciosa</i> (Royle ex Schindl.) Schindl.	CPUH14190	Shrub	Road side	August–October	2030	32.538°	76.052°	NA	Native
	<i>Hyloidesmumpodocarpon</i> (DC.) H. Ohashi & R. Mill	CPUH14089	Herb	Road side	July–September	1901	32.541°	76.067°	NA	Native
Fagaceae	<i>Indigofera atropurpurea</i> Buch.-Ham. ex Hornem.	CPUH14048	Shrub	Road side	May–July	1979	32.539°	76.065°	LC	Native
	<i>Trifolium dubium</i> Sibth.	CPUH14051	Herb	Grassy meadow	April–May	1993	32.539°	76.065°	–	Alien
	<i>Trifolium resupinatum</i> L.	CPUH14229	Herb	Grassy meadow	May–October	2713	32.523°	76.029°	LC	Native
Geraniaceae	<i>Quercus leucotrichophora</i> A. Camus	CPUH14220*	Tree	Forest area	April–June	2198	32.535°	76.048°	NA	Native
	<i>Geranium rectum</i> Trautv.	CPUH14095	Herb	Forest margin	June–July	2365	32.528°	76.041°	NA	Native
	<i>Geranium ocellatum</i> Jacquem. ex Cambess.	CPUH14004	Herb	Road side	March–June	1975	32.540°	76.064°	NA	Native
Haloragaceae	<i>Myriophyllum verticillatum</i> L.	CPUH14090	Herb	Lake side	July–September	1935	32.545°	76.059°	LC	Native
	<i>Deutzia staminea</i> R.Br. ex Wall.	CPUH14037	Shrub	Road side	April–September	2029	32.535°	76.054°	NA	Native
	<i>Hydrangea anomala</i> D. Don	CPUH14225	Climbing shrub	Mixed coniferous forest	April–August	2000	32.539°	76.052°	NA	Native
Juncaceae	<i>Juncus articulatus</i> L.	CPUH14070	Herb	Lake side	May–October	1935	32.544°	76.058°	LC	Native
	<i>Juncus concinnus</i> D. Don	CPUH14140	Herb	Mountain slopes	July–October	2703	32.524°	76.028°	LC	Native

Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruiting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
Lamiaceae	<i>Eisholtzia fruticosa</i> (D. Don) Rehder	CPUH14180	Herb	Road side	July–November	2365	32.529°	76.033°	NA	Native
	<i>Eisholtzia strobilifera</i> (Benth.) Benth.	CPUH14199	Herb	Alpine slopes	June–October	2662	32.525°	76.026°	NA	Native
	<i>Isodon coetosa</i> (Buch.-Ham. ex D. Don) Kudó	CPUH14172*	Herb	Road side	September–November	2158	32.535°	76.048°	NA	Native
	<i>Lamium album</i> L.	CPUH14030	Herb	Road side	April–October	2052	32.541°	76.054°	LC	Native
	<i>Leonurus cardiaca</i> L.	CPUH14116	Herb	Forest trail	July–September	2426	32.534°	76.015°	–	Alien
	<i>Melissa axillaris</i> (Benth.) Bakh.f.	CPUH14130	Herb	Road side	June–December	1997	32.541°	76.560°	NA	Native
	<i>Nepeta govaniiana</i> (Wall. ex Benth.) Benth.	CPUH14147	Herb	Forest area	August–October	2696	32.524°	76.027°	NA	Native
	<i>Nepeta podostachys</i> Benth.	CPUH14202	Herb	Alpine slopes	July–September	2690	32.525°	76.262°	NA	Native
	<i>Stachys splendens</i> Wall. ex Benth.	CPUH14109	Herb	Road side	September–November	2363	32.529°	76.040°	NA	Native
Liliaceae	<i>Lilium polyphyllum</i> D. Don	CPUH14086*	Herb	Forest area	June–August	2206	32.537°	76.462°	CR	Native
Mazaceae	<i>Mazus pumilus</i> (Burm.f.) Steenis	CPUH14088	Herb	Mixed forest slopes	April–October	1950	32.539°	76.066°	NA	Native
	<i>Mazus surculosus</i> D. Don	CPUH14072	Herb	Mixed forest slopes	May–October	1969	32.546°	76.056°	NA	Native
Moraceae	<i>Ficus hederacea</i> Roxb.	CPUH14098	Climber	Forest area	May–July	2127	32.534°	76.051°	NA	Native
Onagraceae	<i>Epilobium amurense</i> subsp. <i>amurense</i>	CPUH14087	Herb	Road side	May–October	2053	32.532°	76.049°	NA	Native
	<i>Epilobium laxum</i> Royle	CPUH14104	Herb	Road side	July–September	2285	32.534°	76.045°	NA	Native
	<i>Oenothera rosea</i> L'Hér. ex Alton	CPUH14092	Herb	Road side	May–October	2034	32.534°	76.051°	–	Alien
Orchidaceae	<i>Calanthe plantaginea</i> Lindl.	CPUH14024	Orchid	Forest area	April–May	2053	32.539°	76.054°	NA	Native
	<i>Epipactis helleborine</i> (L.) Crantz	CPUH14102*	Orchid	Forest area	July–September	2285	32.534°	76.045°	LC	Native
	<i>Goodyera repens</i> (L.) R.Br.	CPUH14158	Orchid	Forest area	July–September	2726	32.520°	76.035°	LC	Native
	<i>Malaxis muscifera</i> (Lindl.) Kuntze	CPUH14157*	Orchid	Forest area	July–September	2730	32.523°	76.029°	VU	Native
	<i>Spiranthes sinensis</i> (Pers.) Ames	CPUH14156	Orchid	Alpine slopes	March–September	2662	32.525°	76.026°	–	Alien
Orobanchaceae	<i>Euphrasia himalayica</i> Wettst.	CPUH14139	Herb	Alpine slopes	May– August	2690	32.524°	76.026°	NA	Native
Phyllanthaceae	<i>Leptopus cordifolius</i> Decne.	CPUH14162	Shrub	Forest trail	May–October	2001	32.532°	76.447°	NA	Native
Plantaginaceae	<i>Digitalis purpurea</i> L.	CPUH14110	Herb	Road side	May–October	2363	32.531°	76.032°	–	Alien
Poaceae	<i>Drepanostachyum falcatum</i> (Nees) Keng f.	CPUH14236	Bamboo	Road side	–	2033	32.545°	76.054°	NA	Native
	<i>Oplismenus undulatifolius</i> (Ard.) P. Beauv.	CPUH14129	Herb	Shady places	August–October	1993	32.538°	76.065°	NA	Native
Polygonaceae	<i>Persicaria pubescens</i> (Blume) H. Hara	CPUH14161	Herb	Moist places	July–October	2285	32.534°	76.045°	LC	Native



Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruiting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
	<i>Persicaria minor</i> (Huds.) Opiz	CPUH14167	Herb	Road side	July–October	1901	32.540°	76.066°	NA	Native
	<i>Polygonum aviculare</i> L.	CPUH14145	Herb	Grassy meadow	July–October	2726	32.521°	76.032°	NA	Native
	<i>Polygonum plebeium</i> R.Br.	CPUH14203	Herb	Grassy meadow	October–April	2730	32.523°	76.029°	LC	Native
	<i>Rumex nepalensis</i> Spreng.	CPUH14043*	Herb	Road side	April–July	2029	32.539°	76.053°	NA	Native
<b>Primulaceae</b>	<i>Androsace rotundifolia</i> Hardw.	CPUH14032	Herb	Rocky surface	April–June	2057	32.540°	76.053°	NA	Native
	<i>Androsace sarmentosa</i> Wall.	CPUH14148	Herb	Alpine slopes	May–August	2726	32.520°	76.035°	NA	Native
	<i>Lysimachia debilis</i> Wall.	CPUH14073	Herb	Road side	June–July	1950	32.539°	76.066°	NA	Native
<b>Ranunculaceae</b>	<i>Clematis connata</i> DC.	CPUH14187	Climber	Forest area	August–October	1942	32.532°	76.049	NA	Native
<b>Rosaceae</b>	<i>Geum roylei</i> Wall.	CPUH14027	Herb	Road side	May–September	1942	32.542°	76.062°	NA	Native
	<i>Potentilla indica</i> (Andrews) Th.Wolf	CPUH14007*	Herb	Road side	March–August	2031	32.548°	76.055°	NA	Native
	<i>Potentilla nepalensis</i> Hook.	CPUH14117	Herb	Grassy meadow	June–October	2452	32.530°	76.024°	NA	Native
	<i>Pyrus pashia</i> Buch.-Ham. ex D.Don	CPUH14213	Tree	Road side	February–March	1960	32.540°	76.065°	LC	Native
	<i>Rosa macrophylla</i> Lindl.	CPUH14060*	Shrub	Road side	April–September	2206	32.536°	76.046°	NA	Native
	<i>Rubus macilentus</i> Cambess.	CPUH14031	Shrub	Road side	April–October	1984	32.542°	76.061°	NA	Native
	<i>Rubus pedunculatus</i> D.Don	CPUH14113	Shrub	Road side	June–August	2410	32.531°	76.032°	NA	Native
	<i>Sorbaria tomentosa</i> (Lindl.) Rehder	CPUH14063	Shrub	Road side	May–October	2208	32.536°	76.044°	NA	Native
<b>Rubiaceae</b>	<i>Galium elegans</i> Wall.	CPUH14074	Herb	Moist places	May–November	2009	32.544°	76.054°	NA	Native
<b>Sapindaceae</b>	<i>Acer cappadocicum</i> Gled.	CPUH14218	Tree	Road side	April–September	2080	32.534°	76.051°	LC	Native
<b>Saxifragaceae</b>	<i>Saxifraga moorcroftiana</i> (Ser.) Wall. ex Sternb.	CPUH14146	Herb	Alpine slopes	August–September	2726	32.520°	76.033°	NA	Native
<b>Scrophulariaceae</b>	<i>Buddleja crispa</i> Benth.	CPUH14219	Shrub	Road side	March–May	2167	32.534°	76.047°	NA	Native
	<i>Scrophularia himalensis</i> Royle ex Benth.	CPUH14183	Herb	Road side	July–September	2370	32.531°	76.039°	NA	Native
<b>Smilacaceae</b>	<i>Smilax elegans</i> Wall. ex Kunth	CPUH14009	Climber	Road side	May–October	2019	32.539°	76.052°	NA	Native
	<i>Smilax vaginata</i> Decne.	CPUH14226	Shrub	Road side	May–June	2204	32.536°	76.044°	NA	Native
<b>Ulmaceae</b>	<i>Ulmus wallichiana</i> Planch.	CPUH14227*	Tree	Road side	March–April	2198	32.536°	76.046°	VU	Native
<b>Urticaceae</b>	<i>Pilea scripta</i> (Buch.-Ham. ex D.Don) Wedd.	CPUH14076	Herb	Moist places	June–October	2029	32.534°	76.054°	NA	Native
	<i>Urtica dioica</i> L.	CPUH14115*	Herb	Forest area	June–August	2057	32.532°	76.044°	LC	Native
<b>Vitaceae</b>	<i>Parthenocissus semicordata</i> var. <i>semicordata</i>	CPUH14175*	Climbing shrub	Forest area	May–August	2193	32.537°	76.046°	NA	Native

Family	Taxa	Voucher no.	Life form	Habitat	Flowering/fruiting	Altitude (m)	Latitude N	Longitude E	IUCN Red List status	Nativity
Zingiberaceae	<i>Caulleya spicata</i> (Sm.) Baker	CPUH14108*	Herb	Road side	August–September	2302	32.529°	76.042°	LC	Native
	<i>Hedychium spicatum</i> Sm.	CPUH14149*	Herb	Road side	August–September	2208	32.537°	76.045°	LC	Native
	<i>Roscoea alpina</i> Royle	CPUH14010*	Herb	Forest area	July–August	2398	32.529°	76.047°	VU (CAMP 2010)	Native
Pinaceae	<i>Abies pindrow</i> (Royle ex D. Don) Royle	CPUH14111*	Tree	Forest area	September–October	2397	32.538°	76.018°	LC	Native
	<i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don	CPUH14221*	Tree	Forest area	October–November	2198	32.535°	76.048°	LC	Native
	<i>Picea smithiana</i> (Wall.) Boiss.	CPUH14205	Tree	Forest area	September–October	2730	32.524°	76.026°	LC	Native
Taxaceae	<i>Pinus wallichiana</i> A. B. Jacks.	CPUH14231*	Tree	Forest area	September–October	2422	32.530°	76.024°	LC	Native
	<i>Taxus contorta</i> Griff.	CPUH14114*	Tree	Forest area	October–November	2703	32.534°	76.020°	EN	Native

\* denotes accession numbers used for ethnobotanical studies.

At the national and regional level, assessments by the Conservation Assessment and Management Plan, 2010 for Himachal Pradesh categorize *Dioscorea deltoidea* and *Polygonatum verticillatum* as Endangered (EN) within the state (CAMP 2010). Additionally, *Selinum vaginatum* and *Roscoea alpina* are listed as Vulnerable (VU) in Himachal Pradesh under CAMP assessments.

Regarding legal protection and trade regulation, *Dioscorea deltoidea* is included in Appendix II of CITES (2025) (Appendices 2025), indicating that although it is not necessarily threatened with extinction globally, its trade must be regulated to avoid utilization incompatible with its survival. Furthermore, *Valeriana jatamansi* has been categorized as Critically Endangered (CR) by FRLHT (Foundation for Revitalisation of Local Health Traditions) under national medicinal plant conservation assessments (ENVIS Centre on Medicinal Plants 2024).

### CONCLUSION

The present study offers valuable insights into the floristic diversity and conservation status of the flora of KKWS, contributing to our understanding of its rich botanical heritage. The sanctuary, distinguished by its diverse ecosystems, serves as a vital habitat for a range of rare and threatened plant species. Despite its protected status, the sanctuary is not immune to anthropogenic disturbances, including tourism pressure, habitat fragmentation, resource extraction, and the growing impacts of climate variability. The outcomes of this investigation establish a significant baseline database that can support efforts in biodiversity management, restoration planning, and policy creation. Continuous floristic assessments, paired with habitat protection strategies and community-based conservation initiatives, are necessary to maintain the Sanctuary's ecological integrity. Strengthening awareness, regulating tourism, and implementing science-based management strategies will be crucial for the sustainable conservation of this ecologically sensitive and biologically rich Himalayan region.

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Image 1. A—*Malaxis muscifera* (Lindl.) Kuntze | B—*Digitalis purpurea* L. | C—*Dioscorea deltoidea* Wall. ex Griseb. | D—*Podophyllum hexandrum* Royle | E—*Lilium polyphyllum* D. Don | F—*Taxus contorta* Griff. | G—*Roscoea alpina* Royle. © Sumit.



Image 2. H—*Rosa macrophylla* Lindl. | I—*Polygonatum verticillatum* (L.) All. | J—*Berberis lycium* Royle | K—*Cautleya spicata* (Sm.) Baker | L—*Hedychium spicatum* Sm. | M—*Berberis napaulensis* (DC.) Spreng. © Sumit.

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**Acknowledgements:** The authors express their sincere gratitude to the head, Department of Botany, Career Point University, and the vice chancellor for providing the necessary facilities. We are also thankful to the forest officials of Kalatop-Khajjiar Wildlife Sanctuary for their support and cooperation during the fieldwork.



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NAAS rating (India) 5.64

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

February 2026 | Vol. 18 | No. 2 | Pages: 28262–28454

Date of Publication: 26 February 2026 (Online &amp; Print)

DOI: 10.11609/jott.2026.18.2.28262-28454

[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

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**Floristic composition and conservation significance of vascular plants in Kalatop-Khajjiar Wildlife Sanctuary, Himachal Pradesh, India**

– Sumit, Gulshan Kumar, Sumit Singh, Kanwaljeet Singh, Taslima Sheikh, P. Vishal Ahuja & Arvind Kumar, Pp. 28263–28274

**Assessing the tree diversity along the Dudhganga River in Kolhapur District of Maharashtra, India**

– Sachin Chavan & Rajaram Gurav, Pp. 28275–28286

**Flower bud growth, mortality rate, and population structure of *Sapria himalayana* Griffith f. *albavinosa* Banziger & Hansen (Rafflesiaceae) in a subtropical forest, northeastern India**

– K. Shamran Maring & Athokpam Pinokiyo, Pp. 28287–28295

**Comparing three sampling techniques for surveying and monitoring arthropods in Moroccan agroecosystems**

– Hanae El Harche, Pp. 28296–28306

**Community structure of Lepidoptera in Nantu-Bolihuto Wildlife Reserve, Sulawesi, Indonesia**

– Chairunnisah J. Lamangantjo, Marini Susanti Hamidun, Sasmianti & Dewi Wahyuni K. Baderan, Pp. 28307–28316

**Foraging niche segregation among woodpeckers in the oak-pine forest of Kumaon Himalaya, Uttarakhand, India**

– Rafat Jahan, Satish Kumar & Kaleem Ahmed, Pp. 28317–28328

**Local knowledge, attitudes, and perceptions of ecosystem services and disservices provided by the Painted Stork *Mycteria leucocephala* Pennant, 1769 (Aves: Ciconiidae) in northern India: insights for conservation**

– Yashmita-Ulman & Manoj Singh, Pp. 28329–28342

## Communications

**Analysis revealed minuscule DNA sequence data availability for Indian marine macroalgal diversity**

– Digvijay Singh Yadav, Aswin Alichen & Vaibhav A. Mantri, Pp. 28343–28349

**Checklist of rust fungi of the Nuratau Nature Reserve, Uzbekistan**

– I.M. Mustafae, M.M. Iminova, I.Z. Ortiqov, S.A. Teshaboyeva & N.Q. Iskanov, Pp. 28350–28357

**Checklist of moths (Lepidoptera: Heterocera) from the campus of University of North Bengal, Siliguri, India**

– Abhirup Saha, Ratnadeep Sarkar, Rujas Yonle, Subhajit Das, Prapti Das & Dhiraj Saha, Pp. 28358–28369

**Vulture diversity and long-term trends in the Ranikhet region, Kumaon Himalaya, Uttarakhand, India**

– Mirza Altaf Baig, Nazneen Zehra & Jamal Ahmad Khan, Pp. 28370–28377

**Nesting dynamics of Red-wattled Lapwing *Vanellus indicus* Boddaert, 1783 in urban and rural regions of Indore, India**

– Kratika Patidar & Vipul Keerti Sharma, Pp. 28378–28386

**Assessing avian diversity and conservation status in Dhamapur Lake World Heritage Irrigation Structure, Sindhudurg, Maharashtra, India**

– Yogesh Koli, Pravin Sawant & Mayuri Chavan, Pp. 28387–28398

**Population status and habitat use of Indian Grey Wolf *Canis lupus pallipes* in Pench Tiger Reserve, Madhya Pradesh, India**

– Iqra Rabbani & Sharad Kumar, Pp. 28399–28405

**Activity budgets of a zoo-housed Mishmi Takin *Budorcas taxicolor taxicolor* (Mammalia: Artiodactyla: Bovidae) herd**

– Nabanita Ghosh, Pranita Gupta, Joy Dey & Basavaraj S. Holeyachi, Pp. 28406–28412

**Extended distribution of *Nymphoides peltata* (S.G.Gmel.) Kuntze (Menyanthaceae) in Manipur, India**

– Aahen Chanu Waikhom & Bimolkumar Singh Sadokpam, Pp. 28413–28418

## Short Communications

***Impatiens chamchumroonii* (Balsaminaceae), a new record for the flora of Vietnam**

– Cuong Huu Nguyen, Diep Quang Dinh, Dinh Duc Nguyen & Keoudone Souvannakhoumane, Pp. 28419–28423

**Occurrence of the wood fern *Arachniodes sledgei* Fraser-Jenk. (Pteridophyta: Dryopteridaceae) in the northern Western Ghats, India**

– Sachin Patil & Jagannath Patil, Pp. 28424–28427

## Notes

**A note on the Petal-less Caper *Maerua apetala* (B. Heyne ex Roth) Jacobs (Capparaceae)**

– Shamsudheen Abdul Kader & Bagavathy Parthipan, Pp. 28428–28429

**Record of *Euploea mulciber* (Cramer, [1777]) (Lepidoptera: Nymphalidae) in Delhi, India: evidence of range extension in a restored urban ecosystem**

– Aisha Sultana, Mohammad Shah Hussain & Balwinder Kaur, Pp. 28430–28432

**Hump-nosed Pit Viper *Hypnale hypnale* feeding on an Allapalli Skink *Eutropis allapallensis* in Karwar, India**

– Nonita Rana, Karthy Shivapushanam, S.J.D. Frank & Govindan Veeraswami Gopi, Pp. 28433–28435

**Sighting of vagrant Red-backed Shrike *Lanius collurio* in the coastal areas of Thoothukudi, Tamil Nadu, India**

– Kishore Muthu, Anand Shibu & Santhanakrishnan Babu, Pp. 28436–28437

**First record of the Diamond Dove *Geopelia cuneata*, an Australian endemic, in Sikhna Jwhlwao National Park, Assam, India**

– Bibhash Sarkar, Bijay Basfore, Leons Mathew Abraham & Anjana Singha Naorem, Pp. 28438–28440

**First photographic record of the Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Kuldiha Wildlife Sanctuary, Odisha, India**

– Tarun Singh, Harshvardhan Singh Rathore, N. Abhin, Subhalaxmi Muduli, Yash Deshpande, Vivek Sarkar, Diganta Sovan Chand, Samrat Gowda, Prakash C. Gogineni, Manoj V. Nair, Bivash Pandav & Samrat Mondol, Pp. 28441–28443

**First photographic evidence of the Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Kapilash Wildlife Sanctuary, Odisha, India**

– Alok Kumar Naik, Sumit Kumar Kar, Shyama Bharati, Ashit Chakraborty & Ashis Kumar Das, Pp. 28444–28446

**Record of a Tiger *Panthera tigris* (Linnaeus, 1758) (Mammalia: Carnivora: Felidae) in Saptari District of eastern Nepal: implications for conservation and habitat connectivity**

– Gobinda Prasad Pokharel, Chiranjibi Prasad Pokharel, Ashish Gurung, Bishnu Singh Thakuri, Ambika Prasad Khatiwada, Aastha Joshi, Birendra Gautam, Mithilesh Mahato, Naresh Subedi & Madhu Chetri, Pp. 28447–28450

## Book Review

**At the Point of No Return? – Reading Pankaj Sekhsaria's Island on Edge: The Great Nicobar Crisis**

– Himangshu Kalita, Pp. 28451–28454

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