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Cover: *Minervarya cepfi* & *Nyctibatrachus petraeus*—mix media. © P Kritika

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ARTICLE

Lichen diversity of Churdhar Wildlife Sanctuary and adjacent areas of Himachal Pradesh, India

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Abstract: Himachal Pradesh supports a rich diversity of both cryptogams and phanerogams including lichens owing to its diverse physiography, climatic heterogeneity and wide elevational range. However, several protected areas including Churdhar Wildlife Sanctuary (CWS) remain unexplored for lichen diversity. The present study provides the first systematic inventory of the lichen biota of CWS based on approximately 230 specimens collected during field surveys conducted in 2024. A total of 102 species belonging to 42 genera and 16 families were identified, including the description of 15 lichen species reported for the first time from the state. The study highlights CWS as an important reservoir of western Himalayan lichen diversity and emphasize the need for continued floristic surveys in protected areas.

Keywords: Ascomycetes, biodiversity, biomonitoring, climate change, corticolous, lichenized fungi, Indian mycota, parmeliaceae, taxonomy, western Himalaya.

सारांश: हिमाचल प्रदेश अपनी विविध भौगोलिक संरचना, जलवायवीय विषमता तथा विस्तृत ऊँचाई के कारण लाइकेन (शैक) सहित क्रिप्टोगैम (अपुष्पी) एवं फेनेरोगैम (पुष्पी) पादपों की समृद्ध विविधता पायी जाती है। तथापि, चूरधार वन्यजीव अभयारण्य सहित राज्य के कई संरक्षित क्षेत्र अभी भी शैक विविधता के दृष्टिकोण से अपेक्षाकृत अन्वेषित हैं। प्रस्तुत अध्ययन में वर्ष 2024 के दौरान किए गए क्षेत्रीय सर्वेक्षणों में एकत्रित लगभग 230 नमूनों के आधार पर CWS की शैक जैवविविधता का प्रथम सर्वेक्षण एवं सूचीकरण प्रस्तुत किया गया है। अध्ययन में कुल 16 कुलों तथा 42 वंशों से संबंधित 102 शैक प्रजातियों की पहचान की गई। इनमें 15 शैक प्रजातियाँ ऐसी हैं जिन्हें पहली बार हिमाचल प्रदेश राज्य से अभिलिखित किया गया है। यह अध्ययन चूरधार वन्यजीव अभयारण्य की शैक विविधता के महत्व को रेखांकित करता है।

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Author contributions: The authors GKM and MS authenticated the specimens and critically reviewed the manuscript. AD carried out segregation, identification, prepared hand-cut sections, compiled the photo plates, and drafted the initial manuscript.

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INTRODUCTION

Protected areas play a crucial role in conserving biological diversity by providing refugia for numerous plant, animal and fungal taxa. In the Himalaya, these landscapes encompass a wide range of habitats and microclimatic conditions that support a rich lichen flora. However, despite their ecological significance, the lichen diversity of many protected areas remains inadequately documented. The state of Himachal Pradesh is located in the western Himalayan region. Despite its relatively small geographical area (55,673 km^2), the state harbours rich biodiversity. Its diverse climatic and geographic conditions support the growth and development of various flora and fauna. Due to its excellent lichen diversity, the state is considered a hotspot of lichen diversity in India (Nayaka et al. 2002). Upreti & Nayaka (2000) have enumerated 309 species from the state. Later, Yadav (2005) enumerated 504 lichen species from 12 districts of Himachal Pradesh. According to Sinha et al. (2024), 716 lichen species were recorded from Himachal Pradesh. At present, the state comprises five National Parks, 26 Wildlife Sanctuaries, and three Conservation Reserves (Himachal Pradesh forest department 2026). However, floristically, many of these protected areas remain unexplored. The Churdhar Wildlife Sanctuary (CWS) is one of the unexplored protected areas of Himachal Pradesh, lying in 30.8108°–30.9108° N and 77.4922°–77.4969° E, covering a wide altitude varying 1,500–3,647 m. The area of CWS falls into two districts of the state, i.e., Sirmaur and Shimla, while the present study was conducted in the area of CWS, which falls into the district of Shimla. The vegetation of CWS is classified into two major types: (I) sub-tropical mixed deciduous and coniferous forest, and (II) temperate to sub-alpine forest. Some of the phorophytes of the sanctuary are; *Abies spectabilis*, *Acer caesium*, *A. acuminatum*, *A. pentapomicum*, *Aesculus indica, Betula utilis*, *Berberis aristata*, *B. coriaria*, *B. jaeschkeana*, *Buxus wallichiana*, *Cedrus deodara*, *Cornus macrophylla*, *Picea smithiana*, *Pinus wallichiana*, *Juglans regia*, *Rhododendron anthopogon*, *R. lepidotum*, *Quercus leucotrichophora*, *Q. semecarpifolia Syringa emodi*, and *Taxus wallichiana* (Subramani et al. 2014; Thakur et al. 2021). These phorophytes have a luxuriant growth of lichens in the region. Although several floristic investigations have been conducted in CWS, no dedicated lichenological survey has been undertaken (Upreti & Nayaka 2000; Yadav 2005; Bajpai et al. 2022). Therefore, this is the first attempt to enumerate and document the lichen biota of CWS.

MATERIALS AND METHODS

The present study is based on approximately 230 freshly collected specimens from CWS. Two field surveys were made during the months of April 2024 and November 2024 (28–30 April 2024 and 04–05 November 2024) (Image 1). Specimens were collected from different substrates, including bark, rock, wood, soil, moss and on leaves. After shade drying for one week in the processing room, the specimens were examined morphologically, anatomically and chemically. The morphological examination of the specimens was done under a stereo zoom microscope (Leica S8 APO). Anatomy of the thallus and spores was studied by thin hand-cut sections observed under a compound microscope (Leica DM500). Chemistry of the specimens was studied by performing spot tests using routine reagents K (10%), C (Calcium hypochlorite), and P (Paraphenylenediamine), Thin Layer Chromatography (TLC) was performed in solvent systems A (Toluene: 1–4, dioxane: acetic acid in ratio of 180: 60: 8 ml) and C (Toluene: 1–4, dioxane: acetic acid in ratio of 180: 60: 8 ml), following Orange et al. (2001). Identification of the specimens up to species level was done following Awasthi (1991, 2007), Sinha et al. (2024) and Wijayawardene et al. (2022) is followed for classification. The identified specimens are preserved in the lichen herbarium of CSIR-National Botanical Research Institute, Lucknow (LWG). Maps of the study area were created using QGIS (version 3.34.9) software.

RESULTS AND DISCUSSION

A total of 102 lichen species representing 42 genera and 16 families were recorded from CWS, including 15 species newly reported for Himachal Pradesh (Table 1; Image 2B). With respect to substrate preference, 79 species were corticolous, followed by seven saxicolous, five lignicolous, four muscicolous, two ramicolous, and one foliicolous species. One species occurred on both soil and bark, while another was recorded from both rock and bark (Image 1C). On the basis of growth forms 62 species were foliose, followed by 23 crustose, 16 fruticose, and one leprose species (Image 2A). Among the families, Parmeliaceae was dominant, comprising 11 genera and 25 species, followed by Physciaceae (5 genera, 23 species), Ramalinaceae (3 genera, 8 species), Caliciaceae (3 genera, 5 species), and Teloschistaceae (4 genera, 4 species). In contrast, Opegraphaceae, Stereocaulaceae, and Strigulaceae were each represented by a single species.

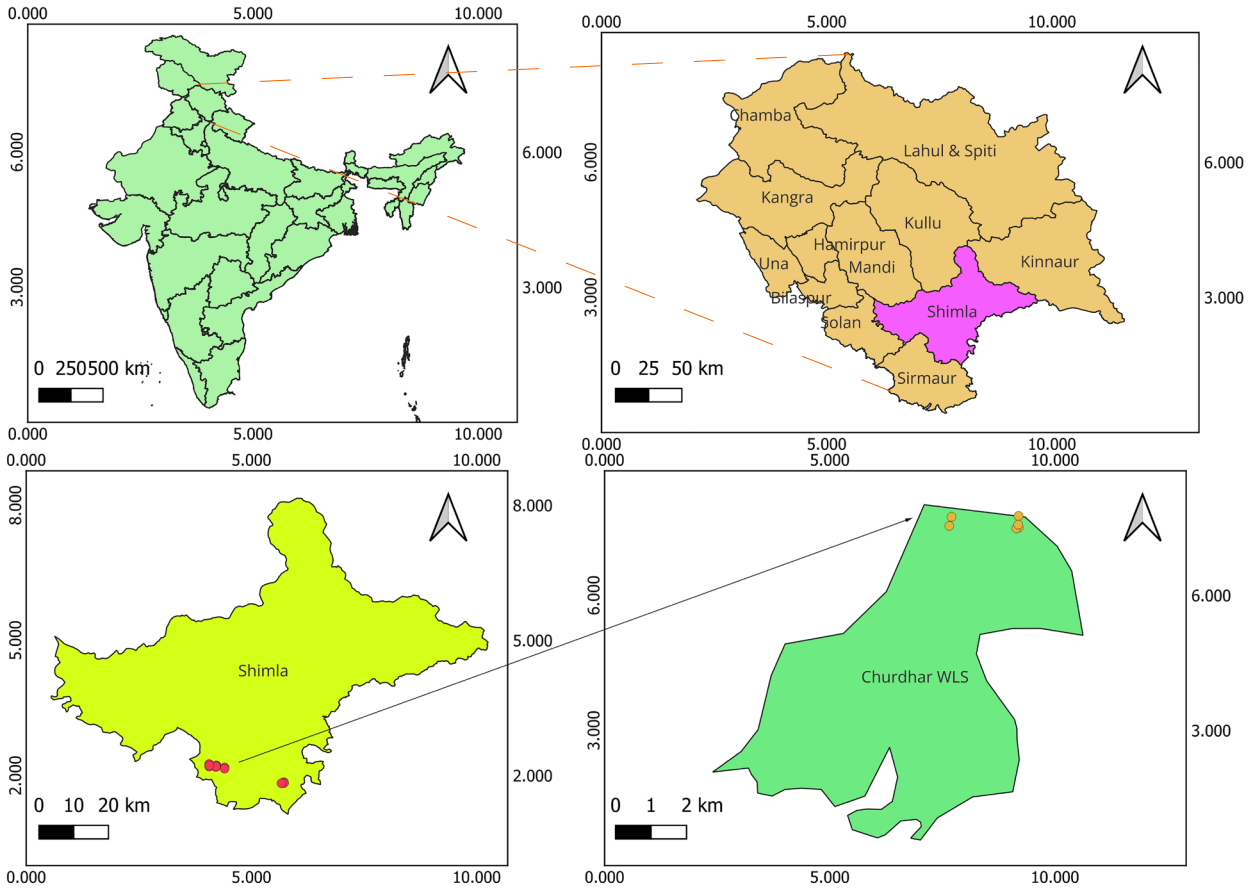

Image 1. A—India | B—Himachal Pradesh highlighting district Shimla | C—Collection sites in and around Churdhar Wildlife Sanctuary District Shimla | D—Collection sites with in the Sanctuary.

The species *Amandinea montana*, *Heterodermia obscurata*, and *H. hypochraea*, *Parmotrema nilgherrense*, and *P. reticulatum*, were common across all sampling localities. Species of *Phaeophyscia, Physcia, Dirinaria,* and *Lepraria* were abundant in the subtropical forests, whereas *Heterdermia, Punctelia, Flavoparmelia, Flavopunctelia, Myelochroa, Lobaria*, and *Ramalina* species were common in the temperate zone, while the alpine zone features diversity of *Acarospora, Aspicillia, Lecanora, Xanthoria*, and *Xanthoparmelia* species.

The present investigation additionally records *Bacidia rufescens*, *Bulbothrix setschwanensis, Cladonia didyma, C. fimbriata, C. fruticulosa, C. rei, Cetrelia collata, C. cetrarioides*, *Lobaria isidiosa*, *L. pindarensis, Myelochroa upretii*, *Phaeophyscia endococcina, P. endococcinodes, P. exornatula*, *P. pyrrhophora*, *P. tribacioides, Physconia detersa, Ramalina baltica, Sticta limbata*, and *Trapelia coarctata* as new additions to the Shimla district.

Among the western Himalayan states, Uttarakhand harbours the highest lichen diversity with 1,034 species followed by Himachal Pradesh with 716 species and Jammu & Kashmir including Ladakh with 457 species (Sinha et al. 2024). Compared with Uttarakhand, Himachal Pradesh exhibits less number of lichen species, which may reflect limited lichenological exploration together with increasing anthropogenic disturbances associated with tourism rather than an actual paucity of species. The state encompasses diverse habitats ranging from tropical to alpine ecosystems, and includes numerous protected areas, that provide favourable conditions for lichen colonization and diversification. Srivastava (2005) documented 263 lichen species from the Great Himalayan National Park. The present study provides the first preliminary assessment of the lichen diversity of CWS and reports 15 species as new records for Himachal Pradesh. These findings indicate that even relatively small protected areas can serve as important reservoirs of lichen diversity and emphasize the need for continued systematic surveys to better improve our understanding, conservation and long-term monitoring

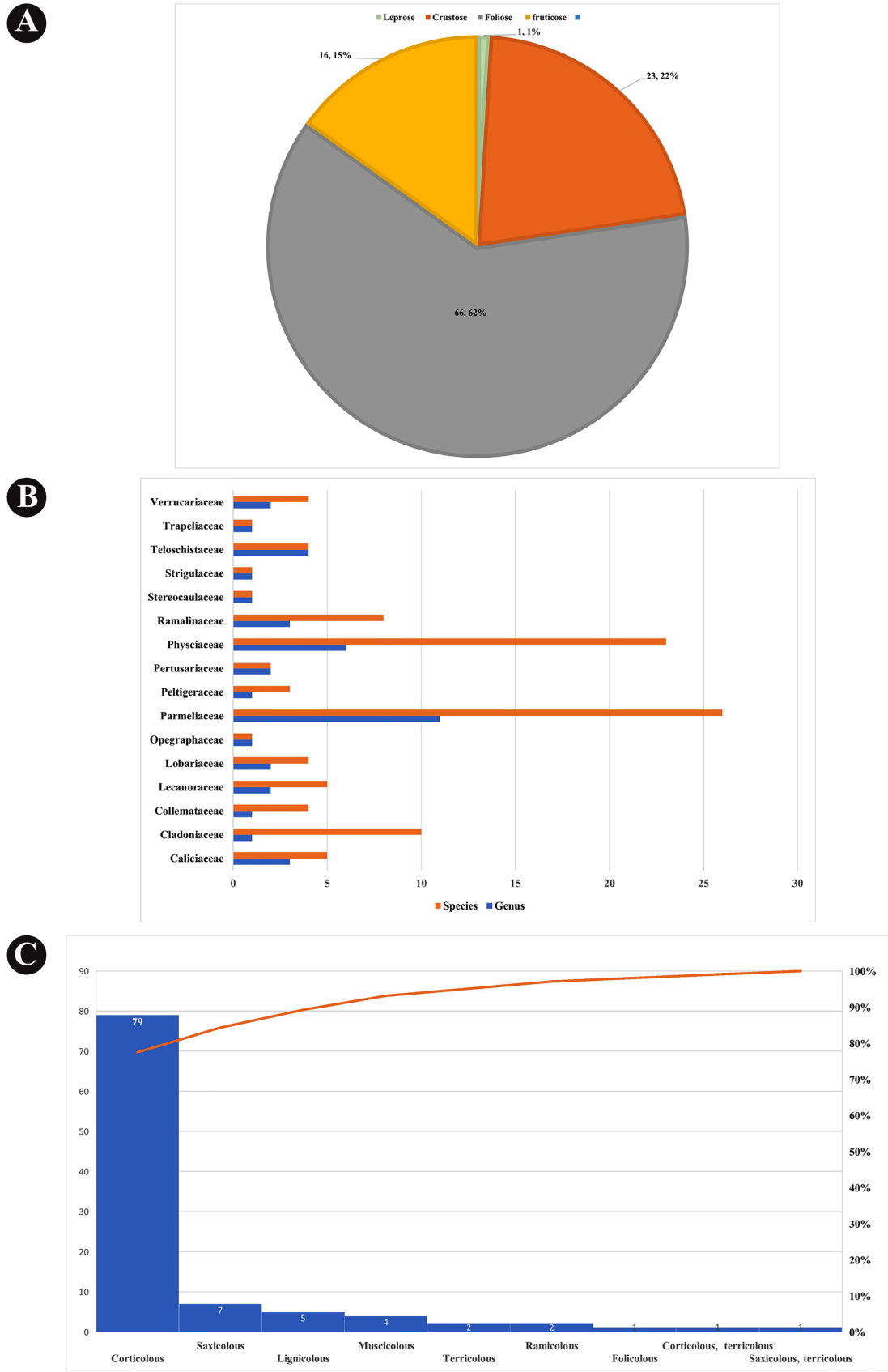

Image 2. A—Percentage of different lichen growth forms | B—Graph representing families, genus and total number of species | C—Clustered bar chart of lichens found on their respective substratum.

Table 1. List of lichen taxa reported from Churdhar Wildlife Sanctuary.

	Name of taxa	GF	Sub	Localities	Altitude (m)	Field No.
I	**Caliciaceae**					
1	*Amandinea montana* (H.Magn.) Marbach	Cr	C	HL CWS SR	2200–2250 3200 2209	24-367574 24-369900 24-369833
2	*A. punctata* (Hoffm.) Coppins & Scheid	Cr	C	HL	2000–2100	24-369832
3	*Calicium adspersum* ssp. *himalayense* G.Pant & D.D.Awasthi	Cr	C	HL	2015	24-369842
4	*Pyxine berteroana* (Fée) Imshaug	Fo	C	HL	2015	24-369457
5	*P. reticulata* (Vain.) Vain.	Fo	C	HL	2015	24-369806
II	**Cladoniaceae**					
6	*Cladonia coniocraea* (Flörke) Spreng	Fr	C	CWS	2753	24-369864
7	*C. corniculata* Ahti & Kashiw.	Fr	L	CWS	3200	24-369871
8	*C. didyma* (Fée) Vain.	Fr	L	CWS	2673	24-369870
9	*C. fimbriata* (L.) Fr.	Fr	M	CWS	2673	24-369867
10	*C. fruticulosa* Kremp.	Fr	L	CWS	2753	24-369865
11	*C. macilenta* Hoffm.	Fr	L	CWS	2700	24-369869
12	*C. ochrochlora* Flörke	Fr	L	CWS CWS	2700 2673	24-369868 24-369881
13	*C. pocillum* (Ach.) Grognot	Fr	M	CWS	2673	24-369882
14	*C. rei* Schaer.	Fr	T	CWS	2700	24-369883
15	*C. pyxidata* (L.) Hoffm.	Fr	M	CWS	4300	24-369866
III	**Collemataceae**					
16	*Leptogium burnetiae* C.W.Dodge	Fo	C	HL HL CWS CWS	2200–2250 1658 2706 2673	24-369440 24-369439 24-369467 24-369888
17	*L. denticulatum* Nyl. *	Fo	C	CWS	2673	24-369877
18	*L. pedicellatum* P.M.Jørg.	Fo	C	HL CWS	2200–2250 2579 2579 2605 2753 2753 2700 2706 2700 2673	24-369436 24-369437 24-369438 24-369442 24-369855 24-369854 24-369856 24-369816 24-369874 24-371407
19	*L. saturninum* (Dicks.) Nyl.	Fo	C	CWS HL CWS	1658 2706 2673	24-369439 24-369468 24-369876
IV	**Lecanoraceae**					
20	*Lecanora achroa* Nyl.	Cr	C	CWS	2605	24-367585
21	*L. alba* Lumbsch	Cr	C	CWS	2579	24-367593
22	*L. campestris* (Schaer.) Hue	Cr	S	HL	2200–2250	24-367587
23	*L. helva* Stizenb.	Cr	R	CWS	2753	24-369894
24	*Lecidella elaeochroma* (Ach.) M.Choisy	Cr	R	CWS	2753	24-369894
V	**Lobariaceae**					
25	*Lobaria isidiosa* (Müll.Arg.) Vain.	Fo	C	CWS	2579	24-369469
26	*L. pindarensis* Räsänen	Fo	C	CWS	2579	24-369444
27	*L. retigera* (Bory) Trevis.	Fo	C	CWS CWS CWS CWS CWS	2579 2605 2700 2673 2673	24-369445 24-367590 24-369858 24-369859 24-369899

	Name of taxa	GF	Sub	Localities	Altitude (m)	Field No.
28	*Sticta limbata* (Sm.) Ach.	Fo	C	CWS	2673	24-369849
VI	**Opegraphaceae**					
29	*Opegrapha simplicior* (Nyl.) Nyl. *	Cr	C	HL HL	2015 2200–2250	24-369831 24-369830
VII	**Parmeliaceae**					
30	*Bulbothrix isidiza* (Nyl.) Hale*	Fo	C	CWS	2605	24-369818
31	*B. meizospora* (Nyl.) Hale	Fo	C	CWS	2706	24-369824
32	*B. setschwanensis* (Zahlbr.) Hale	Fo	C	CWS HL	2706 2200–2250	24-369810 24-369452
33	*Cetrelia braunsiana* (Müll.Arg.) W.L.Culb. & C.F.Culb.	Fo	C	CWS CWS HL CWS	2605 2579–2710 1658 2605	24-367567 24-367566 24-369449 24-369817
34	*C. collata* (Nyl.) W.L.Culb. & C.F.Culb.	Fo	C	CWS	2706	24-369823
35	*C. cetrarioides* (Duby) W.L.Culb. & C.F.Culb	Fo	C	SR HL HL CWS CWS	2209 2605 2200–2250 2605 2673	24-369430 24-367565 24-367570 24-367569 24-371413
36	*C. olivetorum* (Nyl.) W.L.Culb. & C.F.Culb.	Fo	C	HL HL CWS HL	2200–2250 2200–2250 2605 1658	24-369805 24-367568 24-369428 24-369454
37	*C. pseudolivetorum* (Asahina) W.L.Culb. & C.F.Culb.	Fo	C	CWS CWS CWS CWS	2706 2605 2706 2605	24-369451 24-369402 24-369816 24-369403
38	*Flavoparmelia caperata* (L.) Hale	Fo	C	CWS HL CWS CWS CWS	2706 2200–2250 2605 2700 2673	24-369432 24-369455 24-369825 24-371401 24-371406
39	*Flavopunctelia flaventior* (Stirt.) Hale	Fo	C	CWS SR	2605 2209	23-369827 24-369433
40	*Hypotrachyna cirrhata* (Fr.) Divakar, A.Crespo, Sipman, Elix & Lumbsch	Fo	C	CWS	2706	24-368946
41	*H. nepalensis* (Taylor) Divakar, A.Crespo, Sipman, Elix & Lumbsch	Fo	C	CWS	2579	24-369429
42	*H. sinensis* (J.B.Chen & J.C.Wei) Divakar, A.Crespo, Sipman, Elix & Lumbsch	Fo	C	CWS	2706	24-369427
43	*Myelochroa aurulenta* (Tuck.) Elix & Hale	Fo	C	CWS CWS	2706 2605	24-369809 24-369826
44	*M. upretii* Divakar & Elix	Fo	C	HL	2200–2250	24-369448
45	*Parmelia meiophora* Nyl.	Fo	C	SR CWS CWS	2209 3200 3200	24-369435 24-371402 24-371414
46	*Parmelinella wallichiana* (Taylor) Elix & Hale	Fo	C	CWS	2706	24-369813
47	*Parmotrema nilgherrense* (Nyl.) Hale	Fo	C	SR CWS HL CWS CWS	2209 2605 2200–2250 2605 3200	24-369812 24-369808 24-369446 24-369820 24-371409
48	*P. praeisidiosum* Fleig	Fo	C	CWS	2673	24-369873
49	*P. rampoddense* (Nyl.) Hale*	Fo	C	CWS	2605	24-369828
50	*P. reticulatum* (Taylor) M.Choisy	Fo	C	SR HL HL CWS CWS	2209 2015 1658 2706 2763	24-369434 24-369447 24-369456 24-369819 24-371403
51	*P. stuppeum* (Taylor) Hale*	Fo	C	HL	2200–2250	24-369459
52	*Punctelia borreri* (Sm.) Krog	Fo	C	CWS	3200	24-371410

	Name of taxa	GF	Sub	Localities	Altitude (m)	Field No.
53	*P. subrudecta* (Nyl.) Krog	Fo	C	CWS CWS CWS	2605 2605 2605	24-367585 24-369401 24-369844
54	*Usnea orientalis* Motyka	Fr	C	CWS CWS CWS	2579 2700 2753	24-369470 24-369884 24-371411
55	*U. spinosula* Stirt. *	Fr	C	HL	2200–2250	24-369471
VIII	**Peltigeraceae**					
56	*Peltigera elisabethae* Gyeln.	Fo	C	CWS CWS CWS CWS	2706 2706 2605 2706	24-369443 24-367591 24-367586 24-369801
57	*P. polydactylon* (Neck.) Hoffm.	Fo	T	CWS	3200	24-369889
58	*P. praetextata* (Flörke ex Sommerf.) Zopf	Fo	C	HL CWS CWS CWS CWS CWS CWS CWS CWS	2015 2673 2753 3200 3200 2700 2753 2753 2673	24-369441 24-369851 24-369853 24-369852 24-369848 24-369857 24-369878 24-371412 24-371404
IX	**Pertusariaceae**					
59	*Lepra albescens* (Huds.) Hafellner	Cr	C	HL HL	2015 2200–2250	24-367600 24-369802
60	*Pertusaria punctata* Nyl.	Cr	C	HL	2015	24-367595
X	**Physciaceae**					
61	*Heterodermia diademata* (Taylor) D.D.Awasthi	Fo	T, C	CWS HL	2579 1658	24-367582 24-369413
62	*H. firmula* (Linds.) Trevis.	Fo	C	CWS CWS	2706 2579–2710	24-367562 24-367580
63	*H. incana* (Stirt.) D.D.Awasthi	Fo	C	CWS	2579 2605 2706	24-367561 24-367583 24-367581
64	*H. isidiophora* (Nyl.) D.D.Awasthi	Fo	C	HL CWS CWS	2015 2579 2700	24-367579 24-369495 24-369886
65	*H. hypochraea* (Vain.) Swinscow & Krog	Fo	C	CWS HL HL SR CWS HL CWS CWS CWS CWS CWS CWS	2605 2200–2250 2200–2250 2209 2706 2015 2579 2579 2700 2700 2700 2700	24-367558 24-367559 24-367560 24-369410 24-369411 24-369412 24-367581 24-369418 24-367561 24-36924 24-369879 24-369887
66	*H. obscurata* (Nyl.) Trevis	Fo	C	HL HL HL SR CWS HL	1658 2200–2250 2200–2250 2209 2579 2200–2250	24-369416 24-369421 24-369409 24-367577 24-367563 24-369415
67	*H. pseudospeciosa* (Kurok.) W.L. Culb	Fo	C	HL HL CWS CWS CWS	2015 2250 2579 2579 2100	24-367557 24-369414 24-369425 24-369862 24-369847
68	*H. speciosa* (Wulfen) Trevis.	Fo	C	CWS, HL	2000–2100 2605	24-367578 24-369423
69	*H. tremulans* (Müll. Arg.) W.L.Culb.*	Fo	C	CWS	2579	24-369422
70	*Leucodermia boryi* (Fée) Kalb.	Fo	M	CWS CWS CWS	2700 2706 2700	24-369885 24-369861 24-369885

	Name of taxa	GF	Sub	Localities	Altitude (m)	Field No.
71	*Phaeophyscia endococcina* (Körb.) Moberg	Fo	C	CWS	2706	24-369822
72	*P. endococcinodes* (Poelt) Essl.	Fo	C	HL	2015	24-367548
73	*P. exornatula* (Zahlbr.) Kashiw.	Fo	C	HL CWS	2200–2250 2579	24-367555 24-367552
74	*P. hispidula* (Ach.) Moberg	Fo	C	CWS CWS CWS HL CWS CWS CWS CWS	2579 2579 2605 2200–2250 2706 2673 2700 2673	24-367551 24-367544 24-357541 24-367539 24-369821 24-369893 24-369892 24-371405
75	*P. laciniata* Essl. *	Fo	C	CWS HL CWS	2579 2200–2250 2706	24-367550 24-367542 24-367543
76	*P. primaria* (Poelt) Trass*	Fo	C	HL	2200-2250	24-367538
77	*P. pyrrhophora* (Poelt) D.D.Awasthi & M.Joshi	Fo	C	HL	1658	24-367540
78	*Physcia dilatata* Nyl.	Fo	C	CWS HL HL HL HL	2579 2200–2250 2000–2100 1658	24-367547 24-367549 24-367546 24-367545
79	*P. tribacioides* Nyl.	Fo	C	HL	1658	24-367545
80	*Physconia detersa* (Nyl.) Poelt	Fo	S, C	CWS CWS	2700 2700	24-369890 24-369891
81	*P. distorta* (With.) J.R.Laundon	Fo	C	SR	2209	24-367576
82	*P. enteroxantha* (Nyl.) Poelt	Fo	C	HL	1658	24-367554
83	*Polyblastidium japonicum* (M. Satô) Kalb	Fo	C	CWS CWS CWS CWS CWS	2605 2605 2605 2579 2700	24-367556 24-369426 24-369420 24-369419 24-369880
XI	**Ramalinaceae**					
84	*Bacidia convexula* (Müll.Arg.) Zahlbr.*	Cr	C	HL	2200–2250	24-367588
85	*B. rufescens* (Müll.Arg.) Zahlbr.	Cr	C	HL	2200–2250	24-367575
86	*B. submedialis* (Nyl.) Zahlbr.	Cr	C	HL	2015	24-367589
87	*Biatora vernalis* (L.) Fr.*	Cr	C	HL	2000–2100	24-367584
88	*Ramalina baltica* Lettau	Fr	S	SR	2209	24-369466
89	*R. conduplicans* Vain.	Fr	C	HL HL CWS CWS	2000–2100 2200–2250 3200 2700	24-369472 24-369476 24-369850 24-369872
90	*R. pacifica* Asahina	Fr	C	CWS	2706	24-369481
91	*R. sinensis* Jatta	Fr	C	CWS HL CWS HL CWS CWS	2706 2200–2250 2706 2015 3200 3200	24-369478 24-369463 24-369477 24-369464 24-369860 24-369895
XII	**Stereocaulaceae**					
92	*Lepraria isidiata* (Llimona) Llimona & A.Crespo	Le	C	CWS	2579	24-369845
XII	**Strigulaceae**					
93	*Strigula subelegans* Vain. *	Cr	F	HL	2000–2100	24-369898
XIV	**Teloschistaceae**					
94	*Caloplaca himalayana* Y.Joshi & Upreti	Cr	C	HL CWS	2200–2250 2605	24-367575 24-367585
95	*Opeltia flavorubescens* (Huds.) S.Y.Kondr. & Hur	Cr	C	CWS	2605	24-367585
96	*Sanguineodiscus haematites* (Chaub. ex-St.-Amans) I.V.Frolov & Vondrák*	Cr	C	CWS	2673	24-369896
97	*Polycauliona candelaria* (L.) Frödén, Arup & Søchting	Fo	C	HL	2200–2250	24-369476

	Name of taxa	GF	Sub	Localities	Altitude (m)	Field No.
XV	**Trapeliaceae**					
98	*Trapelia coarctata* (Turner) M. Choisy	Cr	S	CWS	2605	24-367598
XVI	**Verrucariaceae**					
99	*Dermatocarpon miniatum* (L.) W.Mann	Fo	S	HL	2200–2250	24-369480
100	*D. miniatum* var. *compactum* (Lamy) Zahlbr. *	Fo	S	CWS	3200	24-369875
101	*Verrucaria margacea* (Wahlenb.) Wahlenb	Cr	S	HL	2015	24-369839
102	*V. muralis* Ach. *	Cr	S	HL	2250	24-369840

CWS—Churdhar Wildlife Sanctuary | SR—Srain | HL—Halau | GF—growth form | Cr—crustose | Fo—foliose | Fr—fruticose | Sub—Substratum | C—corticolous | F—folicolous | L—lignicolous | S—saxicolous | M—muscicolous | R—ramicolous | T—terricolous | *—New to state.

of the lichen biota of the western Himalaya.

DESCRIPTION OF THE SPECIES NEWLY RECORDED FOR HIMACHAL PRADESH

1. *Bacidia convexula* (Müll. Arg.) Zahlbr., Cat. Lich. Univers. 4: 188 (1926) [1927]. (Image 3A).

The species is characterised by crustose, grey thallus with numerous apothecia, corticated at base, apothecia disc brownish red ascospores ellipsoid, transversely septate with 5-6 septa (Awasthi & Mathur 1987).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on tree bark in the district Shimla at an elevation of 2,200–2,250 m. The species was previously reported from Arunachal Pradesh, Assam, Madhya Pradesh, Manipur, Meghalaya, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, village Shalan Forest, alt. 2,200–2,250 m, on tree bark, P. Maurya & A. Devi 24-367588 (LWG).

2. *Biatora vernalis* (L.) Fr., K. svenska Vetensk-Akad. Handl., ser. 3: 271 (1822). (Image 3B).

The species is characterized by crustose, granulose, upper surface grey thallus, having sessile biotorine ascomata, ascospores narrowly ellipsoid, aseptate and monocular. Photobiont *Trebouxia* species (Printzen et al. 2023).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at the elevation of 2,000–2,100 m. This species was previously reported from Arunachal Pradesh, Manipur, Mizoram, and Uttarakhand (Sinha et al. 2024).

Specimens examined: India, Himachal Pradesh, Shimla District, village Shalan Forest, alt. 2,000–2,100 m on tree bark, A. Devi & P. Maurya 24-367584, 24-369466 (LWG).

3. *Bulbothrix isidiza* (Nyl.) Hale, Phytologia 28(5): 480 (1974). (Image 3C).

The diagnostic characters of the species include foliose thallus, having bulbate cilia along the margins, maculate with coralloid isidia, lower side pale brown (Awasthi 2007).

Chemistry: Medulla K+ yellow turning red, C–, KC–, P+ orange red; salazinic acid seen in TLC

Ecology and distribution: The species was found growing on tree bark in the district Shimla at an elevation of 2605 m. The species was previously reported from Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, CWS, alt. 2,605 m, on tree bark, A. Devi & P. Maurya 24-369818 (LWG).

4. *Dermatocarpon miniatum var. compactum* (Lamy) Zahlbr., Cat. Lich. Univers. 1: 226 (1921) [1922]. (Image 3D).

The species has polyphyllous, squamulose, upper side grey thallus, lower side wrinkled and lacking rhizines (Awasthi 2007).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on rock in the district Shimla at an elevation of 2200–2250 m. The species was previously reported from Uttarakhand (Sinha et al. 2024).

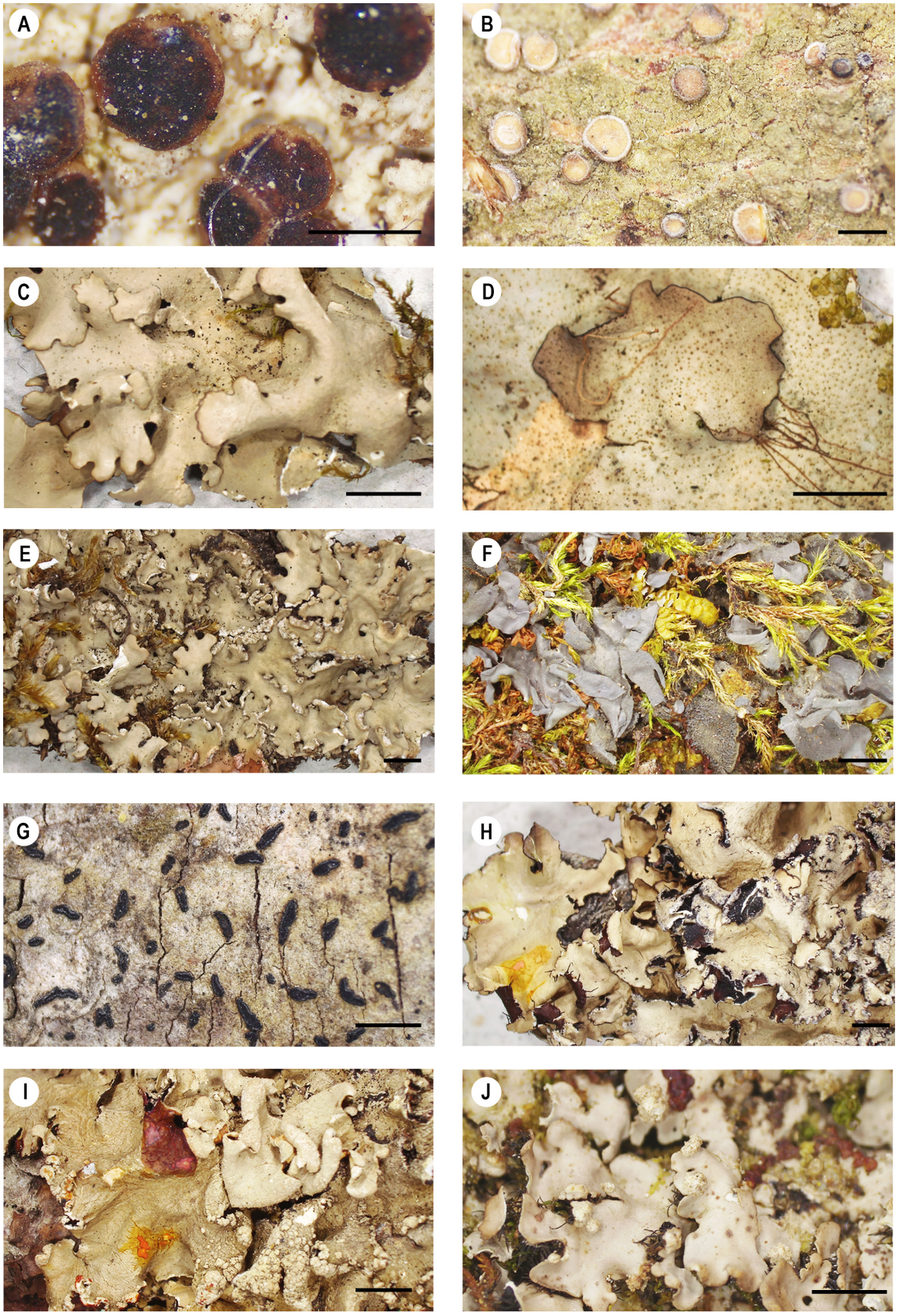

Image 3. New additions of lichens to the state of Himachal Pradesh: A—*Bacidia convexula* | B—*Biatora vernalis* | C—*Bulbothrix isidiza* | D—*Dermatocarpon miniatum* var. *compactum* | E—*Heterodermia tremulans* | F—*Leptogium denticulatum* | G—*Opegrapha simplicior* | H—*Parmotrema rampoddense* | I—*Parmotrema stuppeum* | J—*Phaeophyscia laciniata*. Scale: A–C—1 mm, D—1 cm, E–J—1 mm. © A. Devi.

Specimen examined: India, Himachal Pradesh, Shimla District, CWS, alt. 2,200–2,250 m, on rock, A. Devi 24-369875 (LWG).

5. *Heterodermia tremulans* (Müll. Arg.) W.L. Culb., Bryologist 69: 485 (1967). (Image 3E).

The species is characterized by corticolous, adnate, upper side greyish thallus, with small and narrow lobes, lower side white to daker with concolorous rhizines (Awasthi 2007).

Chemistry: Medulla K–, C–, KC–, P+ pale yellow; atranorin and zeorine seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2579 m. The species was previously reported from Kerala, Madhya Pradesh, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, and West Bengal (Sinha et al. 2024).

Specimen examined: India; Himachal Pradesh, Shimla District, CWS, alt. 2,579 m, on tree bark, P. Maurya & A. Devi 24-369422 (LWG).

6. *Leptogium denticulatum* Nyl., *Annls Sci. Nat.*, Bot., sér. 5 7: 302 (1867). (Image 3F).

The species is characterised by the foliose, corticolous, adnate with irregular lobes, upper surface grey to medium grey with no wrinkles thallus, isidia on margin, apothecia rare, lower surface smooth with scattered tufts of white hair (Awasthi 2007).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2673 m, in Himachal Pradesh. The species was previously reported from Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Uttarakhand, and West Bengal (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, CWS, alt. 2,673 m, on tree bark, A. Devi 24-369877 (LWG).

7. *Opegrapha simplicior* (Nyl.) Nyl., Bull. Soc. linn. Normandie, sér. 2 2: 94 (1868). (Image 3G).

The species has a crustose, white to grey surface thallus, cracked at places with scattered, slightly curved and black lirellate ascomata, asci 8-spored, ascospores elliopsoid, hyaline 3-spetate, 12–16 × .7–1.1 µm (Joseph & Sinha 2011).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2015–2250 m,. The species was previously reported from Assam, Madhya Pradesh and West Bengal (Sinha et al. 2024).

Specimens examined: India, Himachal Pradesh, Village Shalan Forest, alt. 2,015–2,250 m, on tree bark, A. Devi & P. Maurya 24-369830, 24-369831 (LWG).

8. *Parmotrema rampoddense* (Nyl.) Hale, Phytologia 28(4): 338 (1974). (Image 3H).

The species has a corticolous thallus withlarge lobes and emaculate, greyish upper side, marginally sorediate in central parts of thallus, lower side tan, marginal zone erhizinate and involute central lobes (Awasthi 2007).

Chemistry: Medulla K–, C–, KC+ red, P–; alectoronic, α-collatolic acids and skyrin seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2605 m. Earlier, the species was reported from Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Nagaland, Sikkim, Tamil Nadu, Uttarakhand and West Bengal (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, CWS, alt. 2,605 m, on tree bark, A. Devi & P. Maurya 24-369828 (LWG).

9. *Parmotrema stuppeum* (Taylor) Hale [as '*stuppea*'], *Phytologia* 28(4): 339 (1974). (Image 3I).

The species is characterised by foliose, large crenate dentate lobes, ciliate, greyish upper side, emaculate thallus, marginal sorelia on central part, involute sorediate lobes, lower side marginal zone brown, central zone black and medulla white in colour (Awasthi 2007).

Chemistry: Medulla K+ yellow turning red, C–, KC–, P+ orange red; salazinic and consalazinic acids seen in TLC.

Ecology and distribution: The species found growing on tree bark in district Shimla at the elevation of 2,200–2,250 m, The species was previously reported from Andaman & Nicobar Islands, Arunachal Pradesh, Karnataka, Kerala, Mizoram, Nagaland, and Tamil Nadu (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, village Shalan Forest, alt. 2,200–2,250 m, on tree bark, A. Devi & P. Maurya 24-369459 (LWG).

10. *Phaeophyscia laciniata* Essl., Mycologia 70(6): 1247 (1979) [1978]. (Image 3J).

The species has foliose thallus with short lobes and lobulate margins, brownish grey in colour thallus, lower surface black with simple rhizines; bright orange medulla due to the presence of skyrine (Maurya et al. 2024).

Chemistry: Medulla K+ purple, KC–, C–, P–; skyrine seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2,200–2,250 m. The species was previously reported from Kerala and Uttarakhand (Sinha et al. 2024).

Specimens examined: India, Himachal Pradesh, Shimla District, village Halau, alt. 2,200–2,250 m, on tree bark, P. Maurya & A. Devi 24-367542, 24-367543, 24-367550 (LWG).

11. *Phaeophyscia primaria* (Poelt) Trass, *Folia cryptog. Estonica* 15: 2 (1981). (Image 4K).

The species is characterized by corticolous, upper side grey thallus, isidia and soredia absent, rhizines projecting beyond lobes (Maurya et al. 2024).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at the elevation of 2200–2250 m, in Himachal Pradesh. The species was previously reported from Manipur, Meghalaya, Odisha, Rajasthan, Tamil Nadu and Uttarakhand (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, village Shalan Forest, alt. 2,200–2,250 m, on tree bark, P. Maurya & A. Devi 24-367538 (LWG).

12. *Sanguineodiscus haematites* (Chaub. ex-St.-Amans) I.V. Frolov & Vondrák, , J. Syst. Evol. 59(3): 471 (2020). (Image 4L).

The species is corticolous, crustose, grey, unevenly areolate towards centre, blood red apothecial discs, ascospores ellipsoid with thick septum (Mishra et al. 2020).

Chemistry: Thallus K+ purple, C–, KC–, Pd–; parietin seen in TLC.

Ecology and distribution: The species was found growing on tree bark in district Shimla at an elevation of 2673 m. The species was previously reported from Jammu & Kashmir (Sinha et al. 2024).

Specimen examined: **Ind**ia, Himachal Pradesh, Shimla District, CWS, alt. 2,673 m, on tree bark, A. Devi 24-369896 (LWG).

13. *Strigula subelegans* Vain., Ann. Acad. Sci. Fenn., Ser. A 19(no. 15): 23 (1923)**.** (Image 4M).

The species is characterized by epiphyllous thallus having irregular and scattered patches, sometimes round, white, with many small black pycnidia, colourless crystals are commonly dispersed with fungal hyphae, perithecia black, immersed partially, with unequal ascospores (Singh & Pinokiyo 2014).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on leaves in district Shimla at an elevation of 2000–2100 m. The species was previously reported from Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Goa, Karela, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu and West Bengal (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla District, village Halau, alt. 2,000–2,100 m, on leaves, A. Devi & P. Maurya 24-369898 (LWG).

14 *Usnea spinosula* Stirt., Scott. Natural. 6(3): 107 (1881) [1881–1882]. (Image 4N).

The species has a fruticose thallus with solid central axis,, contains spinules, and among the spinules, lateral branches are present, isidia and soredia are absent (Awasthi 2007).

Chemistry: Medulla K+ yellow, then turning red, C-, P+ yellow; usnic acid seen in TLC.

Ecology and distribution: The species was found growing on tree bark in District Shimla at an elevation of 2200–2250 m. The species was previously reported from Arunachal Pradesh, Kerala, Tamil Nadu, and Uttarakhand (Sinha et al. 2024).

Specimen examined: India, Himachal Pradesh, Shimla district, village Shalan Forest, alt. 2,200–2,250 m, on tree bark, A. Devi & P. Maurya 24-369471 (LWG).

15. *Verrucaria muralis* Ach., Methodus, Sectio prior (Stockholmiæ): 115 (1803). (Image 4O).

The species is characterised by crustose, superficial, slightly cracks and with minute pits present, grey to brown in colour thallus, having numerous perithecia, immersed but prominent, black with a clearly visible ostiole; ascospores are colourless, simple and ellipsoid (Joshi et al. 2009).

Chemistry: Thallus K–, C–, KC–, P–; No chemical seen in TLC.

Ecology and distribution: The species was found growing on rock in district Shimla at an elevation of 2200–2250 m. The species was previously reported from Tamil Nadu (Sinha et al. 2024)

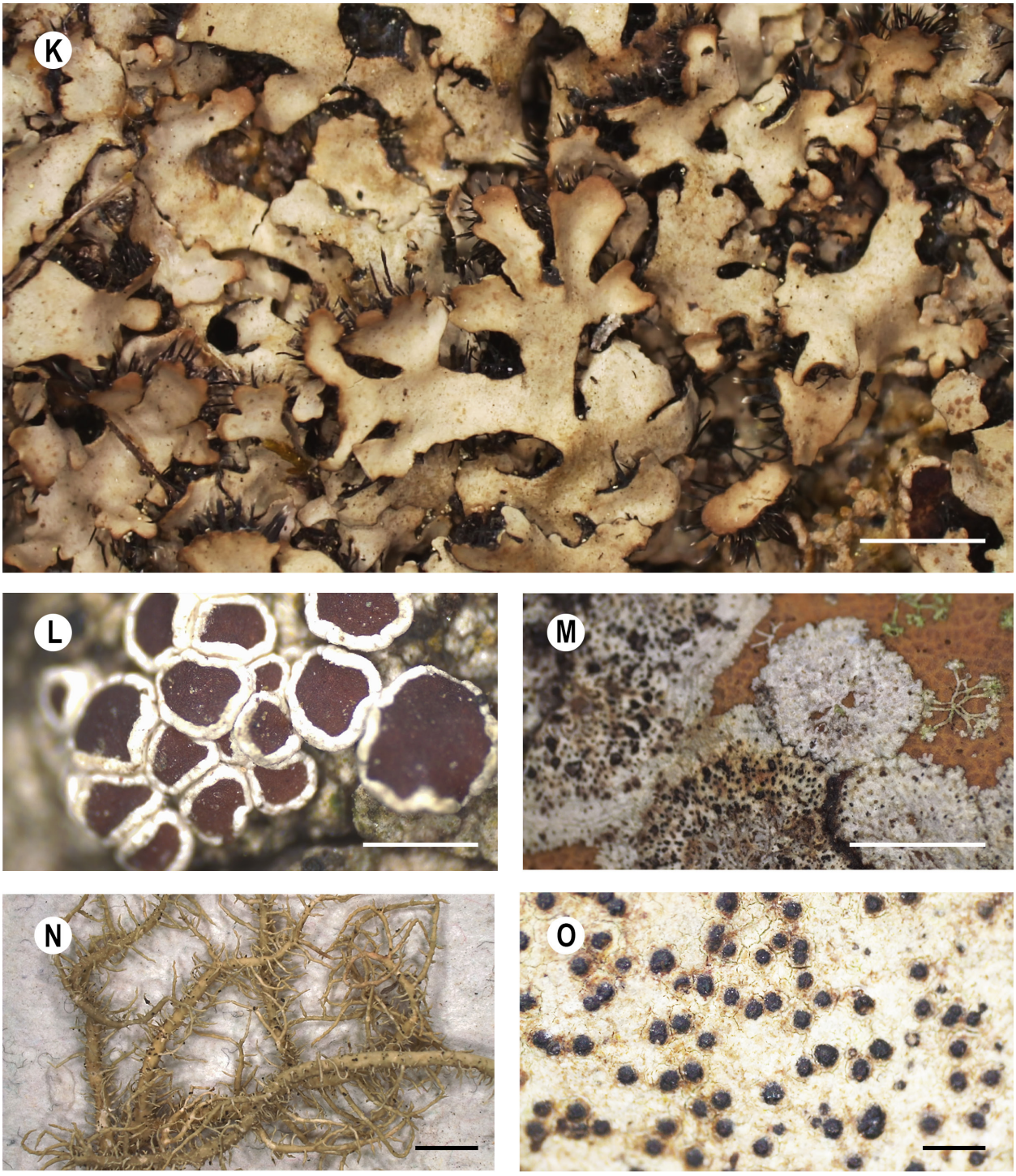

Image 4. New additions of lichens to the state of Himachal Pradesh: K—*Phaeophyscia primaria* | L—*Sanguineodiscus haematites* | M—*Strigula subelegans* | N—*Usnea spinosula* | O—*Verrucaria muralis* | Scale: K–N—2 mm. © A. Devi.

Specimen examined: India, Himachal Pradesh, Shimla District, village Halau Shalan forest, alt. 2,200–2,250 m, on tree bark, P. Maurya & A. Devi 24-369840 (LWG).

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